Prepared by:

Conrad Douglas & Associates Limited

14 Carvalho Drive
Kingston 10
Jamaica W.I.

For:

Red Stripe Jamaica Limited

214 Spanish Town Road,
Kingston 11

Jamaica

Picture courtesy of Red Stripe, 2005

Jamaica Limited

Environmental Impact Assessment for Proposed Wastewater Treatment Plant

June 2005

Document N^{o}: CD*PRJ 417/04

Presented to:

National Environment & Planning Agency
10 & 11 Caledonia Avenue,
Kingston 5

Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

Executive Summary

Introduction and Project Description

Red Stripe, an environmentally aware corporate body, seeks to construct a wastewater treatment plant in partnership with Pepsi Jamaica as a needed and voluntary action in light of section 17 of the NRCA Act. Red Stripe proposes to construct a 4,300m^3/day effluent wastewater treatment facility at 214 Spanish Town Road, Kingston 11. Red Stripe, which shares facilities with Pepsi Jamaica, is an established manufacturer and bottler of brewed beverages, as well as other beverages under the DIAGEO umbrella.

The project essentially entails the construction of an effluent wastewater treatment plant (WWTP) on lands at the south-western end of the Red Stripe property. The WWTP is intended to treat the approximately 4,210m^3/day wastewater stream currently in existence.

In keeping with the NRCA Act of 1991, Red Stripe is required to conduct an EIA on the proposed operations. This includes the wastewater treatment plant and all linkages to and from the plant. This EIA has been submitted to the regulatory agency, National Environment and Planning Agency (NEPA), for review and permitting in order to facilitate implementation of its plans. This EIA has been undertaken by Conrad Douglas and Associates (CD&A).

A detailed description of all elements of the project during the pre-construction, construction and operational phases have been prepared. The elements analyzed include the infrastructures of the project including: drainage features; roads; waste collection, disposal, and management; and utility requirements.

The facility will consist of five main operations:

- Pre-Treatment Liquid Handling,
- Anaerobic Treatment,
- Aerobic Treatment,
- Sludge Handling, and
- Gas Recovery

The facility is to be linked with the existing network of concrete drains leading out of the Red Stripe and Pepsi plants. The installation of the WWTP is a key component of Red Stripe's future plans and is designed to accommodate all existing and any future wastewater streams from the facility.

The discharge of poorly treated effluent (wastewater and sewage) has led to the ecological deterioration of Hunts Bay and Kingston Harbour, a major environmental asset. The existing regime for handling wastewater is well outdated and is not seen as being able to meet future long-term treatment requirements. The decision by Red Stripe to build this facility is seen as needed compliance to meet international standards for such facilities, and also to stay in line with the environmental commitment set forth by the parent body, DIAGEO, and its own policy.

The proposed WWTP's designs and specifications were submitted to the Environmental Heath Unit of the Ministry of Health for their independent review and comments. The designs have been reviewed and their comments have been included in a letter dated May 10, 2005 which has been included as Appendix V. The Environmental Health Unit has expressed no objections to the proposed treatment system.

Methodology

A study of the existing natural conditions found at the proposed site of the development at Red Stripe was conducted. The study compiled data through assessment, characterizing, mapping and field observation.

Terrestrial Ecological Assessment

For the purposes of this report a field assessment was undertaken on Monday, April 25, 2005. This assessment was done to assess the extent of any flora and fauna and their identification, community structure and level of disturbance.

Physical Parameter Assessment

Information was gathered on the existing physical environment, particularly as related to climate, topography, soils and geology, hydrology, water quality and natural hazard vulnerability.

Information on the climate, topography, soils and geology, was obtained by compiling existing data from reports as well as from source agencies such as Water Resources

Authority (WRA). Maps, aerial photography and other source imagery were also examined. Field testing of soils on the Red Stripe plant was also analysed.

Effluent water quality, surface and ground water data were analysed using field investigation, maps, and other source data. Natural hazard vulnerability was analysed using maps and information in other source data.

Conclusion

The project being proposed is to be located within Red Stripe's property boundaries with sufficient set backs from all boundaries as per Jamaica's Building Code.

The proposed project will not have a significant negative impact on the physical environment. It is on a fairly flat site which reduces the landslide impacts. The site is in an established and zoned industrial district. Ambient noise, air quality and water quality will not be negatively impacted by this project.

Wastewater treatment plants have the potential to be an odour nuisance. This proposed project has stipulations for odour control and will be effective once the facility is operated within specifications, and maintenance is carried out on a properly organized schedule.

This project will benefit the rehabilitation of two of Jamaica's pre-eminent water bodies, Hunts Bay and the Kingston Harbour. The quality of effluent from Red Stripe and Pepsi Jamaica will be of a higher standard, in line with NEPA's standards, with the construction of this facility.

No rare, endangered or endemic terrestrial plant species will be threatened by this project. The site is a "brown" site with no important vegetation types or communities that are of economical or ecological value.

The project as proposed will therefore not have any negative impact on the environment, but stands to have a tremendous positive impact on Hunts Bay, Kingston Harbour and the overall marine ecosystem of the area.

Recommendation

The wastewater treatment plant proposed is recommended for approval, permitting and granting of a discharge licence by NEPA on the basis of the quality of the design and the significant environmental benefits that will be achieved. The proposed project is expected to improve the existing water quality of effluent leaving Red Stripe and Pepsi on its way into the coastal waters of Hunts Bay.

PROJECT DESCRIPTION

1 Project Description

1.1 Introduction

Red Stripe proposes to construct an effluent wastewater treatment facility at 214 Spanish Town Road, Kingston 11.

Red Stripe, which shares facilities with Pepsi Jamaica, is an established manufacturer and bottler of brewed beverages, as well as other beverages under the DIAGEO umbrella.

The project essentially entails the construction of an effluent wastewater treatment plant (WWTP) on lands at the south-western end of the Red Stripe property (Figure 1-1 and Figure 1-3). The WWTP is intended to treat the maximum anticipated capacity of approximately 4,210m^3/day wastewater capable of being generated at the site (inclement weather factored in). The design capacity is 4300m^3/day.

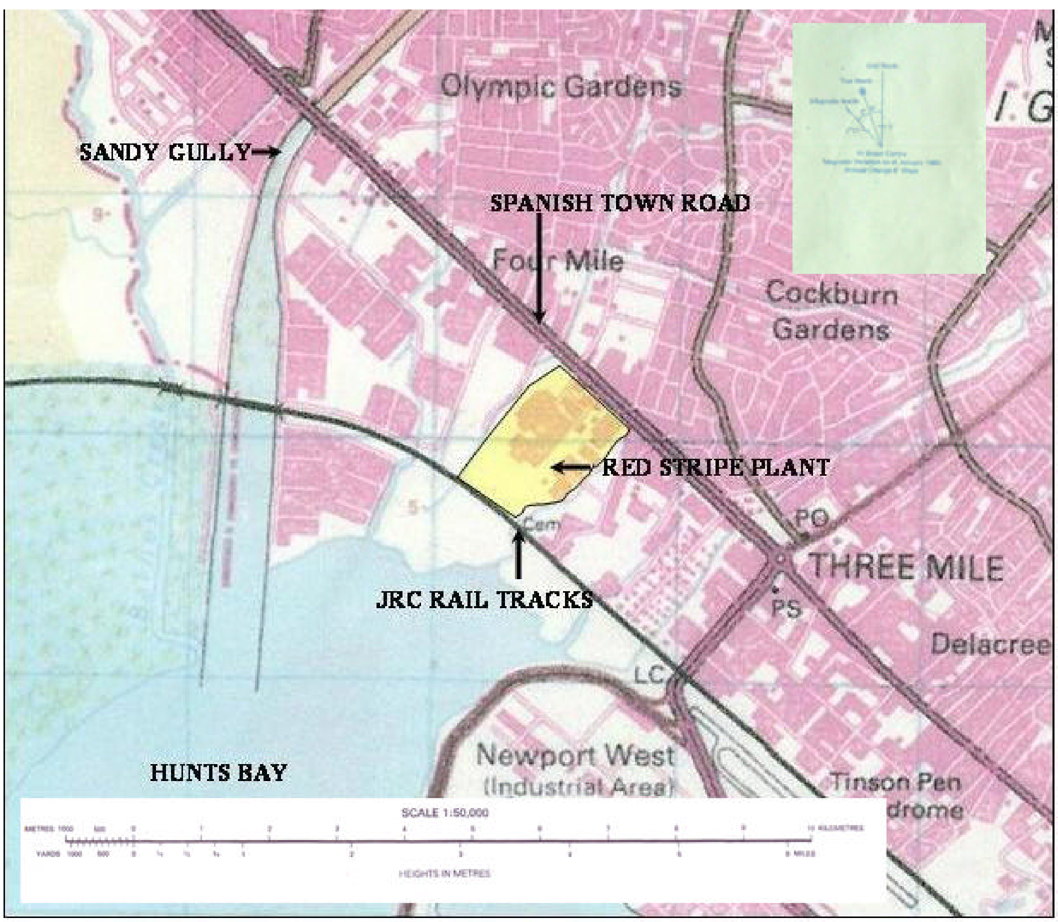


FIGURE 1-1: LOCATION OF RED STRIPE FACILITY

FIGURE 1-2: LAYOUT OF RED STRIPE PLANT WITH WASTEWATER TREATMENT PLANT

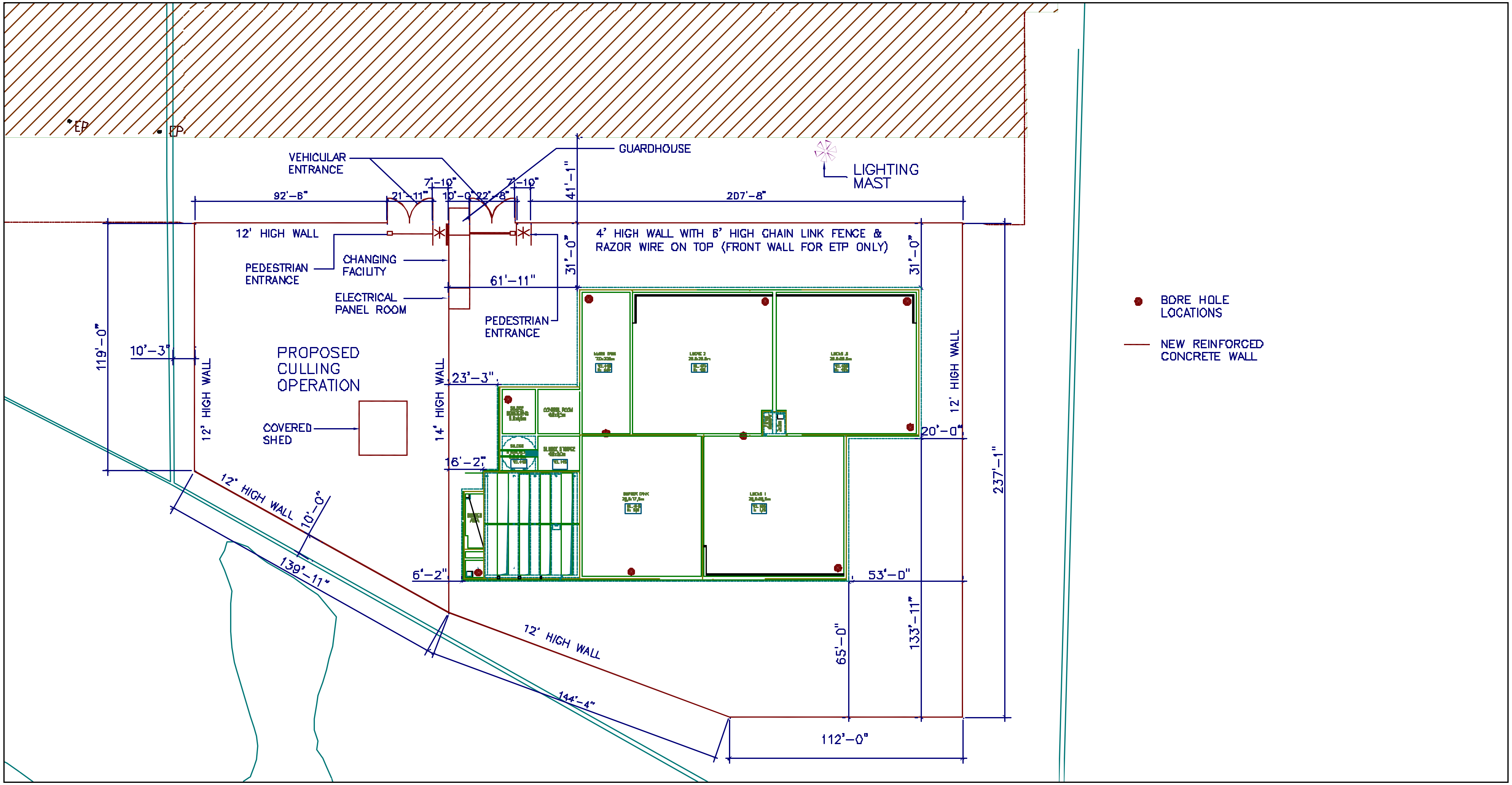


FIGURE 1-3: ZOOMED EXTENT OF WASTEWATER TREATMENT PLANT

In keeping with the NRCA Act of 1991, Red Stripe is required to conduct an EIA on the proposed operations. This includes the wastewater treatment plant and all linkages to and from the plant. This EIA has been submitted to the National Environment and Planning Agency (NEPA), for review and permitting in order to facilitate implementation of the plans. This EIA has been undertaken by Conrad Douglas and Associates (CD&A).

A detailed description of all elements of the project during the pre-construction, construction and operational phases have been prepared. The elements analyzed include the infrastructures of the project including: drainage features; roads; waste collection, disposal, and management; and utility requirements.

The facility will consist of five main operations:

- Pre-Treatment Liquid Handling,
- Anaerobic Treatment,
- Aerobic Treatment,
- Sludge Handling, and
- Gas Recovery

The proposed WWTP was designed by WATERLEAU Global Water Technology of Belgium in consultation with Red Stripe.

The plant will be constructed on low-lying land situated at the south-western section of the Red Stripe facility, to the north of the existing Jamaica Railway Corporation rails and Hunts Bay. The community of Seaview Gardens is located to the south-west of the Red Stripe facility. Maximum elevation at site is approximately 3.5 metres above sea level. The Riverton solid waste disposal site lies to the west of the WWTP site.

The proposed WWTP's designs and specifications were submitted to the Environmental Heath Unit of the Ministry of Health for their independent review and comments. The designs have been reviewed and their comments have been included in a letter dated May 10, 2005 which has been included as Appendix V. The Environmental Health Unit has expressed no objections to the proposed treatment system.

1.2 WWTP Operations

1.2.1 Pre-Treatment Liquid Handling

The Pre-Treatment Liquid Handling will be done by using a series of catchment tanks and screens to manage the incident waste stream. A remote pump pit will be put in place downstream of the point where the brewhouse drain meets the Packaging/Pepsi drain. Influent to this pump pit will be pumped to the treatment plant. A second pump pit will be in place at the third drain, the reverse osmosis (RO) plant drain. At the entrance to the WWTP, a splitter tank will allow an immediate divert to a calamity tank determined by pH. Non-diverted influent will flow into a buffer tank, designed to hold approximately 8 hours influent flow. A rotary screen located close to the splitter tank will remove particulate matter above 1mm in diameter, which will fall into a skip for removal to a landfill. The process liquor from the buffer tank will pass through a pH correction tank. Both acid and caustic will be used for pH correction. A pH of 6.8 – 7.2 is required at the inflow to the anaerobic reactor.

1.2.2 Anaerobic Treatment

The Anaerobic Treatment will be done by constant flow through an anaerobic reactor. A constant upward velocity through the reactor of 1m/hr will be needed. When effluent flow to WWTP is low, water is recycled through the anaerobic reactor from the pH correction tank. The gas recovered from the anaerobic reactor will be burned in a gas engine, for energy recovery in the form of electricity.

1.2.3 Aerobic Treatment

Aerobic Treatment will be accomplished using a standard Sequential Batch Reactor (SBR). The RO stream passes directly from the pump pit to the aerobic phase of the plant. The phases of the process are: filling, aeration, sedimentation, emptying, biological nitrogen removal by activated sludge, and sodium hypochlorite dosed after the aerobic phase for Coliform treatment. Floating aerator units 2m in diameter provide aeration and draw water from a depth of approximately 3m through a direct-coupled screw pump, and then sprayed over the surface of the tank.

1.2.4 Sludge Handling

Sludge handling is accomplished using a dynamic floculator in the sludge-thickening tank to aid sludge thickening. Lime may be added prior to de-watering to reduce the water content through chemical reaction and increase PH to approximately 12. This makes the sludge more attractive for agricultural use. De-watering will be carried out using a belt press. Normal output will allow a skip to be filled in 24hrs.

1.2.5 Gas Recovery

Gas produced in the anaerobic reactor is collected in a standard iso-barometric gas collection balloon. When the pressure in the gas accumulation header falls too low, the gas is automatically diverted to a flare. An electrical ignition system ensures immediate start-up. The flare will be visible. Flashback arresters will be located at key points throughout the process. Liquid will be removed from the gas via two de-mister units located before and after the balloon. The dried gas is pumped at low pressure to the engine for combustion.

1.3 Design Parameters of WWTP

1.3.1 Influent Wastewater

Table 1-1 describes the characteristics of the existing wastewater.

TABLE 1-1: WASTEWATER CHARACTERISTICS - BREWHOUSE, PACKAGING, AND PEPSI PLANT

Parameter	Unit	Design
Water temperature	°C	30-40
BOD5/COD_5		>0,6
CODt, average	mg/l	<2.843
CODt, maximum	mg/l	<3.215
COD		
BODt,	mg/l	<1.700
TSS	mg/l	< 350
Maximum flow rate	m^3/d	4.300
Maximum Peak design flow	m^3/h	350
pH	-	6-12

Table 1-2 reflects the characteristics of the RO reject stream.

Table 1-2: RO Reject Stream

Parameter	Unit	Design
Water temperature	°C	30
Nitrates	mg/l	300
Phosphates	mg/l	20-25
Calcium	mg/l	50
Sulphates	mg/l	100
Oil and greases	mg/l	20
pH		6-9
Flow	m^3/day	800

1.3.2 Effluent Quality

Table 1-3 describes the designed effluent quality of the treatment system

TABLE 1-3: EFFLUENT QUALITY

Item	Unit	Concentration	NEPA Standard
pH		6.5-8.5	6.5 – 8.5
BOD5	mg/l	30	< 30
CODt	mg/l	100	< 100
Nitrate and nitrite	mg/l	10	10
Phosphate	mg/l	5	5.0
TSS all times	mg/l	150	<150
TSS monthly average	mg/l	50	50
Total coliform	MPN/100 ml	500	< 500
Faecal coliform	MPN/100ml	100	<100

1.4 Planning and Design

Construction of the WWTP will essentially consist of concrete and masonry works, a small amount of pipe/drain works for connecting to the plant and associated electrical works.

The treatment plant will receive the wastewater from all three drains, brewhouse, packaging and RO. The plant will consist of several treatment aspects for aerobic and anaerobic treatment:

- Screens and Grit chambers;
- Holding Tanks;
- Equalisation Tanks
- Calamity Tanks etc.

The designs below outline the physical parameters of the treatment plant.

FIGURE 1-4: OUTLINE OF PROPOSED WASTEWATER TREATMENT PLANT

FIGURE 1-5: UTILITIES, PRE-TREATMENT, BUFFERING & EMERGENCY TANK

FIGURE 1-6: PH CORRECTION, CHEMICAL DOSING & ANAEROBIC TREATMENT

FIGURE 1-7: AEROBIC TREATMENT

<u>FIGURE 1-8: SLUDGE TREATMENT</u>

FIGURE 1-9: OFF GAS CONTROL & ODOUR CONTROL

1.4.1 Primary Treatment

1.4.1.1 Screenpress (S1001) + Influent Pit (T1002)

1.4.1.1.1 Functional description

The wastewater from the brewhouse on one side and from the packaging and Pepsi plant on the other side is drained to a new pump pit. On each stream, an automatic sampler is installed to enable all parties to measure the loadings sent to the wastewater plant. The existing samplers will be re-used.

Prior to the pump-pit on a common channel towards the pit (Figure 1-10: Typical Influent Pit), a screen press (S1001) will be installed for the removal of coarse particles to protect the pumps against damage. The screen press will be equipped with a sieve screw for dewatering of the solids to approx 35 % - 40 % DS. The removed particles will be dumped in container (T1001). The container will be equipped with a manual emptying device and draining facilities.

Three submersible pumps (P1001/02/03) will transfer the water to the buffering tanks. Level switches (LS1001/02/03/04) control the operation of the pumps. Delivery includes one automatic sampler (PU1001).

An in-line pH meter (AIT1001) is installed for continuous measurement of the pH. This measurement is used to define if the wastewater is sent to the equalisation tank or the calamity tank

Note: the exact location of the pump pit is not yet defined. We assume a maximum distance of 50m between the pump pit and the wastewater plant.

FIGURE 1-10: TYPICAL INFLUENT PIT

1.4.1.1.2 Dimensioning

	Unit	Value
Peak design flow	m³/h	350
Width	m	3
Length	m	4
Height	m	3
Total volume	m³	36
Minimum retention time	min	6
Material	Reinforced concrete	

Covered with removable grating in aluminium. Inside completely coated.

1.4.1.1.3 Technical specifications

1.4.1.1.3.1 Screenpress

Tag number	S1001
Capacity	360 m³/h
Type	screen press
GCP	
Type	GCP 700
Mesh size screen	1mm
Diameter sieve	705mm
Cleaning	with brushes
Transport zone	
Diameter tubing	323mm

Diameter spirals	280mm
Section	(60*25) + (40*15) mm
Dewatering zone	
Mesh size	5mm
Dewatering up to	50% Dry Matter
Total length	5995 mm
Slope	35°
Materials	
Screen	RVS304
Screw	ST52
Tropicalised	
Number	1

Also to be included: two mobile containers with leaking water drain and with manual emptying device

1.4.1.1.3.2 Influent pumps

Tag number	P1001/02/03
Type	Submersible
Centrifugal	
Supplier	ITT Flygt, KSB, or equal
Function	Feeding of balancing tank
Number	3 (2 in operation, 1 stand by)
Capacity	175 m^3/h
Discharge head	10 mWC
Power	7.5 kW
Impeller	single vane
Hydraulic efficiency	70%
Mechanical seals	corrosion resistant tungstene carbide (WCCR)
Materials	
Pump casing	Cast iron
Impeller	Cast iron sprayed with primer
Studs, nuts	SS 304
Shaft	SS 304
Guiding	SS 304

Also to be included: one mobile hoist, local panel with mounting rack and accessories (manifold, valves)

1.4.1.1.3.3 Level switches

Tag number	LS1001/02/03/04
Type	ENM10
Supplier	Flygt
Number	4

1.4.1.1.3.4 Electro magnetic flow meter

Tag number	FIT1001
Capacity	0-350 m^3/h
Number	1
pH measurement	
Tag number	AIT1001
Number	1

1.4.1.2 Influent Pump Pit Ro Drain (T1003)

1.4.1.2.1 Functional description

Two submersible pumps (P1004/05) will transfer the water to the distribution box prior to the aerobic treatment. Level switches (LS1005/06/07/08) control the operation of the pumps. One of the existing samplers will be installed to take samples and to analyse the average wastewater quality.

1.4.1.2.2 Technical specifications

1.4.1.2.2.1 Influent pumps

Tag number	P1004/05
Type	Submersible
Centrifugal	
Supplier	ITT Flygt, KSB or equal
Function	Feeding of RO wastewater
Number	2 (1 in operation, 1 stand by)
Capacity	50 m³/h
Discharge head	10 mWC
Power	3 kW
Impeller	single-vane
Mechanical seals	corrosion resistant tungstene carbide (WCCR)
Materials	
Pump casing	Cast iron
Impeller	Cast iron sprayed with primer
Studs, nuts	SS 304
Shaft	SS 304
Guiding	SS 304

Also to be included: one mobile hoist, local panel with mounting rack and accessories (manifold, valves)

1.4.1.2.2.2 Level switches

Tag number	LS1005/06/07/08
Type	ENM10
Supplier	Flygt
Number	4

1.4.1.2.2.3 Electro magnetic flow meter

Tag number	FIT1002
Capacity	0-50 m³/h
Number	1

Note: the exact location of the pump pit is not yet defined. We assume a maximum distance of 50m between the pump pit and the wastewater plant.

1.4.1.3 Equalization Tank / Acidification Tank

1.4.1.3.1 Functional description

From the pump pit, the wastewater is normally pumped to the equalisation/ acidification tank. The volume of the equalization/acidification tank (T2001) shall be designed for a maximum hydraulic retention time of 8 hours. This retention time is required for hydraulic peak saving and balancing of the pH and organic load. Also complex organic material will be hydrolysed into sugars, amino acids and fatty acids (acidification process). One submersible mixer (M2001) will be installed to ensure sufficient mixing in the equalization/acidification tank.

The pH of the equalization/acidification tank will be constantly monitored by a pH meter (AIT2001), which generates an alarm at low and high level. In case of a severe calamity acid or caustic can be dosed manually in the equalization/acidification tank. The caustic or acid will be dosed under the lowest operational water level.

The level of the equalization/acidification tank will be measured by hydrostatic level measurement (LT2001). At low level feeding pumps to the correction tank will be stopped to prevent dry running of the mixer (M2001). At high level in the equalization/acidification tank a maximal flow will be pumped to the correction tank to prevent the equalisation tank from flooding. If after a pre-set time the water level is still high, alarm will be given.

The equalization/acidification tank is equipped with an emergency overflow to the effluent channel. The emergency overflow is positioned slightly above the high level measurement.

Two dry mounted pumps (P2001/02) will transfer the wastewater to the anaerobic treatment. The flow is measured and will be adjusted to the level in the equalisation tank (higher flow at higher level and vice versa).

1.4.1.3.2 Dimensioning equalization/acidification tank

	Unit	Value
Daily flow	m^3/day	4.300
Retention time	hr	8
Volume	m^3	1.400
Dimensions concrete tank		
Length	m	20
Width	m	17.5
Water Level (max)	m	4
Hydraulic retention time	hr	8

1.4.1.3.3 Technical specifications

1.4.1.3.3.1 Mixer in equalisation tank

Tag number	M2001
Supplier	Flygt, ABS or equal
Type	Submersible
Number	1
Motor	10 kW
Protection	IP68
Propeller type	open 3 blade, self cleaning,
Shaft sealing	double seal, product side with silicon carbide mechanical seal, independent of direction of rotation and resistant to temperature shock, running in an oil bath with di-sensor for seal monitoring
Materials	
Motor housing	coated cast iron
propeller	SS304
propeller shaft	SS304
Cable	NBR

1.4.1.3.3.2 Transfer pumps to correction tank

Tag number	P2001/02
Type	Dry mounted
Centrifugal	
Supplier	KSB or equivalent
Function	Feeding of anaerobic treatment
Number	2 (1+1)
Capacity	180 m³/h
Discharge head	10 mWC
Power	6 kW
Pump speed	1450 rpm
Impeller	multi channel
Mechanical seals	SiC/SiC
Materials	
Pump casing	JL 1040
Motor casing	JL1040
Intermediate casing	JL1040
Impeller	1.4517
Bearing bracket	JL 1040
Studs, nuts	A4
Shaft	1.4021

1.4.1.3.3.3 Level measurement

Tag number	LT2001
Type	hydrostatic continuous
Supplier	E & H or equal
Number	1

1.4.1.3.3.4 pH measurement

Tag number	AIT2001
Type	CPM151, CPA111, CPS11, CPK7
Vendor	E&H or equal
Number	1

1.4.1.4 Emergency/Diversion Tank

1.4.1.4.1 Functional description

In case pH is out of range, wastewaters are automatically diverted to the emergency tank (T2002). The wastewater is temporarily stored and mixed by means of a submersible mixer (M2002). A centrifugal pump (P2003) pumps the wastewater at a small flow rate back to the equalisation tank. The operation of this pump is controlled by the levels in both tanks, and by the pH in the equalisation tank.

The emergency and equalization tanks are hydraulically connected and controlled by a manual valve in between.

1.4.1.4.2 Dimensioning

	Unit	Value
Daily flow	m^3/day	4.300
Retention time	hr	3
Required volume	m^3	540
Dimensions concrete tank		
Length	m	20.5
Width	m	7.0
Water Level (max)	m	4
Total height	m	4.5

1.4.1.4.3 Technical specifications

1.4.1.4.3.1 Mixer in calamity tank

Tag number	M2002
Supplier	Flygt, ABS or equal
Type	submersible
Number	1
Motor	3 kW
Protection	IP68
Propeller type	open 3 blade, self cleaning,
Shaft sealing	double seal, product side with silicon carbide mechanical seal, independent of direction of rotation and resistant to temperature shock, running in an oil bath with di-sensor for seal monitoring
Materials	
motor housing	coated cast iron
propeller	SS304
propeller shaft	SS304
Cable	NBR

1.4.1.4.3.2 Transfer pump to equalization tank

Tag number	P2003
Type	Dry mounted
Centrifugal	
Supplier	KSB
Function	Transfer to equalisation
Number	1 (+1 available in warehouse for quick replacement)
Capacity	40 m³/h
Discharge head	8 m WC
Installed power	2.2 kW
Impeller	open, self-cleaning
Through let	clog free
Hydraulic efficiency	75%
Motor speed	1465 rpm
Mechanical seals	SiC/SiC
Materials	
Pump casing	JL 1040
Motor casing	JL1040
Intermediate casing	JL1040
Impeller	1.4517
Bearing bracket	JL 1040
Studs, nuts	A4
Shaft	1.4021

1.4.1.4.3.3 Level measurement

Tag number	LT2001
Type	hydrostatic continuous
Supplier	E & H or equal
Number	1

1.4.2 Anaerobic Treatment

1.4.2.1 Correction Tank (T3001)

1.4.2.1.1 Functional description

In the correction tank the pH is measured and adjusted if necessary. From the correction tank, the wastewater is fed to the anaerobic reactor (T5001). The flow towards the anaerobic reactor ensures the mixing of wastewater and sludge inside the anaerobic reactor, and is in principle constant. This flow is the so-called recycle flow and is composed of the inlet wastewater flow coming from the equalization tank plus part of the anaerobic effluent coming from the anaerobic reactor.

1.4.2.1.2 Dimensioning

	Unit	**Value**
Recycle flow	m^3/hr	200
Retention time	min	10
Volume	m^3	35
Dimensions concrete tank		
Length	m	3.0
Width	m	2.5
Water Level	m	4.5
Total height	m	5.0

1.4.2.1.3 Technical specifications

1.4.2.1.3.1 Characteristics of feeding pumps

Tag number	P3001/02
Number	2
Type	Dry mounted
Centrifugal	
Supplier	KSB or equivalent
Function	Feeding of anaerobic treatment
Number	2 (1 in operation, 1 stand by)
Capacity	200 m³/h
Discharge head	15 mWC
Power	11 kW
Impeller	two channel impeller
Mechanical seals	corrosion resistant tungstene carbide (WCCR)
Materials	
Pump casing	Cast iron
Impeller	SS 304
Studs, nuts	SS 304
Shaft	SS 304
Thermal switches in stator	

1.4.2.1.3.2 Mixer in pH correction tank

TAG number	M3001
Supplier	KSB or equal
Type	submersible
Number	1
Motor	1.5 kW
Protection	IP68
Propeller type	open 3 blade, self cleaning,
Shaft sealing	double seal, product side with silicon carbide mechanical seal, independent of direction of rotation and resistant to temperature shock, running in an oil bath with di-sensor for seal monitoring.
Materials	
motor housing	coated cast iron
Propeller	SS304
propeller shaft	SS304
Cable	NBR

1.4.2.1.3.3 Level measurement

Tag number	LT3001
Type	hydrostatic continuous
Supplier	E & H or equal
Number	1

1.4.2.1.3.4 pH measurement

Tag number	AIT3001
Type	CPM151, CPA111, CPS11, CPK7
Vendor	E&H or equal
Number	1

1.4.2.1.4 CHEMICAL DOSING UNITS

1.4.2.1.4.1 Functional description

Caustic will be stored in a new HDPE storage tank with a volume of about 5 m^3. An alarm will be generated at low, very low, and at high level. At low level alarm the operator should take action to refill the tank. The storage tank shall be equipped with a filling connection including hose coupling to refill the tank by truck. At very low level the dosing pump will stop dosing caustic.

The caustic will be dosed with one dosing pump. A second dosing pump will be (100%) stand-by/spare. The dosing pumps will be controlled automatically by a pH measurement after the pH-correction tank.

Acid will be stored in a HDPE storage tank with a volume of 5 m^3. An alarm will be generated at low, very low and at high level.

At low level alarm the operator should take action to refill the tank. The storage tank will be equipped with a filling connection including hose coupling to refill the tank by truck. At very low level the dosing pumps will stop dosing acid.

The acid fumes (HCl) will be collected and treated in scrubber. The acidified water will be discharged in the pH correction tank.

The acid will be dosed with one dosing pump. The second dosing pump will be (100%) stand-by/spare. Both dosing pumps will be controlled automatically by a pH measurement after the pH-correction tank.

1.4.2.1.5 Technical specifications

1.4.2.1.5.1 Caustic dosing pumps

Type	membrane dosing
Supplier	Prominent
Number	2
Operation	depending on the pH in the anaerobic effluent
Location	near chemical storage area
Discharge head	8 bar
Maximum flow	100 l/h
Installed power	0.18 kW
Materials	
pump housing	cast iron
motor housing	cast iron
diaphragm	PTFE (Teflon)
dosing head	PVC

1.4.2.1.5.2 Caustic storage tank

Number	1
Material	PE-HD
extrusion without weld	Colour
black	Type of tank
cylindrical, vertical, SCF type, flat bottom	Supplier
Allibert or equal	Dimensions
Inner Diameter	2900mm
Outer diameter	3100mm
Height	3100mm
Thickness bottom	22mm
Maximal density	1.4 kg/l
Volume	5.000l

Accessories: manhole DN500, level indication alarm (floats with transparent PVC tube), drain (DN50), filling connection DN50

1.4.2.1.5.3 Acid dosing pumps

Type	membrane dosing
Supplier	Prominent
Number	2
Operation	depending on the pH in the anaerobic effluent
Location	near chemical storage area
Discharge head	8 bar
Maximum flow	100 l/h
Installed power	0.18 kW
Materials	
pump housing	cast iron
motor housing	cast iron
diaphragm	PTFE (Teflon)
dosing head	PVC

1.4.2.1.5.4 Acid storage tank

Number	1
Material	PE-HD
extrusion without weld	
Colour	black
Type of tank	cylindrical, vertical, SCF type, flat bottom
Supplier	Allibert or equal
Dimensions	
Inner Diameter	2900mm
Outer diameter	3100mm
Height	3100mm
Thickness bottom	22mm
Maximal density	1.4 kg/l
Volume	5.000l

Accessories: manhole DN500, level indication alarm (floats with transparent PVC tube), drain (DN50), filling connection DN50

One scrubber for acid fumes DN125.

1.4.2.2 UASB Reactor

1.4.2.2.1 Functional description

The Up flow Anaerobic Sludge Blanket Reactor (UASB, T5001) is designed on a volumetric loading rate of 8 kg COD/m^3.day (at 35°C).

The biogas, sludge, and water will be separated within 3-phase settlers.

The effluent will flow over into the anaerobic effluent tank (T3001). Part of the flow flows by gravity back to the pH correction tank, the overflow of the effluent tank flows to the distribution chamber where the anaerobic effluent is mixed with the water from the RO plant, and with the bypass from the equalisation reactor.

The biogas flow will be measured. A low flow alarm (e.g. leakage, blocking, reduced removal efficiency) and high flow alarm (e.g. peak load, sludge wash out) will be provided. The biogas will be burned by means of a flare with invisible flame.

On the UASB at different heights sample points are positioned, in order to determine a sludge profile.

The temperature of the water inside the UASB is measured. The pH of the wastewater in the anaerobic effluent tank is measured. This pH measurement (AIT3002) can be a master control over the pH measurement in the pH correction tank. If the pH of the UASB-effluent remains within limits, the allowed pH-range of the influent can be set wider.

The pH measurement controls the automatic dosing of caustic or acid. When the pH is out of range for a certain period of time, that is when caustic or acid dosing pumps can not dose the amount of neutralization chemicals required, full wastewater recycle over the UASB will take place.

The flow to the UASB can be measured for fine-tuning possibilities, especially during start-up.

1.4.2.2.2 Dimensioning UASB

	Unit	**Value**
Daily flow (max)	m^3/day	4.300
COD load (max)	kg/day	10.000
Volumetric loading	kg COD/m^3.day	8
Volume (brut)	m^3	1.250
Dimensions concrete tank		
Length	m	15.0
Width	m	14.0
Water level	m	6.0
Hydraulic loading	m^3/m^2.hr	0.9
Total flow	m^3/hr	200
Gas production (max)	m^3/d	3.400
	m^3/hr	140-150

1.4.2.2.3 Dimensioning three phase separator

Recycle flow m^3/h 200
Surface load setters $m^3/m^2/h$ 1.4
Required settler surface m^2 134

1.4.2.2.4 Technical specifications

1.4.2.2.4.1 Characteristics of the three phase separators

The three phase separators are overlapping each other in such a way that biogas is isolated towards the gas baffles, while sludge and water enter the inner part of the separators. The angle of the baffles and the smooth surface enhances the settling of the sludge inside the separators.

The baffles are organized in boxes.

Installing lamella separators in the headspace of the reactor further increases the specific surface of the separators.

The three phase separators are organized in four streets with the following dimensions:

	Unit	**Value**
Length	m	14.0
Width	m	2.4
Surface per street	m	33.58
Total surface	m^2	134.0

1.4.2.2.4.2 Covers

In view of the specific location of the WWTP the three phase separators of the cover of the UASB reactor. The covers are easily removable and made of weather resistant plastic.

The covered three phase separators are ventilated by means of a ventilator and pump ejectors in each of the aerobic reactors. The off gases are treated in the aerobic post treatment: automatic valves are opened or closed following the cyclic operation of the aerobic post treatment to make sure that the off gases are immersed in an aerated compartment.

1.4.2.2.4.3 pH/T measurement

Tag number	AIT3002
Type	CPM151, CPA111, CPS11, CPK7, TS11
Vendor	E&H or equal
Number	1

1.4.2.3 Biogas Street

1.4.2.3.1 Functional description

The biogas that is produced in the UASB reactors is collected from the gas domes into a common header. The water droplets are first eliminated from the biogas in a demister. The flow of the biogas is measured to have an indication of the activity of the UASB reactor in relation to its loading (evaluation of the performance of the anaerobic treatment).

The biogas is burned in the flare. The flare is of the “invisible flame” type, with complete incineration. The flare is equipped with a stand by flame, which is a more reliable solution then the flare with auto ignition. It allows us to work without intermediate gas buffer, and gives no variations of pressure in the gas street, other then those due to the variable biogas production (slow variation in time).

1.4.2.3.2 Dimensioning

	Unit	**Value**
Biogas production	Nm^3/kg COD	Approx. 0.3
Biogas production at full load	Nm^3/day	3.500
Average biogas production per hour	Nm^3/hr	140
Capacity of the flare	Nm^3/hr	200
Methane content	%	Approx. 60-80

1.4.2.3.3 Technical specifications

1.4.2.3.3.1 Characteristics of the flare

The flare is equipped with a pilot burner. The pilot burner will be continuously in operation and is fed by the pilot gas compressor. If the pilot is burning, the solenoid valve in the main gas stream will be opened. The backpressure valve in the main gas stream will keep the pressure of the inlet on a constant value.

The flare installation type ground flare will consist of the following parts:

- Stand pipe fabricated of seamless carbon steel pipe
- One frame constructed of UP160
- Burner head and gas mixing pipe
- Valve train included pilot gas compressor of 0.5 kW and inlet valve, manometer, back pressure valve, automatic solenoid valve, drain valve and quantity restriction valve
- Pilot burner and automatic ignition
- Control cabinet in glass fiber reinforced polyester, Class: IP64, equipped with rain strips and supports
- Flame arrestor
- Injection nozzle
- Injection pressure: 20-40 mbar
- The venturi mixer is configured in a vertical construction and fabricated in stainless steel.
- Wind protection pipes in stainless steel

1.4.2.4 Storage Tank Anaerobic Sludge

1.4.2.4.1 Functional description

Excess anaerobic sludge is stored in the anaerobic sludge storage tank. From this tank anaerobic sludge can be pumped back to the anaerobic tank or can be removed by truck.

1.4.2.4.2 Dimensioning

	Unit	**Value**
Concrete tank cover		
Length	m	6.0
width	m	5.0
Water level	m	4.5
Total height	m	5.0
Tank capacity (brut)	m^3	150

1.4.2.4.2.1 Technical specifications

1.4.2.4.2.1.1 Characteristics sludge removal pump

Tag number	P8005
Number	1
Type	Volumetric worm pump
Supplier	Seepex or equivalent
Function	transfer of anaerobic sludge from or to the UASB reactor
Number	1 (transportable)
Capacity	0-5 m³/h
Discharge head	20 mWC
Power	1,5 kW
Impeller	two channel impeller
Sealing	Mechanical seal
Materials	
Pump casing	Cast iron
Rotor	SS 304
Stator	Hypalon CSM

1.4.3 POST TREATMENT

1.4.3.1 Aerobic Treatment

1.4.3.1.1 Functional description

The anaerobic effluent is flowing to the aerobic stage. The post-aeration consists of a LUCAS®-3 activated sludge system (T6001/02/03) where the remaining COD will be absorbed by the activated sludge and subsequently converted into new biomass. The reactors are following a cyclic operation that consists of four phases: feeding with wastewater, aeration, settling and discharge. The active volume is calculated from the total reactor volume times the time fraction that the aerator is aerated (phase one and two).

Aeration and mixing of the reactors is realised by means of a submersible mixer (M6001/02/03) and a surface aerator (A6001/02/03).

Excess aerobic sludge is removed by means of timer controlled pump (P6001/02/03).

For the removal of phosphates $FeCl_3$ will be dosed in the aerobic distribution chamber.

1.4.3.1.2 Dimensioning

	Unit	Value
COD loading	kg/day	2.200
Volumetric loading	kg COD/m³/day	1.0
Active Volume	m³	2.200
Percentage of aeration per day	%	52
Total volume required	m³	4.800
Volume per reactor	m³	1.600
Dimensions concrete tank		
Length	m	20.5
Width	m	20.5
Water Level	m	3.5
Total height	m	4.25

Note: the incorporation of the RO water influences the design of the aerobic post treatment both for hydraulic and operational (removal of nitrates) reasons. As a consequence, the volumes have been increased from 1.100 to 1.600 m³.

1.4.3.1.3 Technical specifications

1.4.3.1.3.1 Characteristics of aerators

Tag number	A6001/02/03
Number	3 (one per reactor)
Function	Aeration of the post aeration
Manufacturer	Aquasystems
Operation	Function of the cyclic operation
Location	floating in reactor
Installed power	55 kW
Tension	380 V, 50Hz
Motor speed	2880 rpm
Materials	
Motor casing	GG20
Screw	SS304

1.4.3.1.3.2 Characteristics of the mixer

Tag number	M6001/02/03
Supplier	Flygt, ABS
Type	submersible
Motor	6 kW
Protection	IP68
Propeller type	open 3 blade, self cleaning, diam.
Shaft sealing	double seal, product side with silicon carbide mechanical seal, independent of direction of rotation and resistant to temperature shock, running in an oil bath with di-sensor for seal monitoring
Materials	
motor housing	SS304
Propeller	SS304
propeller shaft	SS304
Cable	NBR
With mobile hoist	

1.4.3.1.3.3 Excess sludge pump

Tag number	P6001/02/03
Type	Submersible
Centrifugal	
Supplier	ITT Flygt
Function	Feeding of RO wastewater
Number	3 (1 per reactor)
Capacity	20 m³/h
Discharge head	10 mWC
Power	1,75 kW
Impeller	single vane
Sealing	Mechanical seal
Materials	
Pump casing	Cast iron
Impeller	Cast iron sprayed with primer
Studs, nuts	SS 304
Shaft	SS 304
Guiding	SS 304

1.4.3.1.3.4 $FeCl_3$ dosing pumps

Type	membrane dosing
Supplier	Prominent
Number	2
Operation	depending on the pH in the anaerobic effluent
Location	near chemical storage area
Discharge head	8 bar
Maximum flow	100 l/h
Installed power	0.18 kW
Materials	
pump housing	cast iron
motor housing	cast iron
diaphragm	PTFE (Teflon)
dosing head	PVC

1.4.3.1.3.5 $FeCl_3$ storage tank

Number	1
Material	PE-HD
extrusion without weld	
Colour	black
Type of tank	cylindrical, vertical, SCF type, flat bottom
Supplier	Allibert or equal
Dimensions	
Inner Diameter	2900mm
Outer diameter	3100mm
Height	3100mm
Thickness bottom	22mm
Maximal density	1.4 kg/l
Volume	5.000l

Accessories: manhole DN500, level indication alarm (floats with transparent PVC tube), drain (DN50), filling connection DN50

1.4.3.1.3.6 Oxygen measurement

Tag number	AIT6001/02/03
Supplier	E&H
Number	3 (one in each tank)
Level switch	
Tag number	LS6004
Type	ENM10
Supplier	Flygt
Number	1

1.4.3.2 Sludge Thickener

1.4.3.2.1 Functional description

Excess sludge from the aerobic reactors is removed by means of timer controlled pumps (P6001/02/03) to a thickener (T8001). A slow turning raking bridge (R8001) thickens the sludge to a dry solids content of about 3%.

From the thickener, the sludge can be removed by farmers, or to a dewatering unit.

1.4.3.2.1.1 Dimensioning

	Unit	Value
Sludge production	kg/day	611
Sludge loading	kg/m².day	20
Surface required	m²	33
Dimensions		
Water level	m	4
Diameter	m	6
Volume	m³	132

1.4.3.2.1.2 Technical specifications

1.4.3.2.1.2.1 Characteristics of the raking bridge

frame work	epoxy coated
scrapers	stainless steel
drive unit	DBS or equal
installed power	2.2 kW

1.4.3.3 Sludge Dewatering

1.4.3.3.1 Functional description

Excess sludge from the wastewater plant is pumped from the biological treatment to the sludge thickener, in function of the cyclic operation and in function of the sludge growth.

After sludge thickening a sludge dewatering system is provided consisting of an automatic polymer dosing unit and a belt press. The dosing of polymer into the sludge line enhances the flocculation and the dewater ability of the sludge.

The belt press and the polymer preparation unit are automatic and advanced devices that operate on a continuous basis without supervision.

The dewatered sludge falls from the belt press down into a container for further disposal.

1.4.3.3.2 Dimensioning

	Unit	**Value**
Sludge production	Kg DM/day	611
Type of Sludge	Activated sludge from the brewery out thickener	
Feed dry solids concentration	g/l	20
Dry solids quantity/day	kg	600
Volume of sludge / day	m^3/day	30
Operating time / day	Hours	8
Dry solids quantity / hr	kg/hr	75
Output % dry solids	%	15 ± 2

1.4.3.3.3 Technical specifications

1.4.3.3.3.1 Characteristics of the sludge pumps

Tag number	P8001/02
Type	excentric screw pump
Flow	6.5 m3/hour
Pressure	2 bar
Speed	variable
Vendor	Seepex or equivalent
Installed power	2.5 kW

1.4.3.3.3.2 Characteristics of the Poly-electrolyte unit

Tag number	PU8001
Type	powder polymers (two tank badge design)
Installed power	2 x 1.1 kW
Vendor	Aldoss or equivalent

1.4.3.3.3.3 Dosing pumps polymer (final solution 0.2 – 0.4 %)

Tag number	P8003/04
Number	2 (1 and 1 spare)
Type	excentric screw pump
Flow	0.4 m3/h,
Speed	variable speed
Pressure	2 bar
Vendor	Seepex or equivalent

1.4.3.3.3.4 Dynamic sludge flocculator

Tag number	T8004
Type	cylindrical vessel
Material	HDPE, with top entry mixer
Capacity	approx 0.5 m^3
mixing	with top entry mixer
Vendor	COV (Andritz) or equal
Installed power	0.75 kW

1.4.3.3.3.5 Belt filter press

Tag number	PU8002
Type	omega 100100SC
Vendor	EMO
Belt width	1 m
Installed power	0.75 kW
Washwater flow rate	6 m³/h at 7 bar
Belt tracking system	mechanical
Belt tensioning system	mechanical
Materials	
Belt	polyester 540 microns
Frame, guides and supports stainless steel AISI 304 L	Roller
carbon steel and metallization	Belt drive
hollow shaft gear motor	Make
nord gear or equal	Speed
variable with frequency converter	Protection
IP 55 B F	Belt speed
0.72 – 5.1 m/min	Accessories
limit switches telemecanique	Included options
special spray bar with brush	Odour enclosure in fiber glass

1.4.3.3.3.6 Wash water pump

Tag number	PU0001
Type	vertical multicellular
Make	grundfoss
Modem	CR8 80
Flow	9m³/h
Installed power	5.5kW

1.4.3.4 Odour Treatment

1.4.3.4.1 Functional description

The UASB reactor, the correction pit, the anaerobic effluent tank, the sludge thickener and the sludge storage tank are covered. A ventilator (C9001) withdraws the off gases from all covered reactors and transfers the gases to a BEL-AIR® air treatment system. The off gases are adsorbed by the active biomass, and eliminated.

1.4.3.4.2 Dimensioning

	Unit	Value
Air from UASB reactor	m³/h	200
Air from correction pit and effluent tank	m³/h	100
Air from sludge storage	m³/h	200
Total air flow	m³/h	500

1.4.3.4.3 Technical specifications

1.4.3.4.3.1 Compressor for off gases

Tag number	C9001
Function	Transfer of off gases to SBR
Manufacturer	Robushi or equivalent
Type	rotary fan
Operation	Continuous
Installed power	6 kW
Tension	415 V, 50 Hz
Motor speed	1.500 rpm
Flow	500 m³/h at 30°C
Discharge head	400 mbar
Protection	IP55
Isolation class	F
Materials	
Body	cast iron
rotor	cast iron

1.4.3.4.3.2 Characteristics of the BEL-AIR®

Tag number	T9001
Type	BEL-AIR® biofilter
Supplier	Waterleau
Flow	500 m^3/h
Dimensions of concrete tank	
Length	5.0m
Width	2.0m
Total height	2.0m

1.4.3.5 Chlorination

1.4.3.5.1 Technical specifications

1.4.3.5.1.1 Dosing tank in PE

Volume 1000 l
Tubing in PVC
Floating level switches

1.4.3.5.1.2 Dosing pumps

Type	membrane dosing
Supplier	Prominent
Number	2
Location	near chemical storage area
Discharge head	8 bar
Maximum flow	16 l/h
Installed power	0.18 kW
Materials	
pump housing	cast iron
motor housing	cast iron
diaphragm	PTFE (Teflon)
dosing head	PVC

1.4.3.5.1.3 Measurement for free Cl_2

Number 1

Dosing in effluent from LUCAS®-3 reactors. Sufficient contact time (10-15 minutes) provided in concrete channel subdivided with baffles to increase the flow velocity and the mixing between effluent and chemicals.

1.4.3.6 Effluent Measurement/Sampling

The flow will be measured. A new automatic sampler will be used to take flow proportional samples.

1.4.3.6.1 Technical specifications

1.4.3.6.1.1 Automatic sampler

Tag number	PU1001
Make	Endress+Hauser-asp station
Cabinet	stainless steel cavity wall insulated cabinet
Materials	1.4301
Cabinet internal temperature thermostat controlled	
Dimensions	1072*601*637mm
Protection class	IP55
Sample volume	20-200ml
Sampling mode	time and quantity proportional
Number	1

Main advantages of this apparatus: samples are taken using the vacuum principle,

Sample storage thermostat controlled cooled, covered heat exchanger and purge of suction hoses.

1.5 Construction of WWTP

Construction of the WWTP will entail *in situ* excavation and use of the excavated material as fill (if needed). Any additional amounts of earth material, required for construction of the WWTP will be small as the local excavation works will meet most of the needs.

The design takes into account seismic level 3, hurricane wind speeds, and the soil stability report that was conducted.

The building area will be subjected to standard building conditions, such as:

- Construction site free from visible or invisible obstacles, such as old foundations, debris, large vegetation, local rock or stone formations.
- Construction area is large enough for the proposed construction, including space area for normal excavations, site installation and material storage.
- Construction area is accessible for standard equipment, such as trucks, piling machines etc.
- The construction area as well as the access is free from cables, pipes, sewers or other utilities.
- The site is property of Red Stripe.
- The existing grade level is relatively flat, without any significant differences in elevation.

ANALYSES OF ALTERNATIVES

2 Analyses of Alternatives

This section looks at alternatives to the proposed development and its design, and analyses the potential environmental impacts of each option. The objective is to determine the most practical, environmentally sound, economical and technically feasible option for treating Red Stripe's wastewater. The compulsory "No-Action" alternative was considered along with other treatment plant alternatives. For all options seismic level 3 and hurricane winds were taken into account.

2.1 The "No-Action" Alternative

The "No-Action" alternative is a possibility in this situation; however, it is not the recommended alternative for the following reasons:

- The project as designed and proposed represents a positive impact on the environment of the area.
- It does not improve on the quality of the wastewater currently leaving the Red Stripe property
- It does not address the need for proper treatment of industrial wastewater such as that leaving Red Stripe and Pepsi

It does not provide significant positive ecological benefits to the receiving environment.

2.2 The Proposed Development

This alternative would see the construction of the WWTP as proposed by Red Stripe, and as outlined in this EIA document.

- The proposed project is the most practical, environmentally sound and economical option available to Red Stripe currently.
- The proposed project will impact a very small area on the Red Stripe property
- The project is proposed as one that is environmentally friendly and proactive

- As designed it offers a positive boost to Hunts Bay and Kingston Harbour in the way of rehabilitation, and also reduces the burden on Government assisted treatment through a future planned treatment facility

- It will provide Red Stripe with the opportunity to improve its corporate image locally and internationally

This alternative is the recommended alternative. The size and layout as proposed make effective use of the project area while still leaving a considerable area for other uses by Red Stripe including any future expansion. It incorporates all the necessary amenities and infrastructure to meet regulatory, environmental and aesthetic requirements.

2.3 Alternative Wastewater Treatment Options

Several other options were investigated, some proposed modifications of the proposed project, to handle the wastewater streams. None of these options were recommended based on technical feasibility, environmental soundness and economics.

2.3.1 Tie-In to the National Water Commission's (NWC) Proposed 225,000 m^3/Day Soapberry Wastewater Treatment Facility

- This project has been proposed for awhile yet construction has yet to get off the ground. The EIA for this project has already traversed NEPA, and the general public is awaiting the start of construction.

- Continued delays in the startup of this WWTP facility would prolong the impacts on the receiving waters of Hunts Bay and Kingston Harbour.

- The physical location of Red Stripe to the proposed plant may pose difficulties in making a connection. This option retains the same positive benefits as with maintaining the proposed development option, however, timing is a factor.

- If plans for the Facility fall through then Red Stripe would be well behind its schedule for regularizing its trade effluent discharge.

2.3.2 The Proposed Development with Modifications

- Construct the facility using Up flow Anaerobic Sludge Blanket Reactor (UASB) in concrete and other tanks in epoxy coated steel

- Construct the facility using UASB in concrete and other tanks in Stainless Steel 304 (SS304)

- At this time the engineers have decided that these options are not the most ideal, however, they would carry out the same processes with more or less the same result.

- Tanks in epoxy coated steel and others in SS304 are not considered better than civil works in concrete for this location and plant. The proximity to the marine environment is a major consideration.

- These options may have some advantages over civil works, but when compared with civil works the following is relevant.

    - APPLICATION - they take longer to prepare and dry, and require trained operators

    - RESISTANCE TO DAMAGE – brittle easily damaged in shipment or installation

    - LONG TERM PROTECTION – civil works last longer

    - TANK PREPARATION – takes longer to prepare than civil works

2.4 Summary of Alternative Analysis

The recommended alternative is the "Proposed Alternative" because it recognises the viability and need for the proposed development, and is designed to address the myriad of issues, and meets or exceeds all local regulatory requirements.

Additionally, the "proposed alternative" has been designed for operation and maintenance in the marine environment of the Kingston Harbour area.

DESCRIPTION OF THE BASELINE ENVIRONMENT

3 Description of the Baseline Environment

3.1 Physical Environment

3.1.1 Climate

3.1.1.1 Outline

The meteorological data represent the averages of data collected by automated weather stations at the Norman Manley International Airport. The data is measured continuously throughout the day, and logged every two minutes. For the purposes of this EIA, the values are averaged on a monthly basis, and will reflect the prevailing weather patterns associated with the following parameters:

- Rainfall
- Wind Speed & Direction
- Air Temperature

3.1.1.2 Rainfall

Figure 3-1 shows the monthly averages for rainfall for years 1998, 1999, and 2004, based on available data from the Meteorological Office of Jamaica.

The region experiences the highest rainfall during the months of September and November, peak hurricane and rainy season. The lower than normal rainfall observed for November 2004 reflects the onset of a drought period which occurred from November 2004 – April 2005. However, under normal conditions, the previously described trend prevails.

Since historical flow data was used in the determination of the system designs, it is anticipated that the seasonal highs and lows related to rainfall will not disrupt the system operation.

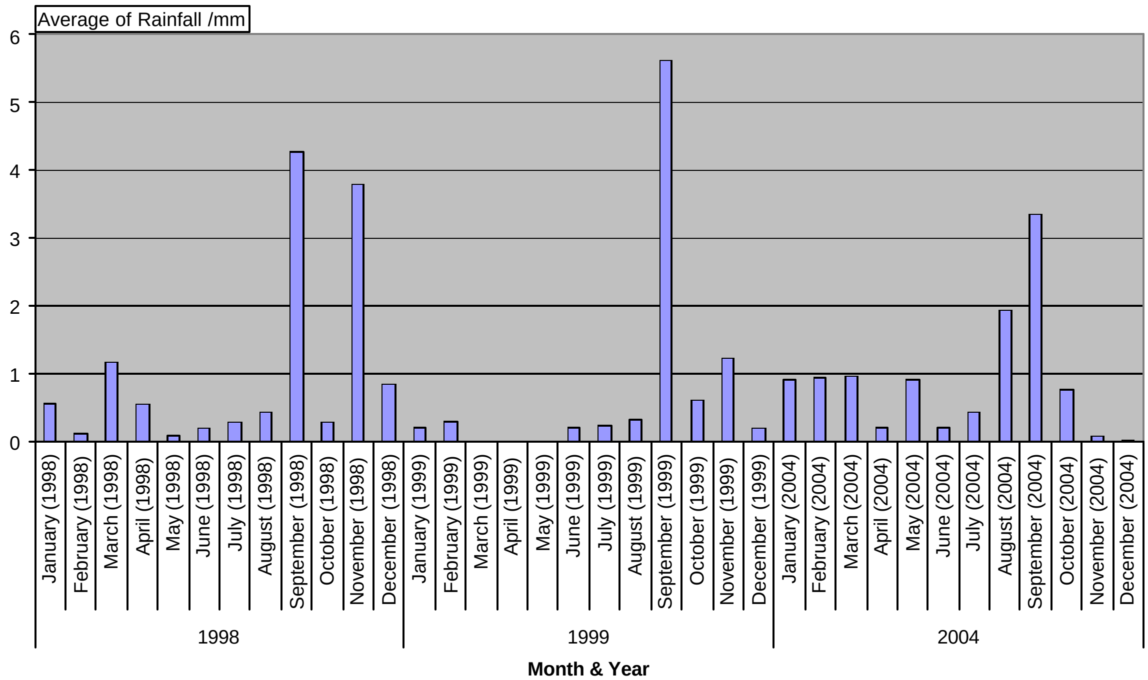


FIGURE 3-1: AVERAGE MONTHLY RAINFALL FOR THE PERIODS 1998, 1999, AND 2004

3.1.1.3 Wind Speed & Direction

Figure 3-2 shows the average wind speeds for 1998, 1999, and 2004. Maximum wind speeds occur mostly during the periods of winter and summer. This is expected as Jamaica is affected by cold fronts during the winter season from the North which travel according to the global convectional cycle. This often produces gusts of wind throughout the period, with the occurrence of prolonged sustained winds which may last more than twenty four hours. The summer winds are accounted for by the change in the air and surface temperatures across the island. The mid summer periods produce the highest temperatures, causing an increase in the rate of movement of air, especially for coastal regions. Therefore, the effects of land and sea breeze become more pronounced during this period.

Wind speed and direction will not result in any negative impact on the faculty or its ability to operate suitable under normal conditions. The system has been designed to withstand significant hurricane wind gusts.

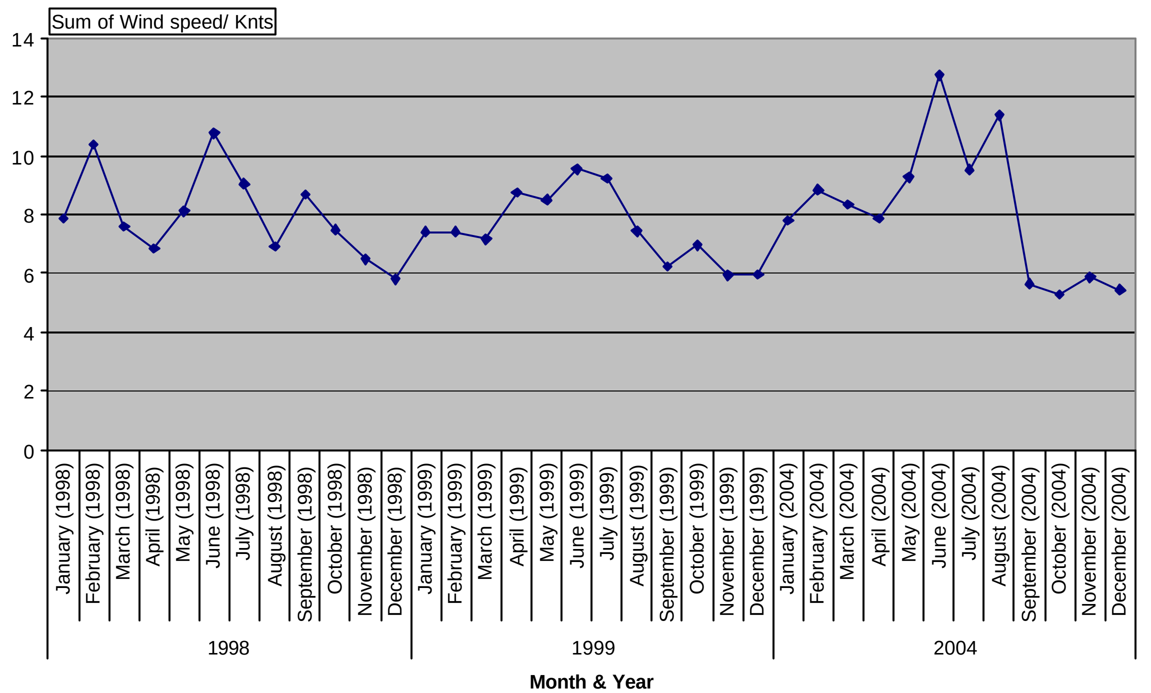


FIGURE 3-2: AVERAGE MONTHLY WIND SPEEDS FOR THE PERIODS 1998, 1999, 2004

Figure 3-3 depicts the average wind direction for the period 1998, 1999, 2004. The wind affecting the greater Kingston metropolitan area blows consistently from the North-east throughout the year. This is the expected trend as the island of Jamaica is directly affected by the North-east trade winds.

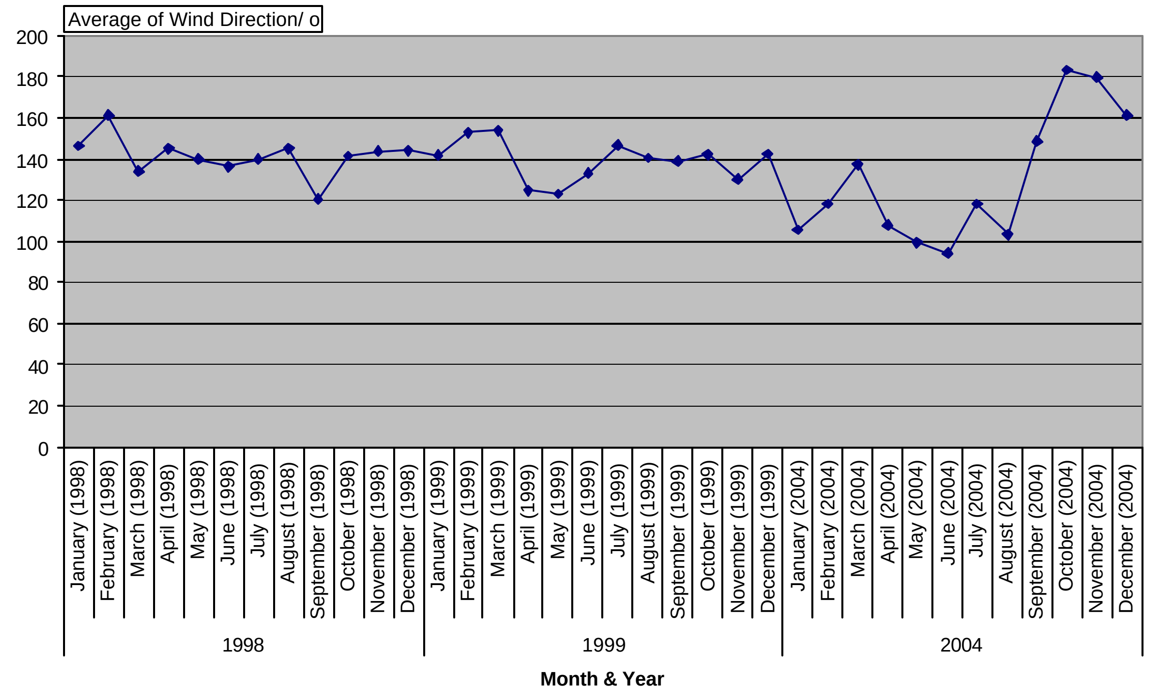


FIGURE 3-3: DOMINANT WIND DIRECTION (MONTHLY) FOR THE PERIOD 1998, 1999, 2004

3.1.1.4 Air Temperature

Figure 3-4 shows the consistency in the monthly average air temperature pattern from year to year. The air temperatures follow the seasonal patterns with maximum temperatures in the summer months of July and August. The maximum temperatures range from 32°C to 30°C. The relatively high temperatures prolonged throughout most of the year combined with coastal winds could result in a dry and sometimes dusty environment, if no controls are in place.

Red Stripe's open lands are all grassed and a landscaping regime is in place for these open spaces. It is not anticipated that normal air temperatures will have a negative impact on the system. If anything the consistent warmth will lead to increased evaporation and evapotranspiration from the system.

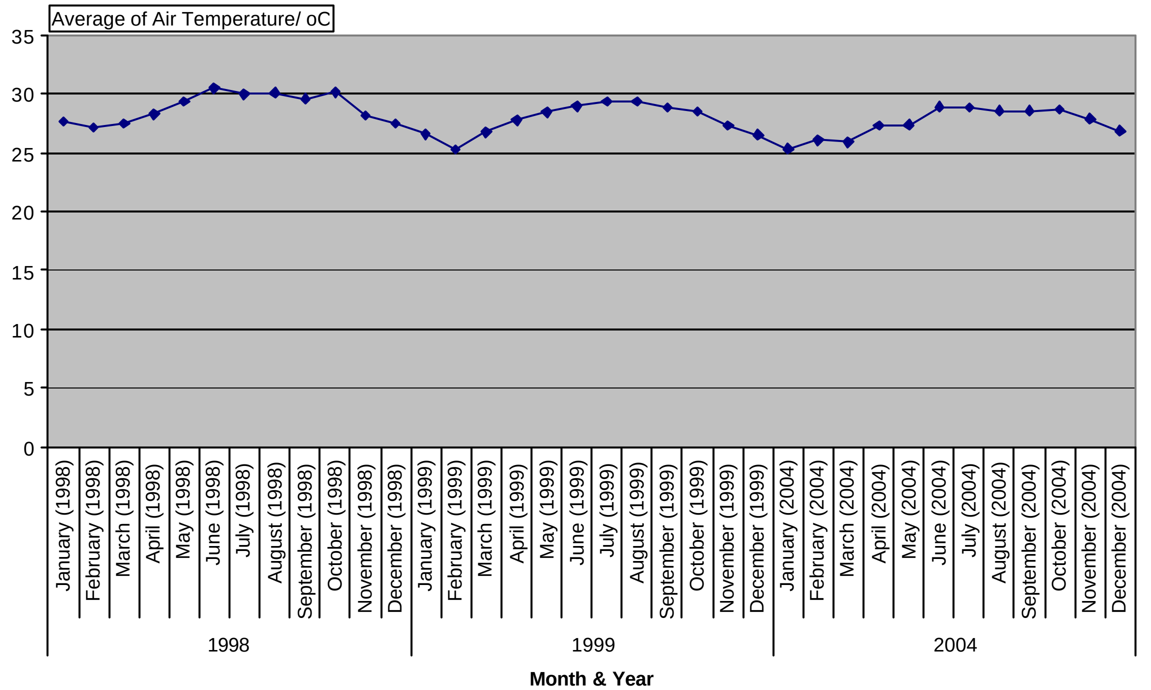


FIGURE 3-4: AVERAGE MONTHLY AIR TEMPERATURE FOR THE PERIODS 1998, 1999, 2004

3.1.2 Topography

Red Stripe's property lies on a piece of flatland bordered by Spanish Town Road to the north, Hunts Bay to the south and Chesterfield Drive to the west. The area is flat with maximum elevation of no more than 4 - 5 meters above sea level, but generally the site is close to sea level. The land slopes very gently towards the south.

The WWTP site is bordered by the existing Red Stripe plant to the north, the property wall along Chesterfield Drive to the west and the property line along the JRC rail track to the south.

It is not perceived that the present topography and geology of the site requires any special considerations prior to a development such as the one proposed being implemented.

3.1.3 Soils and Geology

3.1.3.1 Soils

The Red Stripe property sits on the coastal alluvial plain drained by the Rio Cobre and several gullies in Kingston. This is part of an extensive alluvial plain extending from Kingston in the east to southern Clarendon in the west.

Soil Investigation report conducted by Hill-Betty (Engineers) Ltd. In May 2003 revealed the site is ideal for the WWTP. The soil condition was determined to be "disturbed". The investigation points are reliable for the placement of the WWTP plant (Appendix 7.3.3).

The boreholes were taken to a depth of 15.2m (50 feet) below existing ground elevations, using a truck-mounted rotary drill rig with auger attachments. Representative samples of the soils penetrated were recovered using a split spoon sampler and standard penetration test procedures. The results of the borehole samples revealed a predominant mix of granular soils (sand with gravel) sandwiched by non-granular soils (silt and/or clay). The soils found were generally dark-brown clayey-silt and sand. The densities of the granular soils range from "compact" to "very dense" for five (5) boreholes investigated.

3.1.3.2 Geology

The area is relatively flat with a slight slope towards the south of the property. It is intersected by two or three minor gullies with drainage towards the south.

No significant geologic structures such as faults traverse the site.

3.1.4 Hydrology

3.1.4.1 Surface drainage

The surface drainage of the proposed site is determined by the regional topography and modifications that have altered the local surface flow conditions. The proposed site lies on the south eastern most part of the Rio Cobre River and Sandy Gully drainage basin which is on an alluvium aquifer (Figure 3-5).

The secondary drain of the Sandy Gully flows in a southerly direction along the western boundary of the proposed site, until it gets to the berm along the railway tracks where it takes a south-easterly turn to the southern end of the Red Stripe property boundary. It runs for about 60m before flowing under the rail tracks at a single culvert to lead into a densely wooded area before exiting into Hunts Bay. This vegetated area serves as a filter for all surface run-offs on its way to Hunts Bay.

3.1.4.2 Ground Water

Groundwater was encountered in all five boreholes explored at depths of 2.3m (7.5ft) below existing ground level.

The silty-clay and sand sequence underlying the site is indicative of the eastern reaches of the Rio Cobre Alluvium Aquifer. The water table elevation at the site is 2.3 m below ground level and the groundwater gradient appears relatively flat. There are no naturally occurring rivers that directly impact the Red Stripe facility.

The regional groundwater flow direction is south towards the coast at Hunts Bay.

FIGURE 3-5: HYDROLOGY & HYDROSTRATIGRAPHY OF KINGSTON & ST. ANDREW, WITH THE REDSTRIPE PLANT LABELED

3.1.4.3 Water Quality

Wastewater from Red Stripe's three wastewater drains are monitored for effluent quality on a periodic basis from the sampling stations located at the plant. Laboratory analyses are carried out by a third party laboratory using standard methods for the analysis of wastewater to determine the state of the following parameters:

- Total dissolved solids (TDS)
- total suspended solids (TSS),
- nitrates (NO_3^-),
- phosphate (PO_4^{3-}),
- sulphates (SO_4^{2-})
- chemical oxygen demand (COD),
- biochemical oxygen demand (BOD),
- total coliform
- faecal coliform
- sodium
- oil & grease

3.1.4.4 Flows

Before the implementation of the WWTP, Red Stripe will install a program to eliminate the spent yeast flowing in the brewhouse drain. Red Stripe will also install a program in the brewhouse aimed at reducing the water consumption (Red Stripe beer to water usage = 1/14 whereas the traditional one for breweries internationally is under1/9).

The technology proposed by Waterleau is perfectly suitable to treat Red Stripe/Pepsi wastewater, and is a method utilised worldwide in similarly styled breweries. This will be able to treat wastewater flow from the following drains:

- flow from brewhouse
- flow from packaging
- flow from Pepsi
- combined flow from packaging and Pepsi

This WWTP is designed to fully handle the hydraulic (flow) and organic (COD) loading of wastewater from Red Stripe, utilising the following sampling stations now being used (Table 3-1 below).

- Station 1 – brewhouse effluent,
- Station 2 – Packaging effluent, and
- Station 3 – Packaging/Pepsi.

TABLE 3-1: HYDRAULIC (FLOW) AND ORGANIC (COD) LOADING OF WASTEWATER DESIGN FROM RED STRIPE

	Brewhouse	Packaging	Pepsi	Total
FLOWS (m3/day)				
	1400	1900	1000	4300
COD (mg/l)				
	6600	500	2000	9100
Daily COD load (kg COD/day)				
	9240	950	2000	12190

3.1.4.4.1 Nutrients

3.1.4.4.2 Packaging/Pepsi / Brewhouse Flow

The total amount of nitrogen in the wastewater is between 150 and 220mg/l whereas the total amount of phosphate is between 20 and 25mg/l. This means that the ratio COD/N/P for Red Stripe's wastewater is 100/6.3/0.8 whereas the idealized ratio for anaerobic treatment is 100/1.25/0.25. This indicates no N and P deficiency, so no addition of nutrients will be needed if the circumstances stay the same. The surplus of nutrients will be removed during the aerobic step through the nitrification/denitrification process.

3.1.4.4.3 RO Flow

In the RO stream almost all nitrogen appears as nitrates. There is generally between 70 and 95mg/l of total nitrogen in this stream, thus the need to treat this stream. The phosphate concentration is negligible (max avg. 2.4mg/l). COD is <100mg/l and hence no COD/N/P ratio is necessary.

3.1.4.4.4 Temperature, pH and Suspended Solids

3.1.4.4.4.1 pH

The average pH for Red Stripe and Pepsi's wastewater is 8.1. This may be due to the caustic soda used in the bottling by Red Stripe and Pepsi in the cleaning process. The pH of the RO effluent is constant at 7.9.

3.1.4.4.4.2 Temperature

Measured temperatures for the Packaging/Pepsi effluent ranged between 34 and 35°C. the temperature of the bottling wastewater is higher than the brewing one. No extra heating device is needed for the anaerobic treatment which traditionally requires a minimum temperature of 28-30°C (optimal working conditions of a UASB is 35-37°C)

The temperature is constant in the RO flow at an average of 29.9°C.

3.1.4.4.4.3 Suspended Solids

No high levels of suspended solids were observed for the effluent from Packaging and Packaging/Pepsi. The brewing flow was determined to have high suspended solids content visually. These values will be decreased with the future elimination of spent yeast, spent grains and keiselghur from the effluent. This will also reduce the COD loads in the brewery effluent.

In the RO stream, the TSS concentration was very low, average of 67mg/l whereas a value of 20 to 30 reflects normal clean effluent from a WWTP.

Wastewater from the Red Stripe and Pepsi plant enters Hunts Bay having passed into a drainage ditch on Chesterfield Drive to the west of the property and through a heavily wooded area fronted by mangroves on the eastern shores of the Bay. This drainage ditch also accepts land run-off and other wastewater from other sources.

The concentration of pollutants in Hunts Bay has increased considerably over the last twenty years, and therefore higher levels of eutrophication have been noted in recent years (Webber 2003).

Proactive treatment of wastewater by Red Stripe and treatment of sewage by the proposed Soapberry wastewater treatment plant will considerably improve the water quality of Hunts Bay and Kingston Harbour in the long-term.

3.1.5 Natural Hazard Vulnerability

3.1.5.1 Outline

The plant is designed to handle a maximum throughput of 4300 m^3/day of wastewater. It is essential that the structural and functional integrity of the system be sustainable under conditions brought about by natural hazards.

Breaches to the structural and or functional integrity of the waste water treatment plant may result in untreated effluent entering the surrounding environment. Contamination can occur through processes such as:

This section's purpose is to detail the susceptibility of the area to several types of natural disasters. The natural disasters to be considered are:

- Flooding
- Earthquake
- Hurricane
- Landslide

3.1.5.2 Flooding Susceptibility

Assessing whether an area is prone to flooding requires a hydrostratigraphic assessment of the area, and the collection of physical data such as rainfall run-off patterns, topography and information obtained from actual flooding events (especially as perceived by individuals who reside or frequent the area during such events) over a statistically appreciable period. Such information is not readily available from relevant statutory agencies in a compiled or organized format and is beyond the scope of this Environmental Impact Assessment. However, broad conclusions may be drawn from what data is available.

The project site is located in areas where the soil is permeable, because of the mix of granular soils (sand with gravel) sandwiched by non-granular soils (silt and/or clay). The permeability of the soil is indicated by the presence of an alluvium aquifer (Figure 3-6), which usually acts as a basin for rainfall that percolates through the soil to these aquifers.

In the absence of extreme weather conditions, namely heavy, consistent and prolonged rainfall, the site should not flood readily. Further, the site is not located in a sink hole or in an area of deep depression, neither is it a basin for rainfall runoff from catchment hill slopes.

There is the possibility for localised flooding from the poorly maintained municipal drain, should there be significant, prolonged rainfall at the property boundaries. This, however, is not a potential problem with the siting of the waste water treatment plant. Red Stripe also has an effective network of drains to remove run-off.

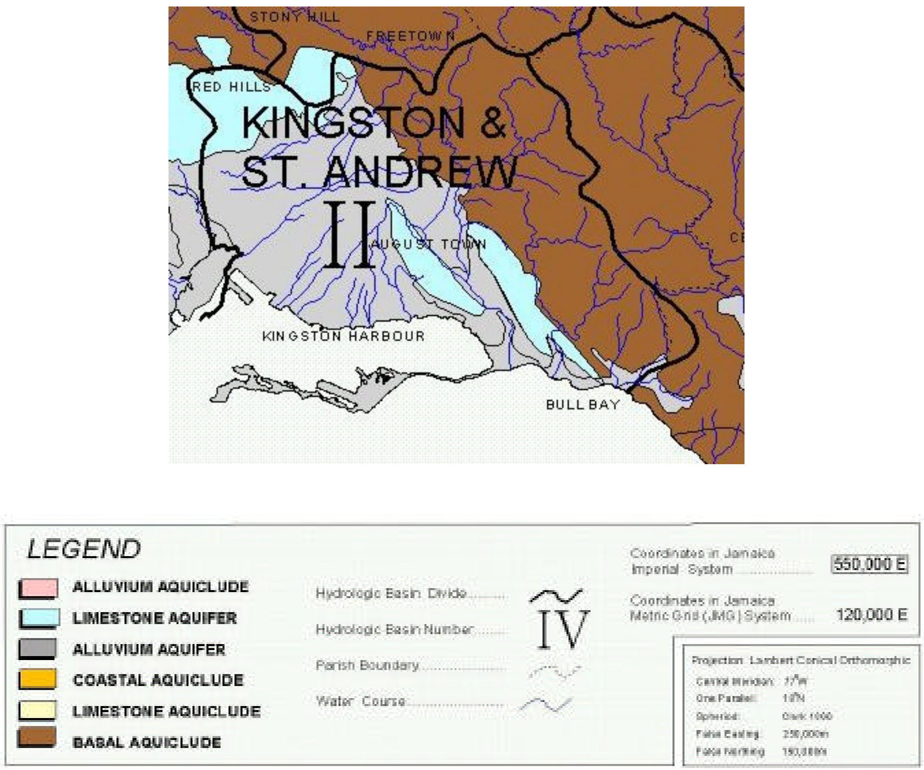


FIGURE 3-6: HYDROSTRATIGRAPHY MAP OF KINGSTON & ST. ANDREW

3.1.5.3 Earthquake Susceptibility

Jamaica lies in the seismically active northern plate boundary zone of the Caribbean Plate (Draper et al., 1994 and Figure 3-7). High magnitude earthquakes originating from as far away as the south coast of Cuba may be felt in Jamaica. For example the Cabo Cruz earthquake of magnitude 6.9 on the Richter scale, which occurred in May 1992, was felt with intensity 4 in Kingston, Jamaica. The 1993 earthquake of magnitude 5.4 which originated in

Jamaica was felt in Cuba with intensities of 3-4. No damage was reported in either case from the distant country (pers. comm. M. Grandison).

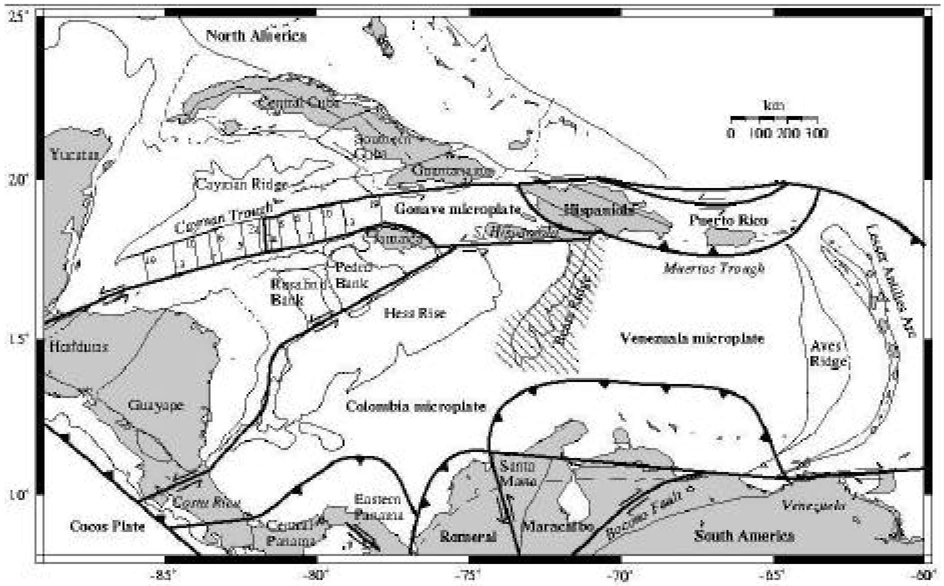


FIGURE 3-7: TECTONIC PLATES IN THE CARIBBEAN REGION

The average seismic activity which has occurred in or has been felt by Jamaica between the years of 1899 and 1998 is approximately 4.2[1], as defined by the Richter scale. Table 3-2 shows that this is equivalent to a degree of Mercalli of III. The design of the entire waste water treatment system has taken into account seismic activities rated at level 3(III) on the Mercalli scale. This design considerations are identical in value to the average seismic activity which has been recorded within the above mentioned time period. Therefore, one can conclude that the waste water treatment plant has been designed to withstand the average occurrence of any seismic activity which originates in or is felt by Jamaica. Given the degree of seismic activity in that area, it is evident that the construction of the waste water treatment plant will not be greatly threatened by the average seismic activity which occurs in Jamaica.

[1] Adapted from data obtained from *Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,* Final Report: Metropolitan Area Seismic Hazard Assessment – Appendix 1: Jamaican Earthquake Data.

TABLE 3-2: RICHTER MAGNITUDES WITH MERCALLI EQUIVALENTS

Magnitude of Richter	Degree of Mercalli
< 3.5	I
3.5	II
4.2	III
4.5	IV
4.8	V
5.4	VI
6.1	VII
6.5	VIII
6.9	IX
7.3	X
8.1	XI
> 8.1	XII

3.1.5.4 Hurricane Vulnerability

Based on the values recorded in Table 3-3, Jamaica is estimated to have a 95% chance of experiencing, at the most, the wind speeds associated with a '*Category 1'* hurricane every 10 years; and a similar chance of experiencing, at most, the wind speeds associated with a '*Category 4'* hurricane every 50 years.

TABLE 3-3: KINGSTON CENTRAL PORT WIND RESULTS (KNOTS): MAXIMUM LIKELIHOOD ESTIMATES AND UPPER PREDICTION LIMITS FOR VARIOUS RETURN PERIODS (1 MINUTE SUSTAINED WIND AT 10 METERS ABOVE GROUND).[2]

Return Period	MLE	50%	75%	90%	95%	99%
10 year	57	58.2	61.2	63.9	66.0	70.4
25 year	76	77.0	81.6	86.7	90.6	104.4
50 year	89	90.5	97.0	105.0	111.4	130.4
100 year	102	103.1	112.8	124.0	133.1	157.8

[2] *Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,* Return Period Estimation of Hurricane Perils in the Caribbean, Caribbean Disaster Mitigation Project April 1999

The MLE (Maximum Likelihood Estimate) column provides the best estimate as to the mostly likely extreme one minute-ten meter sustained wind for the various time frames.

The design specifications make reference to the consideration of winds categorized as "hurricane winds" in determining the durability of the physical structure of the waste water treatment plant. All the edifices on the treatment plant will be made of sulphate resistant concrete or blast furnace concrete, which will be reinforced according to international standards. These edifices will also have concrete roofs and aluminium windows. Reinforced concrete is not susceptible to any recorded hurricane force winds, neither are the aluminium windows gravely threatened by winds which are expected within a 50 year period in Jamaica. Other notable instances where resistance to 'hurricane winds' can be appreciated include:

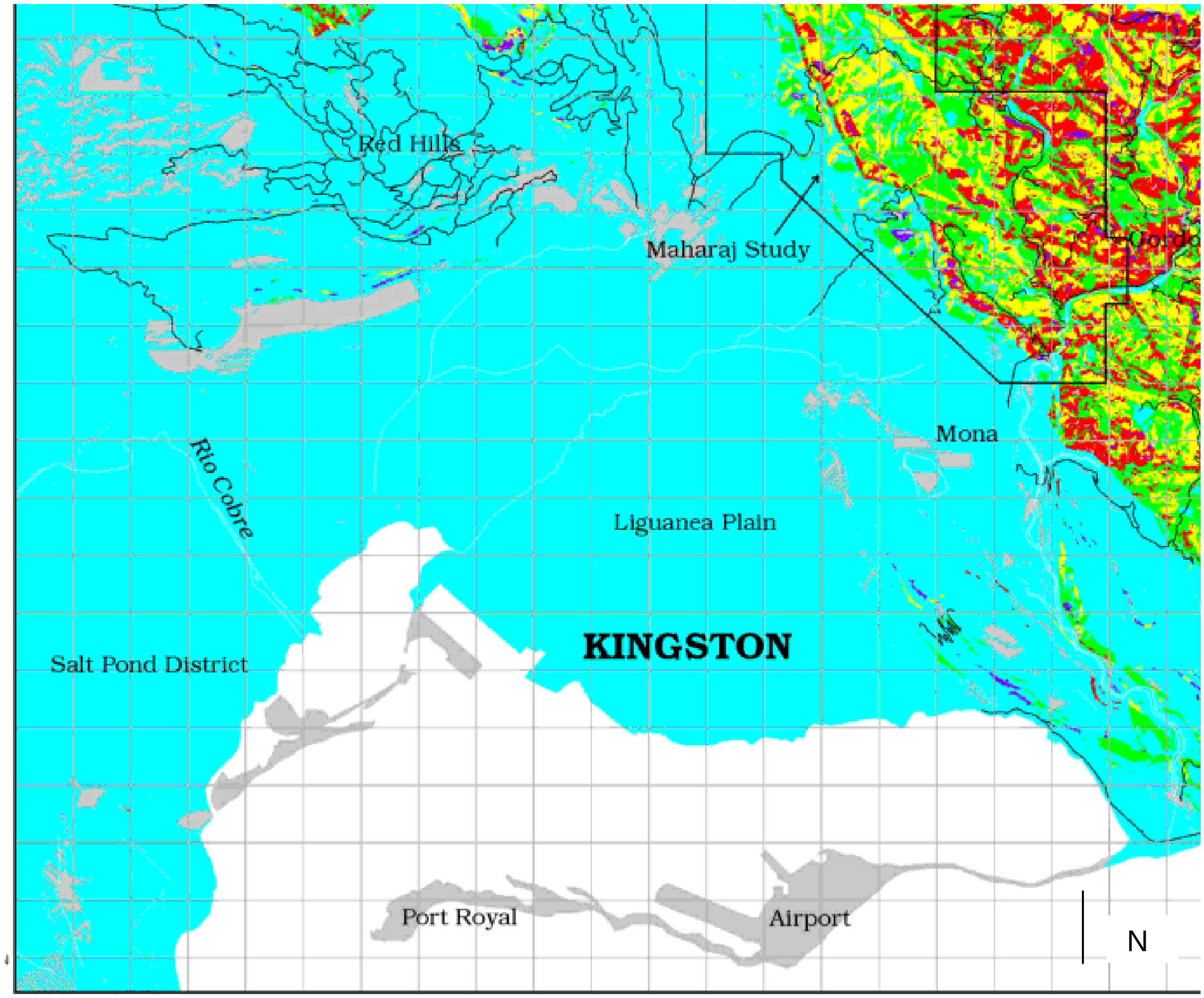
Structures which are to be erected on the foundation of the waste water treatment plant will be bolted down, with brackets and bolts, into the concrete foundation, and are not designed to be top heavy.

The three phase separators are covered with weather resistant plastic, which is streamlined and ventilated to ensure the free movement of wind as it passes over the covers. This will reduce the effect of pressurisation within the aerobic reactors.

3.1.5.5 Landslide Susceptibility

The land on which the proposed waste water treatment plant is to be constructed is relatively flat in topography and grassed throughout. Grass-land terrains of this nature characteristically have good root structures and consequently possess soil which is not likely to be washed away should the land become inundated. As such, the property is not considered to be prone to landslides.

Figure 3-8 below shows the landslide susceptibility of the region of Kingston in which Red Stripe is situated. The colour code for the map indicates that the region is generally categorized as being 'low' in its susceptibility to deep landslides. This classification translates as 0-2% chance of the general area being susceptible to landslide action.



KEY

	Non-Susceptibility
	Low susceptibility (0-2%)
	Moderate Susceptibility (2-3.5%)
	Moderate-High Susceptibility (3.5-4.5%)
	High Susceptibility (4.5-6%)
	Very High Susceptibility (6-83%)

FIGURE 3-8: LANDSLIDE SUSCEPTIBILITY OF KINGSTON[3]

[3] http://www.oas.org/CDMP/document/kma/landslmap.htm

3.1.6 Natural Environment

3.1.6.1 Terrestrial Ecosystem

3.1.6.1.1 Flora

The site is located in an area of open grassland at the southern end of the Red Stripe property. A list of plants identified in the area is given in Table 3-4 below.

The field visit carried out in April, 2005 confirmed the open grassland which has been used by Red Stripe for different purposes since its establishment.

TABLE 3-4: LIST OF FLORA

Family	Botanical Name	Common Name
Zygophyllaceae	*Tribulus cistoides*	Kingston Buttercup
Gramineae	*Cenchrus brownii*	Burr grass
Mimosaceae	*Acacia sp.*	
Mimosaceae	*Mimosa pudica*	Sensitive Weed
Poaceae	*Panicum maximum*	Guinea Grass

3.1.6.1.2 Fauna

No birds were observed on the Red Stripe property. This would be attributed to the openness of the area as well as the lack of nesting and foraging trees.

Butterflies known to inhabit open grasslands were not observed at time of visit. This may be due to the openness and limited amount of flowering plants.

No reptiles known to inhabit open grasslands of this type were observed during the site visit. No endangered species such as the Crocodile, C*rocodylus acutus,* which is known to inhabit nearby environs (Rio Cobre and the Hunts Bay) have ever been observed on or near the Red Stripe facility.

Invertebrates observed on the site included dragonflies, mosquitoes, flies, and land crabs (via holes near drainage ditch at property boundary).

3.1.6.2 Hunts Bay Ecology

Hunts Bay is a 2.2 km^2 restricted embayment with an average water depth of about 1.5 m. The bay waters are very turbid in part due to primary production (Wade et al., 1972). The bottom waters are always saline and surface waters mainly reflect freshwater inputs, from the Rio Cobre and Duhaney River. It also receives input from various industrial entities and from municipal drains. The Sandy Gully, a storm drain, drains West Kingston. The various industrial inputs range from brewery, food processing to leather tanning. Hunts Bay also receives organic waste such as sewage inputs which are carried into the Bay by the rivers and drains (Webber, 1997).

Hunts Bay receives significant trade effluent from many industries along Spanish Town Road, such as Red Stripe. Hunts Bay, despite the large intake of primary treated sewage, raw trade effluent and agricultural run-off, is considered a significant nursery. It supports the shrimping community at the mouth of the Causeway. Fishermen also catch fish to a lesser extent in this area.

There is continued effluent loading in Hunts Bay and this contributes to the continued degradation of the Bay and the adjoining Kingston Harbour. Kingston Harbour has a population of more than half a million people on its shores, the majority from the municipality of Portmore to the west. It is a multi-purpose resource and houses a variety of industries.

Surveys have shown a progressive deterioration since 1968 and the urgent need for a reduction of organic pollution if the benthic fauna is not to be destroyed (Wade et al, 1972).

Any improvements to the inputs to this system can only improve the ecological nature of the area, especially in light of further improvements along the way in the form of the Soapberry Wastewater Treatment Facility to the west of this project in St. Catherine.

SOCIO-ECONOMIC ANALYSIS/COMMUNITY INVOLVEMENT

4 Socio-Economic Analysis / Community Involvement

4.1 Introduction

The nature of the project is such that it should not require a socio-economic survey. It falls totally within private property and will not impact negatively on any surrounding communities. The project site is in an industrial district.

The protocol for informing neighbouring communities should not apply in this case as the project will not be putting out any emissions that may affect a persons health nor are effluent waters being generated and transported in a manner to directly impact any groundwater or other water sources for general consumption.

The project also does not intrude on any traffic regime which would affect the commuting public. In terms of economic impact it will be a positive benefit. This will lower the future burden on the overall cost of cleaning up Hunts Bay and Kingston Harbour, and will be supplemented with the future construction of the Soapberry Wastewater Treatment Facility.

POLICY, LEGISLATION AND REGULATIONS

5 Policy, Legislation and Regulations

5.1 Red Stripe's Environmental Policy Framework

Red Stripe is an environmentally responsible company that operates in a way to protect and enhance its people, brands and the communities in which we work and live. In doing so, we are committed to supporting environmental sustainability and biodiversity. We will comply with all applicable laws and regulations, the DIAGEO Risk Management Standards governing Environmental Management and other relevant requirements.

These aims will be achieved by meeting certain standards of performance on those key aspects of our operations that have environmental impacts. Management at every level and all employees are responsible and accountable for taking actions to preserve the environment. We encourage our business partners, suppliers and contractors to adopt a similar approach.

Greenhouse gases: We shall ensure awareness of the potential impact of generating greenhouse gases and set targets for the reduction of CO2 emissions.

Energy: We shall be aware of non-renewable energy use and conservation, monitor consumption and set energy reduction targets.

Waste: Waste shall be reduced, reused, recycled or disposed of in the most environmentally responsible manner commercially available. Targets for reducing waste shall be set.

Water: We shall source water responsibly, use it efficiently and set targets for reduction in its use.

Effluent: Liquid waste shall not be discharged in a manner that adversely impacts the ground, water or air.

Air Emissions: to the air of dust, gas, odours, vapours or noise shall be minimised.

Packaging: Products and packaging shall be designed to minimize environmental impact. Recycled or recyclable materials shall be used in packaging where feasible.

Hazardous substances: The use of hazardous substances shall be regularly monitored to ensure that toxicity and volume are minimized.

Transport: We shall minimize the environmental impact of logistics, taking into account such factors as mode of transport, vehicle efficiency, fuel type, driving style and journey planning.

5.2 National Policies, Legislation & Regulations

5.2.1 Policy, Legislation, Regulations & Standards

The following represents descriptions of applicable legislative requirements with which activities of this proposed wastewater treatment plant must comply:

Wild Life Protection Act (1945)

The Wildlife protection Act prohibits the discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams. This Act allows for the establishment of Game Sanctuaries and Reserves. Within the sphere of influence of this projected is the American Crocodile, that is protected under this Act.

Natural Resources Conservation Authority Act (1991)

The NRCA Act (1991) is the overriding legislation governing environmental management in Jamaica. It requires all new projects, or expansion of existing projects, which fall within prescribed categories, be subject to an environmental impact assessment (EIA). The regulations require that eight (8) copies of the EIA Report be submitted to the Authority for review. There is a preliminary review period of ten (10) days to determine whether additional information is needed. After the initial review the process can take up to ninety (90) days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted. In the event that the EIA is not approved, there is provision for an appeal to be made to the Minister.

Specifically, the relevant section(s) under the Act which address the proposed project are:

Section 10: Empowers the Authority to request EIAs for the construction of any enterprise of a prescribed category.

Section 12: Addresses the potential for contamination of ground water by trade effluent.

Section 15: Addresses the implementation of stop orders and fines associated with the contamination of ground water

Section 16: Authorises the Government to intervene in order to prevent the contamination of ground water.

Section 17: Addresses the authority of the Government to request in writing, any information pertaining to the:

- performance of the facility quantity and condition of the effluent discharged
- the area affected by the discharge of effluent in keeping with the requirements of this Act

The following submittals have been made in support of this project:

1. Permit Application (pursuant to Section 9)
2. Project information Form (pursuant to Section 10 (1) (a)
3. Completed EIA document (8 copies to NEPA and one electronic)

Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996).

The entire island of Jamaica and its territorial sea has been declared as a Prescribed Area. No one can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit in conjunction with the NRCA Act of 1991.

Natural Resources Conservation (Permits and Licenses) Regulations (1996)

The Permits and License regulations provide the regulations as demanded by the Natural resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order of 1996. Wastewater treatment plants are regulated under these regulations.

TABLE 5-1: TRADE EFFLUENT STANDARDS FOR PLANTS BUILT AFTER 1997

PARAMETER	STANDARD LIMIT
Ammonia /Ammonium	1.0 mg/l
Barium	5.0 mg/l
Beryllium	0.5 mg/l
Boron	5.0 mg/l
Calcium	No Standard
Chloride	300 mg/l
Colour	100 TCU
Detergent	15 mg/l or <0.015 kg/ 1000 kg product
Fluoride	3.0 mg/l
Iron	3.0 mg/l
Magnesium	No standard
Manganese	1.0 mg/l
Nitrate (as Nitrate and Nitrite)	10 mg/l
Oil and grease	10 mg/l or <0.01kg/ 1000 kg product
pH	6.5 – 8.5
Phenols	mg/l
Phosphate	5.0 mg/l

PARAMETER	STANDARD LIMIT
Sodium	100 mg/l
Sulphate	250 mg/l
Sulphide	0.2 mg/l
TDS	1000 mg/l
Temperature	2 °C +/- average ambient temperature
TOC	100 mg/l
TSS	All times <150 mg/l Monthly average 50 mg/l
STREAM LOADING	
BOD5	< 30 mg/l
COD	< 0.1kg/ 1000kg product or < 100 mg/l
DO	> 4 mg/l
BACTERIOLOGY	
Total Coliform	< 500 MPN/ 100ml
Faecal Coliform	<100 MPN/ 100ml

The Public Health Act (1974)

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the handling of food material. In addition, provisions are also made under this Act for the activities of the Environmental Control Division (ECD), a division of the MOH. The functions of the department include:

The monitoring of waste water quality, including regular water quality analysis, using water standards are published by NEPA.

Water Quality NRCA Act (1990)

NEPA has responsibility for the control of pollution in Jamaica's. National standards have been put forward for trade effluent to lagoons, rivers, streams, and harbours.

Town and Country Planning Act (1987)

This Act governs the development and land use (excluding agriculture) in specified areas, through Development Orders, local planning authorities, development planning processes and tree preservation orders. Under this Act the Town and Planning Department is the agency responsible for the review of any plans involving development. The Act allows for specific conditions to be stipulated and imposed on any approved plans.

Parish Council Act (1901; amended 1978) and the Local Improvements Act (1914)

The Kingston and St. Andrew Parish Council (KSAC) is responsible for administering all local government laws in the parishes of Kingston and St. Andrew. The wastewater treatment plant will require a building permit which is administered through a Parish Council.

POTENTIAL ENVIRONMENTAL IMPACTS

6 Potential Environmental Impacts of the Proposed Project

An anticipated environmental impact can be categorised as changes to the existing environmental baseline. An impact matrix is used here to visually express these changes and the magnitude of such changes in terms of their:

- Significance
- Location
- Extent
- Duration

TABLE 6-1: IMPACT IDENTIFICATION MATRIX

	EIA Activities													
	Site Preparation				Construction								Operation	
		Site Clearance	Excavation for tanks	Solid Waste Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Increased workforce	Landscaping	Effluent discharge	Effluent Treatment
TOPOGRAPHY														
GEOLOGY														
AMBIENT NOISE & VIBRATION														
WINDS														
RAINFALL														
GASEOUS EMISSIONS/ ODOUR														
NOISE AND DUST														
DRAINAGE														
TEMPERATURE														
NATURAL HAZARD VULNERABLITY														
Ecological Parameters: -														
TERRESTRIAL ECOSYSTEMS														
VEGETATION														
BIRDS														
OTHER FAUNA														

	EIA Activities													
	Site Preparation				Construction								Operation	
		Site Clearance	Excavation for tanks	Solid Waste Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Increased workforce	Landscaping	Effluent discharge	Effluent Treatment
AQUATIC ECOSYSTEMS														
VEGETATION														
FAUNA														
SENSITIVE HABITATS														
Socio -Economic Parameters:-														
AESTHETICS														
LAND USE COMPATIBILITY														
EMPLOYMENT														
FOREIGN EXCHANGE EARNINGS														
STRUCTURES/ROADS														
WASTE MANAGEMENT														
TRAFFIC ON THE ACCESS ROAD														
INCREASED CRIME														
HAZARD VULNERABILITY														
SOLID WASTE DISPOSAL														
SEWAGE DISPOSAL														
Occupational Health & Safety														

KEY

	Major Negative
	Minor Negative
	No Impact
	Major Positive
	Minor Positive

6.1 Impacts to the Physical Environment

6.1.1 Erosion/Sedimentation Impacts

The topography renders the erosion potential for the site very low. There will be no major vegetation clearance because the area is open grassland and no access roads are needed to get to the site. Excavation works will expose soils in the affected area, however, all exposed areas will either be included in the facility or landscaped at the end of construction to minimise erosion potential.

The potential for sedimentation in the nearby drainage ditch is not considered significant since the site will be landscaped, etc. and the vegetation at the southern end of the property will be substantial to filter any sheet flow due to surface run-off from intense rainfall.

6.1.2 Water Quality Impacts

The impacts to water quality are anticipated to be positive and large. The treatment of wastewater from Red Stripe will effectively lower the stream and nutrient loading of Hunts Bay and Kingston Harbour.

Impacts to surface water may arise from increases sediment loading due to removal of vegetation during pre-construction activities. This is not envisaged to be a significant issue.

There are no anticipated impacts on groundwater quality because the potential to generate contaminated materials capable of adversely impacting on ground water is not anticipated.

6.1.3 Air Quality Impacts

6.1.3.1 Fugitive Emissions

The potential for dust emissions may occur during earth moving activities. These activities can generate particulates that when carried along by the prevailing wind may affect people within the surrounding areas, primarily workers at the southern end of the plant and people traversing Chesterfield Drive in the vicinity of the plant. However, this roadway has very little traffic and any dust generated from this small project would be short-term and thus classified as nuisance.

6.1.4 Odour

This treatment facility is not envisaged to cause any odour pollution because odour prevention mechanisms are built into the design of the WWTP. Also, the distance of the facility from residents and non-industrial activities makes it less likely that odour impacts will be transported at distance if they were to occur.

6.1.5 Noise Impacts

The potential exist for loud noise to be generated from heavy equipment and general construction activities. This could potentially become a nuisance to users of the area. This should not be a problem in the site area because personal protective equipments are supplied to staff, where necessary. Recommendations for any noise mitigations are outlined in next section. Not withstanding, it is not anticipated that noise levels will exceed the industrial level of 70db beyond the boundaries of the Red Stripe facility.

6.1.6 Solid Waste Impacts

Solid waste and top soil will be stockpiled to be used in the back filling and landscaping rehabilitation procedures. Other waste, such as construction waste, will be disposed of through the existing disposal service utilized by Red Stripe. Adequate provision of existing or chemical toilet facilities for workers on the site will be provided.

It is anticipated that any heavy equipment used on the site will be leased from contractors and it will be their responsibility to maintain the equipment at their offsite facilities.

6.1.7 Fire and Hurricane Risks

The building is designed to stand up to hurricane winds typical of those experienced by the island in the recent past. Fire precaution mechanisms are built into the design of the WWTP, and as such are a minimal anticipated impact. The overall fire protection scheme for the Red Stripe facility will be available for this facility.

6.2 Impacts to the Natural Environment

6.2.1 Terrestrial Ecosystem Impacts

There is the potential for impacts to flora and fauna from any construction activities. However, due to the nature of the site, these impacts are considered negligible because there are no species of interest at the site and the site is already a degraded, brown site that has seen various activities performed there along an industrial frame.

6.2.2 Marine and Aquatic Ecosystem Impacts

There is the potential for positive impacts to the marine life of Hunts Bay and Kingston Harbour. The construction of this WWTP will allow for the tertiary level treatment of the wastewater which currently enters these systems. It also will bring Red Stripe into full compliance with NEPA standards on trade effluent.

There is a projected significant positive impact on fisheries as a result of this project. This project will be a start to the clean up of the water quality of the surrounding nursery and fishing grounds, hence a significant positive and long-term impact.

MITIGATION MEASURES & ENVIRONMENTAL MANAGEMENT PLAN

7 Mitigation Measures & Environmental Management Plan

7.1 Mitigation Measures

7.1.1 Ecological

Mitigation: Clearing and construction activity will be constrained to the design footprint for the WWTP.

Any storage of excavated material will be carefully monitored and a regime of sprinkling (irrigation) or covering will be implemented to avoid impact to the surrounding areas (Red Stripe has a significant area on which this material can be laid out or stockpiled if needed).

7.1.2 Soil Erosion

Mitigation: During heavy rainfall measures will be put in place to avoid excavated and disturbed soil getting into the drainage ditch. Bunding will be in place, where necessary, to avoid this sedimentation potential. It is not expected that any undisturbed areas will experience erosion during project activities.

7.1.3 Fugitive Emissions

Mitigation: Exposed soil and other fine particulate building material will be regularly wetted to reduce the potential for wind blown dust particles from the site. In all cases, every effort will be made to remove exposed soils from the site in a timely manner.

Personal protective equipment, such as dust masks, will be issued to workers on the site. Contractors will be required to ensure their workers are properly outfitted as well.

7.1.4 Noise

Mitigation: Workers operating any equipment that generates noises will be equipped with noise protection gear, earplugs, similar to what is currently worn by Red Stripe staff.

It is not anticipated that industrial noise level standards will be exceeded at the site for any appreciable amount of time, and therefore the levels recorded at the property boundaries and beyond should be less.

7.1.5 Safety & Storage

Mitigation: Bunding or berms will be placed around construction material such as marl and sand. Tarpaulin will be used to cover materials, where necessary, to minimise the risk of being washed away during heavy rainfall as well as for general protection of material.

Adequate storage areas will be identified for the placement of all material.

Hazardous chemicals, such as fuel, will be adequately stored in appropriate containers with spill containment devices where required.

Warning signs will be posted throughout the area to highlight any potential hazard, along with an update of the existing health and safety policy to reflect the new facility.

7.1.6 Solid Waste Management

A waste management plan will be prepared and agreed upon by all parties (Red Stripe and construction contractors and others) prior to commencement of any works, with final disposal of any generated wastes at the Riverton landfill or any other approved landfill. This plan will include at a minimum:

- Solid waste storage areas (number and location of skips etc.),
- Collection schedule,
- Responsible party

All discarded construction waste, such as cement bags, PVC piping etc, will be disposed of at the approved dumpsite. All food waste will similarly be discarded following the waste management plan.

There will be adequate provision of chemical toilets for use by workers on site.

7.2 Monitoring Plans

To be in compliance with all statutory regulations, be it NEPA, Ministry of Health or otherwise, an environmental monitoring plan will be implemented if requested to cover pre-construction, construction and operating procedures for this project. This will be done to minimize the extent of impacts to the environment aside from already specified mitigations. Should a permit be granted, the monitoring plan will fully address, at a minimum, the following:

- A description of activities (job description, site supervision, management protocols etc.),

- Schedule for pre-construction, construction and operational activities (such as daily site inspections to minimize fugitive dust emissions, final site clean-up, and water quality testing once operational on new effluent standard etc.) , and

- Measures to be implemented to mitigate negative environmental impacts.

The monitoring report log will be submitted to NEPA on a mutually agreed timetable.

The following is an outline of a typical construction monitoring program that can be modified as necessary to meet the needs of NEPA. A detailed version will be submitted to NEPA after the granting of the permit and prior to the commencement of the proposed development. The monitoring program will include the following at a minimum:

- Introduction – explaining the nature of the project and outlining the need for monitoring program and the relevant specific provisions of the permit license granted.

- The various activities and parameters being monitored

- The methodology to be employed and the frequency of monitoring

- The sites being monitored, stating any outer boundary where no impact from development is expected by NEPA or other local agencies.

- A summary of data collected. Tables and graphs will be used where appropriate.

- Discussion of results with respect to the project in progress, highlighting any parameters, which exceed the standards and mitigation implemented.

- Frequency of reporting to NEPA.

- Recommendations

- Appendices of data and photographs.

At a minimum the following activities will be monitored in the various phases:

Pre-Construction Phase Monitoring

- During site clearing activities, stockpiles of soil and vegetative debris generated should be monitored and maintained to eliminate generation of fugitive dust. (Daily Monitoring)
- Noise levels along the perimeters of the project area should be monitored and recorded to insure that activities at the site are not exceeding standards. (Weekly Monitoring)

Construction phase Monitoring

- Sewage – ensure that workers have access to acceptable toilet facilities at the site including the use of temporary portable chemical toilets (if necessary), if utilised, the contents of temporary portable chemical toilets will be disposed by an approved waste hauler in an appropriate waste disposal facility. (Weekly Monitoring)
- Sand/Marl/Aggregate Supply – Routinely monitor sourcing of quarry materials to ensure supplier is obtaining supplies from licensed operators. (Monthly Monitoring)
- Solid Waste Management – Ensure that solid waste management plan is prepared, and that workers are aware that no solid waste material should be scattered around the site. Monitor availability and location of skips/dumpsters. (Weekly Monitoring)
- Monitor the disposal of refuse to insure that skips/dumpsters are not overfilled. (Weekly Monitoring)
- Routine collection of solid waste for disposal must be implemented, and disposal monitored to ensure use of approved facilities. (Weekly Monitoring)
- Exposed soil areas must be monitored to determine potential for erosion, silting and sedimentation, particularly during storm events. (Weekly Monitoring)
- If erosion, silting or sedimentation is a potential or occurs, immediate steps must be taken to negate the impact on the surrounding environment and other receptors where applicable. (As Needed)

- Equipment staging area and parking areas must be monitored for releases and potential impacts. (Weekly Monitoring)

- Noise levels along the perimeters of the project area should be monitored and recorded to insure that activities at the site are not exceeding standards. (Weekly Monitoring)

Operation Phase Monitoring

- Solid Waste – Monitor solid waste skips/dumpsters and removal contractor to ensure proper waste handling and disposal. (Weekly Monitoring)

- Effluent Drains – Regular inspections of drainage systems should be performed to ensure that the drains remain clear of blockages to safeguard against flooding or erosion and also regular inspections of trade effluent to ensure it meets or exceeds NEPA standards. (Monthly Monitoring)

- Water Quality monitoring – trade effluent discharged will be monitored in keeping with the requirements of the permit. (Monthly Monitoring).

APPENDICES

APPENDIX I

APPENDIX I: TERMS OF REFERENCE

nepa
National Environment & Planning Agency

10 & 11 Caledonia Avenue, Kingston 5, Jamaica W.I.
Tel: (876) 754-7540 Fax: (876) 754-7595-6 toll free help-line: 1-888-991-5005
E-mail: ceo@nepa.gov.jm, Web Site: http://www.nepa.gov.jm

Ref. 2005-02017-EP00096
2005-02017-EL00014

RECEIVED JUN 0 7 2005

June 6, 2005

Mr. Mark McKenzie
Chief Executive Officer
Red Stripe
214 Spanish Town Road
Kingston 11

Dear Sir:

Re: Terms of Reference (TOR) - Environmental Permit & Licence Application for Proposed Waste Water Treatment Facility and Discharge of Trade Effluent at 214 Spanish Town Road, St. Andrew.

Please be advised that the TOR for the abovementioned applications has been accepted. We are also requesting that two additional hardcopies of the TOR be sent to the Agency for filing purposes.

If you have any question or require further clarification please do not hesitate to contact the undersigned or Mr. Jerome Smith at 754-7540 ext. 2246 or email jsmith@nepa.gov.jm. Please be reminded that all communications with regard to this application must quote the reference numbers stated above.

Yours sincerely

for Leonard Francis
for Chief Executive Officer.

cc Mr. Paul Thompson – CEO, Conrad Douglas and Associates

Managing and protecting Jamaica's land, wood and water
A Government of Jamaica Agency

The Environmental Impact Assessment will:

1) Provide a complete description of the existing site proposed for development. Detail the elements of the development, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state.

2) Identify the major environmental issues of concern through the presentation of baseline data which will include social and cultural considerations. Assess public perception of the proposed development.

3) Outline the Legislations and Regulations relevant to the project.

4) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.

5) Identify mitigation actions to be taken to minimise adverse impacts and quantify associated costs.

6) Design a Monitoring Plan which will ensure that the mitigation plan is adhered to.

7) Describe the alternatives to the project that could be considered at that site

To ensure that a thorough Environmental Impact Assessment is carried out, the following tasks will be undertaken:

Task 1: Description of the Project

CD&A will provide a comprehensive description of the project, noting areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative or positive) on the environment. This will involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post construction plans.

Task 2: Description of the Environment

For this EIA Report, CD&A will generate baseline data which will be used to describe the study area in terms of:

i) physical environment

ii) biological environment

iii) socio-economic and cultural constraints.

Methodologies employed to obtain baseline and other data will be clearly detailed.

Baseline data will include:

(A) Physical

i) A detailed description of the existing **geology** and **hydrology.** Special emphasis will be placed on storm water run-off, drainage patterns, effect on groundwater and availability of potable water. Any slope stability issues that could arise will be thoroughly explored.

ii) **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of the development. Quality Indicators will include but not necessarily be limited to nitrates, phosphates, faecal coliform, and suspended solids.

iii) Climatic conditions and air quality in the area of influence including wind speed and direction, precipitation, relative humidity and ambient temperatures,

iv) Noise levels of the undeveloped site and the ambient noise in the area of influence.

v) Obvious sources of pollution existing and extent of contamination.

vi) Availability of solid waste management facilities.

(B) Biological

CD&A will present a detailed description of the flora and fauna of the area, with special emphasis on rare, endemic, protected or endangered species. Migratory species will also be considered. Generally, species dependence, niche specificity, community structure and diversity will be considered.

(C) Socio-economic & cultural

Population demographics, land use, planned developments and issues related to community structure, Public Health and Safety, and the projected impact of the project from a socio-cultural perspective will be detailed.

Task 3: Legislative and Regulatory Considerations

Outline the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include at a minimum, legislation such as the NRCA Act, policies and regulations from the Water Resources Authority, the Watershed Protection Act, Building Codes and Standards, Development Orders and Plans and any appropriate international convention/protocol/treaty where applicable.

Task 4: Identification of Potential Impacts

CD&A will identify the major environmental and public health issues of concern and indicate their relative importance to the design of the treatment facility. Identify potential impacts as they relate to (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- excavation and construction
- loss of natural features, habitats and species by construction and operation
- pollution of surface and ground water
- Air pollution
- capacity and design parameters of proposed sewage treatment facility.
- socio-economic and cultural impacts.

- risk assessment
- noise
- leaching of substances or chemicals into ground water supply

The EIA Report will distinguish between significant positive and negative impacts, direct and indirect, long term and immediate impacts and will identify avoidable as well as irreversible impacts. We will characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental impact will be determined only after examining the impact (positive and negative) on the environment and by the number and magnitude of mitigation strategies which will be required to reduce the risk(s) introduced to the environment. Project activities and impacts will be presented in matrix form with separate matrices for pre and post mitigation scenarios.

Task 5: Mitigation

We will prepare guidelines for avoiding, as far as possible, any adverse impacts due to the proposed project and utilising of existing environmental attributes for optimum development. In the report, we will quantify and assign financial and economic values to mitigating methods.

Task 6: Monitoring

CD&A will design a plan to monitor implementation of mitigatory or compensatory measures and project impacts pre, during and post construction. An Environmental Management Plan for the long term operations of the site will also be prepared.

An outline of the monitoring programme will be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report will include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.

- The methodology to be employed and the frequency of monitoring.
- The sites being monitored. These may in instances, be pre-determined by the local authority and will incorporate a control site where no impact from the development is expected.
- Frequency of reporting to NEPA

The Monitoring report will also include, at a minimum:

- Raw data collected. Tables and graphs, where appropriate
- Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceed the expected standard(s).
- Recommendations
- Appendices of data and photographs.

Task 7: Project Alternatives

The EIA process will include the examination of alternatives to the project including the no-action alternative. This examination of project alternatives will incorporate the history of the overall area in which the site is located and previous uses of the site itself.

All Findings will be presented in the **EIA report** and will reflect the headings in the body of the TOR, as well as references. Eight hard copies and an electronic copy of the report will be submitted to NEPA for distribution to stakeholders and review. The report will include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

APPENDIX II

APPENDIX II: REFERENCES

Adams, C.D. 1972. *Flowering Plants of Jamaica*. University of the West Indies, Mona. 848p.

Natural Resources Conservation Authority, Trade Effluent Standards, September 1995.

Wade, B.A., Antonio, L., Mahon, R., 1972. *Increasing organic pollution in Kingston Harbour*. Marine Pollution Bulletin 3, 106–110.

Webber, D.F., 1997. *The Water Quality of Kingston Harbour, Some Sources and Solutions.* In: Bardwell, M., Vassel, A.R. _Eds.., Proc. Scientific Research Council, 7th Annual National Conference on Science and Technology, Kingston, Jamaica, pp. 45–63.

APPENDIX III

APPENDIX III: TEAM MEMBERS

Information and data for this EIA was compiled from work done by the following people:

- Dr. Conrad Douglas
- Mr. Paul Thompson
- Mr. Orville Grey
- Mr. Vance Johnson
- Ms. Deonne Caines

APPENDIX IV

APPENDIX IV: REPORT ON SOIL INVESTIGATION

REPORT ON

SOILS INVESTIGATION

FOR

PROPOSED EFFLUENT TREATMENT PLANT

AT

SPANISH TOWN ROAD, KINGSTON 11

BY

HILL-BETTY (ENGINEERS) LIMITED

JUNE 2003

HB HILL-BETTY (ENGINEERS) LTD.

CIVIL ENGINEERS AND CONTRACTORS

DIRECTORS:
K. R. HILL
N. O'CONNOR BETTY, B.Sc. (ENG.)

29 BURLINGTON AVENUE
KINGSTON 10
PHONE: 926-8364/906-2961-2
FAX: 960-5648

June 2, 2003

REPORT ON

SOILS INVESTIGATION

FOR

PROPOSED EFFLUENT TREATMENT PLANT

AT

SPANISH TOWN ROAD, KINGSTON 11

INTRODUCTION

This report presents the results of a soils investigation carried out on a site at Spanish Town Road, Kingston 11. An effluent treatment plant is proposed to be constructed at this location.

Authority to proceed with the soils investigation was received from Mr. Monty McDonald of Red Stripe and was based on the acceptance of our financial quotation.

The objective of the investigation was to evaluate the subsurface conditions on the site, so as to provide data for selecting suitable foundations and for use in foundation designs.

FIELD WORK

The subsurface conditions on the site were investigated in May 2003 by the drilling of five (5) boreholes. The boreholes were taken to depth of 15.2m (50-feet) below existing ground elevations.

The boreholes were advanced by using a truck-mounted rotary drill rig with auger attachments. Representative samples of the soils penetrated were recovered by using a split spoon sampler and standard penetration test procedures.

Borehole logs showing the types of soils encountered on the site are appended to the report.

FIELD TESTS

Standard penetration tests were carried out in the boreholes at the depths as shown on the borehole logs. The results of these tests are called N-values, and where soils are encountered, they are indices of the relative densities, (and hence their bearing capacities) when the overburden, groundwater conditions and grain size distribution of the soils are taken into account.

The N-values are the number of blows required to drive a standard penetration tool a specific distance into the soil, using a standard application. N-values as obtained are recorded, as well as plotted with depth on the borehole logs.

SOIL STRATIGRAPHY

The types of soils encountered on the site are shown on the office borehole logs appended to this report. The soil profile shows granular soils (sand with gravel) sandwiched by non-granular soils (silt and/or clay) to the depth explored.

The densities of the granular soils range from 'compact' (borehole Nos. 3, 4 and 5), to 'dense' (borehole Nos. 1, 2, 4 and 5), to 'very dense' (borehole Nos. 1 and 2).

The consistencies of the non-granular soils range from 'stiff' (borehole Nos. 3 and 4), to 'very stiff' (all boreholes), to 'hard' (all boreholes).

GROUNDWATER

Groundwater was encountered in all boreholes at depth of 2.3m (7.5-feet) below existing ground level. There was no noticeable change in the water levels at the end of the drilling operation.

LABORATORY TESTS

All samples recovered from the field exploration were returned to our laboratory where they were carefully laid out and visually examined. Based on this examination, together with that of the field logs, samples were selected and tested for index and classification parameters.

Laboratory test results are contained in an appendix to this report.

DISCUSSION AND RECOMMENDATIONS

GENERAL: The borehole logs and laboratory test data provide the basis of our engineering analysis and recommendations.

The construction of an effluent treatment plant is proposed for the location investigated. The subsurface conditions show granular soils sandwiched by non-granular soils.

BEARING CAPACITY CONSIDERATIONS: For the area represented by borehole No. 1, the average allowable bearing pressure to a depth of 2.0m (6.5-feet) is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 2.7m (9-feet), the average allowable bearing pressure is 1.95 kg/cm^2 (4000 p.s.f.). Below this depth and to a depth of 3.5m (11.5-feet), the average allowable bearing pressure is 2.07 kg/cm^2 (4250 p.s.f.). Below this depth and to a depth of 5.0m (16.5-feet), the average allowable bearing pressure is 2.32 kg/cm^2 (4750 p.s.f.). Below this depth and to a depth of 9.6m (31.5-feet), the average allowable bearing pressure is 2.44 kg/cm^2 (5000 p.s.f.). Below this depth and to a depth of 11.1m (36.5-feet), the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.). Below this depth and to a depth of 12.7m (41.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to a depth of 14.2m (41.5-feet), the average allowable bearing pressure is 2.93 kg/cm^2 (6000 p.s.f.). Below this depth and to the end of the borehole, the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.).

For the area represented by borehole No. 2, the average allowable bearing pressure to a depth of 1.2m (4-feet) is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 2.0m (6.5-feet), the average allowable bearing pressure is 1.95 kg/cm^2 (4000 p.s.f.). Below this depth and to a depth of 6.6m (21.5-feet), the average allowable bearing pressure is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 8.1m (26.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to a depth of 11.1m (36.5-feet), the average allowable bearing pressure is 2.68 kg/cm^2 (5500 p.s.f.). Below this depth and to a depth of 12.7m (41.5-feet), the average allowable bearing pressure is 2.93 kg/cm^2 (6000 p.s.f.). Below this depth and to the end of the borehole, the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.).

For the area represented by borehole No. 3, the average allowable bearing pressure to a depth of 1.2m (4-feet) is 2.20 kg/cm^2 (4500 p.s.f.). Below this depth and to a depth of 2.0m (6.5-feet), the average allowable bearing pressure is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 2.7m (9-feet), the average allowable bearing pressure is 0.73 kg/cm^2 (1500 p.s.f.). Below this depth and to a depth of 5.0m (16.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 6.6m (21.5-feet), the average allowable bearing pressure is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 8.1m (26.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 9.6m (31.5-feet), the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.). Below this depth and to a depth of 11.1m (36.5-feet), the average allowable bearing pressure is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 12.7m (41.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to the end of the borehole, the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.).

For the area represented by borehole No. 4, the average allowable bearing pressure to a depth of 1.2m (4-feet) is 0.98 kg/cm^2 (2000 p.s.f.). Below this depth and to a depth of 2.0m (6.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to a depth of 2.7m (9-feet), the average allowable bearing pressure is 0.98 kg/cm^2 (2000 p.s.f.). Below this depth and to a depth of 3.5m (11.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 5.0m (16.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to a depth of 6.6m (21.5-feet), the average allowable bearing pressure is 0.73 kg/cm^2 (1500 p.s.f.). Below this depth and to a depth of 8.1m (26.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 12.7m (41.5-feet), the average allowable bearing pressure is 1.46 kg/cm^2 (3000 p.s.f.). Below this depth and to a depth of 14.2m (46.5-feet), the average allowable bearing pressure is 2.93 kg/cm^2 (6000 p.s.f.). Below this depth and to the end of the borehole, the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.).

For the area represented by borehole No. 5, the average allowable bearing pressure to a depth of 2.0m (6.5-feet) is 1.95 kg/cm^2 (4000 p.s.f.). Below this depth and to a depth of 3.5m (11.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to a depth of 6.6m (21.5-feet), the average allowable bearing pressure is 1.71 kg/cm^2 (3500 p.s.f.). Below this depth and to a depth of 8.1m (26.5-feet), the average allowable bearing pressure is 0.98 kg/cm^2 (2000 p.s.f.). Below this depth and to a depth of 11.1m (36.5-feet), the average allowable bearing pressure is 1.22 kg/cm^2 (2500 p.s.f.). Below this depth and to the end of the borehole, the average allowable bearing pressure is 3.17 kg/cm^2 (6500 p.s.f.).

FOUNDING: Based on the types of soils encountered on the site and their allowable bearing pressures, it is our opinion that spread and/or strip footing foundations are suitable for founding structures and are, therefore recommended. We also recommend that the foundations be placed at depth not exceeding 0.8m (2.5-feet) below adjacent grade, referred from prepared ground surface.

In order not to overstress the underlying strata, and to allow for blanket allowable bearing pressure to be used across the site, we further recommend that bearing pressures not exceeding 0.98 kg/cm^2 (2000 p.s.f.) and 0.68 kg/cm^2 (1400 p.s.f.) be used in the design of spread and strip footing, respectively.

However, if higher bearing values are desired, we suggest that at least 1.2m (4-feet) of select granular material (e.g. marly limestone), compacted in layers not exceeding 0.5m to at least 90% of the modified AASHTO level of compaction, be placed on the existing soil. Then bearing pressures peculiar to the location on site, given elsewhere in this report, may be used with 70-percent of the values used be reserved for the design of strip footings. If the higher values are used, we recommend that the foundation be placed wholly within the compacted marly limestone.

For foundations designed as recommended, settlement will be of tolerable proportions in the long term. Differential settlement should be negligible.

SPECIAL CONSIDERATIONS

The types of soils encountered on the site require special care or precautions during the construction process.

(i) The silt soils may collapse upon saturation and caused settlements of structures

(ii) Upon changes in moisture content, clay-soils have the tendency to expand and contract causing differential settlement.

(iii) Saturated loose sand may liquefy as result of earthquakes.

Therefore, surface and storm water must be properly drained so as to prevent seepage into the underlying soils.

HILL-BETTY (ENGINEERS) LTD.

....

S. GRAHAM
Geologist

APPENDIX I

BOREHOLE LOGS

HB

PROJECT: Proposed Effluent Treatment Plant

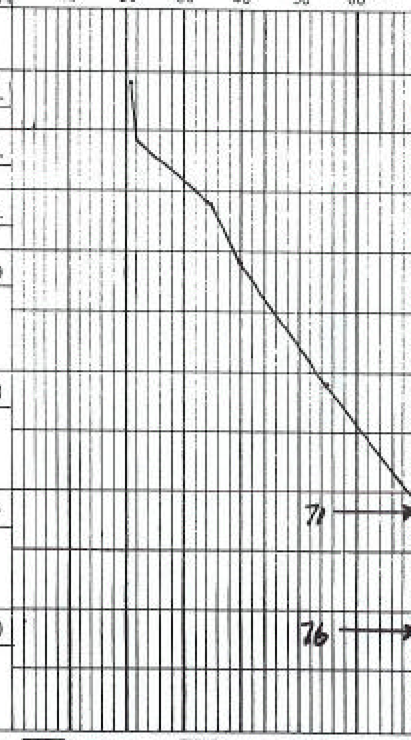
LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION:

TYPE OF BORING: HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐ CONE PENETRATION ☐ WASH BORING ☐ TEST PIT ☐

DIA. OF BORING:

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15M	2nd 0.15M	3rd 0.15M	SOIL LEGEND	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
	1	SS	D	100	9	10	11		Very stiff dark brown clayey silt (ML)	A
1.5	2	SS	D	100	11	11	11		Very stiff dark brown clayey silt and sand	
	3	SS	D	100	12	14	21		Dense dark brown coarse sand with some gravel	
3	4	SS	D	100	23	21	19			
4.5	5	SS	D	100	20	25	30		Very dense dark brown coarse sand with some gravel	
6	6	SS	D	100	27	32	39			
									Very dense dark brown gravelly sand	
7.5	7	SS	D	100	30	36	40			
									Very dense dark brown sand with some gravel	



SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE
RC – ROCK CORE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

PROJECT: Proposed Effluent Treatment Plant

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION:

TYPE OF BORING: HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐ CONE PENETRATION ☐ WASH BORING ☐ TEST PIT ☐

DIA. OF BORING:

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	SPT 1st 0.15M	SPT 2nd 0.15M	SPT 3rd 0.15M	N-VALUE	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
9	8	SS	D	100	39	46	48	94	Very dense dark brown sand with some gravel	
10.5	9	SS	D	100	47	48	33	81	Hard dark brown silty clay and sand (CL)	A
12	10	SS	D	100	30	32	40	72	Hard dark brown clayey silt and sand	
13.5	11	SS	D	100	26	29	34		Hard dark brown silty clay with some sand	
15	12	SS	D	100	36	42	41	93		
16.5									End of borehole - 15.2m	

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

PROJECT Proposed Effluent Treatment Plant

LOCATION Spanish Town Road, Kingston 11

DATE May 2003 **SURFACE ELEVATION** ____

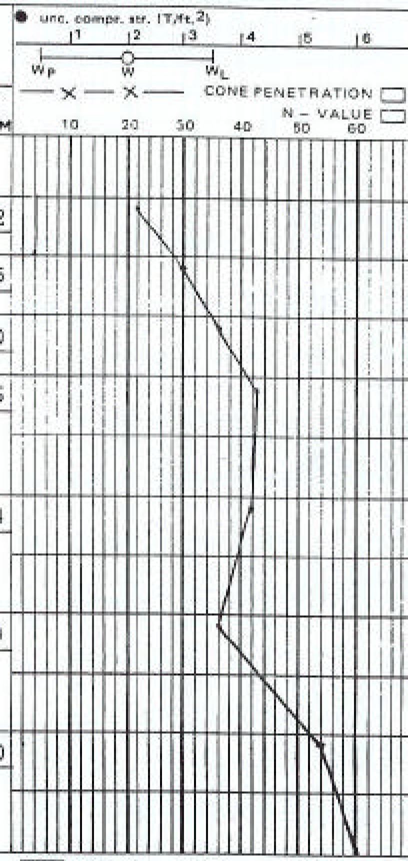
BORE HOLE ____ SHEET 1 OF 6

TYPE OF BORING

HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐
CONE PENETRATION ☐ WASH BORING ☐
TEST PIT ☐

DIA. OF BORING ____

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15M	2nd 0.15M	3rd 0.15M	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
	1	SS	D	100	9	10	12	Very stiff dark brown clayey silt	
1.5	2	SS	D	100	11	14	16		
	3	SS	D	100	12	16	20	Dense dark brown fine silty sand	
3	4	SS	D	100	12	17	26		
4.5	5	SS	D	100	11	18	24	Dense dark brown fine to medium sand	
6	6	SS	D	100	8	16	20		
7.5	7	SS	D	100	16	24	30	Very dense dark brown fine sand and silt	M
								Hard dark brown silty clay	



SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE
RC – ROCK CORE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

HB

PROJECT: Proposed Effluent Treatment Plant

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION: ______

BORE HOLE ______ SHEET ____ OF ____

TYPE OF BORING

HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐

CONE PENETRATION ☐ WASH BORING ☐

TEST PIT ☐ ☐

DIA. OF BORING ______

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	SPT 1st 0.15M	SPT 2nd 0.15M	SPT 3rd 0.15M	N – VALUE / CONE PENETRATION (10–60)	SOIL LEGEND	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
9	8	SS	D	100	19	26	34		Clay	Hard dark brown silty clay (CL)	A
10.5	9	SS	D	100	18	26	30		Clay		
12	10	SS	D	100	26	31	34		Clay		
13.5	11	SS	D	100	34	36	38	74 →	Clay	Hard dark brown silty clay (CL)	
15	12	SS	D	100	31	40	42	82 →	Clay		A
16.5										End of borehole - 15.2m	

unc. compr. str. (T/ft.^{2}) 1 2 3 4 5 6; W_P — W — W_L; — X — X — CONE PENETRATION ☐; N – VALUE ☐

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
- D – DISTURBED
- L – LOST
- F – FAIR
- G – GOOD (UNDISTURBED)

SAMPLE TYPE
- SS – SPLIT SPOON
- TW – THIN WALL SHELBY
- BS – BAG SAMPLE
- WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
- A – ATTERBERG LIMITS
- C – CONSOLIDATION
- D – DENSITY
- H – HYDROMETER
- M – MECH. ANALYSIS
- S – SHEAR
- T – TRIAXIAL

OTHER SYMBOLS
- WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

OFFICE BOREHOLE LOG

HB

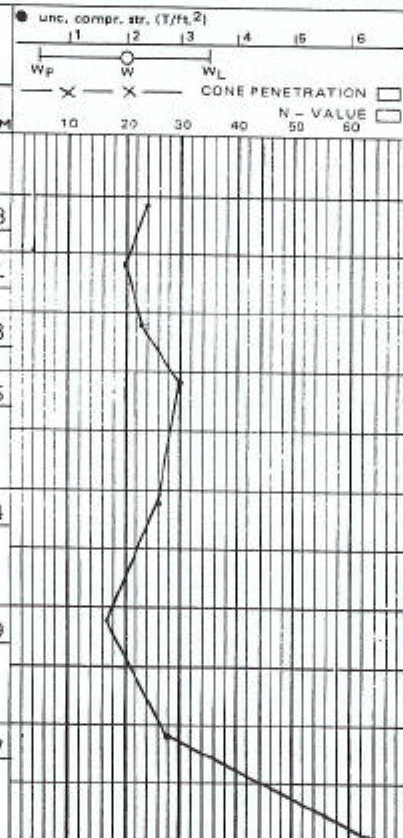
PROJECT: Proposed Effluent Treatment Plant
LOCATION: Spanish Town Road, Kingston 11
DATE: May 2003 SURFACE ELEVATION: ____

BORE HOLE: 3 SHEET: 1 OF: 2

TYPE OF BORING: HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐ CONE PENETRATION ☐ WASH BORING ☐ TEST PIT ☐

DIA. OF BORING: ____

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	SPT 1st 0-15M	SPT 2nd 0-15M	SPT 3rd 0-15M	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
	1	SS	D	100	10	11	13	Compact dark brown silty sand	
1.5	2	SS	D	100	7	9	11	Very stiff dark brown clayey silt	
	3	SS	D	100	9	10	13	Very stiff dark brown silt with some sand	
3	4	SS	D	100	12	14	16	Compact dark brown fine silty sand with some gravel	M
4.5	5	SS	D	100	10	12	14	Compact dark brown fine to medium sand	
6	6	SS	D	100	6	8	9	Very stiff dark brown silty clay	
7.5	7	SS	D	100	10	11	17	Very stiff dark brown clayey silt	
								Hard dark brown silty clay	



3

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

HB

PROJECT: Proposed Effluent Treatment Plant

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003

SURFACE ELEVATION:

SHEET ___ OF ___

TYPE OF BORING

HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐

CONE PENETRATION ☐ WASH BORING ☐

TEST PIT ☐

DIA. OF BORING:

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15m	2nd 0.15m	3rd 0.15m	N – VALUE	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
9	8	SS	D	100	29	36	37	73	Hard dark brown silty clay	
10.5	9	SS	D	100	31	36	38	74	Hard dark brown clayey silt	
12	10	SS	D	100	39	46	47	93	Hard dark brown clayey silt	
13.5	11	SS	D	100	40	46	48	94	Hard dark brown silty clay	
15	12	SS	D	100	39	46	49	95	Hard dark brown silty clay	
16.5									End of borehole - 15.2m	

unc. compr. str. (T/ft.^{2}) 1 2 3 4 5 6; W_P — W — W_L; —X—X— CONE PENETRATION ☐; N – VALUE ☐; 10 20 30 40 50 60

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
- D – DISTURBED
- L – LOST
- F – FAIR
- G – GOOD (UNDISTURBED)

SAMPLE TYPE
- SS – SPLIT SPOON
- TW – THIN WALL SHELBY
- BS – BAG SAMPLE
- WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
- A – ATTERBERG LIMITS
- C – CONSOLIDATION
- D – DENSITY
- H – HYDROMETER
- M – MECH. ANALYSIS
- S – SHEAR
- T – TRIAXIAL

OTHER SYMBOLS
- WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

HB

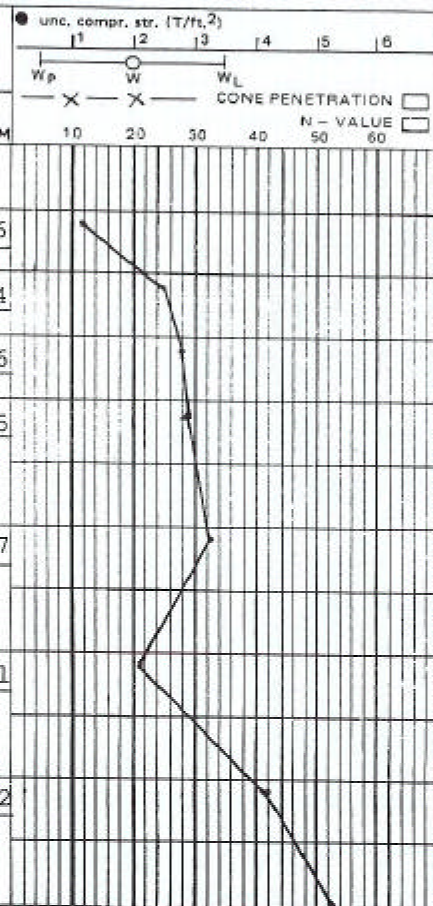
LOCATION Spanish Town Road, Kingston 11

DATE May 2003 SURFACE ELEVATION

HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐
CONE PENETRATION ☐ WASH BORING ☐
TEST PIT ☐

DIA. OF BORING

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15M	2nd 0.15M	3rd 0.15M	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
	1	SS	D	78	5	6	6	Stiff dark brown silt	
1.5	2	SS	D	100	10	11	14	Very stiff dark brown clayey silt	
	3	SS	D	100	11	12	16		
3	4	SS	D	100	12	14	15	Compact dark brown fine to medium sand	
4.5	5	SS	D	100	12	16	17	Dense dark brown medium to coarse sand	
6	6	SS	D	100	6	10	11	Very stiff dark brown silt and sand	
7.5	7	SS	D	100	14	20	22	Hard dark brown clayey silt (ML)	A



SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

HB

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION: ___

HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐
CONE PENETRATION ☐ WASH BORING ☐
TEST PIT ☐

DIA. OF BORING ___

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15m	2nd 0.15m	3rd 0.15m	N-VALUE	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
9	8	SS	D	100	25	27	27		Hard dark brown clayey silt	
10.5	9	SS	D	100	26	28	30			
12	10	SS	D	100	22	28	34			
13.5	11	SS	D	100	24	29	36		Hard dark brown silty clay (CL)	A
15	12	SS	D	100	30	36	40	76 →		
16.5									End of borehole - 15.2m	

unc. compr. str. (T/ft.²) 1 2 3 4 5 6
Wp — W — WL
— X — X — CONE PENETRATION ☐
N - VALUE ☐ 10 20 30 40 50 60

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

BORE HOLE 3 SHEET 1 OF 2

PROJECT: Proposed Effluent Treatment Plant

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION:

TYPE OF BORING: HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐ CONE PENETRATION ☐ WASH BORING ☐ TEST PIT ☐

DIA. OF BORING:

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	STANDARD PENETRATION TEST 1st 0.15M	2nd 0.15M	3rd 0.15M	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
	1	SS	D	100	10	12	15	Very stiff dark brown silt	
1.5	2	SS	D	100	11	14	16	Very stiff dark brown clayey silt	
	3	SS	D	100	20	20	19	Hard dark brown clayey silt	
3	4	SS	D	100	21	22	24	Hard dark brown silt and fine sand	
4.5	5	SS	D	100	20	23	26	Dense dark brown fine sand with some silt and gravel	
6	6	SS	D	100	22	19	10	Compact dark brown coarse sand with occasional gravel sizes	
7.5	7	SS	D	100	10	12	14	Very stiff dark brown silt with some fine sand	
								Hard dark brown clayey silt	

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE
RC – ROCK CORE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
H – HYDROMETER
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

BORE HOLE ______ SHEET ______ OF ______

PROJECT: Proposed Effluent Treatment Plant

LOCATION: Spanish Town Road, Kingston 11

DATE: May 2003 SURFACE ELEVATION ______

TYPE OF BORING: HOLLOW STEM AUGER ☐ ROTARY DRILLING ☐ CONE PENETRATION ☐ WASH. BORING ☐ TEST PIT ☐

DIA. OF BORING ______

DEPTH (METERS)	SAMPLE NO.	SAMPLE TYPE	SAMPLE CONDITION	% RECOVERY	SPT 1st 0.15M	SPT 2nd 0.15M	SPT 3rd 0.15M	DESCRIPTION OF STRATA	LABORATORY TESTS PERFORMED
9	8	SS	D	100	14	19	24	Hard dark brown clayey silt	
10.5	9	SS	D	100	16	20	30		
12	10	SS	D	100	19	30	36	Hard dark brown silty clay	
13.5	11	SS	D	100	24	31	37		
15	12	SS	D	100	31	36	42		
16.5								End of borehole - 15.2m	

SOIL SYMBOLS: SHATTERED BEDROCK, FILL, PEAT OR ORGANICS, CLAY, SILT, SAND, GRAVEL, BOULDER, SEA SHELLS, SOUND BEDROCK

SAMPLE CONDITION
D – DISTURBED
L – LOST
F – FAIR
G – GOOD (UNDISTURBED)

SAMPLE TYPE
SS – SPLIT SPOON
TW – THIN WALL SHELBY
BS – BAG SAMPLE
WS – WASH SAMPLE

LABORATORY TEST SYMBOLS
A – ATTERBERG LIMITS
C – CONSOLIDATION
D – DENSITY
M – MECH. ANALYSIS
S – SHEAR
T – TRIAXIAL

OTHER SYMBOLS
WATER LEVEL

HILL-BETTY (ENGINEERS) LTD.,
37 BURLINGTON AVENUE
KINGSTON, JAMAICA.

HILL BETTY (ENGINEERS) LTD

TERMS USED ON BOREHOLE LOGS

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): includes boulders, gravels and sands either separately or in combination or with some silt.

DESCRIPTIVE TERM	VERY LOOSE	LOOSE	COMPACT ~~MEDIUM~~	DENSE	VERY DENSE	
Relative Density	0	15%	35%	65%	85%	100%
N – Value (blows/ft.)	0	4	10	30	50	
ϕ (degrees)*	25-30	27-32	30-35	35-40	38-43	
Density (pcf) moist	<100	95-125	110-130	110-140	130+	
Submerged	<60	55-65	60-70	65-85	75+	

* Increase 5 degrees for soils containing less than 5% fine sand or silt

FINE GRAINED SOILS (major portion passing No. 200 sieve): includes inorganic and organic silts and clays, gravelly sandy silty clays and clayey silts.

DESCRIPTIVE TERM	VERY SOFT	SOFT	FIRM ~~MEDIUM~~	STIFF	VERY STIFF	HARD
Undrained shear strength (ksf)	0	0.5	1.0	2.0	4.0	8.0
N – value (blows/ft)	0	2	4	8	16	32
Density (pcf) (saturated)	100-120		110-130	120-140		130+

TERMINOLOGY

Terminology used for describing various soil strata encountered in a borehole is based upon the proportion of individual particle sizes in the deposit as follows:

DESCRIPTIVE TERM	PROPORTION (%)
Trace	<10
Some	10 - 20
Adjective (eg silty)	20 - 35
And (eg silt and sand)	35 - 50

P Penetration tool penetrates soil under weight of hammer (N-value = 0)

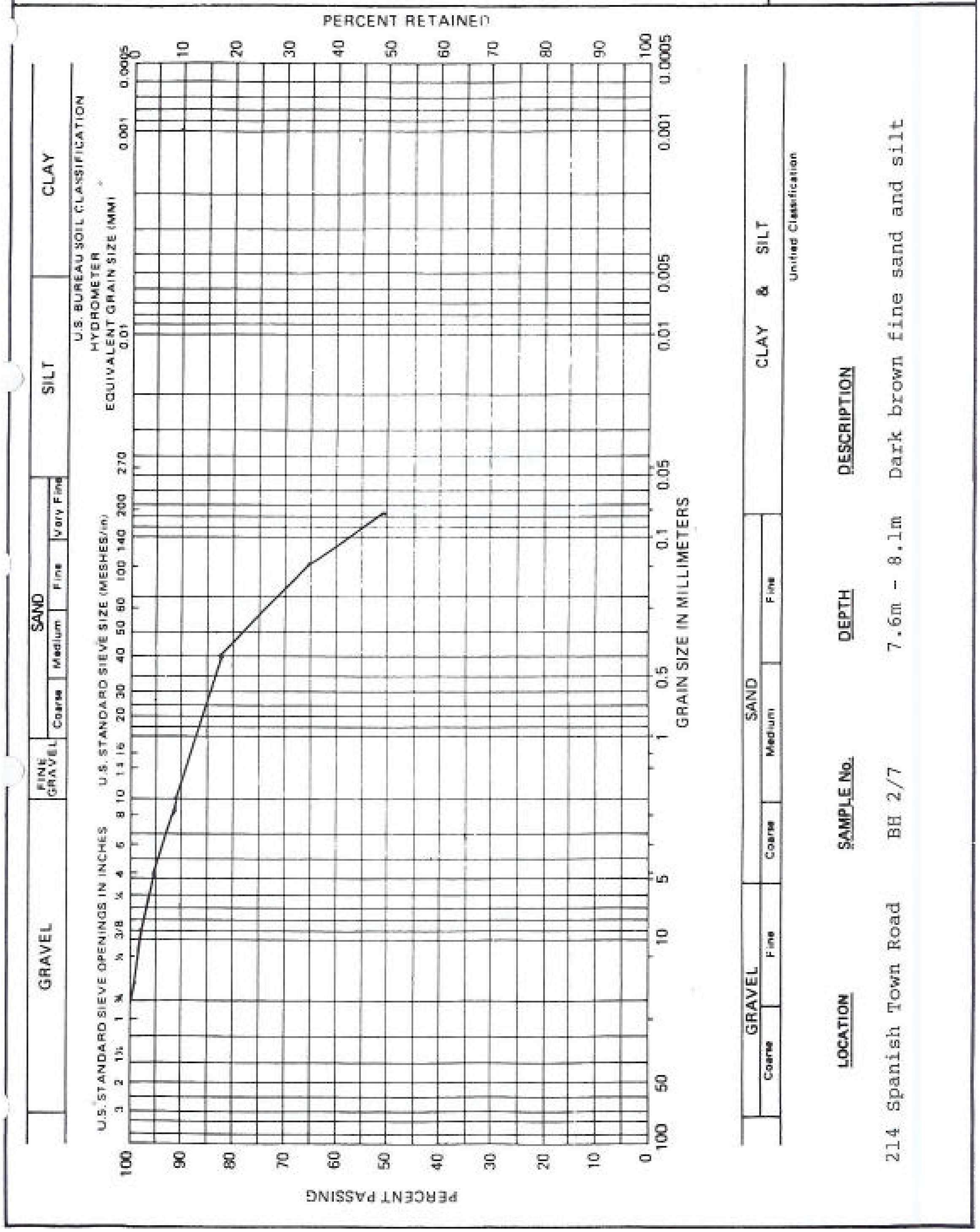
R Penetration tool driven but does not penetrate soil

APPENDIX II

LABORATORY TESTS

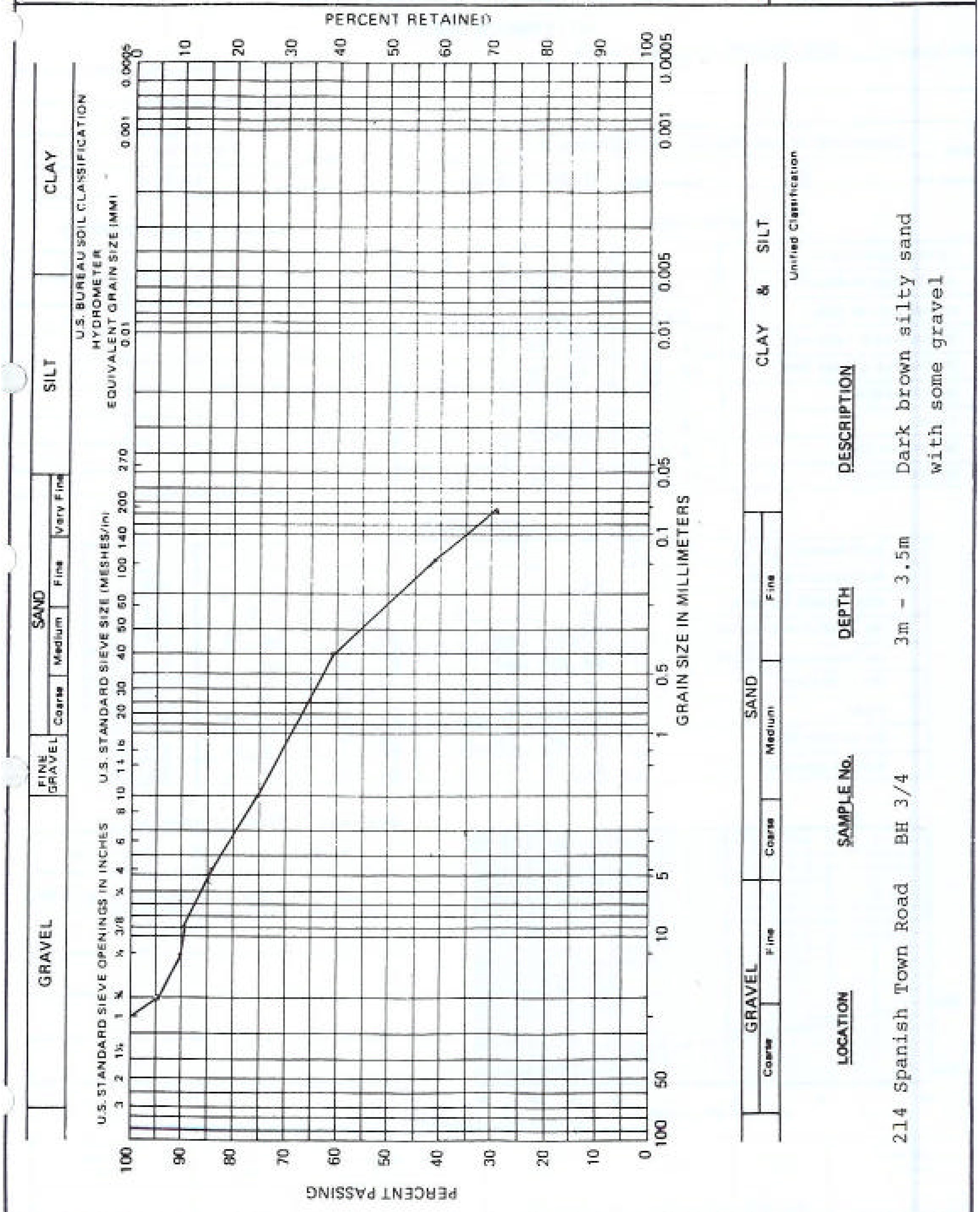
HB GRAIN SIZE DISTRIBUTION

APPENDIX
FIGURE
PROJECT



GRAIN SIZE DISTRIBUTION

APPENDIX
FIGURE
PROJECT



Spanish Town Road, Kingston 11

No 1 Sample depth 0.8m - 1.2m

Test No

Sample No 1

Date 29/5/03

Tested by D. Myrie

PLASTIC LIMIT

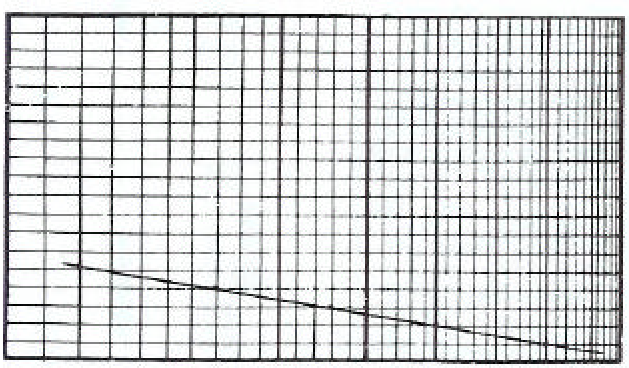
ERMINATION NO.	1	2	3
ITAINER NUMBER	40	5	
IBER OF BLOWS	xxx	xxx	
SAMPLE & TARE WET	51.91	51.88	
SAMPLE & TARE DRY	48.38	48.35	
OF WATER	3.53	3.53	
IE	34.29	34.48	
OF DRY SOIL	14.09	13.87	
ER CONTENT	25.05	25.46	25.25

NATURAL WATER CONTE

1	2	

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	12	10	42	5	73
Wt. SAMPLE & TARE WET	55.21	56.72	57.86	58.74	59.78
Wt. SAMPLE & TARE DRY	48.00	49.27	50.25	50.81	51.74
Wt. OF WATER	7.21	7.45	7.61	7.93	7.98
TARE	31.65	32.00	32.18	31.54	31.87
Wt. OF DRY SOIL	16.35	17.27	18.07	19.27	19.87
WATER CONTENT	44.10	43.14	42.11	41.15	40.16



REMARKS The clayey silt fraction of the soil i of low compressibility

RESULTS SUMMARY

ural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio, B	flow index	toughness index
77	41.50	25.25	16.25			

JOB No

Test No

Sample No 9

. 214 Spanish Town Road, Kingston 11

Date 28/5/03

| No 1 Sample depth 10.6m - 11.1m

Tested by D. Myrie

PLASTIC LIMIT

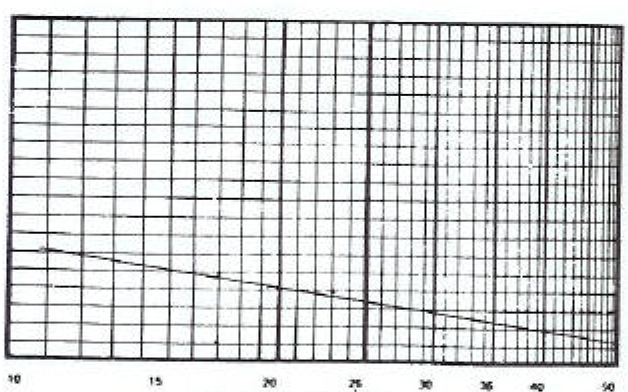
:TERMINATION NO.	1	2	3
)NTAINER NUMBER	99	38	
JMBER OF BLOWS	xxx	xxx	
. SAMPLE & TARE WET	51.53	52.82	
. SAMPLE & TARE DRY	48.76	49.83	
. OF WATER	2.77	2.99	
,RE	34.48	33.79	
. OF DRY SOIL	14.28	16.04	
,TER CONTENT	19.40	18.64	19.02

NATURAL WATER CONTE

1	2	

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	40	9	11	77	48
Wt. SAMPLE & TARE WET	50.42	51.88	52.86	53.20	55.12
Wt. SAMPLE & TARE DRY	45.66	46.76	47.61	48.70	49.56
Wt. OF WATER	4.76	5.12	5.25	5.50	5.56
TARE	32.05	31.66	31.68	31.47	31.58
Wt. OF DRY SOIL	13.61	15.10	15.93	17.23	17.98
WATER CONTENT	34.97	33.91	32.96	31.92	30.92



REMARKS The silty clay fraction of the soil is low compressibility (CL)

RESULTS SUMMARY

ural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio,B	flow index	toughness index
.75	32.40	19.02	13.38			

Spanish Town Road, Kingston 11	JOB No
No 2 Sample depth 9.1m - 9.6m	Test No
	Sample No 8
	Date 28/5/03
	Tested by D. Myrie

PLASTIC LIMIT

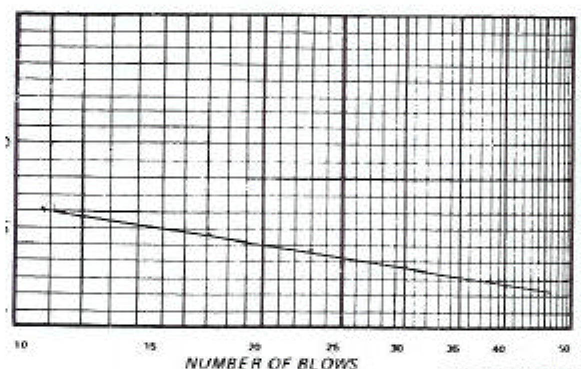
ETERMINATION NO.	1	2	3
NTAINER NUMBER	37	34	
MBER OF BLOWS	xxx	xxx	
SAMPLE & TARE WET	50.65	50.88	
SAMPLE & TARE DRY	47.98	48.15	
OF WATER	2.67	2.73	
RE	34.58	34.62	
OF DRY SOIL	13.40	13.53	
TER CONTENT	19.93	20.18	20.05

NATURAL WATER CONTENT

1	2	3

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	22	38	33	10	2
Wt. SAMPLE & TARE WET	54.16	55.24	56.35	57.46	58.51
Wt. SAMPLE & TARE DRY	48.22	49.05	50.10	51.22	52.01
Wt. OF WATER	5.94	6.16	6.25	6.44	6.50
TARE	31.61	31.32	31.58	31.55	31.55
Wt. OF DRY SOIL	16.61	17.73	18.52	19.67	20.46
WATER CONTENT	35.76	34.74	33.75	32.74	31.77



REMARKS The silty clay fraction of the soil is of low compressibility (CL)

RESULTS SUMMARY

tural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio,B	flow index	toughness index
3.57	33.00	20.05	12.95			

JOB No	
Test No	
Sample No	11
Date	28/5/03
Tested by	D. Myrie

Spanish Town Road, Kingston 11

No 2 Sample depth 13.7m - 14.2m

PLASTIC LIMIT

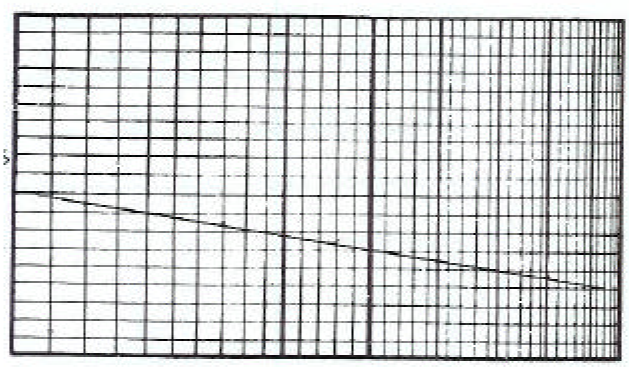
ETERMINATION NO.	1	2	3
NTAINER NUMBER	40	5	
MBER OF BLOWS	xxx	xxx	
. SAMPLE & TARE WET	51.82	51.96	
. SAMPLE & TARE DRY	48.95	49.05	
. OF WATER	2.87	2.91	
RE	34.31	34.52	
. OF DRY SOIL	14.64	14.53	
TER CONTENT	19.59	20.03	19.81

NATURAL WATER CONTEN

1	2	

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	12	10	42	5	73
Wt. SAMPLE & TARE WET	55.34	56.32	57.54	58.37	59.34
Wt. SAMPLE & TARE DRY	49.53	50.50	51.50	52.27	53.26
Wt. OF WATER	5.81	5.82	5.94	6.10	6.08
TARE	31.64	31.99	31.99	31.57	31.90
Wt. OF DRY SOIL	17.89	18.51	19.51	20.70	21.36
WATER CONTENT	32.48	31.44	30.45	29.47	28.46



REMARKS The silty clay fraction of the soil is o low compressibility (CL)

RESULTS SUMMARY

ural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio,B	flow index	toughness index
.05	30.00	19.81	10.19			

JOB No	
Test No	
Sample No	7
Date	28/5/03
Tested by	D. Myrie

Spanish Town Road, Kingston 11

No 4 Sample depth 7.6m - 8.1m

PLASTIC LIMIT

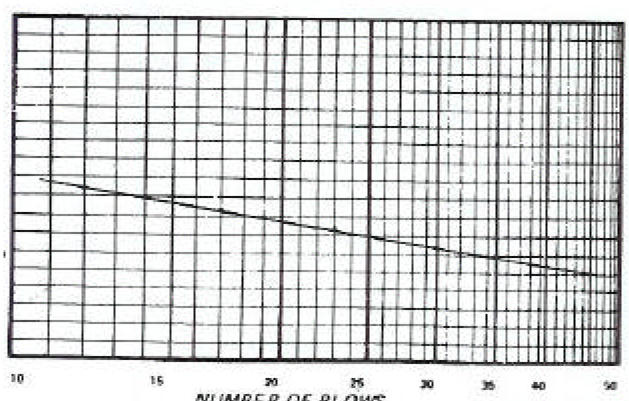
ETERMINATION NO.	1	2	3
INTAINER NUMBER	19	48	
IMBER OF BLOWS	xxx	xxx	
. SAMPLE & TARE WET	50.89	50.78	
. SAMPLE & TARE DRY	47.95	47.93	
. OF WATER	2.94	2.85	
RE	34.30	34.66	
. OF DRY SOIL	13.65	13.27	
TER CONTENT	21.54	21.48	21.51

NATURAL WATER CONTE

1	2	

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	44	43	7	4	3
Wt. SAMPLE & TARE WET	54.55	55.71	56.86	57.90	58.79
Wt. SAMPLE & TARE DRY	49.58	50.53	51.64	52.56	53.48
Wt. OF WATER	4.97	5.18	5.22	5.34	5.31
TARE	32.08	31.65	31.89	31.57	31.74
Wt. OF DRY SOIL	17.50	18.88	19.75	20.99	21.74
WATER CONTENT	28.40	27.44	26.43	25.44	24.43



REMARKS The silt fraction of the soil is of low compressibility (ML)

RESULTS SUMMARY

ural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio,B	flow index	toughness index
.69	25.90	21.51	4.39			

HB

HILL - BETTY (ENGINEERS) LTD.

CIVIL ENGINEERS & CONTRACTORS

SOIL MECHANICS LABORATORY

ATTERBERG LIMITS

SOIL SAMPLE Dark brown silty clay

Locat. Spanish Town Road, Kingston 11

Boring No 4 Sample depth 13.7m - 14.2m

JOB No

Test No

Sample No 11

Date 29/5/03

Tested by D. Myrie

PLASTIC LIMIT

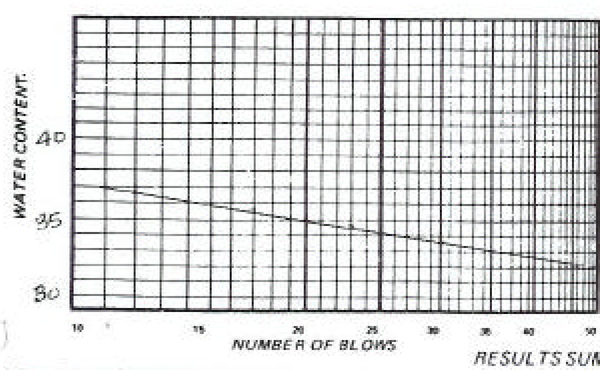
DETERMINATION NO.	1	2	3
CONTAINER NUMBER	19	48	
NUMBER OF BLOWS	xxx	xxx	
Wt. SAMPLE & TARE WET	50.99	50.54	
Wt. SAMPLE & TARE DRY	47.75	47.46	
Wt. OF WATER	3.24	3.08	
TARE	34.30	34.67	
Wt. OF DRY SOIL	13.45	12.79	
WATER CONTENT	24.09	24.08	24.09

NATURAL WATER CONTENT

1	2	3

LIQUID LIMIT

DETERMINATION NO.	1	2	3	4	5
NUMBER OF BLOWS	12	17	23	30	40
CONTAINER NUMBER	4	7	43	44	3
Wt. SAMPLE & TARE WET	54.42	56.05	56.86	57.89	59.48
Wt. SAMPLE & TARE DRY	48.28	49.80	50.38	51.43	52.67
Wt. OF WATER	6.14	6.25	6.48	6.46	6.81
TARE	31.57	32.31	31.74	32.29	31.85
Wt. OF DRY SOIL	16.71	17.49	18.64	19.14	20.82
WATER CONTENT	36.74	35.73	34.76	33.75	32.71



REMARKS The silty clay fraction of the soil is of low compressibility (CL)

RESULTS SUMMARY

natural water content	liquid limit	plastic limit	plasticity index	water-plasticity ratio, B	flow index	toughness index
17.18	34.10	24.09	10.01			

APPENDIX V

APPENDIX V: ENVIRONMENTAL HEALTH UNIT COMMENTS ON RED STRIPE'S WWTP

ANY REPLY OR SUBSEQUENT REFERENCE SHOULD BE ADDRESSED TO THE **PERMANENT SECRETARY** AND THE FOLLOWING REFERENCE NUMBER QUOTED.
EHU 01/3/05-2
Phone No. (876) 967-1100-9
Fax: (876) 967-1280

MINISTRY OF HEALTH
HEALTH PROMOTION & PROTECTION DIVISION
ENVIRONMENTAL HEALTH UNIT
Oceana Building, 4th & 5th Floor
2 - 4 King Street
Kingston, Jamaica, West Indies

Ref No.:

May 10, 2005

Conrad Douglas + Associates Ltd.
14 Carvalho Drive
Kingston 10, Jamaica

RE: Proposed Sewage Treatment Plant for Red Stripe Brewery

The Environmental Health Unit has reviewed the report supporting the abovementioned project whereby the brewery wastewater is to be treated in a system consisting of UASB followed by aerobic treatment in sequencing activated sludge reactors. Phosphate control is to be effected by coagulation and settling by dosing ferric chloride.

The EHU has no objection to the proposed treatment system as described.

The EHU and local health authority should be contacted in writing at midpoint and at 90% completion to allow inspection of proposed wastewater treatment system.

If you have questions or require more information please contact the undersigned.

for Mr. Peter Knight
DIRECTOR
Environmental Health Unit

APPENDIX VI

APPENDIX VI: PHOTO INVENTORY (SITE LOCATION AND ASSOCIATED VEGETATION)

FIGURE 7-1: WASTEWATER TREATMENT PLANT SITE LOCATION (RED STRIPE PLANT IN BACKGROUND)

FIGURE 7-2: SITE LOCATION LOOKING WEST

FIGURE 7-3: WASTEWATER TREATMENT PLANT SITE LOCATION (PROPERTY BOUNDARY TO THE EAST)

FIGURE 7-4: TYPICAL VEGETATION (SENSITIVE PLANT - *Mimosa pudica*)

FIGURE 7-5: TYPICAL VEGETATION

FIGURE 7-6: TYPICAL VEGETATION WITH EXISTING DRAINS

FIGURE 7-7: TYPICAL VEGETATION WITH EXISTING DRAIN

FIGURE 7-8: TYPICAL VEGETATION

Photo Inventory: Monitoring Stations and Associated Drains

FIGURE 7-9: MONITORING STATION 1 AND ASSOCIATED DRAIN

FIGURE 7-10: MONITORING STATION 2 WITH ASSOCIATED DRAIN

FIGURE 7-11: MONITORING STATION 3 (BREW HOUSE) WITH ASSOCIATED DRAIN