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March 11, 2010

Joth Singh, Ph.D.
Environmental Management Authority
8 Elizabeth Street
St. Clair
Port of Spain
Trinidad

Dear Sir:

Project No: **CEC 1469/2006**

Regarding: **Malabar and Maloney Wastewater Project**
Response to Comments

The Review and Assessment Report for CEC 1469/2006, dated December 4, 2009, was received by WASA. This letter addresses the comments brought forward from this report. Please refer to the attached report (**Appendix A**) for the comments.

Section 2.1 Critical Information

2.1.1 – Chlorination Facility

The treated effluent from the Malabar WWTP will be disinfected using UV. A small portion (.001% of Peak Wet Weather Flow (PWWF)) will be recycled within the plant for various purposes such as landscape watering, tank flushing, and line purging. This plant reuse water will be chlorinated for the protection of the operators, through sodium hypochlorite dosing. Sodium Hypochlorite has been chosen due to its low risk on personnel injury or environmental damage. These totes are small, $1m^3$ containers, which are available locally, and a maximum of 4 will be on site at once. These totes will be stored so that in the event of spills, the liquid will be contained and not released to the environment. All spills will be flushed into the wastewater drainage system for treatment through the WWTP.

The MSDS for sodium hypochlorite has been included as **Appendix B.**

2.1.2 – Septage Receiving

The wastewater, received by truck, will be disposed of at the Septage Receiving area of the plant. The septage receiving area consists of a rock trap and a 6mm screen. The screenings, consisting of rags, sticks, and other objects that do not pass through the screens, will be washed and dropped into a dumpster for off-site disposal. Off site disposal will be in a landfill. The quantity of material removed

is dependant on the amount of wastewater received by truck and the characteristics of the septage. The estimated quantity leaving the site would be 1 m^3/week.

The washed screenings will be contaminated and must be handled and disposed of properly. This is a standard procedure used at WWTPs. Operations personnel will be trained in proper practices so risk is minimized.

The liquids will flow by gravity to the influent pump station, also on the WWTP site. These liquids will then undergo treatment at the WWTP.

2.1.3 Stormwater Storage

The procedure used to select the size of the stormwater storage tank was chosen to ensure that the selection was sufficiently conservative to protect the local population and the environment. While meteorological conditions were considered, the conclusion was that the condition of the sewer system was the most important factor in determining the expected level of infiltration and inflow. Topography is another important factor. Flat paved areas tend to collect rainwater that can then flow into the sewer system through openings that develop over time. Using the storm of record at Beetham was considered to be very conservative for the following reasons:

1. Much of the Beetham catchment lies in Port of Spain, which is flat and has significant portions paved for roads, parking lots, etc. This would result in higher levels of infiltration and inflow (I&I) tan would be expected in the Malabar catchment, which is undulating so water runs off to rivers and streams.

2. The majority of the Beetham sewer system was constructed more than 40 years ago. I&I levels are high as indicated by the storm of record. In contrast, the Malabar catchment will be a combination of old sewers installed about the same time as Port of Spain, but will also include more than 100 km of new sewer pipes installed to modern standards.

In summary, we believe the stormwater tank selected for the Malabar WWTP will be able to store a volume of wastewater equivalent to more than twice the Beetham storm of record without overflowing. This meets the stated objective for this facility, i.e., provide a conservative design that will protect public health and the environment.

2.1.4 Sludge Drying

The dried product is expected to comply with Class B requirements of the USEPA Part 503 Regulations. This allows for land application with certain restriction on setbacks. These restrictions are seen in **Appendix C**. As seen in the Appendix, composting at 40^{o}C for 5 days maintaining 55^{o}C for 4 hours during the 5 days will meet the Class B requirements. The dried product is contained at the Malabar WWTP site for 30 days, which exceeds these requirements. In the unlikely event that the dried product does not meet these USEPA Part 503 Regulations, it will only be able to be disposed of at a landfill, which is consistent with USEPA requirements.

2.1.5 Sludge Thickening

The actual polymer will be selected when testing is done during plant commissioning, however a MSDS of the polymer typically used is enclosed in **Appendix D.** Polymer will be delivered in bags or

barrels and will be stored on palates in a dry storage room. All proper MSDS requirements will be followed for storage and handling.

2.1.6 Sludge Drying

The filtrate will be collected in PVC lateral drains that drain the flow back to the influent wet well at the WWTP. These liquids will then be treated in the liquid WWTP process.

2.1.7 Demolition Operations

Wastewater and wastewater sludge from existing tanks will be drained via existing and newly constructed collection system as well as hauled where necessary to the new Malabar WWTP once in operation. Care will be taken so that all liquids are contained and properly treated.

Existing structures including superstructures, foundations, footings, piles, utility drains and other piping 450 mm below finished grade in landscaped areas, and 1 m below finished grade in pavement areas will be demolished. Debris, and other undesirable and unsalvageable material resulting from demolition operations will be disposed of at the nearest landfill site.

The salvaged material and equipment to be retained will be transported to WASA's Carlsen Field Stores. The Carlsen Field Stores is a designated storage site that is operated and maintained by the Authority.

2.1.8 Disposal

Please refer to the answer for 2.1.7.

2.1.9 Scope and Objectives

Yes this statement is correct.

2.1.10 Water Quality

The results of the testing for pH, temperature, and dissolved oxygen (DO) are included in the EIA Report, Appendix 5, Section 4.

Additional historical water quality testing, including pH, temperature, and DO are included in **Appendix E.** An updated Figure 5.9 – Sampling Locations – Water Quality, Vegetation, and Aquatic Macrofauna is also included in **Appendix E.**

2.1.11 Recreational Activities/ Facilities and Public Buildings and Institutions

Please add to the Report Section 5.3.7:

A comprehensive listing of all recreational facilities, public buildings and institutions that the residents of the project area utilize is seen in Appendix II Part B, Community Impact Assessment Study. A listing of the facilities that are located within, the project boundaries is seen below:

In the project area there are the following primary schools:
Arima

1. Arima Hindu Primary
2. Arima Boys' Government Primary

3. Arima Boys' R.C. Primary
4. Arima Centenary Government Primary
5. Arima Girls' Government Primary
6. Arima Girls' R.C. Primary
7. Arima New Government Primary
8. Arima Presbyterian Primary
9. Arima West Government Primary
10. Aripo R.C. Primary
11. Christian Primary Academy
12. EdenWay Pre-Primary Christian School

Arouca

1. Arouca A.C. Primary
2. Arouca Government Primary

Carapo

1. Carapo R.C. Primary

D'Abadie

1. D'Abadie Government Primary
2. Pinehaven SDA School

Malabar

1. Malabar Government Primary
2. Malabar R.C. Primary

Maloney

1. Maloney Government Primary

La Horquetta

1. La Horquetta North Government Primary
2. La Horquetta South Government Primary

Santa Rosa

1. Santa Rosa Government Primary

In the project area there are the following secondary and tertiary schools:

Arima

1. Arima Government Sec
2. Arima Senior Comprehensive
3. Holy Cross College

Malabar

1. Malabar Composite

Tertiary

1. UTT

A discussion on social services (health care, police services and fire station) is found in Appendix II, Part A, Section 2.5. In the project area there are the following:

Medical Facilities:

1. Arima District Health Facility
2. La Horquetta Health Centre
3. Maloney Health Centre

Police Stations

1. Arima Police Station
2. La Horquetta Police Station
3. Malabar Police Station

4. Maloney Police Station
5. Pinto Police Station

Fire Station
1. Arima

Social impacts, as well as mitigation and monitoring plans, are discussed in Appendix II, Part A: Social Impact Assessment Study Report, as well as Section 7 and 8 of the EIA Report.

2.1.12 Construction Phase Activities (Site Access)

For WWTP construction, the service road on the south side of the Churchill Roosevelt Highway will be used, instead of the roads through the Peytonville community. (Figure 1)

Figure 1 Malabar WWTP Site Access

2.1.13 Construction Phase Activities (Transport Management Plan)

The traffic management plan (TMP) will be developed by the overall construction supervision team, who will oversee all contractors for the project. There will be one team for the Malabar project, and one for the Maloney project. The construction supervisors will report to WASA. The TMP will be approved by WASA before construction begins. Once approved the TMP will be distributed to the contractors, who will need to adhere to this plan. It will be the construction supervisors who enforce this TMP for WASA.

2.1.14 Operational Phase Activities (Air Quality)

In order to construct the WWTP parcels of land will need to be acquired by WASA. The entire area of land to be acquired by WASA is seen in Figure 2 by the red line in the attached figure. The land beyond the fence line will be buffer to the surrounding area. On the western side, the largest buffer has been left, which gives extra distance between the proposed WWTP, and the existing homes in the Peytonville area. The southern and eastern boundaries follow the river. Outside of both of these boundaries is undeveloped land. The northern boundary is the service road along the Churchill Roosevelt Highway.

This buffer zone will be the responsibility of WASA to maintain.

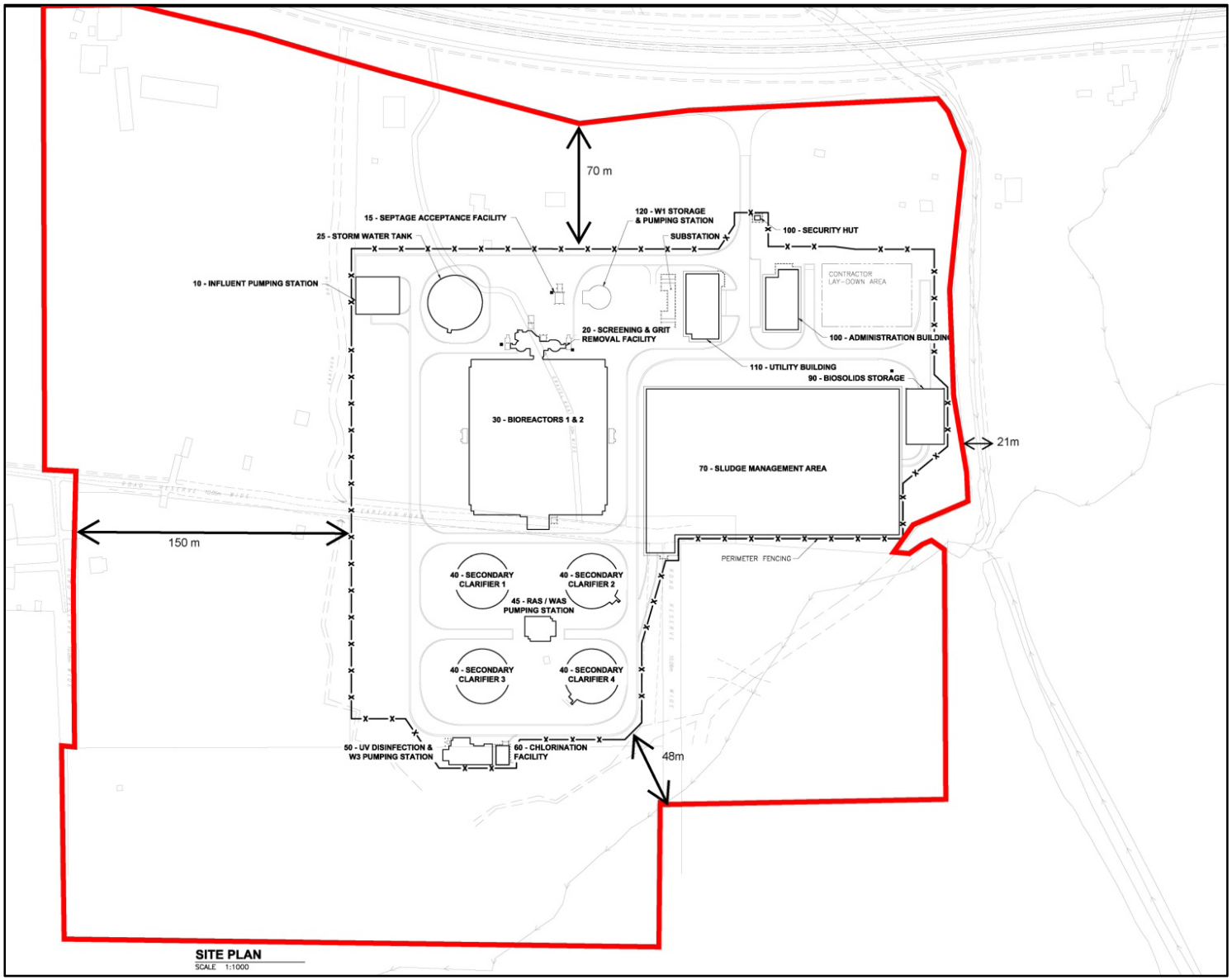

Figure 2 Malabar WWTP Land to be Acquired

Section 2.2 Supplementary Information

2.2.1 Maloney Wastewater Catchment

The correct number is 48.5 km of new sewerage mains. Please refer to Table 3-15 in the report.

2.2.2 Sewerage Transmission Networks

As seen in Section 5 of the report, water quality results have shown that the rivers within the catchment area are already heavily polluted. One common indicator of untreated wastewater is faecal coliforms and the EMA Water Pollution Rules 2001 (as amended) for Inland Surface Water has a limit on faecal coliforms of 400 CFU/100ml. Results on all rivers displayed a minimum of 1600 CFU/100ml on all samples.

Construction of the Malabar and Maloney project will decrease the amount of untreated wastewater that is entering the environment. Water quality tests on rivers will display more favourable results, once all construction is complete.

Different pipe materials have been selected to coincide with factors such as earth and traffic loadings on the pipe, the aggressiveness of the soils, soil stability, system durability as related to operation and maintenance, material availability, pipe classification due to soil stability, cost implications, as well as exposure to corrosive agents and the surrounding environment. Bedding material surrounding the pipe depends on the location of the pipe, and whether it is above or below the water table. All of these design details minimize the likelihood of pipe failure.

In the event that there is pipe failure, an increase of flow will be noticed at the lift stations in the collection system, due to groundwater entering the pipes. The collection system maintenance crew will be dispatched to discover the pipe failure. The collection system maintenance staff, composed of two crews of one crew chief and two labourers, will also be on the lookout for any deficiencies in the system.

2.2.3 Introduction

In 2006 when this letter was written to the EMA, the numbers were preliminary. When the EIA Report was submitted to the EMA, detailed design was complete, and the final plant sizing was based on a total capacity of 189,016 m^3/day.

2.2.4 Process Flow Diagram Water Balance

Please refer to Figure 3 and Figure 4 below.

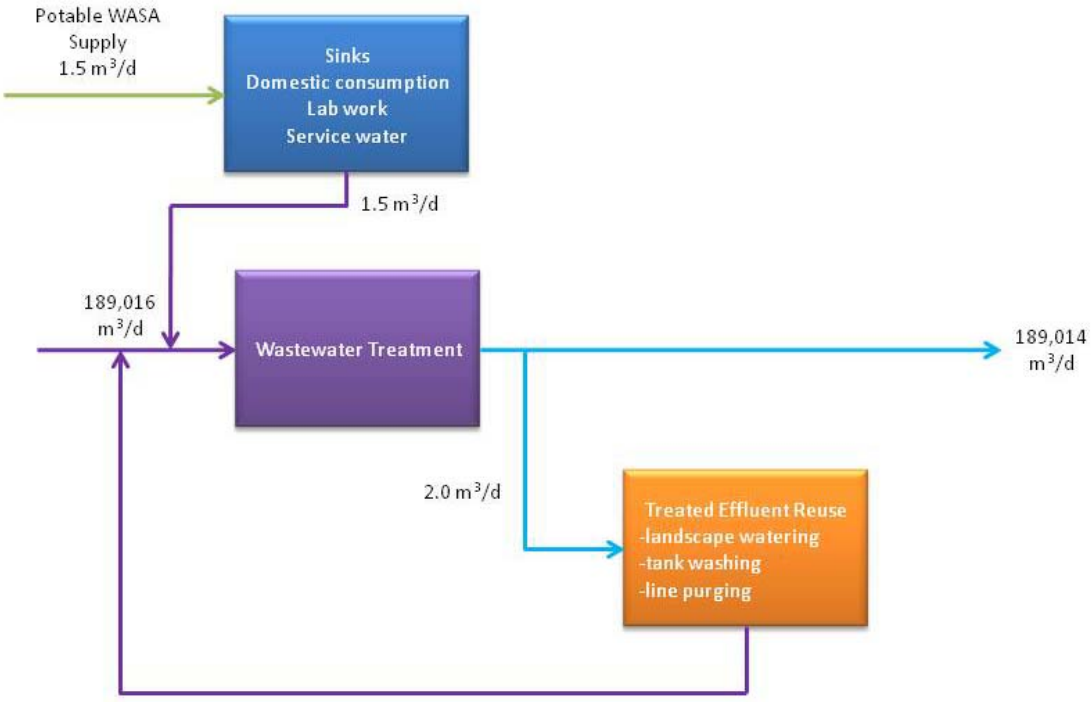

Figure 3 Malabar WWTP Water Usage

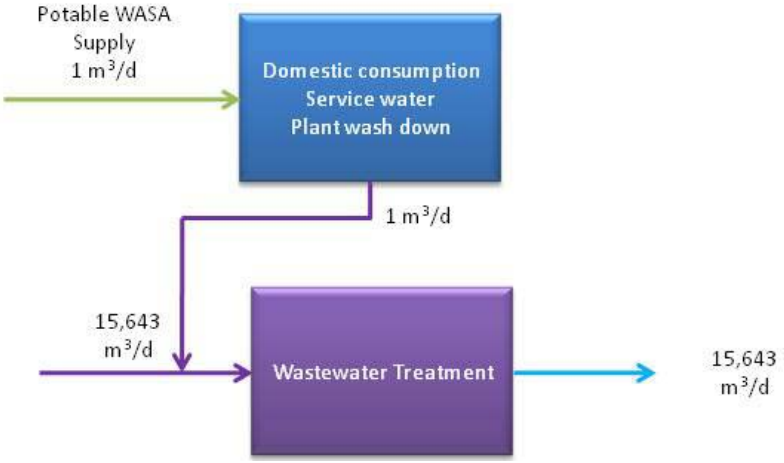

Figure 4 Maloney WWTP Water Usage

2.2.5 Maloney Project Description

A project schedule for Maloney is attached in Figure 5.

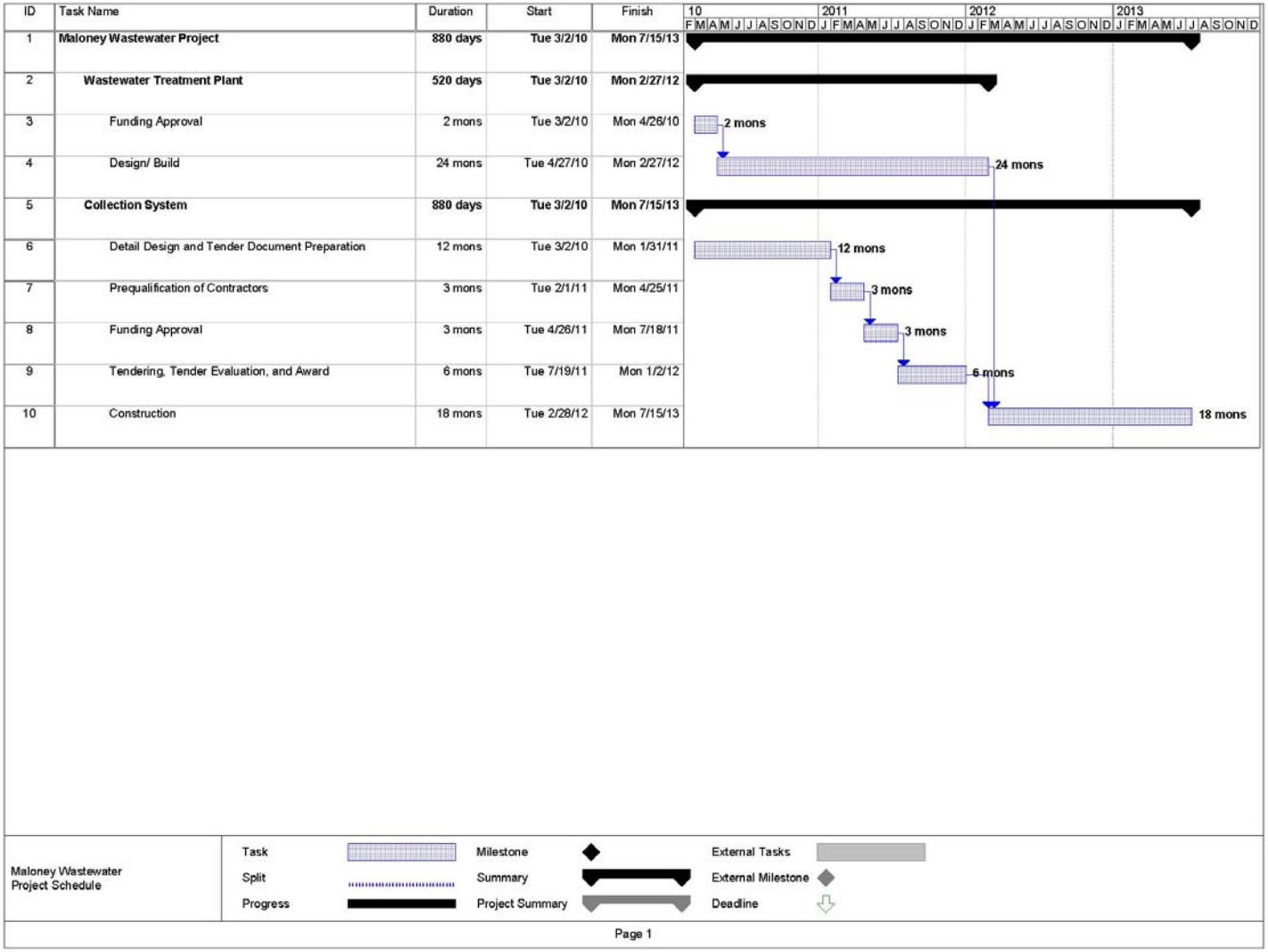

Figure 5 Maloney Project Schedule

2.2.6 Malabar Lab Facilities

Lab testing work that will be conducted at the Malabar WWTP will comprise tests that assist in the running of the daily operations. These tests include BOD, TSS, pH, and temperature. All liquid waste will be treated at the Malabar WWTP. Waste materials such as filter papers containing dried wastewater solids are sterile and will be disposed in the trash. Reagent bottles and containers will be disposed of in accordance with MSDS.

2.2.7 Malabar UV Treatment

Excess Peak Wet Weather Flow (PWWF) that cannot be treated immediately through secondary treatment will be stored in a storm water storage tank until secondary treatment capacity is available A storm of twice the intensity or duration of the record storm from the Beetham WWTP can be held in the Malabar storm water tank and no overflow will occur. This design results in storage for twice the capacity of the worst rainfall storm on record. Any overflow that occurs beyond this will be very infrequent.

In the unlikely event that a storm of twice the capacity occurs, flow will travel from the storm water storage tanks to the disinfection system and then the outfall. The storm water storage tanks will act as a primary clarifier and reduce suspended solids, fats, oils, grease, etc. The disinfection system is sized to hydraulically pass 189 ML/d, and disinfection will occur.

The approach of using storm tanks for excess water storage and storm water flow only receiving some primary treatment and disinfection is standard practice in the UK. In Canada, common practice is to size the primary clarifiers for storm water flows, and then bypass all storm water flows from the primary clarifiers to the outfall.

2.2.8 Sludge Dewatering

All liquid waste from the Belt filter press will travel by gravity to the influent pumping station. From the influent pumping station, it will be treated in the WWTP.

2.2.9 Sludge Dewatering

Please refer to the answer in 2.1.4.

2.2.10 Site Clearing

Unwanted material removed from the site will include household garbage that has been left on the site. All of this garbage will be removed to a landfill.

2.2.11 Microtunnelling and Pipe Jacking

This useful end product can be used as cover material at all landfills. If not needed by the landfills, it will simply be disposed of in the landfill.

2.2.12 Maloney WAS Treatment

The intended method of treatment for the WAS will be to aerobically digest and then transfer to sludge drying beds for further moisture reduction. Refer to Section 3.3.5 in the EIA for a further explanation.

2.2.13 Maloney WAS Treatment

During construction, vegetated waste will be disposed of in a landfill.

2.2.14 Existing Malabar WWTP Civil Decommissioning Plan

Decommissioning of the existing Malabar WWTP will include removal of all structures that are on the site (seen in Figure 3.12 in the EIA Report), and rerouting the wastewater collection system piping to tie into the new collection system, leading to the new Malabar WWTP. The demolition process will be in accordance with Section 3.6.9 in the EIA Report, as well as the following:

Preparation

Prior to demolition, removal or abandonment of structures, accomplish following:

1. Obtain Employer release of such structure.

2. Electrical, VAC, process, and plumbing services rerouted or shut off outside area of demolition.

3. Salvage items to be delivered to WASA's Carlsen Field Stores storage facility. Materials to be salvaged and retained by Employer include:

    - Pumps
    - Motors
    - Standby Generators
    - Valves
    - Hoist
    - Monorails
    - Fittings
    - Aluminum sheeting
    - FRP sheets
    - Other equipment as directed by the Engineer

4. Survey and record condition of existing facilities to remain-in-place that may be affected by Work. After Work is complete, survey conditions again and restore facilities to original condition at no additional cost to Employer. Conduct surveys in presence of Engineer.

Protection

1. Do not close or obstruct streets, walks or other facilities occupied and used by Employer and public without prior written permission from Employer and other authorities having jurisdiction.

2. Structural stability of structures adjacent to or affected by Work of this Contract shall be Contractor's responsibility.

3. Maintain in service and protect from damage existing facilities, utilities, and equipment to remain.

Utilities

1. Notify utilities prior to razing operations to permit them to disconnect, remove or relocate equipment serving existing facilities. Provide and submit all applications/forms as required for Utilities Company's approval.

Demolition Operations

1. Equipment and materials not scheduled to be salvaged shall become property of Contractor and legally disposed of off-site.

2. Wastewater and wastewater sludge from existing tanks will be drained via existing and newly constructed collection system, or if necessary, hauled to the new Malabar WWTP once in operation, as per Engineer's directions. Care will be taken so that all liquids are contained and properly treated.

3. Demolish existing structures including superstructure, foundation, footings, piles, utility drains and other piping 450 mm below finished grade in landscaped areas, and 1 m below finished grade in pavement areas unless otherwise shown on drawings. Completely demolish structures within influence zone of new structures.

4. Provide drainage of structures demolished by cutting openings in floors of structures remaining in-place. Holes shall be 150 mm diameter minimum, spaced at 6.0 m centers maximum (minimum of 2 each confined area). Notify Engineer prior to backfilling structure remaining. Fill in accordance with Division 2 Specifications.

5. Plug or cap utility drains and other piping in accordance with specified abandonment procedures.

6. The final area should be graded to prevent ponding.

Removal Operations

1. Remove existing concrete, steel and masonry to extent indicated on drawings. Provide smooth, straight joint or cut line. Make cuts parallel with walls or floors. Cut and patch in accordance with Contract specifications.

2. Remove utilities and piping to elevations and location shown on drawings and plug and seal permanently with steel cap, concrete plug or other approved method in accordance with specified abandonment procedures.

3. Remove abandoned utilities and underground piping within influence zone of proposed underground piping and proposed structures.

4. Provide temporary shoring and bracing to transfer loads of existing construction to remain from construction being removed where noted.

Abandonment Operations

1. Abandon utilities and underground piping within limits specified by the Engineer.

2. Provide compatible cap for pressurized type piping. Provide thrust blocks for caps unless piping has fully restrained joints.

3. Provide concrete plugs for gravity type piping. Plug shall be thrust block standard concrete in accordance with Division 2, and minimum of 0.6 m thick.

Disposal

1. Dispose of sludge, debris, and unsalvageable material resulting from demolition operations to the nearest landfill site in accordance with the Engineer's directions.

2. Dispose of wastewater to wastewater treatment plant in accordance with Engineer's instructions.

3. All hazardous waste must be disposed off in accordance with the regulation and code requirements and in accordance with the Engineer's direction.

2.2.15 Water Quality, Vegetation, and Aquatic Macrofauna

An improved Figure 5.9: Sampling Locations – Water Quality, Vegetation and Aquatic Macrofauna is included in **Appendix E**.

2.2.16 Water Quality, Vegetation, and Aquatic Macrofauna

In order to effectively gauge the impact that is occurring within the project boundary in relation to water quality, sampling should occur in watercourses that traverse through the boundaries. Samples taken to the north of the Malabar and Maloney catchment will provide a baseline. Data can be compared to the samples taken to the southern end of the catchment, after the river has flowed through the project area, and is close to entering the Caroni River. If the river quality has degraded, or improved, this will indicate the impact that the catchment area has on the water quality.

The Oropuna, Mausica, Arima, and Guanapo Rivers all flow through the Malabar and Maloney catchment area, while the Arouca River passes for only a short distance on the western project boundary. When divided between the Malabar and Maloney collection system catchments, the Oropuna River, and parts of the Mausica and Arouca River are within the Maloney catchment, while the remainder of the rivers are within the Malabar collection system catchment.

To supplement the data already contained in Section 5, historical water quality data has been added in **Appendix E.** An updated Figure 5.9 shows all data sampling locations as well as the WWTPs. Coordinates for all locations are included in the appendix.

2.2.17 Water Quality – Section 5.12 – Water Quality

Historical water quality data have been added in **Appendix E**, as well as indicated on revised Figure 5.9 in addition to the data previously noted in Section 5.

The Institute of Marine Affairs conducted water quality sampling and analysis of the Caroni River Basin in 1997 and 1998[1]. The conclusion of this study revealed that the upper stations of the Caroni

[1] *Institute of Marine Affairs, 2001. Trinidad and Tobago Water Sector Institutional Strengthening Design and Implementation of the Surface Water Quality Monitoring Programme for the Caroni River Basin: Draft Report on Surface Water Quality in the Caroni River Basin*

River Basin are of better quality than the lower stations. Rivers that flow through populated, developed and industrialized areas, including the Arima, Mausica, and Manacal have increased levels of pollutants.

All water quality results indicate high levels of Total Coliforms and Total Faecal Coliforms at all sites. This indicates that raw sewage is entering the river systems. As a result of these high bacteria levels, these rivers are not fit for recreational purposes, when comparing to the:

- First Schedule of the EMA Water Pollution Rules 2001 (as amended) where a pollutant is defined >100 count/100ml;
- Canadian Recreational Water Quality Guidelines[2] where > 2000 *E.Coli*[3] /L is considered unsafe for recreations use.
- World Health Organization where > 500 intestinal *Enterococci*/ 100ml has a significant risk of high levels of minor illness transmission[4].
- In the State of Hawaii, *Enterococcus spp.* is limited to 33/100ml for safe use of recreational inland waters[5].

For this project, *Enterococcus spp.* was not required to be tested, so this value could not be compared; however, improved wastewater treatment systems in the area would undoubtedly result in significant reductions to these high levels.

Reference to Figure 5.7 on page 5-48 was in error. Please correct the reference to Figure 5.9 – Sampling locations – Water Quality, Vegetation and Aquatic Macrofauna. Revision to this figure is attached in **Appendix E.**

The water quality analysis report is attached as **Appendix F**. This report includes the sample record, chain of custody history, testing procedures, quality assurance procedures and quality control for performed analysis.

2.2.18 Chapter 7 Rating System

This significance class ranking system is shown in Table 7-5, in the column titled “Significance Ranking.”

2.2.19 Chapter 7 Cumulative Impacts

It is correct that Table 3-3 lists new and proposed developments within the project area. These developments will all be connected to the proposed collection system for treatment at the new

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[2] *Minister of National Health and Welfare. (1992). Guidelines for Canadian Recreational Water Quality. Federal-Provincial Working Group on Recreational Water Quality of the Federal-Provincial Advisory Committee on Environmental and Occupational Health.*

[3] *When experience has shown that greater than 90 per cent of the fecal coliforms are E. coli, either fecal coliform or E. coli may be determined*

[4] *World Health Organization (2003) Guidelines for Safe Recreational Water Environments: Volume I Coastal and Fresh Waters. Geneva.*

[5] *Department of Health (2004). Hawaii Administrative Rules, Title 11 Department of Health, Chapter 54 Water Quality Standards.*

Malabar WWTP. Wastewater flows from these areas have been incorporated into the 2035 design flow and load projections. The reference to the O'Meara Industrial Estate proposed residential developments actually refers to the HDC Malabar 1, 2 and 3 developments (located north east of the O'Meara Industrial Estate), listed in Table 3-3.

When studying the cumulative impacts of the proposed developments with the project, the short term impacts during construction require the most attention. Increased vehicular traffic and dust generation during construction may generate a cumulative impact if the specific phase of the collection system construction is ongoing in the same area as the development construction. Long term impacts are the same as described in paragraph 2 and 3 of Section 7.8. These include increased pressure on landfill capability, increased traffic and use of vehicles, as well as the associated risks of emissions. All of these impacts however have a minor significance ranking. A long term positive impact to the proposed wastewater project being constructed at the same time as the new housing developments is the impact to the environment, and public health. All wastewater generated by the new developments will be properly collected and treated, which will decrease the negative impact that the developments will have on the risk to public health, and water quality of the surrounding environment.

Mitigation of the negative impacts is included in Table 8.1 of the Report. The largest impact, traffic, will be mitigated through proper phasing of the collection system, so that construction is not ongoing close to any large housing development construction project. A detailed traffic management plan, which needs to be approved by the Ministry of Works, should also highlight any construction activities in the area at the same time.

Section 2.3 General Comments

2.3.1 Demolition Process

The salvaged material and equipment to be retained shall be transported to WASA's Carlsen Field Stores. The Carlsen Field Stores is a designated storage site that is operated and maintained by the Authority.

2.3.2 Maloney Public Consultation

The Maloney catchment is the smallest wastewater catchment located along the east-west corridor. The design population to 2035 was rechecked and found to be consistent with the projected population contained in the document. The Maloney WWTP has been designed to accommodate the 2035 flows. The 2035 flows were calculated to include for existing developments, proposed developments and any green or open spaces contained within the catchment (which have the potential for future development).

There is no potential impact on this project should the anticipated design capacity be reached before 2035, as all construction to the WWTP will be constructed at once to handle the 2035 capacity. Any construction beyond what is contained in this document will be the subject of a CEC application at that time.

2.3.3 TP Abbreviation

TP, which is the abbreviation for Total Phosphorus, is listed in the Glossary at the beginning of the EIA Report.

2.3.4 Citation of Legislation

These incorrect references have been noted. The applicable references will now read:

- The Noise Pollution Control Rule
- The Water Pollution Rules 2001 (as amended)
- Environmental Management Act, Chapter 35:05.

Sincerely,
AECOM Canada Ltd.

James Marx, P.E.
Project Manager

Encl.

Appendix A

EMA Review and Assessment Report
CEC 1469/2006

Our Ref. CEC1469/2006

December 04, 2009

Ms. Denise Lee Sing-Pereira
Project Manager
Water and Sewerage Authority
Farm Road
ST JOSEPH.

Dear Ms. Lee Sing-Pereira,

APPLICATION FOR A CERTIFICATE OF ENVIRONMENTAL CLEARANCE (CEC), CEC1469/2006 PREPARED BY RAPID ENVIRONMENTAL ASSESSMENTS (2003) LIMITED IN ASSOCIATION WITH EARTH TECH AECOM FOR THE ESTABLISHMENT OF REGIONAL WASTEWATER PLANTS AT MALONEY AND MALABAR, ARIMA.

Previous correspondence on the captioned issue, ending with the receipt of twenty-five (25) hard copies and three (3) digital copies of the Environmental Impact Assessment (EIA) Report entitled ***"Environmental Impact Assessment for the Establishment of Regional Wastewater Treatment Plants at Maloney and Malabar, Arima"*** on August 04, 2009 refers.

Reference is also made to a letter dated November 20, 2009 which informed the Applicant that the Environmental Management Authority (EMA) required additional time to review the information submitted in the EIA Report.

The EMA has conducted a review of the EIA Report submitted in support of the application for a CEC on behalf of the Water and Sewerage Authority (WASA) for the above-captioned project. The EMA had also requested comments from the public during the period September 14, 2009 to October 16, 2009. The review process included participation from various State Agencies and has sought the comments of a number of agencies as part of the review process. The invited representatives of the evaluation committee were:

- Environmental Unit – Ministry of Works and Transport;
- Town and Country Planning Division – Ministry of Planning Housing and the Environment.

8 Elizabeth Street, St. Clair, Port of Spain, Trinidad & Tobago, West Indies.
Tel: (868) 628-8042; 8044/5 Fax: (868) 628-9122. E-Mail: ema@ema.co.tt

Our Ref. CEC1469/2006

With reference to Rule 6(2) of the CEC Rules, 2001 the EMA hereby notifies you that we are unable to make a determination of your application within the period specified in these Rules. This decision has been delayed to afford clarification of some of the information provided in your EIA Report. These concerns must be addressed to enable informed and fair decision-making with respect to a determination of your application. Please be guided by the findings of the review detailed in the attached "Review and Assessment Report."

You are reminded that the determination of the application is dependent upon the receipt of your response to the findings of the aforementioned Review and Assessment Report.

In order to provide adequate time for the WASA to address the Report, please note that a determination of your application for a CEC will be made by February 11, 2010 forty (40) working days from December 15, 2009. This timeframe may be reduced or extended, depending on WASA's ability to adequately respond to these concerns in a timely manner to allow for a proper review of the response.

Ten (10) hardcopies and three (3) digital copies of your response must be submitted to the EMA to aid in the review process. For the digital copies, please ensure that the response is submitted in both pdf and Microsoft Word format.

Please contact us at 628 - 8042 Ext 2247 should you require any clarification/further information.

Yours sincerely,
ENVIRONMENTAL MANAGEMENT AUTHORITY

Joth Singh Ph.D.
MANAGING DIRECTOR/CEO

CEC1469/2006

REVIEW AND ASSESSMENT REPORT

Environmental Impact Assessment submitted in support of an Application for a Certificate of Environmental Clearance (CEC1469/2006) for the Establishment of Regional Wastewater Plants at Maloney and Malabar, Arima

This Review and Assessment Report (RAR) has been compiled following a review of the Environmental Impact Assessment (EIA) document prepared by Rapid Environmental Assessments (2003) Limited in association with Earth Tech AECOM on behalf of the Water and Sewerage Authority (WASA) for the establishment of a new Wastewater Treatment Plant (WWTP) and expansion of the existing sewerage network for the Malabar catchment area and the refurbishment of the existing WWTP and expansion of the existing sewerage network for the Maloney catchment area.

This RAR is primarily derived from a review of the EIA document against the Final Terms of Reference (ToR) prepared by the Environmental Management Authority (EMA) and issued on August 03, 2006. The RAR provides an overview of the EIA Report, a statement of deficiency and general comments gathered from the review process including various State Agencies[1] and the general public participating through independent review.

The Report should be used as a guide to facilitate any corrections, alterations or additions that may be required to fulfil the EMA's ToR and enable presentation of the EIA Report in accordance with the principles of good EIA practice.

The Report has been subdivided into the following sections:

1. **Overview**

2. **Assessment**
   - 2.1 **Critical Information**
   - 2.2 **Supplementary Information**
   - 2.3 **General Comments**

3. **Conclusion**

[1] A list of participating agency reviewers is provided in Annex I.

1. OVERVIEW

The overall quality of the EIA Report was good. There was a general adherence to the majority of the requirements of the TOR. However, some of the requirements were not addressed or adequately addressed. These areas will be expanded in the following sections.

2. ASSESSMENT

This section outlines aspects of the ToR that were not addressed or not adequately addressed within the EIA Report. These aspects are divided into three (3) components: **Critical Information, Supplementary Information and General Comments.**

It should be noted that the Critical Information section outlines the issues that are considered critical for the decision-making process, whereas the information contained within the Supplementary Information section is required for a comprehensive assessment of the application. The General Comments section is included for the benefit of the Applicant and also contains comments to note from the Review Team. WASA or its designated representatives must address these concerns in writing to the satisfaction of the EMA. This is necessary to facilitate the EMA's ability to make informed decisions on the relevant impacts of the proposed project on the socio-economic and natural environment.

The EIA Review Committee, including the EMA, is seeking to obtain additional information to facilitate a comprehensive evaluation of the application. **Final approval of the project and the decision to grant a Certificate of Environmental Clearance (CEC) will be dependent on the satisfactory resolution of the issues outlined for the items below.**

2.1 CRITICAL INFORMATION

2.1.1 Section 3.2.7 page 3-18 of the EIA Report – Malabar Wastewater Treatment Plant. Figure 3.4 page 3-22 of the EIA Report Malabar Underground Site facilities of the document.

The ToR (Section 2.2 Project Description) for the proposed development specifies the following:

- **Location – map showing the overall positioning of the project, with an indication of the proposed components in relation to one another and surrounding areas.**

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Annotated on this illustration is a structure identified as a '*Chlorination Facility*'. However, Section 3.2.7.8 of the EIA Report identifies only Ultraviolet (UV) Disinfection as the tertiary treatment method to be implemented at the Malabar WWTP.

Please confirm whether chlorination facilities as illustrated on Figure 3.4 are to be established and operated at the Malabar WWTP.

In event that a Chlorination Facility illustrated on Figure 3.4 of the document is to be established as a component of the Malabar WWTP. Please provide the estimated quantity of chlorine to be stored at the proposed facility and the chlorine handling, storage and dispensing policy and procedure to be implemented at the proposed facility.

In addition, please conduct a suitable and sufficient Qualitative Risk Assessment (QRA) to address the hazards to the public during the installation, storage, dispensing and replacing of chlorine storage tank(s) at the facility. The assessment of risk may be conducted using suitable qualitative or semi-qualitative methodologies (e.g. risk ranking matrix). The assessment should provide a description of the frequency/probability and consequence/severity levels used in the analysis and the rationale for choosing these levels/rankings should be included.

The applicability of these levels/rankings should be justified given the nature of land use patterns within the wider study area of the project.

The following should also be considerations:

- What Chemical(s) of Potential Concern (COPC) are likely to be released by the project;
- Exposure durations (acute, chronic, or both) and pathways (e.g. primary pathways such as inhalation) should be considered;
- The toxicity and the quantity of the chemical(s) that may be released from the facility (i.e., the toxic potential);
- Individuals most likely to be exposed, their location, specific behaviours, and age-groups;
- Sensitive receptors within the area, such as schools or hospitals;
- What habitats, or habitat sub-types, are present within the study area;
- What species or indicators Valued Environmental Components (VECs) best represent the communities present.

The other hazards to be considered should include, but not be limited to:

- Earthquakes and related events;
- Weather hazards (storms, floods).

2.1.2 Section 3.2.7.2 page 3-23 of the EIA Report – Septage Receiving

This section of the EIA Report states that "*screenings will be washed and dropped into a dumpster for off-site disposal*". However, no statement is provided as to the destination of the liquid waste stream generated during the washing of screenings, whether there is any treatment of screenings and the proposed treatment method, the frequency of disposal of screenings and the ability of the waste disposal facility to treat screenings generated at the septage receipt station.

Please provide a statement indicating whether screens generated at the septage receiving station are treated prior to being disposed. This statement should additionally state, the destination of wastewater following the washing of screenings, whether these is any treatment of screenings and the proposed treatment method, the frequency of disposal of screenings and the ability of the waste disposal facility to treat screenings generated at the septage receipt station.

2.1.3 Section 3.2.7.5 page 3-25 of the EIA Report – Stormwater Storage

This Section of the EIA Report discussed the method used to determine the volume/capacity of the stormwater tanks to be established at the Malabar WWTP. The determination of the volume of the tank was achieved by analysis of wet weather flows to the Beetham WWTP, thus a minimum volume of 1760m^3 was achieved. However, to provide additional protection and simplify construction, the tank will be same size as the secondary clarifiers (i.e. 3960m^3).The method used to determine the capacity of the stormwater tanks does not appear to take into consideration contrasting the meteorological, topographical as well as land use patterns of the Malabar catchment area.

Please provide further justification as to the method used to determine the proposed capacity of the stormwater tank.

2.1.4 Section 3.2.7.12 page 3-29 of the EIA Report – Sludge Drying

The EIA Report states that "*The dried product is expected to comply with Class B requirements of the USEPA Part 503 Regulations*". However, a more detailed description of the regulation/standard should be provided as well as the methods to be implemented to achieve this quality dried product. Also, no discussion is provided of treatment methods to be implemented in the event that the quality of the dried sludge does not meet the standards prescribed or whether alternate waste disposal techniques would be implemented.

Please provide further discussion of the criteria to be used to determine the quality of dried product. In addition, please state further treatment methods or alternate disposal techniques to be implemented in the event that the dried sludge generated does not meet the prescribed standard.

2.1.5 Section 3.3.5.9 page 3-53 of the EIA Report – Sludge Thickening

The ToR (Section 2.2 Project Description Bullet 15) for the proposed development specifies the following:

- **Description of chemicals and the associated volumes, that will be used in the operation of each of the proposed wastewater treatment plants. This should include copies of the Material Safety Data Sheets (MSDS) for each of the chemicals proposed for use, if applicable.**

The EIA Report provides a description of the treatment process which includes a polymer dosing and mixing system for sludge thickening. The report however fails to state what polymers will be incorporated in the treatment process.

Please state what polymers are to be incorporated into the treatment process. In addition, all applicable MSDS for all hazardous chemicals to be used at the facility should be provided as well as a description of storage techniques.

2.1.6 Section 3.3.5.11 page 3-55 of the EIA Report – Sludge Drying

The EIA Report states that "*perforated PVC lateral drains are to be connected to the underdrain in symmetry to collect filtrate*". However, no statement is provided as to the destination of the filtrate collected.

Please state the destination of the filtrate collected from the underdrain network system.

2.1.7 Section 3.6.10 page 3-81 of the EIA Report – Demolition Operations

Bullet one of this section states "*all affected tankage and miscellaneous structures will be emptied and wastewater disposed of in an environmentally friendly manner*". However, bullet two of section 3.6.13 (Disposal) states that "*wastewater will be disposed of to the wastewater treatment plant*".

Please elaborate on what is meant by the phrase "*environmentally friendly manner*" which is to be implemented for the disposal of affected tankage, miscellaneous structures and wastewater generated during the decommissioning of existing facilities. In addition, please clarify whether wastewater generated during decommissioning, is to be removed for treatment at a WWTP and provide the name of the facility.

2.1.8 Section 3.6.13 page 3-82 of the EIA Report – Disposal

Bullet one of this section states "*Sludge, debris, and other undesirable and unsalvageable mater resulting from demolition operations will be disposed of to the nearest landfill site*".

This section proposes to dispose of solid waste generated during the demolition of components of existing facilities within the Malabar and Maloney catchment areas. However, further discussions are required to determine the method(s) to be employed to determine the suitability of such materials for disposal. Please clarify.

In addition, the relevant standards to be used for arriving at this determination should be provided as well as any pre-treatment method(s) that may be required prior to disposal. In the event that pre-treatment is required, the name of a Management Facility with trained and experienced personnel, appropriate equipment and insurance for proper treatment and disposal of such waste should be provided.

2.1.9 Section 4.1 page 4-1 of the EIA Report – Scope and Objectives

Bullet one of this section states "*Connection of all point sources of discharge of grey water from homes, commercial, institutional and industrial entities in the Malabar/Maloney catchment areas to a centralized sewer collection, transmission and treatment system.* "

Please confirm whether this statement is accurate and that the WWTPs are to collect and treat sewage and grey water within the catchment areas.

2.1.10 Section 5.12 page 5-48 of the EIA Report – Water Quality

- The TOR (Section 2.3.1 Physical environment) requested an assessment of ambient water quality particularly – **water quality of the freshwater environments during both the wet and dry seasons; analysis of water quality parameters should include pH, temperature, dissolved oxygen, total suspended solids, chemical oxygen demand, biochemical oxygen demand, nitrates, phosphates, contaminants (e.g. heavy metals, hydrocarbons), and coliforms. An assessment of annual and seasonal variations (especially at discharge locations for effluent and comparison with applicable water quality standards and any historical data for the area to be affected) should be included.**

Tables 5-11, 5-12, 5-13, 5-14, 5-15, 5-16 and 5-17 of the EIA Report lists parameters sampled to determine the water quality of identified watercourses within the catchment areas. However, the parameters (pH), temperature and dissolved oxygen (DO) were not included in this assessment as requested in the Final TOR.

In this regard, additional sampling of ambient water quality is requested to provide a complete assessment of ambient water quality within the catchment areas.

2.1.11 Section 5.13.6 page 5-65 of the EIA Report – Recreational Activities/Facilities and Section 5.13.7 page 5-66 Public Building and Other Institutions

These sections identify several recreational facilities and administrative facilities within the Malabar and Maloney catchment areas. However, several other sensitive receptors (e.g. schools, religious centres, emergency services, etc.) were not identified and no discussions were provided in the impact chapter in terms of the intensity and duration of impacts that these receptors may be subjected to as a result of construction activities within the catchment area.

Please provide further discussion identifying other sensitive receptors within the Malabar and Maloney catchment areas. Applicable impact ratings and mitigation and monitoring measures to be applied should also be provided in the appropriate sections of the EIA Report.

2.1.12 Section 7.6 page 7-9 of the EIA Report – Construction Phase Activities (Site Access)

The final statement of this paragraph states "*Site access will be restricted to existing roads.*" During the site visit conducted on October 02, 2009 it was noted that the Paytonville community which is located to the west of the site of the proposed Malabar WWTP. As such, the existing road network in this community may be unable to accommodate an increase volume of traffic as well as large vehicles necessary to transport materials, equipment and supplies.

The EMA is requesting reconsideration of the proposed method for the transportation of equipment, materials and supplies particularly to the site proposed for the establishment of the Malabar WWTP.

2.1.13 Section 7.6 page 7-16 of the EIA Report – Construction Phase Activities (Transport of construction materials and Wastes)

This section of the EIA Report states that the impacts of increased vehicular traffic congestion as a result of the project "*will be carefully mitigated with an aggressive traffic management plan (TMP) to be developed and implemented by WASA and complied with by their construction contractors*".

However, discussions with representatives of WASA during the site visit conducted on October 02, 2009 informed that the upgrade of the Maloney WWTP will be design/build contract and several contractors are to be used during the installation of sewerage mains and other appurtenances in both catchment areas. As such, guidelines for the TMPs will be drafted by WASA but the actual TMP will be developed and implement by contractors.

Please confirm this statement.

2.1.14 Section 7.7 page 7-22 of the EIA Report – Operational Phase Activities (Air Quality)

It is proposed that "*a final level of protection for the surrounding communities is the substantial buffer around the plant*".

Throughout the document no previous mention was made of the nature or extent of this proposed buffer zone.

As such, please provide a description of the proposed buffer zone(s), the proposed maintenance program and the party who will be responsible for maintaining the buffer zone(s) at the WWTPs. This buffer should also be illustrated on appropriate illustrations through out the document.

2.2 SUPPLEMENTARY INFORMATION

2.2.1 Section 1.1.1 page 1-4 of the EIA Report - Maloney Wastewater Catchment

Section 1.1.1 of the EIA Report stated that of the six (6) existing WWTPs in the Maloney catchment area five (5) are to be decommissioned and one (1) is to be refurbished and upgraded inclusive of the installation of 48.5 km of sewerage mains. However, it is stated in the Executive Summary (The Project Site) paragraph three that "*over 19km of new sewerage mains" are to be installed in the catchment area.*"

Please clarify the extent of sewerage mains to be installed in the Maloney Catchment area.

2.2.2 Sewerage Transmission Networks

A component of the proposed upgrade of sewage treatment facilities within the Malabar and Maloney Catchment area will involve the installation of several hundred kilometers of sewerage mains (Ref. Section 1.1.1 paragraph 3 and Section 1.1.2 paragraph 4). The installation of these mains will increase the potential for groundwater contamination if these sewer lines are placed below the water table.

Provide a statement on the potential for sewage main failure and the potential risk this poses to groundwater resources. Further, provide a discussion on any monitoring that will be implemented as part of the control of this risk.

2.2.3 Introduction to the EIA Report page 1-5 – Malabar Wastewater Catchment

In your letter to the EMA dated June 26, 2006 it was stated that "a new Malabar WWTP will be constructed, consisting of two (2) modules of 16,390 m^3/day". However, in the introduction to the EIA Report it is stated that the "new plant will consist of two modules with a total capacity of 189,016 m^3/day".

Please clarify this statement, confirming the actual operational capacity of the Malabar WWTP.

2.2.4 Figure 3.2 page 3-20 of the EIA Report – Process Flow Diagram of the Malabar WWTP

The figure provided illustrates process streams for both solid and liquid waste entering the plant, however this figure does not indicate all contributing sources of influent and effluent at the facility.

As such, please provide a water balance for both the Malabar WWTP and the Maloney WWTP. The water balance should demonstrate the general route taken by water (both potable water and wastewater streams) at the facility from intake to discharge point(s). In addition, all operations producing or contributing to wastewater must be indicated as well as average flows in cubic meters per day (m^3/d).

2.2.5 Sections 3.2.3 Malabar Scope of Works page 3-9 and 3.3.1 Maloney Scope of Works page 3-41 of the EIA Report

In submitting the scope of works for the Malabar and Maloney WWTPs the proponent listed all the communities within the Malabar catchment area as well as their existing and proposed sewerage infrastructure. The scope of works for the Maloney catchment area briefly outlined the proposed expansion area for the WWTP and the proposed expansion of the sewerage transmission network.

A scope of works of greater detail is requested. This scope of works may take the format of a Gantt Chart, such that details of various activities which are to take place during the execution of the project are identified as well as timeframes for the execution of each component of the project.

2.2.6 Section 3.2.7 page 3-18 of the EIA Report – Malabar WWTP

This section states that laboratory facilities will be housed at the facility during its operation. Please provide a description of the laboratory testing work that will be conducted at these laboratories. Further, please provide a discussion as to the anticipated type and quantity of waste which may be generated at these laboratories as well as methods to be implemented for the collection, treatment and disposal of waste generated from these laboratory at the facility.

Please provide some discussion to inform the technique(s) to be implemented for the collection, treatment and disposal of waste generated from any laboratory to be established at the facility.

2.2.7 Section 3.2.7.8 page 3-27 of the EIA Report – UV (Ultraviolet Disinfection):

Paragraph three of this section stated that, "*Flow in excess of 110 ML/d, in duration beyond the capacity of the stormwater storage tank, will receive primary clarification in the stormwater storage tank, and then pass through UV disinfection. This approach to disinfection is common in other jurisdictions and eliminates the expense (both capital and operational) of providing a very large UV disinfection system that will only be used to its full capacity for a few hours each year.*"

The method provided for the treatment of Peak Wet Weather Flows (PWWF) though appropriate in other jurisdictions may not be applicable to a small island tropical environment such as Trinidad. As such, please provide a rationale as to the applicability of using this method from a physical and socio-economic context, complete with references/citations of jurisdictions where this is practiced.

2.2.8 Section 3.2.7.11 page 3-29 of the EIA Report – Sludge Dewatering

The section of the EIA Report states "As the sludge travels along the dewatering path, pressure is increased, expelling water from the material. On return travel, the three belts are washed by a flow of clean water." However, no statement is provided as to the destination of this waste stream generated.

Please provide a statement on the destination of wastewater generated from the washing of Belt Filter Presses on their return travel.

2.2.9 Section 3.2.7.12 page 3-29 of the EIA Report – Sludge Drying

The EIA Report states that "*The dried product is expected to comply with Class B requirements of the USEPA Part 503 Regulations*". However, a more detailed description of the regulation/standard should be provided as well as the methods to be implemented to achieve this quality dried product. Also, no discussion is provided of treatment methods to be implemented in the event that the quality of the dried sludge does not meet the standards prescribed or whether alternate waste disposal techniques would be implemented.

Please provide further discussion of the criteria to be used to determine the quality of dried product. In addition, please state further treatment methods or alternate disposal techniques to be implemented in the event that the dried sludge generated does not meet the prescribed standard.

2.2.10 Section 3.2.11.2 page 3-40 of the EIA Report – Clearing

This section of the EIA Report stated "*site clearing will involve removing the undeveloped bush as well as removal and disposal of unwanted material*".

Please elaborate on phrase "unwanted material" classifying this waste into categories such as vegetative waste, construction debris, sanitary waste, etc.

In event that this "unwanted material" includes any sanitary waste and/or hazardous waste please indicate the method(s) of collection, storage and treatment and disposal.

2.2.11 Section 3.4.5.2 page 3-63 of the EIA Report – Microtunnelling and Pipejacking

This section identifies the proposed method for pipeline installation across the Churchill Roosevelt Highway. It further mentions the method for the removal of spoils generated during the tunneling and pipejacking process. However, no statement is provided for the subsequent use or disposal of spoil generated. Please clarify the intended destination of spoil generated during microtunnelling and pipejacking.

2.2.12 Section 3.9.1 page 3-92 of the EIA Report - Treatment Plant Process Control

The proposed method for the dewatering of Waste Activated Sludge (WAS) at the Malabar WWTP is described in this section of the EIA Report. However, two (2) methods of WAS dewatering were proposed for the Maloney WWTP.

Please indicate the intended method for the treatment of WAS generated at the Maloney WWTP.

2.2.13 Section 3.9.3 page 3-95 of the EIA Report - Waste Management

Bullet 7 of this section of the EIA Report proposes to "*Restrict the burning of removed vegetated materials to designated areas only*". Though this method can be utilised for the reduction in the volumes of waste, the burning of organic materials will generate further impacts namely the suspension of Particulate Matter (PM) into the atmosphere as well as the release of Aldehydes, Polycyclic Aromatic Hydrocarbons and Carbon Monoxide into the environment.

As such, please propose an alternate method for the disposal of vegetated waste generated during construction activities.

2.2.14 Figure 3.12 page 3-80 of the EIA Report – Existing Malabar WWTP Civil Decommissioning Plan

This figure depicts satellite imagery of the existing Malabar WWTP but provides no details as to the proposed sequencing of decommission activities, or identification of structures that are to be retained or demolished to facilitate the establishment of the new Malabar WWTP.

Please clarify the intention of this image in the context of the "Existing Malabar WWTP Decommissioning Plan"

2.2.15 Figure 5.9 page 5-30 of the EIA Report – Sampling Locations – Water Quality, Vegetation and Aquatic Macrofauna

This figure which identifies the locations where sampling was conducted is vague and does not allow for the identification of sampling location. This is due to the fact that the figure does not name or identify the water courses; neither are reference coordinates (GPS reference points) provided.

Please provide amended map(s) identifying the all sampling locations within the study area. Map(s) should be in a format such that sampling locations can be clearly identified or multiple maps provided where sampling locations overlap.

2.2.16 Figure 5.9 page 5-30 of the EIA Report - Sampling Locations – Water Quality, Vegetation, and Aquatic Macrofauna

This figure identifies sampling locations within the Malabar and Maloney catchment areas. However, the extent of sampling coverage particularly in the Maloney catchment is limited to one (1) water quality and one (1) aquatic macrofauna sampling location. As such, baseline conditions within this catchment area are difficult to ascertain.

In light of this, please provide evidence of a more extensive sampling coverage within the catchment area or a justification for the limited coverage of sampling locations within the Maloney catchment area.

In addition, though both the Malabar and Maloney catchment areas are identified on the figure, the footprint of the locations of the proposed WWTPs were not indicated on the figure, the precise locations of their outfall points as well as reference coordinates of the proposed locations of the WWTPs were not provided.

These omissions make it difficult to establish a relationship between the proposed WWTPs and the surrounding environment.

As such, please amend this figure such that the footprints of the proposed plants can be identified.

2.2.17 Section 5.12 page 5-48 of the EIA Report – Water Quality

The TOR (Section 2.3.1 Physical environment) requested an assessment of ambient water quality particularly – **Ambient water quality – water quality of the freshwater environments during both the wet and dry seasons; analysis of water quality parameters should include pH, temperature, dissolved oxygen, total suspended solids, chemical oxygen demand, biochemical oxygen demand, nitrates, phosphates, contaminants (e.g. heavy metals, hydrocarbons), and coliforms. An assessment of annual and seasonal variations (especially at discharge locations for effluent and comparison with applicable water quality standards and any historical data for the area to be affected) should be included.**

Paragraph one of Section 5.12 indicated the period within which water quality sampling were conducted. However the period identified (June 30th and July 7th, 2009) is known as a transition period between the wet and dry season and as such the sampling conditions may not truly represent the conditions that exist at peak wet and dry season conditions.

Please provide a justification for the selection of this period for the conducting of water quality sampling, demonstrating how the sampling period satisfies the requirements of the ToR. This justification should include, additional data, such as meteorological conditions that existed during sampling, along with rainfall data, to verify and support that these chosen days for sampling does represent the conditions for both seasons.

Where necessary to satisfy the requirements of the ToR, please conduct further water quality analysis. This may include data from previous relevant studies or the collection and testing of new samples.

Data submitted should be provided such that it demonstrates the following:

- Sample records;
- Chain of custody records;
- Quality Control (QC) sample records;
- Sample Management records;
- Data Handling records;
- Competency of personnel/ testing laboratory.

This section also makes reference to Figure 5.7 of the EIA Report. However Figure 5.7 identifies the distribution of shallow earthquakes in the eastern Caribbean. Please clarify this citation.

Water quality samples were compared against the Water Pollution Rules 2001 (as amended) (WPR). This is erroneous as they are discharge limits, not ambient water quality standards. Data should be compared to international water quality standards or previous studies in similar water courses. Please address.

2.2.18 Chapter 7 of the EIA Report – Environmental Impact Analysis

In chapter, section 7.2 (Methodology) proposed a rating system for the classification of impacts throughout the chapter. However, throughout this chapter the classification system was not implemented.

Please amend this section, implementing the proposed classification system.

2.2.19 Section 7.8 page 7-44 of the EIA Report – Cumulative Impacts

With respect to the analysis of cumulative impacts of the proposed project, the ToR (Section 2.5.2) specifies the following:

The cumulative impacts associated with other existing or proposed activities within the study area to be determined include, but are not limited to the following:

- **Relate potential impacts from proposed activity with existing impacts from other activities within the study area, in terms of effects to the socio-economic climate and civil amenities/infrastructure.**

An account must be given of the assessment methods used for all the impacts identified and the level of uncertainty of any predictions.

In response to this request, the EIA Report states "*It is noted that currently there are no significant ongoing or future planned projects within the project locale which require consideration regarding cumulative impact*".

It is noted however that Table 3-3 of the EIA Report listed several developments being constructed or proposed within the catchment areas. Thus the proponent is capable of identifying additional sources of increased load to the WWTPs.

Please provide a more thorough analysis of potential cumulative impacts associated with other existing or proposed activities within the study area as well as the potential for these facilities to capture additional effluent streams such as, but not limited to, liquid waste discharged from the O'Meara Industrial Estate, proposed residential developments (planned as well as currently under construction).

2.3 General Comments

2.3.1 Section 3.6.9 page 3-79 of the EIA Report – Demolition Process

Bullet three of this section states "Salvaged material and equipment to be retained shall be transported to a designated storage site".

Please provide the location of these facilities as well as the entities responsible for the operation and maintenance of such facilities.

2.3.2 Section 6.5.1.1 page 6-6 of the EIA Report – Maloney Public Consultation

During the first Maloney public consultation conducted on November 18, 2008 it was stated by a participant that "the projected population seemed unrealistic since they expected the figure to be much larger due to internal migration that currently exist an unplanned development." A representative of WASA responded by stating that "the population does sound low and this would be reviewed in terms of completing the design component for the collection system."

Though the report provides design capacities for an anticipated population projection up to 2035, no discussion is provided in event that the design capacities of the plants are exceed prior to this period.

In light of this, please discuss the potential impact(s) of this occurrence on the project. This discussion should propose contingencies to be implemented or describe the ability of the plant to increase its treatment capacity.

If there are any changes to be made to the project design, then the changes need to be presented to the EMA prior to the completion of the application process.

2.3.3 Section 9.2 page 9-3 of the EIA Report – Environmental and Social Impact Monitoring Plan

Bullet five of this section listed an abbreviated parameter 'TP' which is to be tested for during weekly testing of effluent from the WWTPs.

Please define or correct the abbreviation TP, which is listed in the document.

2.3.4 Citation of Legislation

Throughout the document the citation of several pieces of legislation is incorrectly quoted.

Please amend where applicable to read as listed below:

- The Noise Pollution Control Rule;
- The Water Pollution Rules 2001 (as amended);
- Environmental Management Act, Chapter 35:05.

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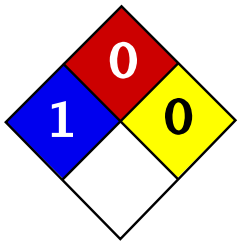
ANNEX I

LIST OF PARTICIPATING AGENCIES

- Environmental Management Authority
- Environmental Unit – Ministry of Works and Transport
- Town and Country Planning Division – Ministry of Planning, Housing and the Environment

Appendix B

Material Safety Data Sheet (MSDS)
Sodium Hypochlorite, 5%



Material Safety Data Sheet
Sodium Hypochlorite, 5% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Hypochlorite, 5%

Catalog Codes: SLS1654

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water

CI#: Not applicable.

Synonym: Chlorine Bleach, Bleach, Soda Bleach, Chlorox; Sodium Hypochlorite, Solution, 5% Available Chlorine

Chemical Name: Hypochlorous acid, sodium salt, solution

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hypochlorite	7681-52-9	4-7
Sodium hydroxide	1310-73-2	<1
Water	7732-18-5	>92

Toxicological Data on Ingredients: Sodium hypochlorite: ORAL (LD50): Acute: 5800 mg/kg [Mouse]. 8910 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite].
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide].
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to lungs, mucous membranes, skin, eyes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: combustible materials, metals, organic materials

Explosion Hazards in Presence of Various Substances:
Slightly explosive in presence of open flames and sparks.

Non-explosive in presence of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Releases chlorine when heated above 35 deg. C.
The substance itself is non-combustible and does not burn. However, when heated to decomposition it emits corrosive and/or toxic fumes.
May ignite combustibles.
Fire risk in contact with organic materials.
Contact with metals may evolve flammable hydrogen gas.

Special Remarks on Explosion Hazards:
Anydrous Sodium Hypochlorite is very explosive.
Primary amines and calcium hypochlorite or sodium hypochlorite react to form normal chloroamines, which are explosive.
Interaction of ethyleneimine with sodium (or other) hypochlorite gives the explosive N-chloro cmpd.
Removal of formic acid from industrial waste streams with sodium hypochlorite soln becomes explosive at 55 deg C.
Several explosions involving methanol and sodium hypochlorite were attributed to formation of methyl hypochlorite, especially in presence of acid or other esterification catalyst.
Use of sodium hypochlorite soln to destroy acidified benzyl cyanide residues caused a violent explosion, thought to have been due to formation of nitrogen trichloride.
(Sodium hypochlorite)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Corrosive liquid. Oxidizing material.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Air Sensitive Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Sodium hypochlorite
TWA: 1 CEIL: 1 (ppm as Cl2)
STEL: 1 (ppm as Cl2) from ACGIH (TLV) [United States]
Sodium hydroxide
STEL: 2 (mg/m3) from ACGIH (TLV) [United States]
TWA: 2 CEIL: 2 (mg/m3) from OSHA (PEL) [United States]
CEIL: 2 (mg/m3) from NIOSH
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Characteristic. Chlorine-like (Slight.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light greenish yellow

pH (1% soln/water): Neutral.

Boiling Point: Decomposition temperature: 40°C (104°F)

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: 1.07 - 1.093 (Water = 1)

Vapor Pressure: 2.3 kPa (@ 20°C)

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials. light, air, heat

Incompatibility with various substances: Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum.
Corrosive in presence of stainless steel(304), of stainless steel(316).
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Decomposed by carbon dioxide from air. Slowly decomposes on contact with air. Unstable in air unless mixed with sodium hydroxide.
Incompatible with ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, and ammonium phosphate. Decompostion of sodium hypochlorite takes place within a few seconds with these salts.
Also incompatible with primary amines, phenyl acetonitrile, ethyleneimine, methanol, acidified benzyl cyanide, formic acid, urea, nitro compounds, methylscellulose, celloluse, aziridine, ether, ammonia.
Mixing this product with chemicals (e.g. ammonia, acids, detergents, etc.) or organic matter (e.g. urine, feces, etc.) will release chlorine gas.
Chloramine gas may be evolved when ammonia and bleach are mixed.
Decomposed by hot water.
Sensitive to light. Exposure to light accelerates decompositon.

Special Remarks on Corrosivity:
Sodium Hypochlorite is extremely corrosive to brass, and moderately corrosive to bronze.
There is no corrosivity information for copper.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 5800 mg/kg [Mouse]. (Sodium hypochlorite).

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite].
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide].
Contains material which may cause damage to the following organs: lungs, mucous membranes, skin, eyes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, .
Hazardous in case of skin contact (corrosive), of eye contact (corrosive).
Slightly hazardous in case of inhalation (lung sensitizer, lung corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic) (Sodium hypochlorite)

Special Remarks on other Toxic Effects on Humans:
Potential Health Effects:
Can cause severe irritation and possible burns to skin and eyes.
Eye contact may also cause corneal and conjunctival edema, conjunctival hemorrhages.
Contact with skin may also cause vesicular eruptions and eczematoid dermatitis which becomes evident upon re-exposure.
Prolonged or repeated eye contact may cause conjunctivitis.
Ingestion can cause burns to the digestive tract. Symptoms may include: 1. pain and inflammation of the

mouth, pharynx, esophagus, and stomach, 2. erosion of the mucous membranes (chiefly of the stomach), nausea, vomiting, choking, coughing, hemorrhage, 3. circulatory collapse with cold and clammy skin (due to methemoglobinemia), cyanosis, and shallow respirations, 4. confusion, delirium, coma, 5. edema of the pharynx, glottis, larynx with stridor and obstruction, 6. perforation of the esophagus, or stomach, with mediastinitis or peritonitis.
Inhalation causes slight to severe respiratory tract irritation and delayed pulmonary edema. Prolonged or repeated inhalation may cause allergic respiratory reaction (asthma).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Dilute with water and flush to sewer of local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hypochlorite solution UNNA: 1791 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sodium hydroxide
Illinois chemical safety act: Sodium hydroxide
New York release reporting list: Sodium hydroxide
Rhode Island RTK hazardous substances: Sodium hydroxide
Pennsylvania RTK: Sodium hypochlorite; Sodium hydroxide
Florida: Sodium hypochlorite
Minnesota: Sodium hypochlorite; Sodium hydroxide
Massachusetts RTK: Sodium hypochlorite; Sodium hydroxide
New Jersey: Sodium hypochlorite; Sodium hydroxide
Louisiana spill reporting: Sodium hydroxide
TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water
CERCLA: Hazardous substances.: Sodium hypochlorite: 100 lbs. (45.36 kg); Sodium hydroxide: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive liquid.

DSCL (EEC):
R8- Contact with combustible material may cause fire.
R31- Contact with acids liberates toxic gas.
R36/38- Irritating to eyes and skin.
S28- After contact with skin, wash immediately with plenty of water.
S36/37/39- Wear suitable protective clothing, gloves and eye/face protection.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:32 PM

Last Updated: 11/06/2008 12:00 PM

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Appendix C

US EPA Part 503
Class B Sludge Requirements

TABLE

FEDERAL PART 503 BIOSOLIDS REGULATION PATHOGEN AND VECTOR ATTRACTION REDUCTION REQUIREMENTS

PATHOGEN REQUIREMENTS		VECTOR ATTRACTION REDUCTION REQUIREMENTS
CLASS A	**CLASS B**	
1. Fecal Coliform <1,000 MPN/gr TS, or Salmonella <3 MPN/4 gr TS - In Addition - 1. Raise temperature of biosolids and maintain for an amount of time according to a time/temperature formula, or 2. Alkaline treatment. Raise pH above 12 for at 72 hours maintaining a temperature greater than 52°C for at least 12 hours. After the 72 hours, biosolids is to be air dried to over 50 percent TS, or 3. Enteric viruses <1 PFU/4 gr TS and viable helminth ova <1/4 gr TS, or 4. Composting. In-vessel or static aerated, maintain at 55°C for 72 hours. Windrow, maintain at 55°C for 15 days. 5. Heat drying. Reduce moisture <10 percent. 6. Heat treatment. Liquid biosolids heated to 180°C for 30 minutes. 7. Thermophilic aerobic digestion at 55°C to 60°C for 10 days. 8. Beta Ray or Gamma Ray irradiation. 9. Pasteurization. Raise temperature to 70°C for 30 minutes. 10. PFRP equivalent process.	1. Fecal coliform <2,000,000 MPN/gr TS, or 2. Fecal coliform <2,000,000 CFU/gr TS, or 3. Aerobic digestion for 40 days at 20°C or 60 days at 15°C, or 4. Air drying for 3 months. Two of three months air temperature >0°C, or 5. Anaerobic digestion for 15 days at 35°C to 55°C or 60 days at 20°C, or 6. Composting at 40°C for 5 days maintaining 55°C for 4 hours during the 5 days, or 7. Lime stabilization. Raise pH to 12 for 2 hours, or 8. PSRP equivalent process.	1. Anaerobic or aerobic digestion where mass of VSS reduced by 38% or more, or 2. Anaerobic digestion. If 38% VSS cannot be achieved, further digestion using bench scale unit at 30°C to 37°C for 40 days results in <17% VSS reduction, or 3. Aerobic digestion. If 38% VSS cannot be achieved, further digestion at 2% TSS using bench scale unit 20°C for 30 days results in <15% VSS reduction, or 4. Aerobic digestion. SOUR <1.5 mg O_2/gr TS/hr at 20°C, or 5. Composting or other aerobic process: temp. >40°C for 14 days with average temp. >45°C. 6. Alkaline stabilization. Raise pH to 12 and maintain pH at 12 for 2 hours and at least 11.5 for additional 22 hours, or 7.,8. Drying to 75% when there are no unstabilized primary biosolids and to 90% when unstabilized primary biosolids is included, or 9. Injection beneath soil surface. Class A biosolids must be injected within 8 hours of discharge from PFRP, or 10. Incorporation within 6 hours of application. Class A biosolids must be incorporated within 8 hours of discharge from PFRP. 11. Surface disposal daily cover. Sewage biosolids or domestic septage placed on a surface disposal site must be covered with soil or other material at the end of each day. 12. Domestic septage treatment. Raise pH to 12 and without adding more alkali, pH remains above 12 for 30 minutes.
- Site restrictions placed on land applied Class B biosolids (see Table 3-3).		
- Biosolids must meet one of the pathogen requirements and a vector attraction reduction requirement. For Class A biosolids, vector attraction must be reduced simultaneously with or following pathogen reduction.		
Note: MPN - Most Probable Number, CFU - Colony Forming Unit, VSS - Volatile Solids, TS - Total Solids, PFU - Plaque Forming Unit, PSRP - Process to Significantly Reduce Pathogens, PFRP - Process to Further Reduce Pathogens.		

TABLE

EPA PART 503
LAND APPLICATION POLLUTANT LIMITS[1]

Pollutant	Ceiling Concentration Limits[2] (mg/kg)	Cumulative Pollutant Loading Rates (kg/ha)	"High Quality" Pollutant Concentration Limits[3] (mg/kg)	Annual Pollutant Loading Rates (kg/ha/yr)
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Chromium	3,000	3,000	1,200	150
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	0.85
Molybdenum	75	(Under Review)	(Under Review)	(Under Review)
Nickel	420	420	420	21
Selenium	100	100	36	5.0
Zinc	7,500	2,800	2,800	140

[1] All Values on a Dry Weight Basis

[2] Maximum Values

[3] Monthly Averages

TABLE

SITE USE RESTRICTIONS FOR CLASS B SLUDGES

1. Food crops with harvested parts that touch the sewage sludge/soil mixture (e.g., melons, cucumbers) shall not be harvested for 14 months after application.

2. Food crops with harvested parts below the soil surface (e.g. potatoes, carrots) shall not be harvested for 20 months after application if the sewage sludge is not incorporated for at least 4 months and shall not be harvested for 38 months after application if the sewage sludge is incorporated in less than 4 months.

3. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after sludge application.

4. Animals shall not graze on a site for 30 days after sludge application.

5. Turf shall not be harvested for one year after sewage application if the turf is placed on land with a high potential for public exposure.

6. Public access to land with high potential for public exposure shall be restricted for one year after sewage sludge application.

7. Public access to land with a low potential for public exposure shall be restricted for 30 days after sewage sludge application.

TABLE

MANAGEMENT PRACTICES FOR LAND APPLICATION OF SLUDGES OTHER THAN EXCEPTIONAL QUALITY SLUDGES

1. Bulk sewage sludge shall not be applied to flooded, frozen, or snow-covered ground so that the sewage sludge enter wetlands or other waters of the U.S. unless authorized by the permitting authority.

2. Bulk sewage sludge shall not be applied at rates above agronomic rates, with the exception of reclamation projects when authorized by the permitting authority.

3. Bulk sewage sludge shall not be applied if likely to adversely affect a threatened or endangered species.

4. Bulk sewage sludge shall not be applied less than 10 meters from waters of the U.S., unless authorized by the permitting authority.

5. Sewage sludge sold or given away shall have either a label affixed to the bag or other container, or an information sheet shall be provided to the person who receives the sewage sludge for application to the land that provides information on proper use, including the annual whole sludge application rate that does not cause any of the annual pollutant loading rates to be exceeded.

Appendix D

Material Safety Data Sheet (MSDS)
PAM C-60

MATERIAL SAFETY DATA SHEET

PAM C-60

Section 01 - Chemical And Product And Company Information

Product Identifier ……... PAM C-60

Product Use ……..... Cationic water treatment polymer.

Supplier Name…….…. ClearTech Industries Inc.
2302 Hanselman Avenue
Saskatoon, SK. Canada
S7L 5Z3

Prepared By.....……..…. ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date.....……..…... February 18, 2009

24-Hour Emergency Phone……... 306-664-2522

Section 02 - Composition / Information on Ingredients

Hazardous Ingredients....……..... Contains no hazardous ingredients

CAS Number.....……....Not available

Synonym (s).....……...None

Section 03 - Hazard Identification

Inhalation.....……..... May cause sneezing, slight irritation of nose or throat.

Skin Contact / Absorption……..... Irritating to skin.

Eye Contact.....……..... Irritating to eyes.

Ingestion.....……. Not available

Exposure Limits……... Nuisance dust: 15mg/m³

Section 04 - First Aid Measures

Inhalation..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

Skin Contact / Absorption..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

Eye Contact..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention.

Ingestion..... Do not induce vomiting. Consult a physician.

Additional Information..... Not available

Section 05 - Fire Fighting

Conditions of Flammability..... Not available

Means of Extinction..... Foam, carbon dioxide, dry powder

Flash Point..... Not available

Auto-ignition Temperature..... Not available

Upper Flammable Limit ..... Not available

Lower Flammable Limit..... Not available

Hazardous Combustible Products... Nitrogen oxides, carbon monoxide and carbon dioxide.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing. When this product comes in contact with water, surfaces become very slippery.

Explosion Hazards..... Not available

Section 06 - Accidental Release Measures

Leak / Spill..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Do not flush with water. Clean up promptly by sweeping or vacuum. After cleaning, flush away traces with water.

Deactivating Materials..... Not available

Section 07 - Handling and Storage

Handling Procedures..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. For good industrial hygiene, avoid contact with skin and eyes, avoid forming dust, and wash hands before breaks and at the end of the workday. Avoid all situations that could lead to harmful exposure.

Storage Requirements..... Keep in a dry, cool place with the container well sealed.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

Eyes..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Respiratory..... Use dust masks where dust exceeds 15mg/m³

Gloves..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Clothing..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Footwear..... No special footwear is required other than what is mandated at place of work.

Engineering Controls

Ventilation Requirements……..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.

Other……..... Use exhaust if dusting occurs. Otherwise natural ventilation is adequate.

Section 09 - Physical and Chemical Properties

Physical State.....……...……..... Granular solid

Odor and Appearance…..…….... Virtually no odor, off white

Odor Threshold...…….....…. Not available

Specific Gravity (Water=1)…….. Not available

Vapor Pressure (mm Hg, 20C)…….. Not available

Vapor Density (Air=1)..……..... Not available

Evaporation Rate.....……..…….…. Not available

Boiling Point.....…….…..... Not available

Freeze/Melting Point....……..... Not available

pH.......……..…. 4-6 @ 5g/L

Water/Oil Distribution Coefficient.... Not available

Bulk Density.....……..…. Not available

% Volatiles by Volume……..……... Not available

Solubility in Water...……..... Complete

Molecular Formula.....…….…..... Not available

Molecular Weight.....……..... Not available

Section 10 - Stability and Reactivity

Stability.....……...……. Product is stable

Incompatibility..... Oxidizing agents, galvanized metals, mild steel, copper and brass.

Hazardous Products of Decomposition.. Thermal decomposition may produce nitrogen and carbon oxides.

Polymerization..... Will not occur

Section 11 - Toxicological Information

Irritancy..... Testing on rabbits showed the material to be non-irritating to the skin.

Sensitization..... Testing on guinea pigs showed this material to be non-sensitizing.

Chronic/Acute Effects..... Acute testing on rabbits shows the material to be non-toxic even at very high dose levels. A two-year feeding study on rats did not reveal adverse chronic health effects.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD_{50}(oral, rat)= >5000mg/kg

Carcinogenicity..... Not considered to be carcinogenic by NTP, IARC, and OSHA.

Reproductive Toxicity..... Not available

Teratogenicity..... Not available

Mutagenicity..... Not available

Section 12 - Ecological Information

Fish Toxicity..... LC_{50}(96 hrs, Fathead minnows)= >1000mg/L

Biodegradability..... Not readily biodegradable.

Environmental Effects..... The product is not considered toxic to aquatic organisms or harmful to the aquatic environment.

Section 13 - Disposal Consideration

Waste Disposal.....Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class……..……..…..... Not regulated

Group.....……....……..... Not regulated

PIN Number.....…….……..... Not regulated

Other……..... Secure containers (full and/or empty) with suitable hold down devises during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....……....Not a controlled product

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3
Phone: 306-664-2522
Fax: 306-665-6216

www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522

Appendix E

Historical Water Quality Testing
Updated Figure 5.9: Sampling Locations

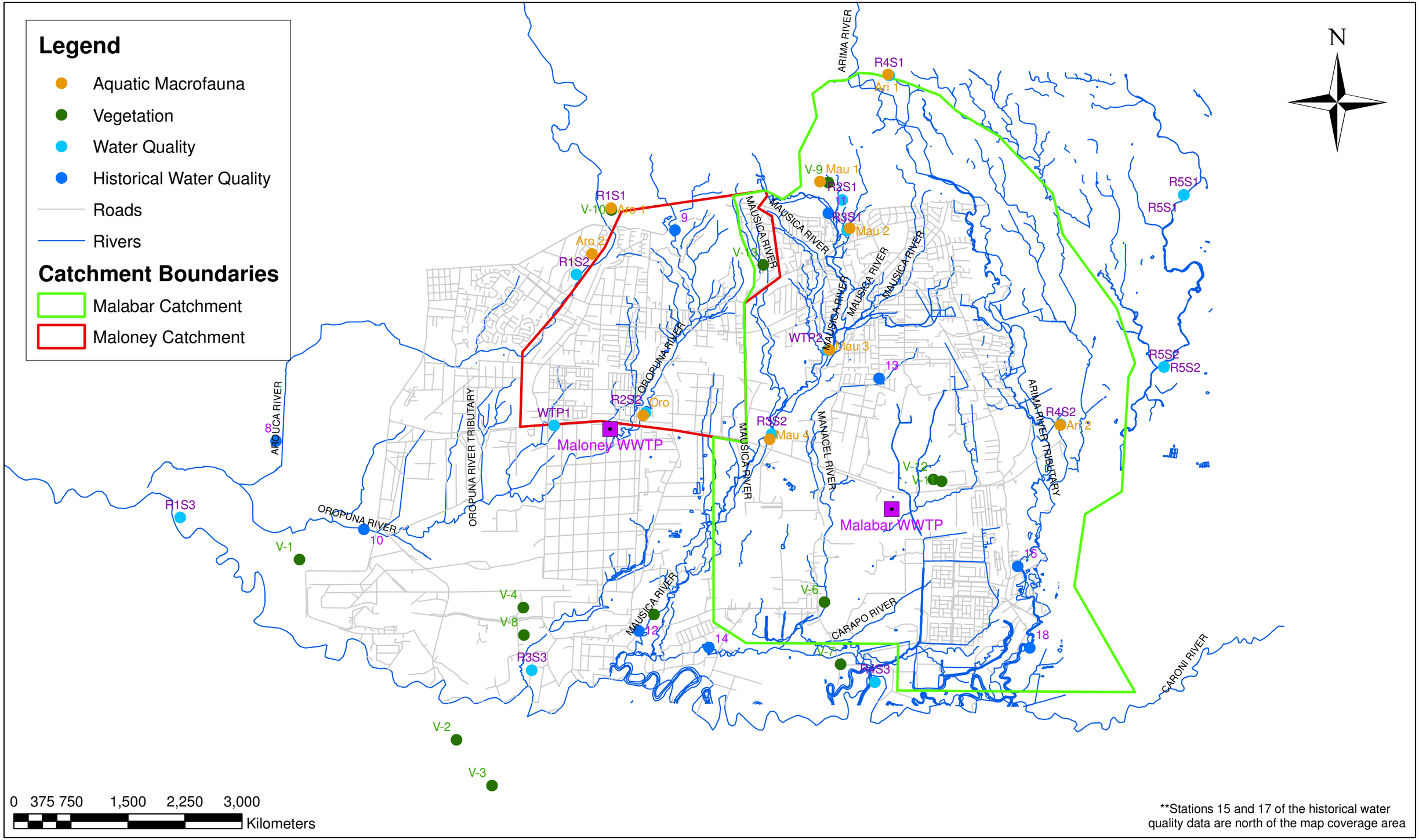

Figure 5.9: Sampling Locations - Water Quality, Vegetation and Aquatic Macrofauna

GPS Reference Points

Table 1 Aquatic Marco Fauna Sampling GPS Reference Points

Point	Easting	Northing
Aro 1	684049	1176573
Aro 2	683795	1175973
Oro	684472	1173844
Mau 1	686802	1176918
Mau 2	687194	1176310
Mau 3	686927	1174705
Mau 4	686140	1173531
Ari 1	687700	1178329
Ari 2	689969	1173718

Table 2 Vegetation Sampling GPS Reference Points

Point	Northing	Easting
V-1	679942	1171948
V-2	682013	1169581
V-3	682481	1168978
V-4	682892	1171316
V-5	684615	1171226
V-6	686861	1171388
V-7	687073	1170569
V-8	682901	1170960
V-9	686913	1176909
V-10	684054	1176546
V-11	688405	1172980
V-12	688295	1173005
V-13	686055	1175824

Table 3 Water Quality Sampling GPS Reference Points

Point	Northing	Easting
R1S1	684048	1176568
R2S1	687095	1176684
R4S1	687714	1178320
R5S1	691598	1176750
R5S2	691335	1174482
R5S1	691598	1176750
R5S2	691335	1174482
R4S2	689974	1173725
R3S2	686164	1173599
R2S2	684503	1173882
WTP1	683299	1173712
WTP2	686902	1174698
R3S1	687158	1176285
R1S2	683591	1175699
R4S3	687525	1170336
R3S3	683004	1170493
R1S3	678370	1172501

Table 4 Historical Water Quality Sampling GPS Reference Points[1]

Station	X_Coord	Y_Coord
8	679632.3884	1173508.5067
9	684891.355	1176282.4035
10	680789.7512	1172348.1704
11	686913.0224	1176508.6091
12	684415.1159	1171011.4303
13	687580.6417	1174334.3629
14	685338.1659	1170792.0676
15	686344.7757	1182827.7991
16	689408.4988	1171859.4614
17	689883.8838	1182570.6487
17*	689436.1024	1182869.0100
18	689567.1887	1170787.2733

*1998 Adjusted sampling location

[1] *Institute of Marine Affairs, 2001. Trinidad and Tobago Water Sector Institutional Strengthening Design and Implementation of the Surface Water Quality Monitoring Programme for the Caroni River Basin: Draft Report on Surface Water Quality in the Caroni River Basin*

Table 5 Existing and Proposed WWTP Locations (fence boundary corners)

WWTP Name	X_Coord	Y_Coord
Existing Arima WWTP	686724	1174835
	686719	1174668
	686882	1174656
	686938	1174829
Existing Malabar WWTP	688082	1173149
	688088	1173055
	688184	1173157
	688167	1173062
Maloney WWTP	683388	1173801
	683305	1173804
	683387	1173711
	683297	1173714
Proposed Malabar WWTP	687647	1172723
	687967	1172722
	687950	1172565
	687827	1172565
	687807	1172464
	687647	1172466

Table 6 Existing and Proposed WWTP Outfall Locations

Outfall Name	X_Coord	Y_Coord
Existing Arima WWTP	686890	117464
Existing Malabar WWTP	688085	1173037
Maloney WWTP	683302	1173702
Proposed Malabar WWTP	687731.994	1172428.494

Arouca River, 1997, Stations 7 (Upper) and 8 (Lower)[1]

TABLE 4: THE CHEMICAL ANALYSIS OF THE AROUCA RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	7.4	8.0	7.8	7.5	7.4	7.5	7.6	0.2
	LOW	7.3	7.5	7.3	7.3	7.3	7.3	7.3	0.1
TEMP.	UP	28.0	23.0	24.0	26.5	24.0	25.0	25.1	1.9
°C	LOW	25.0	28.0	27.0	26.0	25.0	29.0	26.7	1.6
COND.	UP	171	170	180	180	115	150	161	25
umho/cm	LOW	320	290	380	310	135	300	289	82
COD	UP	0.9	1.2	0.8	1.7	8.3	1.2	2.3	2.9
mg/L	LOW	2.4	4.0	7.3	5.4	18.0	5.2	7.1	5.6
BOD	UP	0.5	0.7	<0.5	<0.5	1.1	2.9	1	1
mg/L	LOW	2.6	3.6	3.8	2.9	5.1	5.2	4	1
DO	UP	NA	8.0	6.0	5.9	8.0	NA	7.0	1.2
mg/L	LOW	NA	5.2	1.3	NA	7	NA	5	3
TSS	UP	3	3	1	3	44	1	9	17
mg/L	LOW	5	11	10	21	355	12	69	140
TDS	UP	76	132	105	215	100	94	120	50
mg/L	LOW	126	171	204	287	116	151	176	63
NO2	UP	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
mg/L	LOW	0.15	0.08	0.01	0.14	0.01	0.03	0	0
NO3	UP	0.57	0.15	0.11	0.21	0.42	0.38	0	0
mg/L	LOW	0.79	0.61	0.05	2.48	0.44	0.89	1	1
NH3	UP	0.06	0.02	0.03	0.04	0.03	0.03	0	0
mg/L	LOW	2.66	1.62	4.15	2.09	0.25	1.12	2	1
ORG-N	UP	16.9	5	1.2	3.77	2.8	0.8	5	6
mg/L	LOW	19.4	4.78	2.1	0.72	3.9	0.7	5	7
CL-	UP	12	11	11	11	6	10	10	2
mg/L	LOW	18	18	25	19	4	16	17	7
S-2	UP	<0.01	0.01	0.01	0.01	<0.01	<0.01	0	0
mg/L	LOW	<0.01	0.01	0.01	0.01	0.36	0.03	0	0
PO4	UP	0.06	0.19	0.22	0.38	0.11	0.5	0	0
mg/L	LOW	0.53	0.61	1.64	1.56	0.44	0.55	1	1
O&G	UP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
mg/L	LOW	1.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Zn	UP	70.0	<5.0	<5.0	<5.0	7.0	<5.0	38.5	115.7
ug/L	LOW	19.0	8.0	<5.0	7.0	52.0	20.0	21.2	86.0
Pb	UP	8.53	<2.0	2.44	<2.0	<2.0	<2.0	5	4
ug/L	LOW	<2.0	<2.0	4.02	<2.0	33.35	<2.0	19	21
Cr	UP	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
ug/L	LOW	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
Cu	UP	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
ug/L	LOW	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
Fe	UP	0.120	<0.1	<0.1	0.218	0.651	0.235	0.306	0.236
mg/L	LOW	0.790	1.690	1.230	1.082	2.532	1.017	1.390	0.635
Tot.Col	UP	63,000	230,000	48,000	66,000	97,000	80,000	97333	67075
counts/100mL	LOW	280,000	260,000	1,600,000	90,000	83,000	180,000	415500	586097
Fec.Col.	UP	1,200	5,100	2,400	1.14	850	2,200	1959	1775
counts/100mL	LOW	4,500	8,600	180,000	18,000	3,400	17,000	38583	69551

[1] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Arouca River, 1997 and 1998, Station 8 (Lower)[2]

TABLE 4 : THE CHEMICAL ANALYSIS OF THE AROUCA RIVER (STATION # 8).

PARAMETER	MAR - 97	APR - 97	MAY- 97	JUN - 97	JUL - 97	AUG - 97	DEC - 97	JAN - 98	FEB - 98	MAR - 98	APR - 98	MAY - 98	MEAN	SD
pH	7.3	7.5	7.3	7.3	7.3	7.3	7.4	6.9	7.2	7.0	6.9	7.1	7.2	0.2
TEMP. °C	25	28	27	26	25	29	27.0	26.5	28.6	28.0	30.0	27.0	27.3	1.5
COND. umho/cm	320	290	380	310	135	300	290	175	390	400	400	390	315	87
DO mg/L	NA	5.2	1.3	NA	7	NA	4.2	4.3	3.7	3.3	3.5	5.1	4.2	1.6
BOD mg/L	2.6	3.6	3.8	2.9	5.1	5.2	2.1	1.9	5.8	3.9	2.8	5.8	3.8	1.4
TSS mg/L	5	11	10	21	355	12	10	6	6	40	4	104	49	100
NO2 mg/L	0.15	0.08	0.01	0.14	0.01	0.03	0.12	0.07	0.05	0.04	0.02	0.07	0.07	0.05
NO3 mg/L	0.79	0.61	0.05	2.48	0.44	0.89	0.89	0.75	0.46	0.53	0.16	0.08	0.68	0.64
NH3 mg/L	2.66	1.62	4.15	2.09	0.25	1.12	0.75	1.68	3.05	2.45	2.63	0.67	1.93	1.13
ORG-N mg/L	19.4	4.78	2.1	0.72	3.9	0.7	0.81	0.14	1.46	0.47	NA	1.78	3.30	5.54
CL- mg/L	18	18	25	19	4	16	18	25	21	21	21	19	19	5
PO4 mg/L	0.53	0.61	1.64	1.56	0.44	0.55	0.34	0.35	0.84	0.67	1.33	0.60	0.79	0.46
Pb ug/L	< 2.00	< 2.00	4.02	< 2.00	33.35	< 2.00	< 2.00	< 2.00	3.74	2.50	< 2.00	< 2.00	10.9	15.0
Cr ug/L	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	8.96	< 1.00	1.50	< 1.00	5.2	5.3
Tot.Col. counts/100mL	280,000	260,000	1,600,000	90,000	83,000	180,000	190,000	64,000	12,400	89,000	83,000	800,000	310950	456097
Fec.Col. counts/100mL	4,500	8,600	180,000	18,000	3,400	17,000	11,000	4,900	3,500	7,800	4,000	190,000	37725	69002
Flow Rate m^3/s	0.227	0.218	0.177	0.177	0.227	0.064	0.139	0.153	0.041	0.068	0.068	0.068	0.136	0.071

[2] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Oroupna River, 1997, Stations 9 (Upper) and 10 (Lower)[3]

TABLE 5: THE CHEMICAL ANALYSIS OF THE OROPUNA RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	7.8	7.6	7.4	7.3	7.4	7.4	7.5	0.2
	LOW	7.3	7.6	7.1	7.1	7.0	7.1	7.2	0.2
TEMP.	UP	25.0	26.0	28.0	26.0	26.5	28.0	26.6	1.2
°C	LOW	25.0	27.0	28.0	28.0	26.0	29.5	27.3	1.6
COND.	UP	300	300	300	280	250	295	288	20
umho/cm	LOW	330	315	320	295	160	335	293	66
COD	UP	3.2	5.9	6.1	4.1	3.5	3.7	4.42	1.26
mg/L	LOW	5.0	9.3	5.3	7.1	8.7	4.7	6.68	1.99
BOD	UP	2.6	3.5	6.8	2.1	2.6	2.7	3.38	1.73
mg/L	LOW	7.7	3.9	6.2	3.7	0.7	3.7	4.32	2.41
DO	UP	6.2	4.1	5.9	5.6	7.0	7.5	6.05	1.19
mg/L	LOW	1.7	2.2	1.0	3.8	5.0	6.5	3.37	2.12
TSS	UP	4	6	15	25	8	1	10	9
mg/L	LOW	7	13	11	48	119	15	36	44
TDS	UP	198	178	180	274	162	184	196	40
mg/L	LOW	225	186	172	258	127	175	191	46
NO2	UP	0.10	0.18	0.09	0.07	0.04	0.07	0.09	0.05
mg/L	LOW	<0.01	0.01	<0.01	0.01	0.03	0.02	0.02	0.01
NO3	UP	0.83	0.37	0.17	0.37	0.41	0.37	0.42	0.22
mg/L	LOW	0.19	0.05	0.01	0.10	0.37	0.20	0.15	0.13
NH3	UP	0.22	1.29	2.06	0.72	0.53	0.58	0.90	0.67
mg/L	LOW	2.00	2.54	3.26	3.00	0.48	0.29	1.93	1.27
ORG-N	UP	35.30	2.22	2.13	1.08	2.00	6.00	8.12	13.42
mg/L	LOW	3.58	2.64	3.59	2.78	9.30	9.60	5.25	3.28
CL-	UP	23	19	20	19	15	19	19	3
mg/L	LOW	19	19	18	17	9	18	17	4
S-2	UP	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.00
mg/L	LOW	0.01	0.02	0.03	0.02	0.22	0.03	0.06	0.08
PO4	UP	0.16	0.52	0.47	0.61	0.20	0.38	0.39	0.18
mg/L	LOW	0.73	0.90	0.93	0.91	0.33	0.58	0.73	0.24
O&G	UP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
mg/L	LOW	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Zn	UP	11.0	10.0	40.0	7.0	13.0	11.0	15.33	79.84
ug/L	LOW	19.0	8.0	11.0	6.0	20.0	14.0	13.00	44.05
Pb	UP	<2.0	3.91	5.16	<2.0	11.64	<2.0	6.90	4.15
ug/L	LOW	<2.0	3.91	<2.0	<2.0	13.90	<2.0	8.91	7.06
Cr	UP	<1.0	<1.0	5.41	<1.0	1.65	<1.0	3.53	2.66
ug/L	LOW	1.14	4.23	<1.0	<1.0	2.16	<1.0	2.51	1.57
Cu	UP	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-
ug/L	LOW	<1.0	<1.0	1.81	<1.0	<1.0	<1.0	1.81	-
Fe	UP	2.800	1.360	3.100	1.869	2.112	1.477	2.120	0.704
mg/L	LOW	1.110	1.210	0.550	1.589	2.192	0.948	1.267	0.566
Tot.Col	UP	300000	890000	370000	830000	760000	870000	670000	264197
counts/100mL	LOW	360000	300000	61000	570000	6600000	93000	1330667	2588159
Fec.Col.	UP	70000	53000	45000	260000	94000	36000	93000	84347
counts/100mL	LOW	80000	68000	62000	150000	1800000	8900	361483	706176

[3] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Mausica River 1997, Stations 11 (Upper) and 12 (Lower)[4]

TABLE 6: THE CHEMICAL ANALYSIS OF THE MAUSICA RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	7.5	7.4	7.0	7.0	7.2	7.3	7.2	0.2
	LOW	7.5	7.5	7.3	7.2	7.0	7.0	7.2	0.2
TEMP.	UP	25.0	26.0	26.5	26.0	26.0	28.0	26.3	1.0
°C	LOW	25.0	26.0	27.0	27.0	26.0	28.0	26.5	1.0
COND.	UP	250	240	210	250	215	245	235	18
umho/cm	LOW	290	310	350	280	175	280	281	58
COD	UP	2.4	1.6	2.8	1.4	1.1	1.6	1.8	0.6
mg/L	LOW	4.3	4.3	3.8	6.0	4.5	5.0	4.7	0.8
BOD	UP	0.7	6.7	2.7	<0.5	0.5	0.6	2.2	2.7
mg/L	LOW	1.3	3.5	2.0	2.8	3.4	3.6	2.8	0.9
DO	UP	6.5	5.8	8.0	5.8	6.6	6.6	6.6	0.8
mg/L	LOW	4.4	3.9	0.3	5.0	5.1	5.9	4.1	2.0
TSS	UP	1	<1.0	5	2	2	9	4	3
mg/L	LOW	9	9	7	34	33	33	21	14
TDS	UP	155	136	143	208	151	132	154	28
mg/L	LOW	407	180	185	214	119	169	212	100
NO2	UP	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.00
mg/L	LOW	0.23	0.18	0.13	0.24	0.10	0.19	0.18	0.05
NO3	UP	0.44	0.29	0.21	0.25	0.40	0.09	0.28	0.13
mg/L	LOW	1.19	0.84	0.45	0.94	0.73	0.57	0.79	0.27
NH3	UP	0.06	0.12	0.42	0.13	0.06	0.13	0.15	0.13
mg/L	LOW	0.45	1.88	1.58	0.74	0.35	0.74	0.96	0.63
ORG-N	UP	32.40	0.86	3.35	2.89	5.80	1.30	7.77	12.19
mg/L	LOW	1.33	1.36	1.12	2.91	10.60	1.20	3.09	3.74
CL-	UP	21	19	17	16	14	17	17	2
mg/L	LOW	25	23	23	20	13	21	21	4
S-2	UP	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.00
mg/L	LOW	0.01	0.01	0.11	0.01	<0.01	0.03	0.03	0.04
PO4	UP	0.12	0.31	0.34	0.48	0.10	0.24	0.27	0.14
mg/L	LOW	0.40	0.61	0.50	0.54	0.39	0.61	0.51	0.10
O&G	UP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
mg/L	LOW	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Zn	UP	41.0	8.0	28.0	<5.0	<5.0	<5.0	25.67	64.77
ug/L	LOW	12.0	8.0	<5.0	9.0	30.0	20.0	15.80	58.42
Pb	UP	<2.0	2.1	<2.0	<2.0	<2	<2	2.1	-
ug/L	LOW	<2.0	<2.0	<2.0	<2.0	4.2	<2	4.2	-
Cr	UP	<1.0	<1.0	<1.0	<1.0	1.7	<1	1.7	-
ug/L	LOW	<1.0	2.3	<1.0	<1.0	2.2	<1	2.2	0.1
Cu	UP	<1.0	<1.0	<1.0	<1.0	<1	<1	0.0	-
ug/L	LOW	<1.0	<1.0	1.8	<1.0	<1	<1	1.8	-
Fe	UP	0.52	1.27	0.52	0.57	0.53	0.60	0.67	0.30
mg/L	LOW	1.59	1.36	1.28	2.28	2.63	2.51	1.94	0.60
Tot.Col	UP	85000	700000	130000	81000	80000	370000	241000	251197
counts/100mL	LOW	100000	60000	340000	340000	500000	78000	236333	182079
Fec.Col.	UP	8600	200000	27000	8000	3700	31000	46383	76070
counts/100mL	LOW	4100	2500	38000	78000	47000	3800	28900	30865

[4] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Manacal/ Carapo River, 1997, Stations 13 (Upper) and 14 (Lower)[5]

TABLE 7: THE CHEMICAL ANALYSIS OF THE MANACAL/CARAPO RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	7.5	7.5	7.3	7.0	6.3	7.4	7.2	0.5
	LOW	7.3	7.6	7.2	6.7	6.9	7.3	7.2	0.3
TEMP.	UP	25.0	27.0	28.0	26.0	26.0	30.0	27.0	1.8
°C	LOW	25.0	27.0	32.0	25.0	25.5	27.0	26.9	2.7
COND.	UP	230	275	315	135	140	300	233	79
umho/cm	LOW	320	345	290	200	145	300	267	77
COD	UP	4.3	4.3	5.4	16.2	14.2	3.2	7.9	5.7
mg/L	LOW	4.7	4.4	5.4	12.2	58.2	4.8	15.0	21.4
BOD	UP	2.7	2.2	5.4	4.4	3.2	1.8	3.3	1.4
mg/L	LOW	1.1	0.7	5.4	2.9	2.9	0.9	2.3	1.8
DO	UP	4.0	7.2	1.1	8.4	7.9	4.5	5.5	2.8
mg/L	LOW	2.1	1.7	3.7	2.5	4.0	3.3	2.9	0.9
TSS	UP	1	1	2	40	33	2	13	18
mg/L	LOW	5	3	3	31	101	9	25	39
TDS	UP	168	168	185	124	108	200	159	36
mg/L	LOW	215	215	146	104	139	204	171	47
NO2	UP	0.10	0.11	0.12	0.02	0.02	0.03	0.07	0.05
mg/L	LOW	0.08	0.04	0.05	0.01	0.03	0.04	0.04	0.02
NO3	UP	0.91	0.90	0.45	0.68	0.30	0.52	0.63	0.25
mg/L	LOW	3.57	2.05	0.92	1.00	1.23	2.55	1.89	1.04
NH3	UP	0.10	0.45	0.25	0.14	0.14	0.05	0.19	0.14
mg/L	LOW	0.35	0.30	0.32	0.05	0.17	0.17	0.23	0.12
ORG-N	UP	24.80	2.57	0.61	2.24	3.30	1.00	5.75	9.38
mg/L	LOW	39.90	5.85	1.79	3.59	4.40	1.10	9.44	15.02
CL-	UP	18	18	20	3	7	14	13	7
mg/L	LOW	25	25	25	11	12	22	20	7
S-2	UP	0.01	0.01	0.01	0.02	<0.01	<0.01	0.01	0.01
mg/L	LOW	0.01	0.01	0.01	0.01	0.14	0.02	0.03	0.05
PO4	UP	0.7	1.31	1.97	0.53	0.36	0.57	0.91	0.61
mg/L	LOW	0.79	1.11	1.11	0.62	0.84	0.76	0.87	0.20
O&G	UP	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	0.70	-
mg/L	LOW	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	0.70	-
Zn	UP	19.0	10.0	53.0	21.0	84.0	14.0	33.50	86.82
ug/L	LOW	<5.0	20.0	10.0	12.0	39.0	<5.0	20.25	65.31
Pb	UP	<2.0	<2.0	<2.0	8	<2	<2	8.00	-
ug/L	LOW	<2.0	<2.0	<2.0	9.4	17.972	<2	13.69	6.06
Cr	UP	<1.0	<1.0	<1.0	<1	3.55	<1	3.55	-
ug/L	LOW	<1.0	<1.0	<1.0	<1	2.66	<1	2.67	-
Cu	UP	<1.0	2.69	<1.0	7.9	<1	<1	5.30	3.68
ug/L	LOW	<1.0	1.26	2.34	<1	<1	<1	1.80	0.76
Fe	UP	0.360	0.220	0.380	0.650	0.931	0.327	0.478	0.26
mg/L	LOW	0.760	0.490	0.550	2.833	3.753	1.063	1.575	1.38
Tot.Col	UP	140,000	270,000	570,000	730,000	360,000	2800000	811667	996703
counts/100mL	LOW	50,000	34,000	52,000	290,000	50,000	140000	102667	99315
Fec.Col.	UP	31,000	30,000	90,000	170000	90000	370000	130167	128219
counts/100mL	LOW	2,000	510	12,000	21,000	20,000	10000	10918	8649

[5] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Arima River, 1997, Stations 15 (Upper) and 16 (Lower)[6]

TABLE 8: THE CHEMICAL ANALYSIS OF THE ARIMA RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	7.9	8.0	7.9	7.5	7.4	7.4	7.7	0.3
	LOW	7.6	7.7	7.7	7.2	7.3	7.5	7.5	0.2
TEMP.	UP	22.0	23.5	25.0	24.0	23.0	24.0	23.6	1.0
°C	LOW	24.5	26.5	32.0	25.0	25.0	26.0	26.5	2.8
COND.	UP	190	210	270	200	116	180	194	50
umho/cm	LOW	330	350	220	250	210	300	277	59
COD	UP	0.9	1.2	0.8	2.2	1.8	1.2	1.4	0.5
mg/L	LOW	3.0	2.9	4.3	6.1	4.3	2.4	3.8	1.4
BOD	UP	0.5	<0.5	0.8	1.5	1.2	<0.5	1.0	0.4
mg/L	LOW	1.4	1.4	4.3	2.5	1.4	2.1	2.2	1.1
DO	UP	7.3	8.3	4.7	8.5	9.9	8.5	7.9	1.8
mg/L	LOW	0.5	1.1	4.6	3.6	7.0	4.3	3.5	2.4
TSS	UP	1	<1	<1	8	2	1	3	3
mg/L	LOW	5	2	9	44	48	11	20	21
TDS	UP	155	148	203	84	106	132	138	41
mg/L	LOW	217	212	118	123	142	217	172	49
NO2	UP	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
mg/L	LOW	0.01	<0.01	<0.01	0.03	0.03	0.13	0.050	0
NO3	UP	0.30	0.19	0.10	0.14	0.31	0.31	0.23	0.09
mg/L	LOW	0.43	0.05	<0.01	0.90	0.41	0.93	0.54	0.37
NH3	UP	0.06	0.02	<0.01	0.02	0.02	0.03	0.03	0.02
mg/L	LOW	1.66	1.65	4.50	0.56	0.44	0.97	1.63	1.50
ORG-N	UP	4.84	7.52	1.02	2.53	4.50	2.90	3.89	2.26
mg/L	LOW	33.70	5.71	4.74	2.02	3.80	1.90	8.65	12.37
CL-	UP	10	9	9	6	7	8	8	1
mg/L	LOW	15	16	17	8	10	13	13	4
S-2	UP	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.00
mg/L	LOW	0.01	0.01	0.02	0.01	0.07	0.02	0.02	0.02
PO4	UP	0.05	0.47	0.23	0.13	0.1	0.32	0.22	0.16
mg/L	LOW	0.33	0.52	0.91	0.35	0.18	0.47	0.46	0.25
O&G	UP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
mg/L	LOW	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Zn	UP	<5.0	8.0	<5.0	<5.0	<5.0	<5.0	8.00	-
ug/L	LOW	6.0	13.0	10.0	10.0	7.0	99.0	24.17	152.05
Pb	UP	<2.0	<2.0	<2.0	<2	<2	<1	-	-
ug/L	LOW	<2.0	<2.0	<2.0	<2	<2	12.45	-	-
Cr	UP	<1.0	<1.0	<1.0	<1	2.413	<1	2.413	-
ug/L	LOW	<1.0	2.06	<1.0	<1	2.159	<1	2.110	0
Cu	UP	<1.0	1	2.88	<1	<1	<1	1.940	1
mg/L	LOW	<1.0	1.52	<1.0	<1	<1	<1	1.520	-
Fe	UP	<0.10	<0.1	<0.1	0.168	0.151	0.258	0.192	0
mg/L	LOW	0.710	0.810	0.830	1.259	0.991	0.833	0.906	0.195
Tot.Col	UP	58,000	94,000	36,000	64,000	83,000	72000	67833	20282
counts/100mL	LOW	190,000	250,000	110,000	260,000	290,000	300000	233333	71740
Fec.Col.	UP	3,000	2,600	1,600	640	4000	7600	3240	2429
counts/100mL	LOW	36,000	11,000	10,000	24,000	37,000	10800	21467	12757

[6] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Guanapo and Aripo River, 1997, Stations 17 (Upper) and 18 (Lower)[7]

TABLE 9: THE CHEMICAL ANALYSIS OF THE GUANAPO RIVER

Parameter.	ST.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	MEAN	SD
pH	UP	8.0	7.7	7.8	7.2	7.4	7.6	7.6	0.3
	LOW	7.4	7.5	7.4	7.3	7.3	7.7	7.4	0.1
TEMP.	UP	23.0	23.5	25.0	23.5	24.0	26.0	24.2	1.1
°C	LOW	27.0	27.5	26.5	27.0	26.0	27.0	26.8	0.5
COND.	UP	250	175	310	135	112	120	184	80
umho/cm	LOW	290	310	340	210	230	230	268	52
COD	UP	0.9	1.3	2.4	1.1	1.9	2.1	1.6	0.6
mg/L	LOW	4.7	8.2	7.4	8.1	3.7	4.6	6.1	2.0
BOD	UP	0.5	1.4	<0.5	<0.5	<0.5	<0.5	1.0	0.6
mg/L	LOW	6.2	5.1	1.5	2.6	1.0	1.4	3.0	2.2
DO	UP	7.5	8.4	6.9	8.5	8.6	7.2	7.9	0.7
mg/L	LOW	4.5	4.6	4.4	6.3	7.8	5.2	5.5	1.3
TSS	UP	3	1	2	1	4	<1	2	1
mg/L	LOW	180	80	24	75	44	25	71	58
TDS	UP	152	136	118	79	78	90	109	31
mg/L	LOW	176	219	132	73	143	146	148	48
NO2	UP	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
mg/L	LOW	<0.01	0.05	0.03	0.04	0.02	0.02	0.03	0.01
NO3	UP	0.59	0.16	0.20	0.04	0.21	0.27	0.25	0.19
mg/L	LOW	0.38	0.20	1.00	0.43	0.36	0.76	0.52	0.30
NH3	UP	0.02	0.01	1.57	<0.01	0.01	0.03	0.33	0.69
mg/L	LOW	1.05	1.32	0.91	0.17	0.18	0.25	0.65	0.51
ORG-N	UP	2.61	2.61	1.07	1.53	5.90	1.40	2.52	1.78
mg/L	LOW	0.46	0.84	<0.01	2.10	3.50	4.70	2.32	1.79
CL-	UP	11	8	8	6	6	7	8	2
mg/L	LOW	15	31	11	8	8	9	14	9
S-2	UP	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.00
mg/L	LOW	0.02	0.03	0.01	0.04	0.07	0.05	0.04	0.02
PO4	UP	0.04	0.9	0.23	0.31	0.08	0.3	0.31	0.31
mg/L	LOW	0.27	0.29	0.35	0.28	0.16	0.36	0.29	0.07
O&G	UP	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
mg/L	LOW	<0.5	<0.5	<.05	<0.5	<0.5	<0.5	-	-
Zn	UP	13.0	<5.0	<5.0	<5.0	7.0	<5.0	10.00	42.43
ug/L	LOW	<5.0	<5.0	<5.0	6.0	10.0	33.0	16.33	89.21
Pb	UP	<2.0	<2.0	<2.0	<2	<2	<2	-	-
ug/L	LOW	3.17	<2.0	<2.0	<2	5.982	<2	4.58	1.99
Cr	UP	<1.0	4.19	<1.0	<1	2.286	<1	3.24	1.35
ug/L	LOW	4.43	2.99	<1.0	<1	1.525	<1	2.98	1.45
Cu	UP	<1.0	<13.0	<1.0	<1	<1	<1	-	-
ug/L	LOW	1.89	1.26	<1.0	<1	<1	<1	1.58	0.45
Fe	UP	<0.10	<0.1	<0.1	<1	0.171	0.096	0.13	0.05
mg/L	LOW	1.4	0.88	0.86	1.336	1.132	1.431	1.17	0.26
Tot.Col	UP	8,100	31,000	20,000	63,000	100,000	41000	43850	33286
counts/100mL	LOW	630,000	41,000	96,000	320,000	2,100,000	60000	541167	795818
Fec.Col.	UP	160	2,100	1,600	2000	2300	80	1373	998
counts/100mL	LOW	120,000	200,000	16,000	37,000	250,000	2100	104183	103348

[7] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Guanapo River, 1997 and 1998, Station 18 (Lower)[8]

TABLE 5 : THE CHEMICAL ANALYSIS OF THE GAUNAPO RIVER (STATION # 18).

PARAMETER	MAR - 97	APR - 97	MAY- 97	JUN - 97	JUL - 97	AUG - 97	DEC - 97	JAN - 98	FEB - 98	MAR - 98	APR - 98	MAY - 98	MEAN	SD
pH	7.4	7.5	7.4	7.3	7.3	7.7	7.9	6.9	7.4	7.1	7.1	7.4	7.4	0.3
TEMP. °C	27.0	27.5	26.5	27.0	26.0	27.0	24.5	26.0	27.5	27.0	28.0	27.4	26.8	0.9
COND. umho/cm	290	310	340	210	230	230	245	250	355	320	310	310	283	48
DO mg/L	4.5	4.6	4.4	6.3	7.8	5.2	3.9	3.4	3.3	4.2	5.0	7.8	5.0	1.5
BOD mg/L	6.2	5.1	1.5	2.6	1.0	1.4	0.8	0.6	9.5	3.3	2.7	1.6	3.0	2.7
TSS mg/L	180	80	24	75	44	25	19	15	30	110	107	17	61	51
NO2 mg/L	<0.01	0.05	0.03	0.04	0.02	0.02	0.08	0.08	0.09	0.07	0.06	0.04	0.05	0.02
NO3 mg/L	0.38	0.20	0.31	0.43	0.36	0.76	1.14	0.77	0.40	0.53	0.29	0.04	0.47	0.30
NH3 mg/L	1.05	1.32	1.57	0.17	0.18	0.25	0.57	0.30	2.13	1.90	1.56	0.55	0.96	0.71
ORG-N mg/L	0.46	0.84	<0.01	2.10	3.50	4.70	1.62	0.15	1.23	0.16	NA	7.70	2.25	2.42
CL- mg/L	15	31	11	8	8	9	12	13	16	18	17	11	14	6
PO4 mg/L	0.27	0.29	0.35	0.28	0.16	0.36	0.10	0.12	0.31	0.19	0.52	0.14	0.26	0.12
Pb ug/L	3.17	< 2.00	< 2.00	< 2.00	5.982	< 2.00	< 2.00	< 2.00	< 2.00	2.40	< 2.00	< 2.00	3.9	1.9
Cr ug/L	4.43	2.99	< 1.00	< 1.00	1.52	66.42	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	18.8	31.7
Tot.CoL counts/100mL	630,000	41,000	96,000	320,000	2,100,000	60000	89,000	74,000	220,000	97,000	191,000	94,000	334333	579888
Fec.CoL counts/100mL	120,000	200,000	16,000	37,000	250,000	2100	2,900	2,100	36,000	2,800	20,000	3,200	57675	85461
Flow Rate m^3/s	0.876.	1.263 .	1.383	5.452	13.601	2.185	1.066	1.066	1.171	0.837	0.512	1.060	2.539	3.719

[8] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Upper Aripo River, 1997 and 1998, Station 17 (Lower)[9]

TABLE 11 : THE CHEMICAL ANALYSIS OF UPPER ARIPO RIVER (CONTROL STATION # 17).

PARAMETER	MAR - 97	APR - 97	MAY- 97	JUN - 97	JUL - 97	AUG - 97	MAR - 98	APR - 98	MAY - 98	MEAN	SD
pH	8.0	7.7	7.8	7.2	7.4	7.6	7.6	7.4	7.5	7.6	0.2
TEMP. °C	23.0	23.5	25.0	23.5	24.0	26.6	24.0	24.8	24.5	24.3	1.1
COND. umho/cm	250	175	310	135	112	120	340	370	370	242	109
DO mg/L	7.5	8.4	6.9	8.5	8.6	7.2	9.1	7.5	6.5	7.8	0.9
BOD mg/L	0.5	1.4	<0.5	<0.5	<0.5	N.D	<0.5	1.1	<0.5	1.0	0.5
TSS mg/L	3	1	2	1	4	<1	1	<1	<1	2	1
NO2 mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
NO3 mg/L	0.59	0.16	0.20	0.04	0.21	0.27	0.19	0.18	0.21	0.23	0.15
NH3 mg/L	0.02	0.01	1.00	<0.01	0.01	0.03	<.01	0.03	0.10	0.17	0.37
ORG-N mg/L	2.61	2.61	1.07	1.53	5.90	1.40	1.00	0.45	1.57	2.02	1.62
CL- mg/L	11	8	8	6	6	7	11	15	18	10	4
PO4 mg/L	0.07	0.90	0.23	0.31	0.08	0.30	0.24	0.11	0.11	0.26	0.26
Pb ug/L	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	-	-
Cr ug/L	<1.00	4.19	<1.00	<1.00	2.28	<1.00	<1.00	<1.00	1.57	2.68	1.36
Tot.Col. counts/100mL	81,000	31,000	20,000	63,000	100,000	41,000	27,000	30,000	1,700	43,856	31,413
Fec.Col. counts/100mL	160	2,100	1,600	37,000	250,000	2,100	30	1,300	380	32,741	82,337

[9] Institute of Marine Affairs, Draft Final Report on Surface Water Quality in the Caroni River Basin, 2001

Appendix F

Water Quality Analysis Report
June & July 2009

EcoTox Environmental Services Ltd.

Water Analysis Report

14th August 2008

Client: Rapid Environmental Assessment Limited

Project Code: REAL-09A

Date Tested: 30th June 2008

Test Conducted By:

ECOTOX Environmental Services Ltd.

 # 211 Caroni Savannah Road, Charlieville, Chaguanas, Trinidad, W.I.

Telephone: (868) 672-6620 Fax: (868) 665-8620 E-mail: admin@ecotoxes.com

Nafeesa Ali

Lab Supervisor

Mikaiel Dookie

Analytical Chemist

Date of Report: **14th August 2008**

Client: **Rapid Environmental Assessment Limited (REAL)**

Client Address: **Corner Noel Street, Couva, Trinidad, West Indies.**

Project Code: **REAL-09A**

Project Number: **09**

Abstract:

ECOTOX Environmental Services Ltd. was contracted by Rapid Environmental Assessment Limited (R.E.A.L.) to conduct analytical testing on thirteen (13) River Water samples and two (2) Waste Treatment Plant Effluent water samples. These water samples were taken from various areas of North Eastern Trinidad.

Table 1: Details for River Samples

Client Sample ID	Location	ECOTOX Sample ID	Sampling Date/Time
R1S1	Arouca	REAL-09A-01	30th June 2008
R1S2		REAL-09A-02	30th June 2008
R1S3		REAL-09A-03	7th July 2008
R2S1	Oropune	REAL-09A-04	30th June 2008
R2S2		REAL-09A-05	30th June 2008
R3S1	Mausica	REAL-09A-06	30th June 2008
R3S2		REAL-09A-07	30th June 2008
R3S3		REAL-09A-08	7th July 2008

Table 1 (cont'd): Details for River Samples

Client Sample ID	Location	ECOTOX Sample ID	Sampling Date/Time
R4S1	Arima	REAL-09A-09	30th June 2008
R4S2		REAL-09A-10	30th June 2008
R4S3		REAL-09A-11	7th July 2008
R5S1	Guanapo	REAL-09A-12	30th June 2008
R5S2		REAL-09A-13	30th June 2008

Table 2: Details for Waste Treatment Plant Effluent Samples

Client Sample ID	Location	ECOTOX Sample ID	Sampling Date/Time
WTP 01	Maloney	REAL-09A-14	30th June 2008
WTP 02	Omeara	REAL-09A-15	30th June 2008

Summary:

The samples were taken on the 30th June 2008 and 7th July 2008; and received by Mr. Mikaiel Dookie, a representative of Ecotox Environmental Services Limited from Mr. Floyd Lucas a representative of R.E.A.L. Samples were collected and preserved according to recommended procedures as stipulated in the Standard Methods for the Examination of Water and Wastewater 20th Ed. and the Water Pollution Rules 2000 for the requested parameters. Samples were logged into the ECOTOX sample tracking system and assigned sample identification numbers. The samples were appropriately stored until the tests were initiated.

Results:

Tests were done in accordance with those stipulated in the Water Pollution Rules 2006 and the TTS:547 Standard. Standard test procedures were followed for all analyses conducted with several quality control measures implemented for each parameter investigated. The results for the requested analyses are listed below in Table 2. Replicate analyses were done for all samples. Blanks, spikes and standard reference materials were included during tests to assess the accuracy and precision of the analytical results obtained as listed in Appendix A.

Table 2: Analyses of River Water Samples from Arouca

Parameter mg/L	R1S1	R1S2	R1S3
Total Suspended Solids (TSS)	5.0	4.0	13.0
Biological Oxygen Demand (5-Day)	11.0	10.0	12.0
Chemical Oxygen Demand (COD)	113.27	57.50	108.25
Total Sulphates	125.2	98.4	121.5
Total Oil and Grease (OG)	1.16	0.59	<0.10
Available Phosphorous	0.91	1.02	0.62
Total Phosphorous	1.52	1.29	1.40
Available Nitrite	1.4	3.2	4.9
Available Nitrate	2.9	2.1	11.8
Ammonia	1.6	4.1	3.6
Total Coliform MPN/100mls	≥1600.0	≥1600.0	9000.0
Total Fecal Coliform MPN/100mls	≥1600.0	≥1600.0	700.0

Table 3: Analyses of River Water Samples from Oropune

Parameter mg/L	R2S1	R2S2
Total Suspended Solids (TSS)	18.5	154.0
Biological Oxygen Demand (5-Day)	12.0	9.0
Chemical Oxygen Demand (COD)	22.88	59.42
Total Sulphates	108.9	77.6
Total Oil and Grease (OG)	0.12	9.80
Available Phosphorous	1.22	1.04
Total Phosphorous	2.14	3.01
Available Nitrite	2.1	1.8
Available Nitrate	3.2	2.4
Ammonia	2.1	3.8
Total Coliform MPN/100mls	≥1600.0	≥1600.0
Total Fecal Coliform MPN/100mls	≥1600.0	≥1600.0

Table 4: Analyses of River Water Samples from Mausica

Parameter mg/L	R3S1	R3S2	R3S3
Total Suspended Solids (TSS)	17.00	238.50	51.0
Biological Oxygen Demand (5-Day)	9.0	21.0	10.0
Chemical Oxygen Demand (COD)	15.58	714.23	182.03
Total Sulphates	117.0	102.8	107.9
Total Oil and Grease (OG)	0.73	34.78	1.34
Available Phosphorous	0.80	3.92	1.44
Total Phosphorous	1.50	6.22	3.10
Available Nitrite	1.6	8.4	6.4
Available Nitrate	1.9	11.6	13.3
Ammonia	1.9	0.9	4.9
Total Coliform MPN/100mls	≥1600.0	≥1600.0	≥1600.0
Total Fecal Coliform MPN/100mls	≥1600.0	≥1600.0	2200.0

Table 5: Analyses of River Water Samples from Arima

Parameter mg/L	R4S1	R4S2	R4S3
Total Suspended Solids (TSS)	3.0	3.0	29.0
Biological Oxygen Demand (5-Day)	12.0	11.0	11.0
Chemical Oxygen Demand (COD)	28.52	31.51	42.00
Total Sulphates	117.6	111.7	95.4
Total Oil and Grease (OG)	0.74	0.60	1.30
Available Phosphorous	0.85	2.1	0.85
Total Phosphorous	1.74	3.18	1.74
Available Nitrite	2.8	0.8	3.8
Available Nitrate	2.4	1.4	11.1
Ammonia	1.9	1.9	3.8
Total Coliform MPN/100mls	≥1600.0	≥1600.0	3500.0
Total Fecal Coliform MPN/100mls	900.0	≥1600.0	900.0

Table 6: Analyses of River Water Samples from Guanapo

Parameter mg/L	R5S1	R5S2
Total Suspended Solids (TSS)	4.0	18.00
Biological Oxygen Demand (5-Day)	11.0	9.0
Chemical Oxygen Demand (COD)	36.20	85.62
Total Sulphates	204.5	88.3
Total Oil and Grease (OG)	0.39	25.41
Available Phosphorous	0.66	1.80
Total Phosphorous	2.04	3.85
Available Nitrite	1.1	1.1
Available Nitrate	1.8	2.9
Ammonia	1.8	2.1
Total Coliform MPN/100mls	≥1600.0	≥1600.0
Total Fecal Coliform MPN/100mls	1600.0	≥1600.0

Table 6: Analyses of Wastewater Treatment Plant Effluents

Parameter mg/L	WTP01 Maloney	WTP02 Omeara
Total Suspended Solids (TSS)	105.50	51.50
Biological Oxygen Demand (5-Day)	36.0	28.0
Chemical Oxygen Demand (COD)	187.31	32.31
Total Sulphates	75.1	88.2
Total Oil and Grease (OG)	37.36	3.93
Available Phosphorous	6.91	11.06
Total Phosphorous	10.20	15.85
Available Nitrite	16.4	20.4
Available Nitrate	22.6	31.4
Ammonia	32.8	26.1
Total Coliform MPN/100mls	≥1600.0	≥1600.0
Total Fecal Coliform MPN/100mls	≥1600.0	≥1600.0

All methods were derived from Standard Methods for the Examination of Water and Wastewater, 20th Edition. The necessary quality assurance and control details are listed in Appendix A. The relative standard deviation (RSD) was less than 10.0 % for all analyses conducted and demonstrates that excellent

precision was achieved. Standard reference materials and spiked solutions were used with 90 –100% recovery obtained during testing. These are illustrated in Appendix A.

APPENDIX A

QUALITY ASSURANCE PROCEDURES AND QUALITY CONTROL DATA

Appendix A

Quality Control and Quality Assurance Procedures for Analyses Performed.

All sampling and tests procedures employed by ECOTOX for the duration of this project were a direct adaptation from standard procedures as outlined in the Standard Methods for the Examination of Water and Wastewater 19th Ed.

The following is a table of the calculated detection limits and the associated bias for each of the analyses performed.

Table 3: List of Parameters with Associated Instrument Detection Limits and Bias.

Parameter	Detection Limit/Range	Bias
Total Oil and Grease	0.05ppm	±0.01ppm

ppm = mg/L

Sample Calculations

The following will illustrate sample calculations and quality control measures typically used in the determination of each parameter during testing.

Oil and Grease (OG)

Samples were analysed according to SMEWW # 5520-B and 5520-F. For every ten (10) samples analysed, one (1) blank, one (1) duplicate and one (1) standard reference material was run. These were used to provide the necessary quality control and assurance measures for the particular batch. Table 4 summarises some of these results.

Table 4: Sample Results for OG Batch #1

Sample #	Final Wt. (g)	Initial Wt. (g)	Mass Coll. (g)	Vol. Used (mls)	TPH (mg/L)	Avg. (mg/L)
1A	89.6749	89.6577	0.0172	345	49.71	49.80
1B	121.6779	121.6602	0.0177	355	49.89	
Blank	99.4545	99.4543	0.0002	370	0.5	0.5
						% Recovery
SRM-1	101.2263	101.2132	0.0131	340	38.5	96.3%

Sample Calculation

OG is calculated as follows:

$$TPH = \frac{(A - B) \times 1000 \times 1000}{C}$$

Where A – Final Weight of Flask (g)
B – Initial Weight of Flask (g)
C – Volume of Sample Used (mls)

The mass is converted from grams to milligrams and the expressed as mg/L.

Ref : Sample 1A in Table 4

$$OG = \frac{(89.6749 - 89.6577) \times 1000 \times 1000}{345} = 49.71 \text{ mg/L}$$

Applying the same calculation to 1B, OG = 49.89

Therefore average value for sample 1 is calculated

= (49.71+49.89) / 2 = 49.8 mg/L

and the corresponding standard deviation = 0.1273 mg/L

RSD = (0.1273/49.8) x 100 = 0.26%

Once again, RSD < 5.0 %, indicating good precision between replicate analyses.

For the Standard Reference Material (SRM), a 20.0 mg/L TPH solution was prepared using a hexadecane/acetone spiked solution. The blank was simply laboratory distilled water. Both the blank and SRM were subjected to the same preservation, storage, extraction and concentration conditions as samples. It can be seen that the percentage recovery for the SRM was greater than 95% which shows very high accuracy. Also the blank was considerably lower than for all samples analysed which implies that there was no significant amount of contamination or impurities present during testing between batches. Similar results were obtained for all batches of samples analysed.

Table 5: Recovery of Standard Reference Materials For Analyses Performed.

The following are the actual mean recoveries for the individual analyses performed during this batch of testing.

Test	SRM	Quantity	% Recovery
OG	Stearic Acid/ Acetone Mixture	15.0 mg/L	92.01%