GOVERNMENT OF GHANA

GA SOUTH (WEIJA) MUNICIPAL ASSEMBLY

FOM-H

(FACILITY OPERATION AND MAINTENANCE HANDBOOK)

for

MALLAM MAIN, MALLAM SCC, OBLOGO No.1 AND SARBAH REHABILITATED DUMPSITES

JANUARY 2014

REHABILITATION OF DUMPSITES

1. This Facility Operation and Maintenance Handbook (FOM–H) is prepared for the closed dumpsites; Mallam Main (No.1&2), Mallam SCC, Oblogo No.1 and Sarbah dumpsites, all within the Ga South Municipal Assembly (GSMA) in the Greater Accra Region.
2. The rehabilitation and closure of three of the sites (Oblogo No.1, Mallam Main (No.1 &2), and Mallam SCC) were carried out as part of the Accra Metropolitan Assembly (AMA) - managed Solid Waste Management component of the Government of Ghana/World Bank Urban Environmental Sanitation Project-Phase II (UESP-II). The rehabilitation and closure of the Sarbah disposal site was carried out as part of the GSMA component of "Quick Gains" project under the Ghana- Netherlands Water, Sanitation and Hygiene (WASH) Project.
3. To sustain a better O&M management of the sites, all stakeholders including the Assembly and the Community members must be involved.

Summary of rehabilitated dumpsite in Ga South Municipality

Name of Dumpsite	MALLAM MAIN (No 1 & 2		MALLAM SCC	OBLOGO No.1	SARBAH
Location	Gbawe		MaCarthy Down	Oblogo	Weija
Period-in-Use/Period Closed (Yrs)	July 1991-May 2001 (10yrs)		Feb 2009 – Dec. 2009 (9 months)	Jan 2002- July 2007 (5 yrs)	Dec. 2009 – June 2012
Estimated volume of Waste Dumped/Placed	2,698,570 Metric tons		400,000 Metric tons	2,378,390 Metric tons	1,025,385 Metric tons
Plan Area/ha	4.3	4.4	1.6	5.5	3.9
Actual Project Completion date	September 2013		September 2013	August 2013	February 2014
Source of Funding	Accra Metropolitan Assembly/World Bank Second Urban Environmental Sanitation Project (UESP II)				Ghana Netherlands WASH Project

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4. This FOM-H contains activities for effective and efficient O&M of the rehabilitated sites and shall include, but not limited to the following:
    - **Leachate Management System**
        - *Sump*
        - *Leachate Transmission pipes*
        - *Attenuation Tank*
        - *Sub-surface Leachate Re-circulation/Irrigation System*
        - *Toe pipe*
    - **Erosion Control and Re-vegetation**
        - *Capped surface & sloped surfaces*
    - **Landfill Gas emission monitoring**
    - **Surface and Groundwater Quality Monitoring**
    - **General Site Maintenance and Operation**
        - *Site Security*
        - *Warning Signs*
        - *Fences*
        - *Access roads*
        - *Drainage system*

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1 LEACHATE MANAGEMENT SYSTEM

For reducing the impact and handling of generated leachate, the sites have a WasteCare Sub-surface Irrigation of Re-circulated Leachate system (WC-SIRL) installed. Leachate generated through the anaerobic decomposition of waste flow through the refuse mass to the lowest points. Perforated Toe pipes laid at these lower sections carry the leachate to the sump.

The leachate is stored in the sump for about a month before the sump is filled up. The leachate is then pumped to the attenuation tank. This completes the first cycle of the re-circulation process.

For the second cycle, leachate is released slowly from the Attenuation tank into a Sub-surface perforated pipe network in the waste mass

To ensure, the efficiency of the Re-Circulation System, proper maintenance of each component of the system is essential.

THE SUMP

All the sites have a reinforced concrete tank (sump) at the lowest point of the site to facilitate easy collection of leachate by gravity.

Possible Defects	**Mitigation measures**	
Reduction in the tank volume: This is due to sedimentation of sand and/or other suspended particles	• Level of leachate in sump should be checked frequently especially in the rainy season where leachate production is expected to increase; • Pumping should be done periodically to prevent tank overflow • The surface of the sump should not be covered /submerged totally with soil to ensure easy access to tank outlet • No excavation should be done around the sump. • Desludge the tank every 5years	

THE TRANSMISSION PIPE

The Transmission pipe consists of a series of connected non-perforated PVC pipes and conveys leachate from the Sump into the Attenuation tank.

Possible defect	
Pipe burst & Blockage: This may be caused by high internal/external pressure within or on the pipe. Pipe burst leads to the accumulation of sand in the pipe	
Mitigation Measure	
Remove and replace burst/blocked section of the pipe	

THE ATTENUATION TANK

The tank consists of Rambo 1000 polytank with connected PVC pipe fixtures. The tank is relocated from a grid and connected to the other grid for about a year and half ($1\frac{1}{2}$) to two (2) years

Possible Defects	**Mitigation Measure**	
Tank burst or leakage:	Disconnect all fixtures and pipes. Replace tank	
Leakage from connecting pipe fixtures & fittings: This occurs as a result of poor connection between tank and fixtures or defective fittings	Properly tighten the connections using pliers/spanner Replace the defective fixture. Ensure proper cover of tank to make it water-tight Ensure that Protective fence is locked	

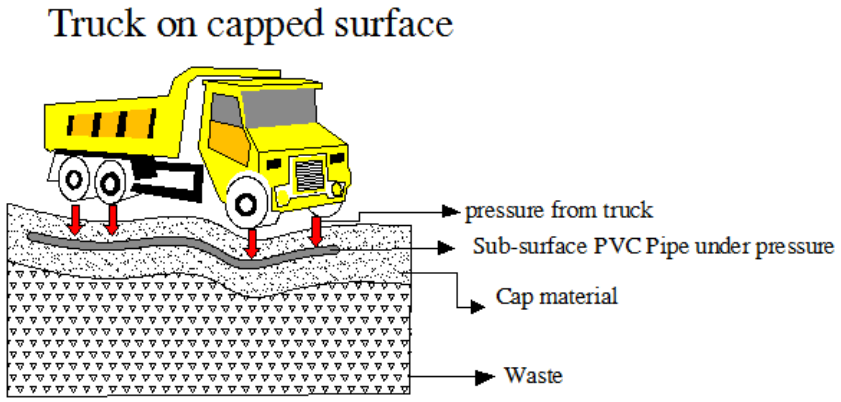
THE SUB-SURFACE RE-CIRCULATION/IRRIGATION SYSTEM

This system consists of a network of perforated pipes for redistribution of leachate into the waste beneath the capped surface. The connecting and redistribution pipes are laid in a grid networked pattern. To enhance the re-circulation of leachate in the waste mass, two (2) separate sub-surface grids are installed. One grid is used for about a year and half ($1\frac{1}{2}$) to two (2) years after which it is allowed to rest while the other grid is put to use.

The possible associated defects are internal blockage of the pipes/perforated holes and damage caused by differential settlement of the capped surface.
These defects are detected when;

- leachate is seen on the capped surface of the site
- Flow through the valve/fixtures to the Re-Circulation System ceases.

Sub-surface pipe network can easily be damaged by pressure from trucks and other heavy equipment on the capped surface as shown below.



It is therefore important to restrict the movement of heavy duty equipment from moving on the site after the installation of the WC-SIRL and other pipe networks.

TOE PIPE

The Toe pipe is a series of connected semi-perforated pipes that convey leachate from the waste into the sump.

Possible Defects	Mitigation measures	
Silting of the pipe: This is caused by the accumulation of sand/silt in the pipe leading to blockage and possible ponding around the toe pipe	The blocked section of the pipe should be removed, desilted and replaced. Alternatively, the blocked section could be replaced with a new one.	

This defect is often detected when flow into the sump ceases and if section along which the toe pipe was laid is always wet.

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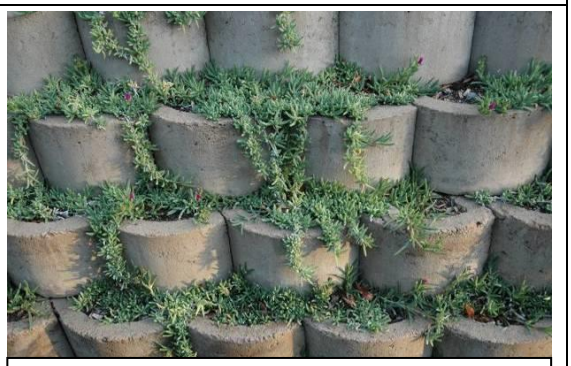
2 EROSION CONTROL & RE-VEGETATION

The washing away of the capping material causes the buried waste to be exposed, thereby making access to rain water easy. This increases the amount of leachate produced.
Erosion is often severe on slopes, hence stability of slopes should always be ensured.

Possible Defects	Mitigation measures	
Capped surface erosion: This is caused by surface run-off	The affected portion should be filled with appropriate cover material and well compacted	
Sloped surface Erosion: This is as a result of surface run-off or surface sliding due to poor compaction of sloped surfaces	Fill affected portion with laterite and ensure adequate compaction and stability. Provide good vegetation cover for the slope surface. Alternatively, hollow interlocking blocks can be placed along steep slope surfaces	 Circular Interlocking Hollow blocks  Rectangular Interlocking Hollow blocks
Loss of vegetation cover:	Areas lacking sufficient vegetation cover must be reseeded. In some cases, soil amendments are added to help establish the native vegetation	

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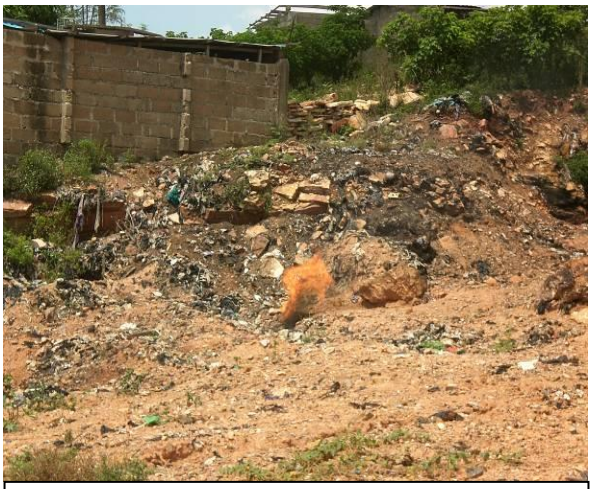
3 LANDFILL GAS EMISSION CONTROL

Landfill Gases (mainly Methane gas) are highly explosive and easily flammable. There is potential leakage of gases through the capped surface. Therefore no naked fire/flame should be lit around the site. These gases can be detected using gas monitoring probes. Also frequent checks on installed Gas Extraction System, if any should be done, to ensure its proper functioning

Emission of landfill gas from a blow-out hole



Ignited landfill gas

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4 SURFACE AND GROUNDWATER QUALITY

Pollution of surface and ground water occurs when leachate seeps through the bottom of unlined landfill sites. All the sites under consideration are not well engineered hence leachate may seep into surrounding water bodies contaminating them.
Periodic (semi-annual) monitoring test of the surrounding water bodies should be done to identify and remediate any contamination in due time.

The drawing below shows sampling points for monitoring water quality of the Densu River

Sample point	Coordinates
Sample point 1	Latitude: $5^{o}33'52.90"$ N Longitude: $0^{0}19'23.61"$W
Sample point 2	Latitude: $5^{o}33'52.34"$ N Longitude: $0^{0}19'14.73"$W
Sample point 3	Latitude: $5^{o}33'50.44"$ N Longitude: $0^{0}19'09.05"$W

5 GENERAL SITE OPERATION AND MAINTENANCE

SITE MAINTENANCE GANG

Two (2) caretakers are needed for each site. Caretakers shall undergo facilities' operating and maintenance training.

Caretakers will have additional responsibility for site security to protect installed facilities.

Annex 3 shows a draft maintenance assessment form to aid personnel in their routine maintenance work.

Training of Caretakers very important	

WARNING SIGNS

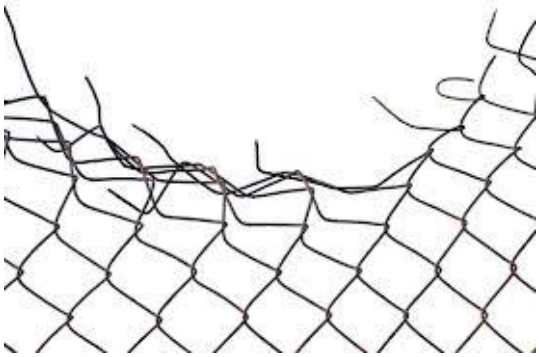
Warning signs/posts should be placed at vantage points to inform and keep the public away from the rehabilitated sites.

Meaning	Sign
Keep off , danger ahead	
NO SMOKING OR NO NAKED LIGHT Naked fire can cause explosion.	
NO EXCAVATION No excavation should be done here.	
NO ENTRY, AUTHORISED PERSONS ONLY	
EXPLOSIVE/FLAMMABLE GASES Landfill gas (LFG) – highly explosive and easily flammable.	
KEEPS OFF LEACHATE	

FENCES

Protective fencing around the sites and installed facilities provides security and helps in the control of air-blown litter unto the site. It also checks access to the sites and illegal dumping of refuse by neighboring residents.

Damaged fences should be repaired promptly.



Repair/Replacement of damaged fence wires (Use protective gloves and pliers)

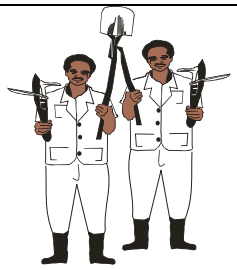
ACCESS ROADS

Access roads leading to the sites should maintained and be motorable.

DRAINAGE SYSTEM

The main drainage system of the sites is the peripheral drain. This drain conveys storm water run-off from the site.
The drain should be cleaned and desilted to allow free of water.

The maintenance gang will supervise periodic cleansing of drains

ENGAGE GANG TO CARRY OUT PERIODIC CLEANSING OF DRAINS	 
ORGANIZE PERIODIC CLEAN-UP EXERCISES TO CLEAN UP THE DRAINS ESPECIALLY BEFORE THE RAINY SEASON	
DO NOT DUMP REFUSE, HUMAN EXCRETA AND ANIMAL WASTE INTO DRAINS. ENSURE THAT DRAINS ARE ALWAYS KEPT CLEAN.	

PUMP SERVICING

Each site installed with WC-SIRL has pumps for pumping leachate from the Sump into the Attenuation tank. It is important to service these pumps every 3 months

Pump should always be serviced, cleaned and greased and put in storage when not in used.

Coupling of the pipe should be securely fixed for efficient pumping

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6 PERSONNEL REQUIREMENT SCHEDULE FOR O&M

The personnel requirement and their roles in O&M are shown in the table below.

Personnel	No. Required	Role
Caretaker/Security (2 shifts per day)	2	1. Keep good record of status of installed facilities and various pumping test carried out. 2. Supervise labourers to carry out their duties 3. Keep inventory of all equipments and supplies 4. Report all faults to the appropriate authority for remedy 5. Carry out periodic check on installed facilities 6. Ensure safety of installed facilities
AS AND WHEN REQUIRED		
Plumber	1	1. Carry out repairs on all plumbing fixtures
Pump Repairer	1	1. Carry out routine servicing and repairs on pump
Electrician	1	1. Carry out repairs on all electrical fixtures
Mason	1	1. Carry out all masonry repairs, mainly drains.

FOM-H **7** **ANNUAL OPERATIONS AND MAINTENANCE COST**

Equipment and Services List for Operations

ITEM	DESCRIPTION	Quantity.	Present Unit Cost/Rate (GH ¢)	Amount/year (GH ¢)
Maintenance tools				
1	Cart or wheel barrows: for refilling eroded capped portions 	4x1 No./3 years /site (Total = 4)	70.00 (Estimated Amount provided every 3 years)	280.00
2	Concentrated Disinfectant: For cleansing hands after working with leachate. 	4x2 Gallons/year/site (Total = 8)	20.00	160.00
3	Hand Towels: For wiping hands after cleaning 	4x12 No./Year/site (Total = 48)	3.00	144.00
4	Medicated Soap: For washing of hands after maintenance works 	4x12 No./year/site (Total = 48)	2.00	96.00
5	Pair of Hand Gloves: 	4x4 Pairs/year/site (Total = 16)	15.00	240.00
6	Nose masks: For maintenance works, especially when working with leachate 	4x24 No./year/site (Total = 96)	5.0	480.00
7	Wellington boots 	4x2 No./year/site (Total = 8)	25.00	200.00

8	Overall coat 	4x2 No./year/site (Total = 8)	25.00	200.00
9	Shovel & Compaction tools 	4x4 No./year/site (Total = 16)	50	800.00
10	Pliers and Spanners 	4x1 set/site (Total = 4)	50	200.00
			Sub-Total	**2,800.00**
11**. Environmental Monitoring Activities**				
	Ground water monitoring Tests	4x8 No.	1500	48000
	Surface water monitoring Tests	4x4 No.	1500	24000
	Leachate Quality Evaluation Test	4x4 No.	1500	24000
			Sub-Total	**96,000.00**
12. **General Site Inspection & Maintenance Activities**				
	Fence repair (site & Recreationals)	1	11,775	11,775
	Re-grading of Access roads	1	4000	4000
	Drainage system repairs	1	2000	2000
	Site Caretakers/Security	8	8X12 (GHC 250/month)	24,000
	Security Company Services	1	600x 12	7,200
	Warning signs	1	1000	1000
	Plant removal & Rodent control	1	4000	4000
	Pump Servicing	5	100	500
			Sub-Total	**54,475.00**
13**. Leachate Management System**				
	Transmission pipe repair	1	300	300
	Toe pipe repair	1	1000	1000
	Maintenance of the Attenuation tank and valve repairs	4	2500	10,000
	Settlement damage to cover /Sub-surface pipe network.	1	1500	1500
	Desludging of the sump (when necessary)	1	600	600
			Sub-Total	**5,900.00**

14. **Erosion Control and Re-vegetation**				
	Erosion damage/Re-grading to cover	1	5,000	5,000
	Annual Re-seeding	1	2000	2000
	Replacement of damaged Interlocking hollow blocks	1	1500	1500
			Sub-Total	**8,500.00**
15. **Landfill Gas Emission Monitoring**				
	Detection of surface emission gases using monitoring probes (Portable Multifunctional Flammable Gas Detector Co...) 	200	1	**200.00**
16. **Utility Bills**				
	Electricity Bill/Light source	4x12 months (1year)	100.00/month	**4,800.00**
	Water services bill	4x12 month (1year)	60.00	**2,880.00**
TOTAL ANNUAL OPERATION COST			**GH₵**	**175,555.00**

ANNEX 1 :

FIELD INSPECTION CARD

NAME OF SITE: _____ MONTH:_____

DATE	TIME	FENCES 	DRAIN 	TOE PIPE 	SUMP 	ATTENUA-TION TANK 	CAPPED SURFACE 	SLOPE SURFACE 	REMARKS	CHECKED BY	SIGN

Note: Indicate defects by checking(√) the appropriate section and provide brief detail in remarks column

ANNEX 2: DRAIN CLEANSING & TOE PIPE INSPECTION CARD

DATE	TIME	SECTION OF DRAIN / TOE PIPE	CONDITION	REMARKS

ANNEX 3: SITE MAINTENANCE ASSESSMENT FORM

Capped Surface Maintenance	**YES**	**NO**
Are there any eroded areas that need to be repaired? If yes, placed additional soil, re-graded, reseeded and mulched on: Date:_____		
Are there any depressions or areas of subsidence on the landfill or does water collect and pond on areas of the landfill after a rainfall? If yes, placed additional soil, re-graded to level ground: Date:_____		
Is a shrub or grassy vegetation established? If no, reseeded and mulched on: Date:_____		
Are there bare spots or areas of dead vegetation? If yes, placed additional soil, re-graded, reseeded and mulched on: Date:_____		
Are there any areas where leachate is surfacing and pooling on the landfill? If yes, area around the leachate outbreak must be dug out, pipe must be checked. Also additional clay soil placed, area regraded, reseeded and mulched on: Date:_____		
Landfill Gas Extraction System	**YES**	**NO**
If there is a gas collection or extraction system present on the landfill:		
Is there an approved methane gas collection or extraction system design or operations plan(s) for the landfill?		
If yes, does it include an inspection, operation and maintenance schedule?		
If yes, include required actions and dates you performed the required actions: Date:_____Action:_____ Date:_____Action:_____ Date:_____Action:_____ Date:_____Action:_____		
If no, please answer the following questions: Have you inspected the components of the LFG extraction system? If yes, list the dates of inspection: Dates:_____ and_____		
Were problems observed? If yes, decribe: _____ _____ _____		
Prior to repairs or replacement parts being installed or modifications being made to the extraction system, did you contact the consultant? If yes, provide the date and who you spoke with: Date:_____ Who you spoke with:_____		

Were repairs or replacements made to the system? If yes, list when and describe: Date:_____ Describe:_____ _____		
Does your landfill have methane gas monitoring wells? If yes, what is the required monitoring frequency? Weekly Monthly Quarterly (*circle all that apply*)		
If yes, have you conducted and submitted the results for the monitoring to the appropriate authority? If yes, list dates: Dates:_____ who _____		
Surface & Ground water Monitoring	**Yes**	**No**
Have you inspected and sampled the surface water around the dumpsite to ensure they are tested in the laboratory? If yes, list dates: Dates:_____ and_____		
Have you inspected and sampled the groundwater around the dumpsite to ensure they are tested in the laboratory? If yes, list dates: Dates:_____ and_____		
Have you notified the Environmental Health Department (EHD) of the concerned assembly about the results of the laboratory test? If yes, list date and staff of EHD informed: Date:_____ EHD Staff_____ (*provide copy of result to consultant*)		

Specify/describe other maintenance works done:

_____
_____
_____
_____
_____

Name of Inspection Officer:_____

Date of completing the entire form:_____

Signature:_____

WASTECARE

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