FINAL REPORT

CLOSURE PLAN FOR THE WESTERN TERMINAL SEWAGE TREATMENT PLANT IN THE PARISH OF KINGSTON, JAMAICA

Submitted to

WEST KINGSTON POWER PARTNERS,
10 Grenada Way
Kingston 5

CL ENVIRONMENTAL
Taking Care of You and Your Environment.

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MAY 2010

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1.0 EXECUTIVE SUMMARY

West Kingston Power Partners as a partial requirement of the fulfillment of Environmental Permit # 2009-01017-EP00076 and Specific Condition 28 the development of this Closure Plan outlines the activities and timelines associated with the proper closure of the Western Terminal Sewage Plant.

The site is presently not being used officially for treatment of sewage and the buildings and equipment are in a dilapidated state.

The Closure Plan calls for the demolition of thirteen (13) major structures presently on the site. These are;

1. Reinforced concrete building with concrete slab roof
2. Reinforced concrete building having no roof
3. Reinforced concrete building with concrete roof slab
4. Concrete blockwall building with no roof
5. Partially destroyed blockwall building with no roof
6. Reinforced concrete pump house with pump and sump
7. Reinforced concrete pump house with 4m deep sump and piping
8. Reinforced concrete tank with circular opening -primary digester
9. Reinforced concrete tank - secondary digester
10. Reinforced concrete settling tanks
11. Reinforced concrete grit channel
12. Other reinforced concrete structures to the North of the site

Other structures onsite include; reinforced concrete panel box, five (5) reinforced concrete manholes, fifteen (15) concrete electric poles each 5.18m (17ft) high, abandoned sewer outfall (diameter 1.22m (4ft), length 218m) and the removal of approximately 4,650 cu ft. of asbestos pipes and pieces of asbestos roofing sheeting.

The main pollutants onsite are asbestos laden pipes and roofing materials containing 20-40% Chrysotile and wastewater in the settling tanks and pump house and sump beside the secondary digester. The parameters that exceeded the standards at some of the locations measured include; ammonia, oil and grease, total phosphates, total organic

compounds, total suspended solids, biochemical oxygen demand(BOD), chemical oxygen demand (COD), faecal coliforms and zinc.

The following activities and estimated timelines are required for the closure of the site;

i. Erection of chainlink fence to temporarily secure the construction site – approx. 7 days.
ii. The diversion of sewage - approx. 5 months.
iii. The construction of the access roadway will take approx. 2 weeks.
iv. The pumping of the wastewater from the structures will take approx. 2 weeks.
v. Asbestos removal, packaging and disposal as per NEPA permit – approx. 16 days.
vi. The demolition of existing buildings and structures - approx. 9 weeks.
vii. The filling of the voids where structures have been removed - approx. 6 weeks.
viii. Site filling, grading and properly compacted – approx. 6 weeks.
ix. The building/rehabilitation of the perimeter wall – approx. 10 weeks.

It is anticipated that the entire site closure process will take approximately 100 days (just over 3 months) to be completed.

2.0 BACKGROUND

The Western Terminal Sewage Treatment Plant (WTSTP) is located in the community of Tivoli Gardens and is bordered to the west by Industrial Terrace, to the south by lands – volume 1378 Folio 468, to the east by the Seprod's perimeter wall and to the north by the Jamaica Railway Corporation defunct workshop. It was built in 1938 and services areas in the old eastern end of the city such as Rae Town and Kingston Gardens.

The WTSTP is a mechanical plant and was designed to accommodate two (2) to three (3) million gallons of sewage daily. Mechanical plants can be big tanks with booms[1] that move across the surface of the water slowly for a period of time thus allowing solids present to settle. The solids or sludge, as it is often termed, are relocated to 'drying beds' and are removed when dry and can be used as fertilizer. The WTSTP is a typical example of a primary sewage treatment facility. The remaining effluent[2] still contains impurities such as bacteria, nutrients, suspended solids and industrial pollutants (if present) flows into the sea (Kingston Harbour – located to the south).

In 1997, it was reported that WTSTP received approximately seven (7) million gallons of sewage daily and was not operational. In conjunction with Greenwich Sewage Treatment Plant (GSTP), a total of 20 million gallons of sewage were untreated and released into Kingston Harbour daily. However, in 1996, improvement plans for the WTSTP was designed for implementation in 1997/1998 which would bring the plant back into operation. The plans included an upgrade of the plant's capacity to five (5) million gallons; construction of a sewage transmission pump main from the WTSTP to GSTP and rehabilitation and upgrading of GSTP.

The site is presently not being used officially for treatment of sewage and the buildings and equipment are in a dilapidated state. Most sewage that was being treated has been diverted from the site to Greenwich Sewage Treatment Plant and ultimately to the Soapberry Sewage Treatment Plant (tertiary) in St. Catherine for treatment and final disposal. However, upon further investigation it was discovered that a sewage stream is still flowing onto the site from the Tivoli gardens community.

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[1] A barrier composed of a chain of floating logs enclosing other free-floating logs, typically used to catch floating debris or to obstruct passage (http://dictionary.reference.com/browse/boom).

[2] Sewage that has been treated in a septic tank or sewage treatment plant (http://dictionary.reference.com/browse/effluent).

The site at present has grass, shrubs and trees and has concrete buildings, structures and defunct equipment (remnants of the wastewater treatment facility) (Figure 1).

There are several major structures presently on the site. These are;

1. Reinforced concrete building with concrete slab roof
2. Reinforced concrete building having no roof
3. Reinforced concrete building with concrete roof slab
4. Concrete blockwall building with no roof
5. Partially destroyed blockwall building with no roof
6. Reinforced concrete pump house with pump and sump
7. Reinforced concrete pump house with 4m deep sump and piping
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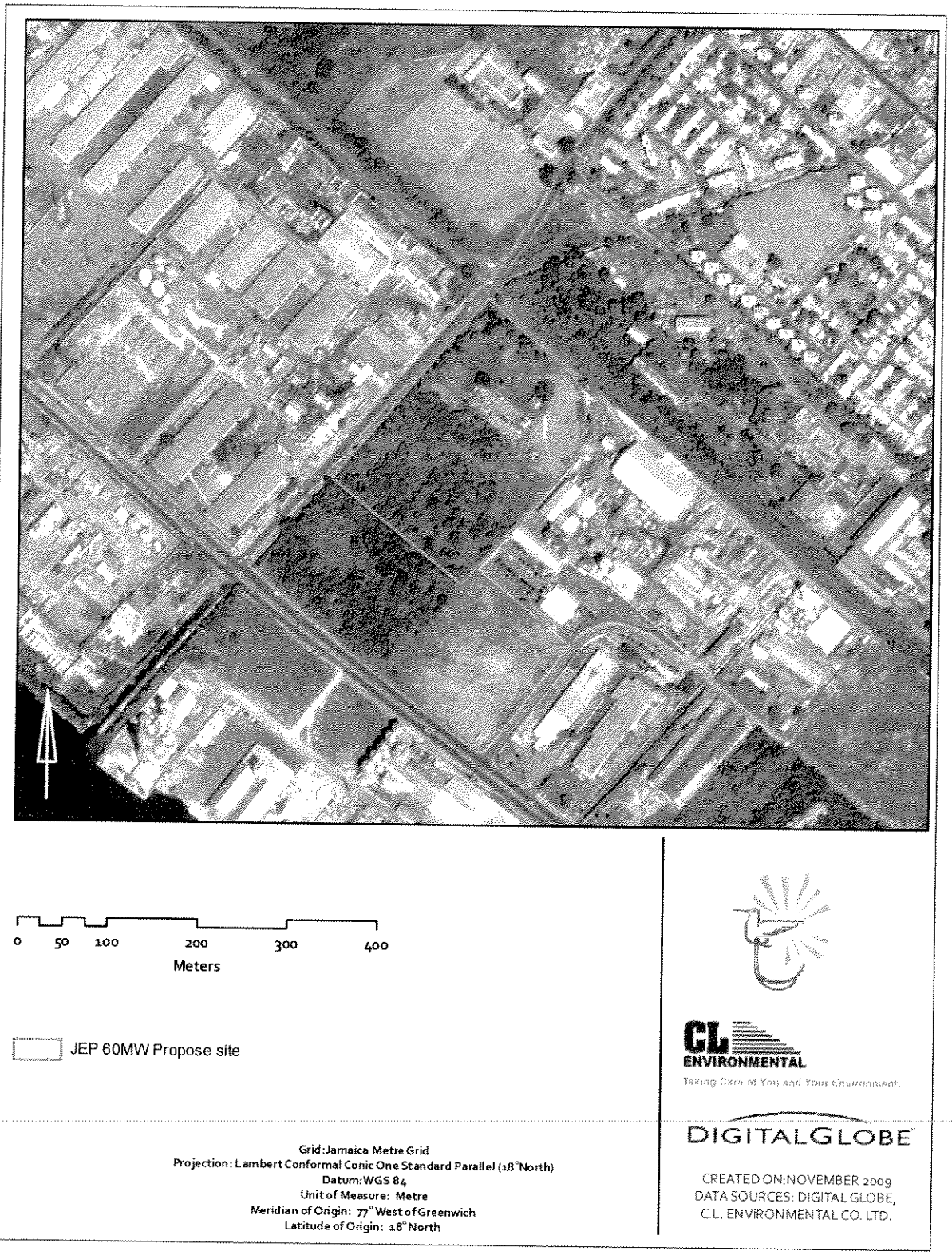

Figure 1 Location of the Proposed West Kingston 66 MW Power Plant

2.1 BASELINE

2.1.1 Pollutants

There were no chemicals stored onsite or used for disinfection as the site was used for primary treatment of the sewage. Other possible contaminants are the wastewater currently contained in the settling tanks, secondary digester, pump house and asbestos from left over pipes on the site and from roofing material.

2.1.2 Zoning

The site is zoned for government purposes and statutory undertakings as depicted in the Kingston Development Plan. Other areas around it are zoned industrial, residential and private open spaces (Figure 2).

2.1.3 Topography

The land gently slopes downwards from north which is approximately 12m above sea-level to south (≈ 4m above sea-level) towards the Kingston Harbour (Figure 3).

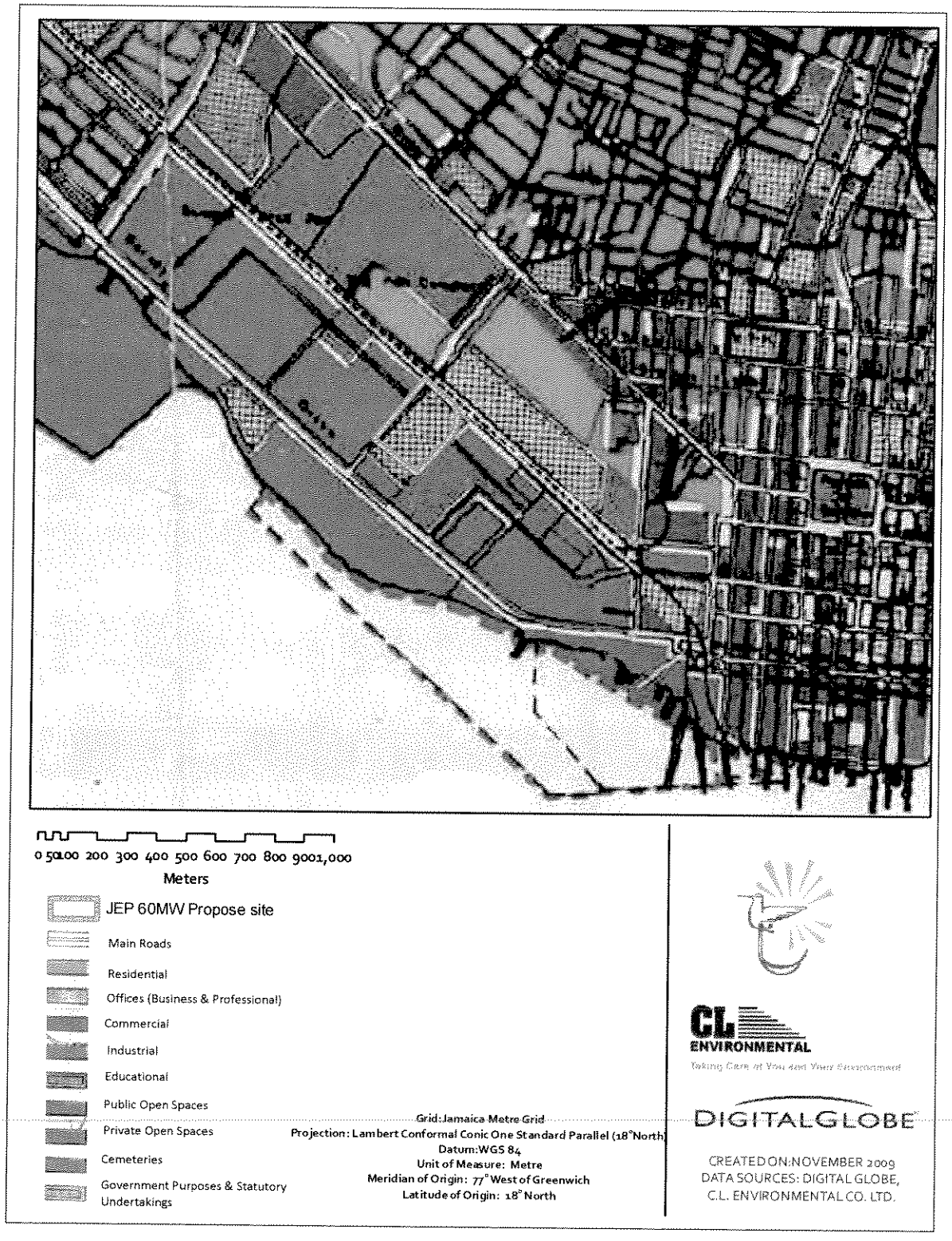

Figure 2 Kingston Development Plan

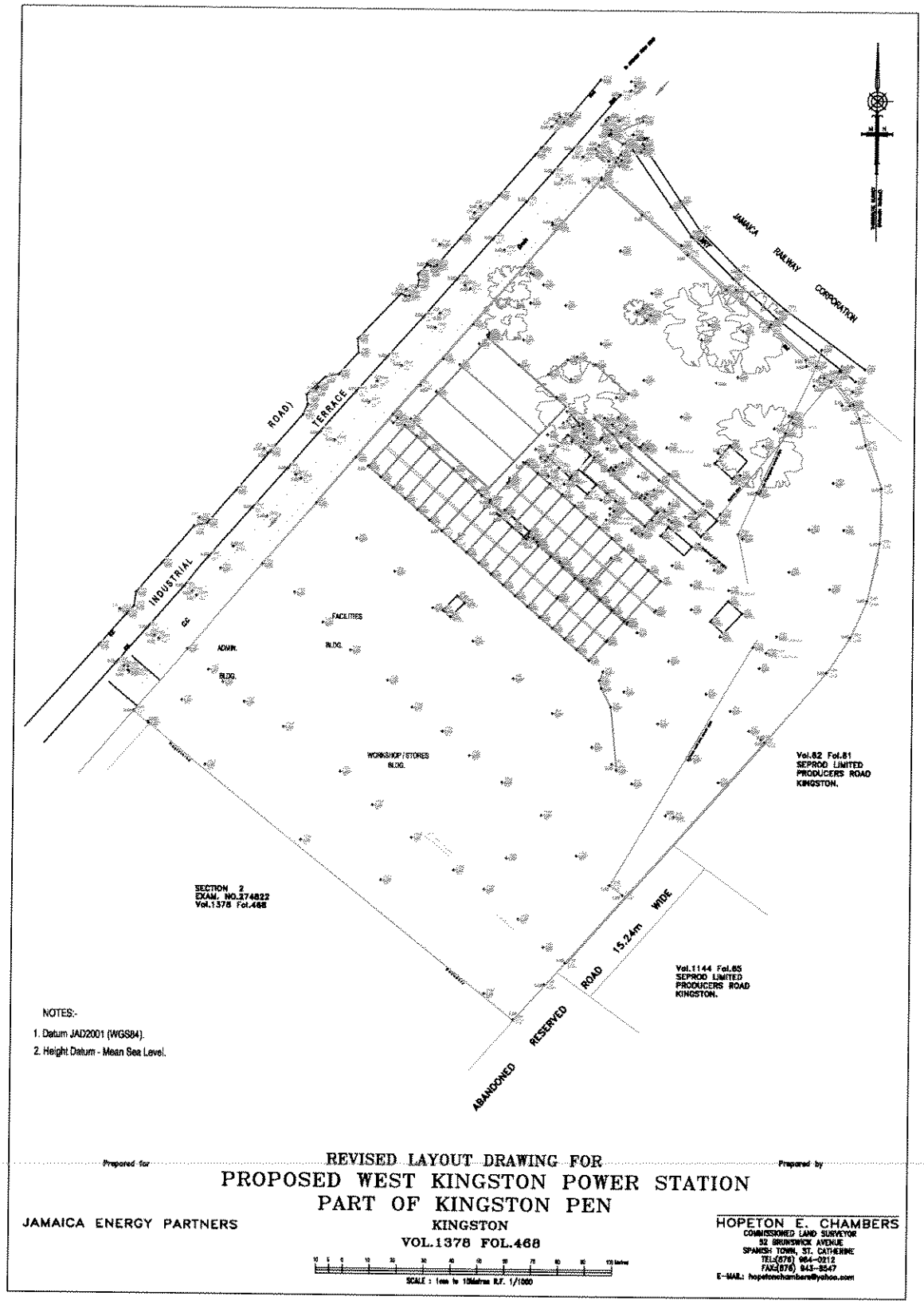

Figure 3 Topographic map

2.1.4 Soils

Geotech Exploration Services Limited was contracted by Jentech to advance eighteen (18) boreholes, one (1) of which was located within an existing tank and was not accessible during the time of the fieldwork.

The borelogs indicated that conditions were similar across the site. At the top of the boreholes and down to approximately 3 metres, silty sand or clay material with varying amounts of peat was encountered. Ground water was encountered within this layer in all boreholes and the final water level recorded tended to be closer to the surface than the original water levels. Below this superficial peaty layer, alternating layers of silty clay and sands were encountered. Silty clays were generally described as being dark brown in colour with some variation to pink/brown or grey at depths at, and extending below 30 metres.

The cohesion less material encountered varied between brown and grey in colour and was generally encountered either as a coarse sand and gravel mix or as silty medium to fine sand. There seemed to be an almost uniform, if relatively narrow band of gravely sand atop silty sand encountered in the depth range of approximately 15 metres. It should also be noted that boulders are possible within and just above this layer as there were reports at most locations of the augers grinding on coarse material during drilling (Jentech June 2009).

2.1.5 Springs/Wells

There are no springs within the area, however there are numerous wells in proximity to the WTSTP site. There are 18 wells within 1km of the WTSTP (Table 1 and Figure 4).

Table 1 Wells within 1km of the proposed development area

ID	E2001	N2001	LOCATION	PARISH	OWNER	DEPTH (m)	ELEV (m)	STRUCK (m)	PRINCIPAL	RWL (m)	HYDROLOGIC
1772	771112.499	646874.622	Producers Road #1 (Seprod #1)	Kingston	Seprod Limited				Alluvium		Kingston (II)
1771	770868.498	646843.622	Producers Road #2 (Seprod #2)	Kingston	Seprod Limited	30.48			Alluvium		Kingston (II)
101	770673.498	647895.625	Boys' Town (Father Sherlock well)	St. Andrew	Boys' Town	40.54			Alluvium		Kingston (II)
94	769953.495	647087.623	JPS Borehole #6	Kingston	Jamaica Public Service Company Limited	5.79		1.22	Alluvium	0.30	Kingston (II)
92	769938.494	647026.622	JPS Borehole #4	Kingston	Jamaica Public Service Company Limited	5.79		2.13	Alluvium	0.30	Kingston (II)
1968	770898.497	646813.622	Producers Road #1A (Seprod #1A) replacement	St. Andrew	Seprod Limited	30.48			Alluvium	0.42	Kingston (II)
93	769941.496	647042.622	JPS Borehole #5	Kingston	Jamaica Public Service Company Limited	6.10		1.52	Alluvium	0.46	Kingston (II)
1757	770258.496	647026.622	Hunts Bay (Marcus Garvey Driv) Power Station	Kingston	Jamaica Public Service Company Limited	13.41	2.79	3.35	Alluvium	0.61	Kingston (II)
96	770216.498	646667.622	JPS Borehole #10	Kingston	Jamaica Public Service Company Limited	6.10		2.44	Alluvium	0.65	Kingston (II)
1769	770837.499	646782.622	Producers Road 2A (Seprod #2A) replacement	Kingston	Seprod Limited	30.48		1.22	Alluvium	0.81	Kingston (II)
89	769999.497	646843.622	JPS Borehole #3	Kingston	Jamaica Public Service Company Limited	5.18		1.83	Alluvium	0.84	Kingston (II)
95	770213.496	647148.623	JPS Borehole #9	Kingston	Jamaica Public Service Company Limited	6.55		2.44	Alluvium	0.85	Kingston (II)
1761	770441.498	646996.622	Tivoli Depot - Marcus Garvey Drive	Kingston	Jamaica Omnibus Service (JOS)	32.00			Alluvium	0.91	Kingston (II)
1773	771142.498	646417.621	Kingston Abattoirs	Kingston	Kingston & St. Andrew Corporation	24.38	3.05	1.83	Alluvium	0.91	Kingston (II)
87	770203.497	646706.622	JPS Borehole #1	Kingston	Jamaica Public Service Company Limited	6.71		3.05	Alluvium	1.07	Kingston (II)
88	770014.497	646685.621	JPS Borehole #2	Kingston	Jamaica Public Service Company Limited	6.71		3.66	Alluvium	2.13	Kingston (II)
69	770258.496	647026.622	Hunts Bay Power Station (replacement)	Kingston	Jamaica Public Service Company Limited	24.38	6.10	2.44	Alluvium	3.96	Kingston (II)
1764	770685.498	647392.623	Tivoli	Kingston	Ministry of Mining and Energy	22.86			Alluvium	10.67	Kingston (II)

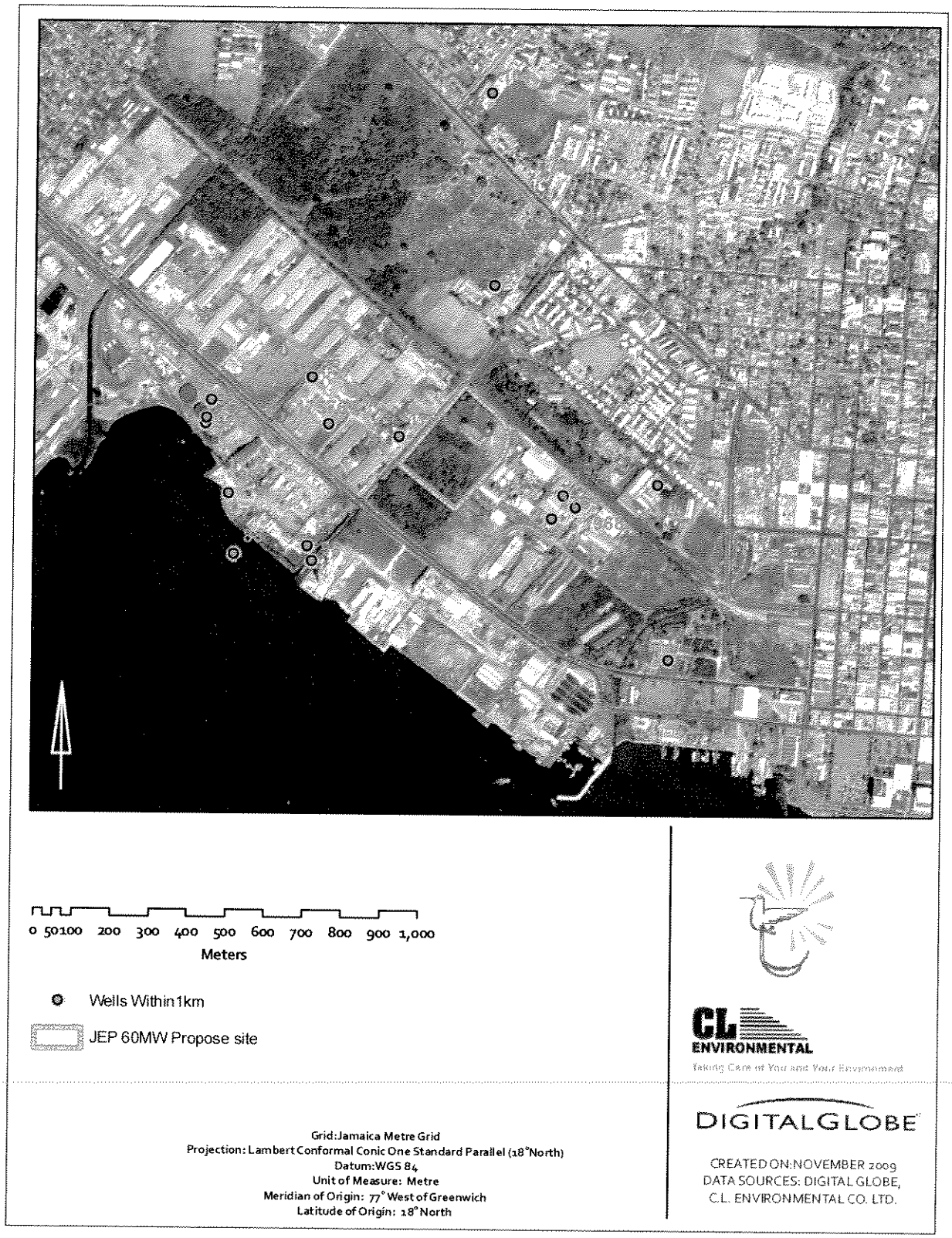

Figure 4 Wells within 1km of the WTSTP site

2.1.6 Solid Waste Disposal

The National Solid Waste Management Authority is responsible for domestic solid waste collection within the study area. The waste is transported to the Riverton City landfill located in St. Andrew, approximately 8 km (≈5 miles) west of the proposed WTSTP site.

2.1.7 Security of Facility/Area

The site presently has a partial perimeter fence and wall but is unsecure. A chain link fence will be constructed to secure the site upon receipt of a letter of possession from the National Water Commission (NWC). A permanent concrete wall will subsequently be constructed. The site will be secured before commencing the tasks outlined in the closure plan (Section 4.0).

3.0 INVESTIGATIONS

The major pollutants on the site are; (i) the wastewater in the settling tanks and pump house and sump beside the secondary digester; and (ii) asbestos laden pipes and roofing material.

3.1 WATER QUALITY

3.1.1 Methodology

Figure 5 depicts the locations of the water quality sampling stations. Sampling was conducted on August 3, 2009 between the hours of 8:00am and 12:30pm. At each location, samples were collected in pre-cleaned plastic and glass bottles, stored on ice and sent to three different laboratories, whereby each laboratory was required to test for a different set of parameters. The laboratories used were Scientific Research Council, Environment Technical and Analytical Services Ltd., Mines and Geology Division of the Ministry of Mining and Telecommunications, and TestAmerica Laboratories Inc. in Miami, Florida, USA.

A second sampling event, which is representative of a rainy (wet) season (done following approximately 1 week of rainfall), was conducted on September 23, 2009 between the hours of 10:00am and 1:00pm. These samples were sent to the Scientific Research Council for analysis.

At each location, Temperature, salinity, conductivity, pH and Dissolved Oxygen were measured in situ using a Yellow Springs Instruments (YSI) model 556 multi probe meter.

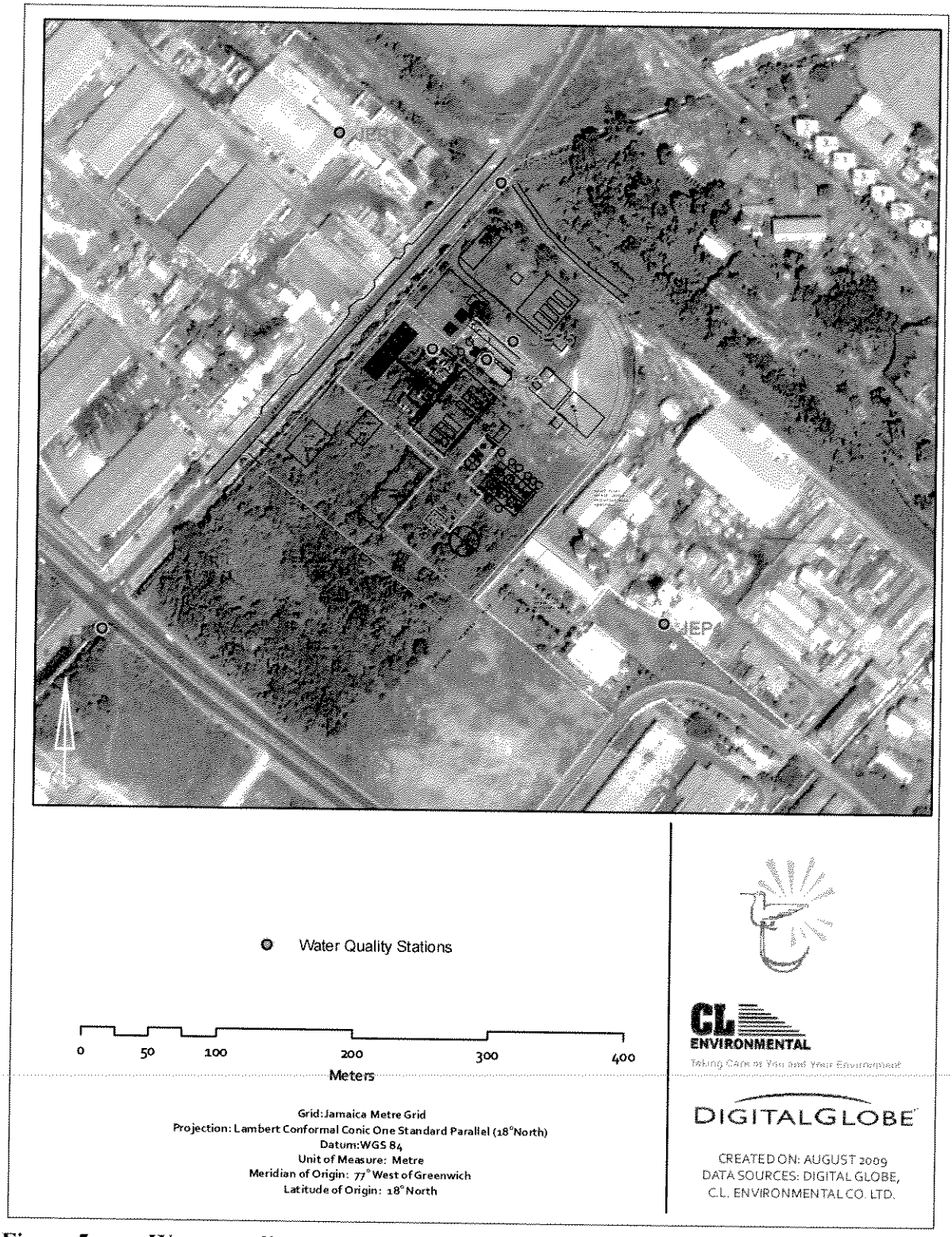

Figure 5 Water quality stations

3.1.2 Results

3.1.2.1 Groundwater

There are no wells on the site, however, two wells in proximity to the site were sampled. These were; (i) Tivoli Depot – Garmex Freezone and (ii) Seprod #2. The results of the water quality testing results are listed below.

Table 2 shows a summary of historical data concerning the groundwater quality at the Tivoli Depot – Garmex Freezone and Seprod #2. Nitrate levels at both locations are extremely high as expected for groundwater, and are not compliant with the WHO standard.

Table 2 Results of historical water quality data for ground water in proximity to the proposed site

Parameter	JEP1 – Tivoli Depot (1982)	JEP4 – Seprod#2 (1974)
Total Dissolved Solids (mg/l)	780	
Calcium (mg/l)		176
Magnesium (mg/l)		53
Sodium (mg/l)		120
Chloride (mg/l)	111	220
Sulphate (mg/l)		86
Nitrate (mg/l)	115	248
Hardness (mgCaCO3/l)	656	
Alkalinity (mgCaCO3/l)	354	352
Potassium (mg/l)		3.1
Bicarbonate (mg/l)		431

Water sampling was conducted on the two wells above for the EIA and the results are listed below (Table 3, Table 4, Table 5 and Table 6).

Table 3 Results of ground water sampling at two locations

PARAMETERS	JEP1	JEP4
Temperature (°C)	28.29	28.78
Conductivity (mS/cm)	1.034	0.85
Salinity (ppt)	0.51	0.44
Dissolved Oxygen (mg/l)	6.76	6.8
pH	7.5	7.6

Table 4 **Summary of biological and chemical data concerning the groundwater (JEP1 and JEP4) in and around the site**

Parameters	JEP1	JEP4
Ammonia (mgN/l)	0.16	0.04
Barium (mg/l)	0.52	0.34
Beryllium (mg/l)	ND	ND
Boron (mg/l)	ND	ND
Calcium (mg/l)	113	129
Chloride (mg/l)	70.5	72.4
Colour (Pt-co)	<15	<15
Detergent (mg/l)	1.67	0.65
Fluoride (mg/l)	0.15	0.21
Iron (µg/l)	<20	<20
Magnesium (mg/l)	25.6	26.7
Manganese (µg/l)	<20	<20
Nitrates (mg/l)	86	91.3
Oil and Grease (mg/l)	1.67	1.17
Phenols (mg/l)	ND	ND
Total Phosphate (mg/l)	0.56	0.44
Sodium (mg/l)	93.5	98.4
Sulphate (mg/l)	91.3	109
Total Dissolved Solids (mg/l)	643	672
Total Organic Compounds (mg/l)	266	228
Total Suspended Solids (mg/l)	<1	<1
Biochemical Oxygen Demand (mg/l)	<2	<2
Chemical Oxygen Demand (mg/l)	ND	ND
Faecal Coliform (MPN/100ml)	4.5	1.8
Residual Chlorine (mg/l)	0.03	0.03
Petroleum Range Organics (mg/l)		
C8-C40	ND	ND
C8-C10	ND	ND
C10-C28	ND	ND
C28-C40	ND	ND
HEAVY METALS		
Arsenic (µg/l)	<10	<10
Cadmium (µg/l)	<20	<20
Chromium (µg/l)	<20	<20
Copper (µg/l)	<10	<10
Cyanide (mg/l)	ND	ND
Lead (µg/l)	<20	<20
Mercury (µg/l)	<0.5	<0.5

Parameters	JEP1	JEP4
Nickel (µg/l)	<20	<20
Selenium (µg/l)	16	76
Silver (mg/l)	ND	ND
Tin (mg/l)	ND	ND
Zinc (mg/l)	<10	<10

*ND – None Detected (Below detection limits).

Table 5 Results of ground water sampling at two locations (Wet Season)

PARAMETERS	JEP1	JEP4
Temperature (°C)	28.4	29.16
Conductivity (mS/cm)	1.023	1.072
Salinity (ppt)	0.5	0.53
Dissolved Oxygen (mg/l)	6.8	6.8
pH	7.44	7.67

Table 6 Summary of biological and chemical data concerning groundwater (JEP1 and JEP4) in and around the site (Wet Season)

Parameters	JEP1	JEP4
Biochemical Oxygen Demand (mg/l)	<2	<2
Chemical Oxygen Demand (mg/l)	ND	ND
Faecal Coliform (MPN/100ml)	17	7.3
Residual Chlorine (mg/l)	0.02	0.02
Sulphate (mg/l)	48	57
Nitrates (mg/l)	40.04	36.52
Total Nitrogen (mg/l)	ND	ND
Orthophosphates (mg/l)	0.26	0.22
Total Suspended Solids (mg/l)	ND	12
Oil and Grease (mg/l)	1.36	5.5

*ND – None Detected (Below detection limits).

3.1.2.2 Wastewater

The results of the analyses are provided in Table 7, Table 8, Table 9 and Table 10 below. Dissolved oxygen readings for locations JEP5 and JEP6 were both below 4mg/l and were therefore non compliant with NEPA trade effluent standards. For the second sampling event (wet season), all locations except JEP7 had dissolved oxygen readings below 4mg/l, thus non compliant with NEPA standards. All locations had pH values within the desired range for both NEPA and World Bank standards. Temperature, conductivity and salinity values are deemed normal for all locations.
Ammonia (JEP 2, JEP 5 and JEP 6), Detergent (JEP 2), Oil & Grease (JEP 5, JEP 6 and JEP 7), Total Phosphates (JEP 2, JEP 5, JEP 6 and JEP 7), Total Organic Compounds (JEP 2, JEP 5, JEP 6 and JEP 7), Total Suspended Solids (JEP 5), Biochemical Oxygen Supply (JEP 5), Chemical Oxygen Demand (JEP 5, JEP 6 and JEP 7), Faecal Coliform (JEP 2, JEP 5, JEP 6 and JEP 7) and Zinc (JEP 2, JEP 5, JEP 6 and JEP 7) were all non compliant with the standards. For the second sampling event (wet season), Biochemical Oxygen Demand (JEP5), Chemical Oxygen Demand (JEP2, JEP5, JEP6, and JEP7), Faecal Coliform (JEP2. JEP5, JEP6, JEP7 and JEP8), Orthophosphates (JEP5, JEP6, and JEP7), Total Suspended Solids (JEP5) and Oil & Grease (JEP5 and JEP7) were all non compliant with the standards.

Table 7 Results of surface wastewater sampling at four locations

PARAMETERS	JEP2	JEP5	JEP6	JEP7	NEPA Trade Effluent Stds.	World Bank Stds.
Temperature (°C)	27.92	32.01	30.58	32.21		
Conductivity (mS/cm)	0.83	0.79	0.77	0.85		
Salinity (ppt)	0.4	0.38	0.37	0.41		
Dissolved Oxygen (mg/l)	4.4	2	2.2	4.6	4	
pH	7.8	7.4	7.53	7.6	6.5-8.5	6-9

Table 8 **Summary of biological and chemical data concerning the surface wastewater (JEP2, JEP5, JEP6, JEP7 and JEP8) in and around the site**

Parameters	JEP2	JEP5	JEP6	JEP7	JEP8	World Bank Stds.	NEPA Trade Effluent Stds.
Ammonia (mgN/l)	1.49	1.11	1.18	0.97			1
Barium (mg/l)	0.13		0.11	0.14	0.13		5
Beryllium (mg/l)	ND		ND	ND	ND		0.5
Boron (mg/l)	ND		ND	ND	ND		5
Calcium (mg/l)	64.4	85.2	82	96.2			None
Chloride (mg/l)	52.3	41.5	43.7	48.8			300
Colour (Pt-co)	<15	37	32	36			100
Detergent (mg/l)	10.05	9.35	8.15	8			15
Fluoride (mg/l)	0.32	<0.02	<0.02	0.16			3
Iron (µg/l)	173	667	134	103		1000	3000
Magnesium (mg/l)	20.1	15.6	14.1	20.5			None
Manganese (µg/l)	121	31	43	39			1000
Nitrates (mg/l)	1.5	1.38	3.03	2.56			10
Oil and Grease (mg/l)	5.75	13.67	15	14		10	10
Phenols (mg/l)	0.0072		0.019	0.017	ND		0.1
Total Phosphate (mg/l)	5.7	10	8.6	7.1			5
Sodium (mg/l)	77	62.3	61	78.7			100
Sulphate (mg/l)	110	108	66.6	123			250
Total Dissolved Solids (mg/l)	413	427	532	455			1000
Total Organic Compounds (mg/l)	168	256	164	224			100
Total Suspended Solids (mg/l)	8.33	160	28	77		50	150
Biochemical Oxygen Demand (mg/l)	19.3	119	<2	<2			<30
Chemical Oxygen Demand (mg/l)	33	352	172	168			<100
Faecal Coliform (MPN/100ml)	>1600	>1600	>1600	>1600			100
Residual Chlorine (mg/l)	0.06	<0.02	<0.02	<0.02		0.2	

Parameters	JEP2	JEP5	JEP6	JEP7	JEP8	World Bank Stds.	NEPA Trade Effluent Stds.
Petroleum Range Organics (mg/l)							
C8-C40	ND		0.25	2.7	0.4		
C8-C10	ND		ND	ND	ND		
C10-C28	ND		0.14	2.8	0.26		
C28-C40	ND		0.1	0.32	0.17		
HEAVY METALS							
Arsenic (µg/l)	<10	<10	<10	<10		500	500
Cadmium (µg/l)	<20	<20	<20	<20		100	100
Chromium (µg/l)	<20	<20	<20	<20		500	1000
Copper (µg/l)	<10	<10	<10	<10		500	100
Cyanide (mg/l)	ND		ND	ND	ND		0.2
Lead (µg/l)	<20	<20	<20	<20		500	100
Mercury (µg/l)	<0.5	<0.5	<0.5	<0.5		5	20
Nickel (µg/l)	<20	<20	<20	<20			1000
Selenium (µg/l)	108	31	215	42			500
Silver (mg/l)	ND		ND	ND	ND		100
Tin (mg/l)	ND		ND	ND	ND		None
Zinc (mg/l)	14	77	14	30		1	1.5

*ND – None Detected (Below detection limits). Numbers highlighted in red are non compliant with the standards.

Table 9 Results of surface wastewater sampling at five locations (Wet Season)

PARAMETERS	JEP2	JEP5	JEP6	JEP7	JEP8	NEPA Trade Effluent Stds.	World Bank Stds.
Temperature (°C)	32.57	30.42	29.67	30.61	27.59		
Conductivity (mS/cm)	0.76	0.704	0.752	0.439	0.871		
Salinity (ppt)	0.37	0.34	0.36	0.21	0.42		
Dissolved Oxygen (mg/l)	2.49	0.81	0.84	4.31	1.13	4	
pH	7.81	7.73	7.47	7.93	7.6	6.5-8.5	6-9

Table 10 **Summary of biological and chemical data concerning the surface wastewater (JEP2, JEP5, JEP6, JEP7 and JEP8) in and around the site (Wet Season)**

Parameters	JEP2	JEP5	JEP6	JEP7	JEP8	World Bank Stds.	NEPA Trade Effluent Stds.
Biochemical Oxygen Demand (mg/l)	<2	135	<2	<2	3.07		<30
Chemical Oxygen Demand (mg/l)	174	321	122	291	2		<100
Faecal Coliform (MPN/100ml)	>1600	>1600	>1600	>1600	>1600		100
Residual Chlorine (mg/l)	<0.02	<0.02	<0.02	<0.02	0.03	0.2	
Sulphate (mg/l)	66	58	47	65	69		250
Nitrates (mg/l)	2.2	3.08	5.72	2.2	3.52		10
Total Nitrogen (mg/l)	11.1	24.5	17.9	20.4	5.2		
Orthophosphates (mg/l)	4.1	6.8	6.9	5.3	0.97		5
Total Suspended Solids (mg/l)	52	158	6	16	ND	50	150
Oil and Grease (mg/l)	7.27	18.67	9.11	15.33	1.89	10	10

*ND – None Detected (Below detection limits). Numbers highlighted in red are non compliant with the standards.

3.1.2.2.1 Comparison of Wastewater with NWC Influent Standards

The results from the wastewater analyses have shown that the parameters are in compliance with the NWC influent standards (Table 11) and therefore can be disposed of at the NWC sewage treatment facility.

Table 11 Comparison of wastewater characteristics and NWC influent standards

PARAMETERS	STATIONS			NWC STD.
	JEP 5	JEP 6	JEP 8	
Temperature (°C)	30.42	29.67	27.59	≤ 35
pH	7.73	7.47	7.6	6 - 9
Phosphates (mg/l)	6.8	6.9	0.97	8
Total Nitrogen (mg/l)	24.5	17.9	5.2	50
Total Suspended Solids (mg/l)	158	6	ND	240
Biochemical Oxygen Demand (mg/l)	135	<2	3.07	250
Sulphate (mg/l)	58	47	69	250

ND - Not done

3.2 ASBESTOS

3.2.1 Methodology

Bulk samples of the pipe and roof materials were collected and carried to the Occupational and Environmental Safety and Health, Chemistry Department of the University of the West Indies Mona campus for analyses. The method used for the analyses was the National Institute for Occupational Safety and Health (NIOSH) Method 9002 which uses polarized light microscopy (PLM).

3.2.2 Results

Pipe culverts that are currently being stored onsite and roofing material from the existing building were tested and both were found to contain asbestos with a content of 20-40% Chrysotile. Both are encased in concrete and are not friable so they should not pose any serious health risks.

4.0 CLOSURE PLAN

4.1 INTRODUCTION

A Closure Plan is the document that is used to establish the procedures that will be employed during 'closure' of a facility. The use of the term 'closure' in reference to any hazardous waste treatment, storage or disposal facility signifies the process by which the establishment is secured in order to prevent and/or minimize any future impacts to human health or the environment. This can be done by complete decontamination or sanitization of the site in order that exposure to any remaining contaminants is minimized.

Closure of a contaminated site may occur via two (2) processes, clean closure and dirty closure. Clean closure or closure by removal occurs when all contaminants at the facility are removed that laboratory analysis indicates that the contaminants are below the detection limits and are in no danger to human health or the environment. Dirty closure or closure-in-place occurs when the contaminants remain in place at the site either in the soil, groundwater or both.

In the case of the WTSTP, the method to be employed will be clean closure. This report serves to outline the measures that will be undertaken to address the environmental issues and bring closure to the site in order to allow for the commencement of construction of the West Kingston Power Station.

4.2 CLOSURE PLAN - WASTE REMOVAL PROCEDURES

Before construction of the power plant can commence, proper closure and demolition of the existing structures of the old Western Sewage Plant need to be done.

The first step will be the erection of chainlink fence to temporarily secure the construction site. This is expected to take approximately 7 days.

The diversion of sewage that is still flowing onto the site from the Tivoli/Darling Street area will be done in conjunction with other site closure activities. The National Water Commission will be responsible for doing the sewage diversion. This will involve laying a 300mm sewer line along Industrial Terrace from the bridge at the northern end of the property all the way south to the Universal Freight Handlers complex where it will connect to the main sewer line along Marcus Garvey drive. The flow that is presently coming onsite will then be connected to this sewer line. It is anticipated that this phase will take approximately 5 months. A contractor has already been selected by the NWC and a contract signed for the diversion to be carried out.

4.2.1 Access Road

An access road will be built along the eastern boundary of the property along the abandoned reserve road which falls on Seprod Limited's property. Permission was sought and granted from the owners for the reinstatement of the road. The construction of this roadway will take approximately 2 weeks.

4.2.2 Wastewater

The next step in the plan is to remove the wastewater and sludge onsite. This will entail the emptying (by pumping) of existing sumps, tanks and other structures containing wastewater at the site. Currently there is sewage/wastewater in the secondary digester, settling tanks, the intake structure in the toilet/changing room as well as the pump houses. The volume of sewage/wastewater contained in these structures is approximately 4,440m^3 (1,172,924 gallons). This wastewater will be collected by cesspool trucks and carried to the Greenwich Sewage Plant (GSP) which is in close proximity to the site and which connects to the National Water Commissions (NWC) sewer line with ultimate treatment at the Soapberry (tertiary) Sewage Treatment Plant

(GSP). In addition, any sludge at the bottom of these structures will be transferred in a similar manner to the GSP for final disposal.

It is estimated that the pumping of the wastewater from the structures will take approximately 2 weeks.

4.2.3 Asbestos

Asbestos removal, packaging and disposal are regulated by NEPA; a permit to undertake the removal and packaging work will be sought from NEPA. Upon satisfactory completion of NEPA paperwork and queries a permit to remove and package asbestos will be issued.

The site has large asbestos pipes and pieces of asbestos roofing sheeting following disintegration of the roofing sheets. The asbestos pipes will be packaged intact to minimize spreading asbestos in the environment.

Visible asbestos materials will be removed and there will be clearing of the bushes on the site to expose any asbestos materials underneath. This will be followed by packaging and disposal of asbestos cement roofing and piping materials. Asbestos packaging is required by National Environment and Planning Agency (NEPA) to be wrapped in plastic and containerized before disposal.
The total volume of visible asbestos materials is estimated to be 132 m^3 (≈4,650 cu ft.) and will require five 20 foot containers to dispose of the materials and debris.

NEPA will inspect the asbestos packaging and containerization; when satisfied a permit to dispose will be issued.

The National Solid Waste Management Authority (NSWMA) has a commercial site for the disposal of asbestos materials (at Riverton City) once packaging is cleared and a disposal permit is issues by NEPA.

NEPA also requires engagement with the community proximal to the work site.
The asbestos removal project supervisor (Prof. Ishenkumba Kahwa) will ensure that all regulatory requirements are met and asbestos materials are properly removed, packaged and disposed of. He will also make representations on behalf of the project to the public or any agency as the need arises.

Training of Workers

Part of the regulatory requirement is that workers be trained before the start of asbestos removal activities. The requirement is 40 hours scheduled as shown in Table 12.

Table 12 Training Schedule for 40 hours

Duration	Topic/Activity
Day 1	Asbestos: nature, uses and application **(emphasis will be on both international local experiences)**
Day 2	Adverse health effects of asbestos fibres
Day 3	Working safely with asbestos (emphasis will be on safe work practices and appropriate and adequate protective equipment and Regulatory Issues)
Day 4	Practical Sessions
Day 5	Medical screening; Revision, test and remedial instructions, if necessary

Full Schedule of Work

Asbestos removal activity will commence as soon as the regulatory requirements have been met. The visible asbestos materials will be removed first and then the site will be cleared to expose hidden pieces. The work schedule is shown in Table 13.

Table 13 Full Schedule of Work for Asbestos Removal

Activity	Day 0	Days 1-5	Days 6-10	Days 11-15	Day 16
Beginning of regulatory activities - Permit Application for Asbestos Removal and Packaging					
Training of workers					
Removal and packaging of visible asbestos materials					
Clearance of site to reveal hidden pieces					
Disposal					

4.2.4 Demolition Material

After disposal of the wastewater and sludge, the demolition of existing buildings and structures will take place. There are thirteen buildings/structures that will be demolished. The demolition plan indicate that the facilities that will be demolished include concrete buildings, concrete electric poles, pump houses, settling tanks; primary and secondary waste treatment tanks and sludge drying beds (Figure 6). These structures consist of an approximate volume of 1,632m^3 of concrete or approximately 86 truckloads. Before demolition, it will be ensured that the electrical wires presently on the electrical poles are not "live" by consulting with the Jamaica Public Service Co. Ltd. If they are then the necessary steps will be taken to deactivate power to them.

The structures to be demolished are of two types block wall and reinforced concrete. The structures will be demolished using a combination of a D6 bulldozer, a CAT excavator with breaker attachment and hand operated jack-hammers.

It must be mentioned that all the steelwork which formed part of the sewage treatment system has already been removed by persons that are in the scrap iron business.

The demolition of the structures will take approximately 9 weeks and the excess materials will be carried by properly covered trucks to the Riverton City Dump.

Water (groundwater) will be pumped from around and within the structures which fall below the water table while demolition is taking place. This water will be pumped to an area on the site that is not currently being used.

Approximately 150mm of topsoil will be removed and stockpiled at the north-western corner of the site to be used in landscaping. The filling of the voids where structures have been removed will take approximately 6 weeks. The site will be filled with 150mm of shingle, graded and properly compacted after which approximately 150mm of marl will be placed on the shingle and graded properly. This activity is expected to take 6 weeks.

The building/rehabilitation of the perimeter wall will be done during the demolition exercise. This will involve the removal of shrubs growing on existing wire mesh fence and walls, building buttress wall on top of existing rubble walls, excavating foundation and building of new security walls including installing razor wire. This will

permanently secure the site. It will take approximately 10 weeks to construct the boundary wall.

It is anticipated that the entire site closure process will take approximately 100 days (just over 3 months) to be completed.

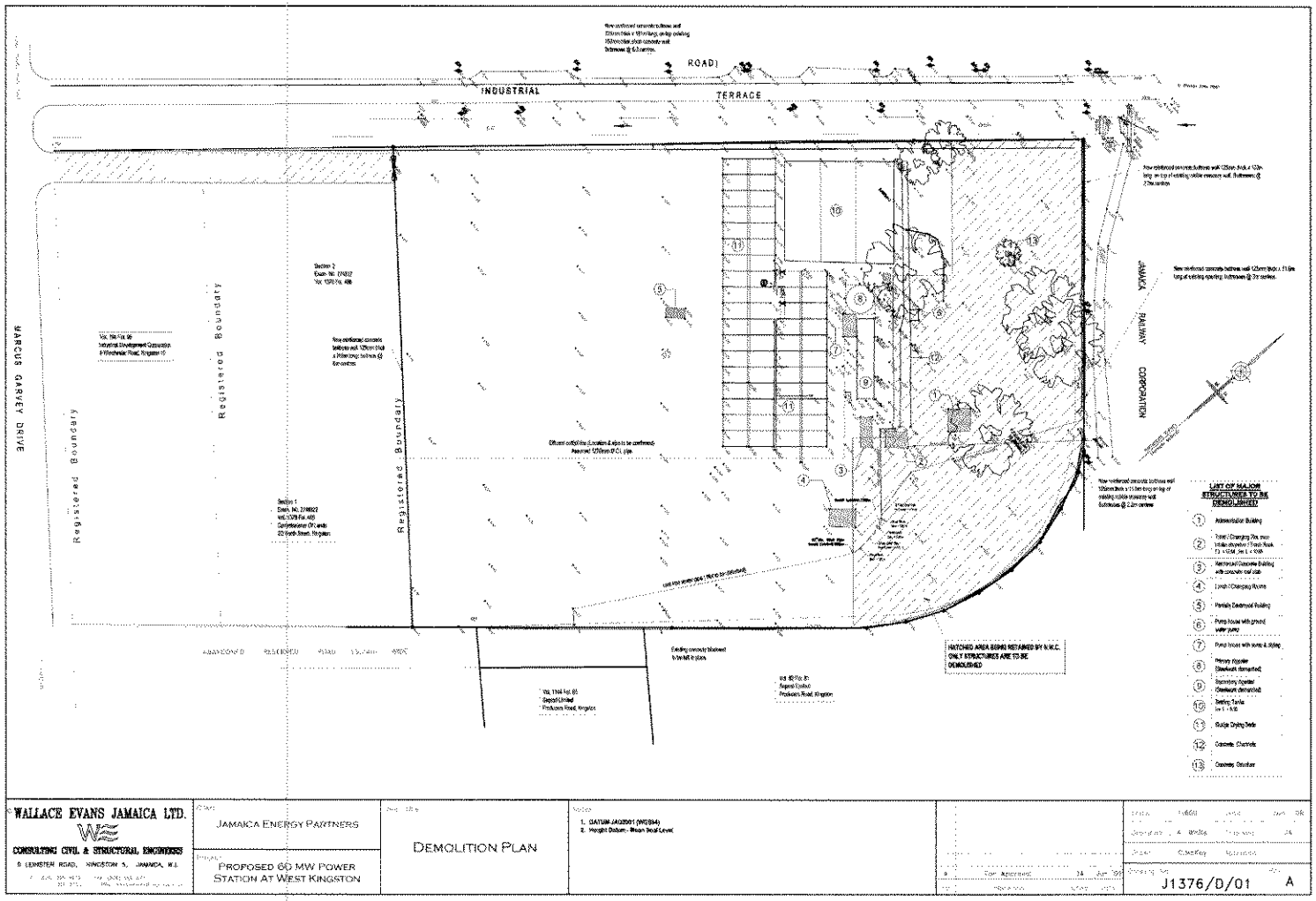

Figure 6 Demolition Plan Map

5.0 SCHEDULED TIMELINE

The scheduled timeline for the closure of the Western Terminal Sewage Plant is outlined in Figure 7.

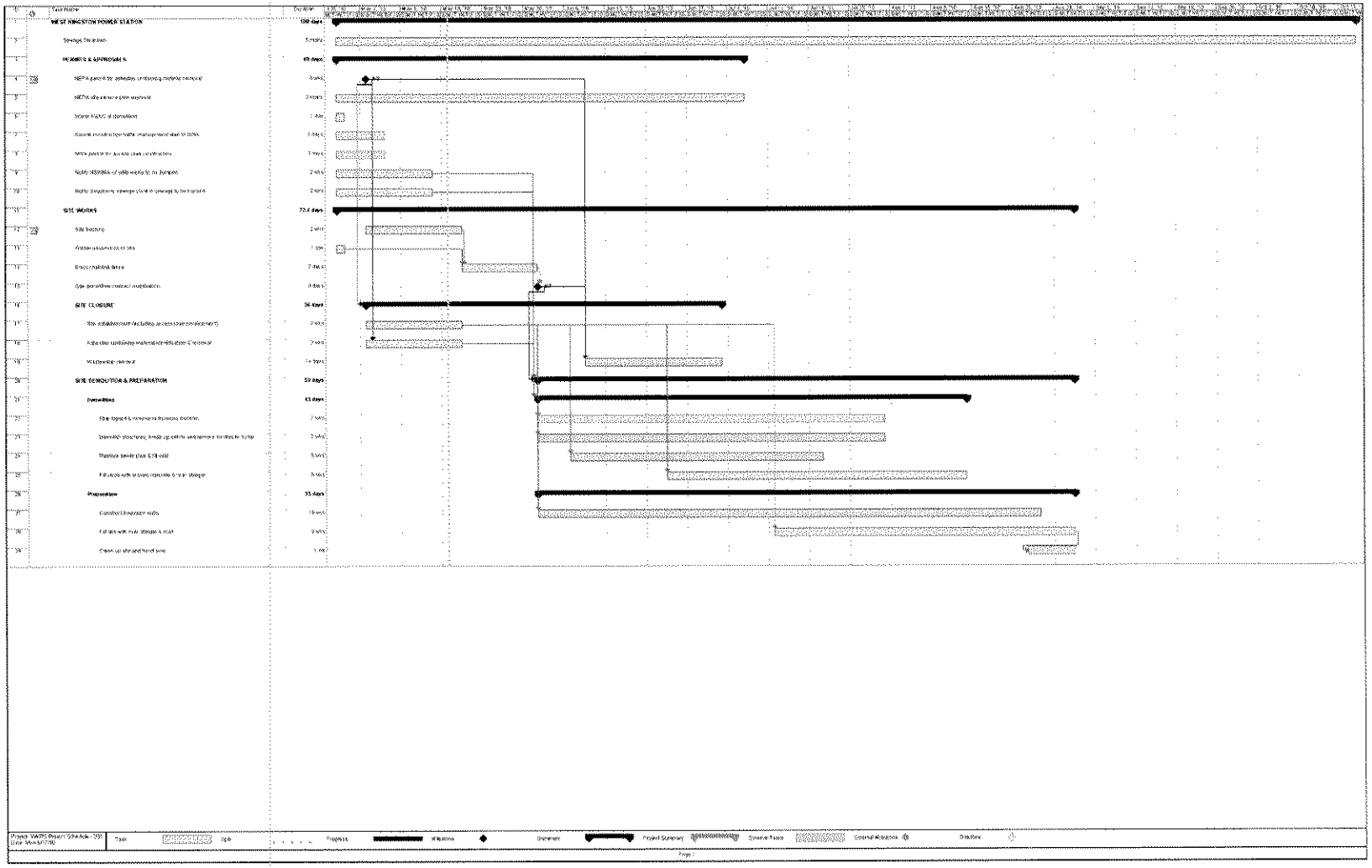

Figure 7 Closure plan schedule

6.0 POST CLOSURE MONITORING

Asbestos air monitoring

Representative sampling will be conducted to determine exposure levels within the site. The results of this monitoring will be compared to the initial exposure monitoring of the made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures.

The asbestos abatement shall be considered final when the levels post abatement is ≤ 0.1 fibre per cubic centimetre of air as an eight (8) hour time-weighted average (TWA).

7.0 REFERENCES

The Jamaica Gleaner (www.jamaica-gleaner.com) Newspaper Archives

- *The treatment of sewage – A heavy price to pay.* Submitted by the Jamaica Environment Trust.
- *High hopes for Harbour clean-up.* Submitted by Janice Ansine, Staff Reporter. February 22, 1996.
- *What a mess! Sewage clean-up to take over five years.* Submitted by Eulalee Thompson, Staff Reporter. October 2, 1997.
- *Manley Meadows on target.* Submitted by Norman Grindley. May 31, 1997.

West Kingston Power Partners 66MW Power Plant Industrial Terrace, Kingston. Jentech Consultants Limited, 2009/612/A.