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WASTEWATER TREATMENT PLANT

FOR

THE WHIM AND BRAMPTON FARMS HOUSING DEVELOPMENTS

ST. CATHERINE

FCS # 0853/76/C

Operations and Maintenance Manual

Prepared for: GORE DEVELOPMENTS LIMITED
2C BRAEMAR
KINGSTON 10

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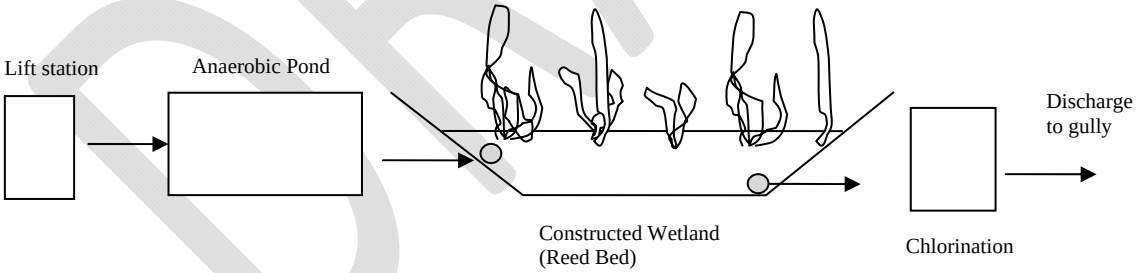
Overview

Gore Developments Limited acquired land just north of Old Harbour Bay St. Catherine for the construction of approximately 2250 two-bedroom detached houses on the property. The proposed development aims to satisfy the demand for housing along the Highway 2000 corridor between Spanish Town and May Pen and will support the housing needs for staff In addition to the homes the development will include a basic school and future construction will include a commercial area and primary and secondary schools.

The proposed waste water treatment plant (WWTP) will provide tertiary level treatment of the wastewater generated by the residential developments at The Whim, Brampton Farms, commercial development area, as well as that of the proposed primary and secondary schools to be built in the future. The collection system from both the WHIM and Brampton Farms development will direct the sewage flow to a terminal lift station which will then pump the sewage into the head works of the WWTP.

The proposed WWTP is a biological system which includes anaerobic ponds, reed beds, and a chlorination chamber with final disposal in an existing gully as shown in the flowchart below. This operations and maintenance manual describes the plant treatment requirements, the operations of the various treatment processes, equipment maintenance and preliminary safety guidelines. After equipment has been procured the manual will be updated with the equipment specification operational guide sheets



Operations and Maintenance

The operations and maintenance plan includes activities that cover the lift station including the electrical and mechanical equipment, the anaerobic pond, reed beds, chlorination equipment and the testing required to maintain a reliable sewage treatment service for the subdivision.

Operation

The operator of the lift station and chlorine contact chamber must be a Secondary School graduate and must be trained as an operator by the equipment suppliers.
The following are general requirements for the WWTP as a whole:

- All equipment on site must be operated in accordance with the suppliers' manuals.
- The weigh scales and other measurement devices must be calibrated once every six months by the Bureau of Standards Jamaica.
- The plant site must be kept orderly and cleaned regularly.

Lift Station

The lift station proposed at the sewage treatment plant site is designed with the following characteristics:

	Sump and Pump levels	Qty	Unit
a	Pumping rate	4,234	Lpm
b	Minimum running time (tr min.)	3	min
c	Minimum cycle time (tc min.)	17.5	min
d	V = working volume of wet well		
e	Minimum working vol based on running time		
	V min = (tr min.) x (Q out - Qmin in)	11,979	L
f	Minimum working vol based on cycle time		
	Shortest cycle time when Q in = 0.5 x Qout		
g	V min = (0.5 Q out x tc min)/2	18,522	L
h	Working volume =	18,522	L
	or	18.52	cu m
	Rectangular sewage well		
j	Plan dimensions (L)	3.00	m
	Width	3.00	m
	area	9.00	sq m
k	Height of working volume	2.06	m

The pumps chosen will have the capacity to lift 32.1 l/s to approximately 4 m. As part of the operation of the lift station the following is required.

This lift station will be in operation prior to completion of all phases of the project. The float switches are to be adjusted in order to ensure that the sewage does not have a retention time in the wet well long enough to cause it to become septic.

- The trash basket is to be inspected at the beginning of each shift and cleared prior to the morning and evening peak flow
- The waste collected in the basket is to be stored for collection and disposal at a solid waste landfill
- Pumps are to be started according to the directions in the manufacturers manual
- The pump operating curve and extracts from the operations and repair manual is to be on site in the operations booklet.
- The sewage flow meters are to be read daily at the same time, and the amount of sewage pumped is to be recorded.

This lift station will be in operation prior to completion of all phases of the project. The float switches are to be adjusted in order to ensure that the sewage does not have a retention time in the wet well long enough to cause it to become septic (over 30 minutes). The sewage pumping log will aid in the adjustment of the float switches.

Anaerobic Pond

The primary treatment component of the WWTP consists of two anaerobic ponds each with a capacity of 2,257 m^3. Anaerobic ponds are designed for removal of Biochemical Oxygen Demand (BOD) which is achieved by sedimentation of solids, and subsequent anaerobic digestion in the resulting sludge.

For the commissioning of the WWTP anaerobic ponds must be filled with raw sewage and seeded with sludge from conventional sewage treatment plants or septic tanks. After filling and seeding, the pond should gradually be loaded up to the design-loading rate (which is specified in the design report).

The pond contents should have a pH above 7, to allow the development of methanogenic bacteria. Lime or soda ash is added, if necessary, to rise the pH in the pond.

For a new sewerage system with a low flow rate to the anaerobic pond, the sewage may be bypassed till the flow rate and the loading rate from the sewerage systems satisfies the condition to be discharged in the pond. It is important to have a bypass from the anaerobic pond that will be used during de-sludging.

It is also recommended that the ponds be commissioned during the beginning of the hot season, in order to allow the quick establishment of microorganisms of importance for the waste stabilization ponds.

- At the commencement of operations the influent is to be sampled daily to ensure pH, and BOD levels meet the design criteria
- The influent and effluent is to be sampled and tested weekly to ensure removal efficiency levels are achieved.
- Influent and effluent concentrations are to be recorded for submission to the regulatory authorities.

- The distribution box to the ponds is to be inspected daily and cleared of any blockages.

Frequent monitoring of the final effluent quality of a pond system is required to address the following needs:

1. Regular assessment regarding whether or not the effluent complies with the NEPA discharge standards; and
2. Detection of any sudden failure, or determining if the pond effluent has started to deteriorate; it also may help identify the causes of the problem(s) and the remedial actions to be taken.

Reed Beds / Constructed Wetland

Constructed wetlands are designed to be passive and low maintenance, thereby not requiring continual upkeep. This wetland is designed as a horizontal sub surface flow wetland. The species have not been chosen for this wetland, this depends on the locally available plants at the time of construction. The species under consideration are typha, Phragmites, and scirpus.

Operational control required for effective performance includes the following.

- For commissioning the water levels need to be controlled so that the plants will not drown.
- During the start-up period, the operator should inspect the wetland several times per week
- When the plants are established the water levels need to be raised to design levels.
- Replacing plants as required (seedlings are planted 0.4 to 1.0 m apart);
- Maintaining the embankments;
- Removing litter and debris;
- Checking the water flow rate to a constructed wetland to determine if it is in accordance with the design;
- Removing any blockages in the inlet and outlet works;
- Removing any unwanted weed species from the constructed wetland;
- Checking the plants for any sign of diseases;
- Correcting erosion and slumping; and
- Checking for any signs of over-flooding.

Chlorination Chamber

The chlorination chamber is designed to reduce fecal coliform levels to acceptable standards prior to discharge into the storm water drain and natural wetland. The following is necessary for operation of the chlorination chamber.

- Maintain one full chlorine tank in storage unconnected to the chlorination equipment. Three 45kg cylinders must be on site at all times.
- Connect two chlorine tanks with only one in use until depleted.
- Calculate the chlorine usage, and order further chlorine stocks when necessary.
- Cleaning the equipment room weekly.

- Check the chlorine residual levels in the effluent daily and, as necessary, adjust the rotameter to increase the feed rate if they are too low and decrease it if they are too high.
- Check and record the effluent quality monthly.

The appendix contains daily and monthly condition report forms as well as forms to report malfunctions. All records must be available for inspection by the Health Inspector for their review at all times in the office at the plant site.

Maintenance

General maintenance for the sewage treatment plant includes the following:

- Repairing any damage to the fences or gates.
- Clearing the drain around the WWTP
- Cutting the grass in the buffer zone
- Removal of garbage

Lift Station

The lift station components should be inspected every 3 months. The pumps should be removed and cleaned; the level switches should also be cleaned. After cleaning, the pump should be rinsed out with clear water and a number of automatic pumping cycles carried out.

Before commencing any maintenance work the pump should be completely disconnected from the electricity. The operator is to refer to the equipment manual to determine the correct procedure for disconnecting the pump.

Anaerobic Pond

Maintenance of the ponds should be carried out regularly to avoid odors, flies and mosquito nuisances. The routine maintenance includes:

- Removing screenings and grit from the inlet and outlet works;
- Cutting grasses on the embankment, and removing it so that it does not fall in the ponds;
- Maintaining scum on the surface of the anaerobic ponds and not removing it, since this will help the treatment processes;
- Removing any accumulated solids in the inlet and outlet works;
- Repairing any damaged embankment as soon as possible; and

Anaerobic ponds require desludging annually or when they are one third full of the sludge by volume. It is estimated that these pond will require de sludging every two (2) years.

The sludge from the pond may be disposed of in sludge lagoons or transported to a landfill site, agricultural land or other suitable disposal area. The sludge disposal should be done in accordance with local regulations

Frequent monitoring of the final effluent quality of a pond system is required to address the
The methods for collecting composite samples are as follows:

- Automatic sampler -- which takes samples every 1-2 hours, with subsequent manual flow weighting if this is not done automatically;
- Grab samples -- every 1-3 hours, with subsequent manual flow weighting; and
- Column samples – near the final pond outlet.

Reed Beds / Constructed Wetland

The wetland has been designed as three wetlands in parallel in order to ensure continued operation of the WWTP during maintenance and repairs.

The maintenance of the reed beds primarily involves the inspection of inlet and outlet structures to ensure adequate water levels are maintained in the wetland. Submerged inlet and outlet manifolds should be flushed periodically. Additional cleaning with a high-pressure water spray or by mechanical means also may become necessary. Maintenance will also include removal of unwanted species.

Berms and dikes require mowing, erosion control, and prevention of animal burrows and tree growth.

Routine maintenance of the wetland vegetation is not required for systems operating within their design parameters and with precise bottom-depth control of vegetation. Wetland plant communities are self-maintaining and will grow, die, and re-grow each year. Plants will naturally spread to un-vegetated areas with suitable environments (e.g., depth within plant's range) and be displaced from areas that are environmentally stressful.

Harvesting and litter removal may be necessary but a well-designed and well-operated VSB system should not require routine harvesting. Harvesting of Phragmites at the height of the growing season and just before the end of the growing season does help to remove some nitrogen from the system.

At the end of its design life (15-20 yrs), a wetland will be either be refitted, or decommissioned if no longer required. Refitting may be required when the accumulation of wetland sediments is adversely affecting wetland performance. Major refits may include the removal of accumulated peat, and replacements of substrates.

Safety

Safety precautions must be adhered to by all personnel and visitors to the WWTP. These can be in the form of clearly marked signs throughout the plant site. Safety precautions should be discussed in relation to testing wastewater and other hazardous substances. First aid procedures for dealing with accidents involving personal injury should be available through adequate training and the maintaining of a first aid handbook and kit on site.

Rubber gloves must be worn with the direct handling of sewage or sludge and if there is direct contact hands must be washed and rinse in a bactericidal solution. Food and drinks should be kept in office areas and measures taken to prevent contamination.

REFERENCES

Constructed Wetlands Treatment of Municipal Wastewaters
EPA/625/R-99/010 September 1999

WASTE STABILIZATION PONDS AND CONSTRUCTED WETLANDS DESIGN MANUAL
UNEP-IETC with the Danish International Development Agency
S. Kayombo, T.S.A. Mbwette, J.H.Y Katima, N. Ladegaard, S.E. Jørgensen

APPENDIX

- Malfunction Reporting Form
- Daily Plant Condition Form
- Monthly Scheduled Maintenance Form
- Estimate of Waste Water Flows

Malfunction Reporting Form

THIS FORM TO BE COMPLETED AND SENT TO THE MINISTRY OF HEALTH ENVIRONMENTAL HEALTH DIVISION WITHIN 24 HOURS OF MALFUNCTION	
The Whim & Brampton Farms WWTP **St. Catherine**	**Process Type: Wastewater tertiary level treatment**
Malfunction Reporting Form	
Date of malfunction:	**Staff on duty at time of malfunction**
Time of malfunction:	
Date of report:	**Report prepared by:**
Description	
Nature of Malfunction	
Immediate actions	
Further actions required	
Plant restored to satisfactory operations	
Name of officer/s:	
Date and time:	
Send to:	
1) Manager:	
2) Manager Ministry Of Health	
Environment Health Department	
Spanish Town, St. Catherine	
Tel:	
Fax:	

Daily Plant Condition Report Form

Whim & Brampton Farms WWTP		
St. Catherine		**Process Type: Wastewater tertiary level treatment**

Daily Plant Condition Report Form

Date:		**Staff schedule**
Insert 'Y' for yes or 'N' for no beside question if component is OK		
General description of plant		
OK		
Repairs required		**Report prepared by:**
Description		Name of Inspector / comments
Wet Well		
Pump flow rate		
OK		
Repairs required		
Pressure reading		
OK		
Repairs required		
Operator action, repair or changes required:		
Pumping equipment		
Operator action, repair or changes required:		
Anaerobic Ponds		
Operator action, repair or changes required:		
Reed Bed		
Operator action, repair or changes required:		
Chlorinator		
Chlorine regulator and scale OK		
Operator action, repair or changes required:		
Residual Chlorine Measurements		
Location 1		
Location 2		
Location 3		
Operator action, repair or changes required:		

Monthly Maintenance Form

The Whim & Brampton Farms WWTP	
St. Catherine	**Process Type: Wastewater tertiary level treatment**

MONTHLY SCHEDULED MAINTENANCE FORM

Date:	**Report prepared by:**
Scheduled Inspections	
Description of equipment	**Serial number**
Parts to be replaced and date for scheduled replacement	
Regular maintenance Please list activity and dates to be carried out	

Estimate of Waste Water Flows

Gore Whim and Brampton Water Demand Estimate			
Item	**Description**	**Qty**	**Unit**
1	**Number of residential lots**	2,250	No
2	Estimate of the number of persons per lot	4.50	No
3	Population Estimate	10,125	No
4	Average per capita consumption per household resident	227	Liters
5	Estimate of domestic water use	2,298,375	Liters
6			
7	**Commercial and Light Industry**		
8	Commercial and shopping area	78,768.00	m^2
9	Usage per unit area commercial space	14.68	L/m^2
10	% Area used for commercial floor space	20%	
11	Estimate of floor space	15,753.60	m^2
12	Water for commercial and light Industry	231,265	L
13			
14	**Basic School**		
15	Student Population	250	No
16	Staff Population	25	No
17	Total Basic School population	275	No
18			
19	**Primary School**		
20	Student Population	1,800	No
21	Staff Population	144	No
22	Total primary school population	1,944	No
23			
24	Per Capita demand for each head of school population	57	Liters/day
25	Estimate of Basic School demand	15,675	Liters/day
26	Estimate of Primary School demand	110,808	Liters/day
27			
28	**Other water use** (5% domestic use)	114,918.75	Liters
29	**Average day demand**	**2,771,041.46**	**Liters**
30		**2,771**	**m^3/d**
31	sewage generation factor	0.85	
32	**Average daily sewage generation**	**2355**	**m^3/d**
33	Safety factor	1.17	
34	**Required STP capacity**	**2771**	**m^3/d**