FORT PORTAL MUNICIPAL COUNCIL

Environmental Impact Statement for the Proposed Landfill and Waste Composting Plant at Kiteere Village, Kibimba Parish, West Division, Fort Portal Municipality

Prepared by,

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We hereby certify that the Environmental Impact Assessment (EIA) for the proposed Waste disposal and composting site for Fort portal Municipal council in Kiteere Village, Kibimba Parish, West zone, Fort Portal municipality, Kabarore District was carried out and this Statement prepared in accordance with the Terms of Reference (appendix). It is comprehensive to all the issues and possible environmental impacts of the proposed project. Below is a description of the consulting team and the different aspects studied;

Name	Description	Aspect/(s) studied	Signature
Moses Muhumuza M	BA. Environment Management Team Coordinator. *Certified Environmental practitioner*	Socio economics and planning;	
Otim Moses	BSc (Industrial Chemistry), MSc (Environmental Systems Analysis and Management) *Certified Environmental practitioner*	Solid Waste management; Site suitability analysis	
Nkutu David	BSc. Forestry *Certified Environmental practitioner*	Ecological, site sensitivity and biodiversity;	
Ivan Birungi	BSc, Hydrogeology	Site suitability analysis, Geophysical sounding	

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Acknowledgements

The Assessment Team would like to thank all those who provided information that made it possible to prepare this report. In particular, the Assessment Team would like to thank Fort portal Municipal Council Officials, residents and the business community within FMC, neighbours to the proposed project site and the technical staff from NEMA.

Abbreviations and Acronyms

CIP	Cleaning in Place
EIA	Environmental Impact Assessment
EIS	Environmental Impact Assessment
FMC	Fort portal Municipal Council
NEA	National Environment Act
NEMA	National Environment Management Authority
NWSC	National Water and Sewerage Corporation
P B	Project Brief
WIS	Waste Information System

EXECUTIVE SUMMARY

Waste management in Fort Portal Municipality has been a great challenge, given the growing population and waste generation rates. The Municipality with a population of 41,203 persons generates up to 89 tons of waste per day, of which only 65% is collected and disposed, due to resource limitations. The major waste sources include markets, institutions, shops and households. Up to 80% of this waste is biodegradable. The waste disposal sites used by the Municipality in the past have been unsuitable, including one at Buhoiza Central Forest Reserve, at Booma – a residential area, and Bukwali pit – in a grave yard, currently used and already filling up. Attempts to acquire waste disposal sites have been futile, but with the acquisition of 6 acres at Kiteere within the less populated West Division, approximately 5.6 km from the Town Centre, presents an opportunity for the Municipality to ensure this disposal site is developed to have a longer lifespan.

Open dumping is neither safe nor hygienic, and no longer tenable in Fort Portal Municipality and other urban centres in the country. Uganda is among several countries that signed the United Nations Framework Convention on Climate Change (UNFCC), making a commitment to combating Green House Gas (GHG) emissions. This protocol also put in place the Clean Development Mechanism (CDM) to allow developed countries invest in projects that realise reduction in GHG emissions. With an estimated generation of more than 70 tons of organic waste per day, the methane emissions for Fortportal Municipality are quite significant.

Methane constitutes 50% of Land Fill Gas (LFG) emissions. The major factors driving LFG emission levels are the amount of organic material deposited in landfills, the type of land filling practices, the extent of anaerobic decomposition, and the level of landfill methane recovery and combustion. Composting, when managed properly limits methane and carbondioxide emissions only to transportation and mechanical turning. In the case of Fort Portal Municipality elimination of methane emissions through waste composting presents an opportunity for carbon trading under the CDM, sell of manure, and a longer lifespan for the landfill estimated at twenty five years for 2.45 acres if excavated to a depth of 10m.

The major components of the landfill and waste composting plant will include an access road, an office block, parking yard, fence, weighbridge, the different landfill cells, drainage channels, waste composting slab and shade, windrows for waste composting, a leachate collection and treatment plant, and slabs and shade for compost manure and other landfill products.

Other additional infrastructure to be extended to the site will include electrical power from the national grid, and NWSC water connection. Given the nature of the site, excavations will be required in constructing access roads, waste composting slab, office block, parking yard and installation of the weighbridge.

During the operational phase the major activities will involve maintenance of the landfill and composting site infrastructure to ensure effective performance and minimal injury to the environment. There will be composting of the vegetable matter and other easily biodegradable materials, packaging of the compost and daily covering of other wastes with murram gravel.

Project Benefits

Development of a landfill and waste composting plant will go a long way in ensuring safe and sound disposal and utilisation of municipal solid waste, and when handled effectively it will turn into an income generating activity for the Municipal council in addition to ensuring availability of rich compost manure. The municipality will then witness less complaints arising from poor management of solid waste, improved infrastructure and skills for waste management. The local community of Kiteere will also benefit with extension of water and electricity.

Other benefits include elimination of odour problems and vermin infestation associated with existing dumpsite, a longer lifespan for the 6 acre landfill, and improved capacity and efficiency in waste management within the municipality.

Identified likely negative impacts

Landfill and composting sites development can result in negative social and environmental impacts, which can be addressed during the design, construction and operation phases. These among others include loss of site biodiversity and land cover, emission of odorous smell, vermin infestation, contamination of water sources by leachate from the landfill, noise and dust generation from trucks transporting the waste, and likely accidents during transportation.

- A site suitability analysis was undertaken prior to choice of Kiteere. Alternatives to composting evaluated including methane gas trapping and energy generation, several mitigation measures recommended and an environmental management plan

developed for implementation by Fort Portal Municipal Council. Below is a summary of mitigation measures.

- Ensure construction of leachate plant as per plan; Put in place an impervious lining at bottom of landfill, and construct a sump to trap resulting run-off; construct ventilated improved pit (VIP) Latrines for use by the staff; Undertake baseline water quality analysis;
- Undertaking site geo-technical investigation prior to development; Planting of grass and trees on embankments and in stabilised areas;
- Proper landscaping after construction; Construction of shade over windrows to avoid wind effects;
- Follow approved site development plan;
- Develop operation guidelines for waste composting plant, Limited use of earth moving equipment;
- Have in place construction and transportation guidelines;
- Map out land use and land cover prior to site development, undertake biodiversity counts before site development. Prepare site plan and seek planning Authority Approval. Limit site clearance to specific infrastructure sites.
- Limit site clearance to specific infrastructure sites. Restore preferred natural habitat e.g. indigenous tree species, Limit mechanised works;
- Put in place signage to guide traffic; Have a parking yard for vehicles; Improve access roads to site and ensure their maintenance; Develop road safety guidelines for truck drivers;
- Extend piped water and electricity and construct water kiosks for the Kiteere community; Provide appropriate PPE for the workers; Ensure a functional First Aid Kit on site;
- There will be no clinical or chemical waste allowed to the disposal site; such waste will be incinerated away, from the already existing incinerators in the municipality. This will be in addition to such varied measures as fines to health centres and any suspect source points, where such waste is found on the nearby skips;
- Ensure proper lighting around the facility; Employ guards to ensure safety of the facility workers; Liase with local security for any incidents;
- Stabilise foundation for administrative block to withstand strong earthquakes; Utilise geotechnical investigation findings and recommendation about the site geological profile; Put in place flood protection structures; Ensure drainage construction to direct water downstream away from the landfill;

- Install a safety ramp and signage against the steep depression that is along the route to the project site;
- Fire emergency plan should guide operations during fire outbreaks; Installation and proper maintenance of fire fighting equipment; Training employees in basic fire-fighting methods and ensure that the fire escape routes are always free from any obstacles;

Implementation of the proposed mitigation measures and monitoring plan will require participation of various stakeholders, and these should ensure that;

- The proposed mitigation measures are implemented and are functional at the landfill, including the landfill and composting plant designs and construction guidelines;

- The proposed environment monitoring and management plan is implemented so that operations comply with national environmental laws;

- Safe water/piped water is extended to the local community at Kiteere dependent on the Kagezi springs and stream, in addition to providing for safe water for the domestic animals;

- Regular monitoring of the protected springs water quality downstream to detect any contamination from leachate;

- Broader stakeholder participation in waste management in the Municipality, including the private sector;

- Regular environmental audits must be carried out at least once every year and reports submitted to the National Environment Management Authority for review to ascertain compliance with the environmental regulations and suggested mitigation measures.

Conclusion

The landfill and waste-composting site at Kiteere is suitable given its isolation from residential areas, sensitive habitats, and that this EIA has addressed all ecological and socio-economic concerns predictable, and has proposed mitigation measures for adverse impacts.

Fort Portal Municipal Council is committed to implementation of the proposed mitigation measures, and the developed environmental monitoring and management plan presented in this report.

1.0 BACKGROUND INFORMATION

1.1 Introduction

Fort Portal Municipal Council has had a long-standing challenge in waste management, including locating suitable sites, resources for waste collection and disposal, and the short life span of temporary open dumpsites. With collaboration with NEMA under the CDM, Fort Portal Municipality has an opportunity to improve Municipal solid waste management through waste composting and trading in GHG emissions reductions.

Uganda is among several countries that signed the United Nations Framework Convention on Climate Change (UNFCC), making a commitment to combating Green House Gas (GHG) emissions. This protocol also put in place the Clean Development Mechanism (CDM) to allow developed countries invest in projects that realise reduction in GHG emissions.

Methane constitutes 50% of Land Fill Gas (LFG) emissions. The major factors driving LFG emission levels are the amount of organic material deposited in landfills, the type of land filling practices, the extent of anaerobic decomposition, and the level of landfill methane recovery and combustion. Composting, when managed properly limits methane and carbondioxide missions only to transportation and mechanical turning.

The other waste constituents include plastics and polyethene bags (4.85%), paper (2.55)%, metal Scrap (2.9%, and construction debris (13%).

The site measures approximately 6 acres and is under secondary vegetation a result of periodic cultivation over a long period of time. Development of a landfill and waste composting site can have both positive and negative impacts on the environment hence the need to undertake an assessment for this project to come up with an informed decision.

Section 20 (3) of the National Environment Act Cap 153, requires that all projects or policies that may, are likely to or will have significant impacts on the environment be subjected to EIA so that adverse impacts can be eliminated or mitigated. This EIS identifies, predicts, and evaluates the likely environmental impacts, both beneficial and adverse, with the view to eliminating where possible, or minimising the negative impacts while optimising the positive impacts.

1.2 Objectives, scope and terms of reference of the EIA

The overall objective of the EIA study was to identify possible environmental and social impacts resulting from the development of this landfill and waste composting plant, and to ensure that the environmental considerations are incorporated into the project implementation plan.

Other specific objectives as contained in the terms of reference included:

- Evaluation of the status and suitability of the identified waste disposal sites to be used for final disposal and composting of the wastes;
- To identify and assess the magnitude and duration of both positive and negative impacts resulting from the implementation and operation of the landfill and waste composting, and propose mitigation measures;
- Identify possible involvement of stakeholders and partners for sustainability of the project;
- Identification of existing and potential market opportunities for compost manure and other by-products of the project;
- Elaboration of an environmental management Plan to ensure compliance to the national environmental laws;
- Assessment of the training and capacity building needs necessary for successful project implementation; and
- Compiling an environment impact statement of the project to assist in the decision making process and serve as a basis for future environmental monitoring of the project – offer guidance.

1.3 Methodology

To capture required information for the landfill and waste composting plant EIA, several methods were used including socio-economic methods, bio-physical methods, and engineering methods.

Data and information collection methods varied from one expert to another on the team. For example while the terrestrial biodiversity and aquatic ecologists used standard ecological methods, the socio-economist employed the social methods. Some general methods used by the EIA team members included: Literature review, Field visits, stakeholder consultations and expert opinion. All the project development phases were taken into account. The legal and

policy implications of each have also been pointed out to ensure conformity of proposed activities with legal and policy provisions of the Republic of Uganda.

Documents readily available relating to FMC and immediate neighbourhood were reviewed. These included waste generation factors such as population, economic activities, land use, area physical and proposed development plans among others. Other documents reviewed included the Kabarole District State of Environment Report, the Fort Portal Municipality three year development plan, documentation of waste management in other municipalities, and legislation applicable to waste management.

The socio economic impact analysis was carried out in two phases: Key informant interviews with Government and local institutions and community consultation/ interviews. Literature review and questionnaires were among the approaches used to capture sociological information. The consulting team held consultative meetings in Kiteere village, and with the leadership of all Municipal Divisions to capture information on the acceptability and viability of the project, and on the effectiveness of waste management system in the municipality. It also helped to check on responses/information given by individuals interviewed privately.

The Spatial Planner/Engineering specialist employed mainly the general methods above combined with expert opinion to assess the likely impacts of the proposed project on the environment.

To study the vegetation structure and composition in the area a transect was established to cover the entire project area. Circular plots located every 50 meters were used to assess the plant diversity and abundance. Herbs and shrubs were enumerated in a radius of 2 meters with all individuals counted and recorded while trees were enumerated in 10m radius from the centre of the plots and numbers recorded. Opportunistic sampling was done to record other species that were not recorded within the plots to come up with a complete species list of the site. Effort was made to capture as many distinct vegetation communities as possible and also to capture as many habitats as possible.

Bird species assessments were done using Timed Species Counts (TSCs) a method of rapid surveys which have been widely used in East Africa (*Freeman et al 2004*). Water samples were also taken downstream of the proposed landfill and composting plant site at Kagezi

spring and were analysed at the Government Analytical Laboratory to establish the baseline water quality status.

Transect walks were conducted through the proposed landfill and waste composting sites assessing site suitability and the likely impacts as a result of project implementation. This enabled the consultants to physically make professional observation of the physical environment in addition to other social and environmental attributes likely to affect or be affected by the implementation of this project.

As a result of site visits and observation, consultants were able to triangulate findings from documents reviews, identify land use patterns, vegetation cover, population densities, settlement patterns and prevailing economic undertakings.

1.4 The Consulting Team

The survey team was composed of the core consulting team, which was responsible for directing the study. It was composed of core consultants from different professional specializations and included an EIA expert and Team Leader, Solid Waste Management Specialist, an Economist, a Sociologist, Terrestrial Biodiversity Specialist and a Hydro geologist, three of whom are certified EIA Practitioners with NEMA. The consultants pooled together their varied expertise and experiences to be able to accomplish this assignment.

1.5 Structure of this EIS

The remainder of this EIS is divided into the following principal sections:

Section 2 deals with the legislation taken into consideration that has a bearing on this project;
Section 3 provides a general outline of the existing environment in the area of the proposed project;
Section 4 describes the proposed Landfill and waste composting project, analyses development options, and presents a waste management strategy for Fort Portal Municipality;
Section 5 deals with each aspect of the environment in detail, providing an account of baseline conditions, prediction and evaluation of the impacts of the project and proposed mitigation measures, as well as a site restoration plan;
Section 6 comprises an Environmental Monitoring and Management Plan identifying the measures to be adopted during the operational life of the project to minimise any adverse impacts and provide for appropriate environmental monitoring;
Section 7 puts across main findings and recommendations of the consultancy team.

2.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

Environmental Impact Assessments are a legal requirement and should be carried out for all proposed developments that are likely to have significant environmental impacts so that any negative impacts can be minimised or eliminated. This EIS addresses Kiteere Landfill and Waste Composting Plant which falls under the third schedule of the National Environment Act cap 153 (category 12), waste disposal including sites for solid waste disposal – hence the need to call for carrying out an EIA to conform to the regulatory requirements. The regulations that were considered during this exercise and which will be observed during project implementation (both during installation and operation phases) are stated in this section.

2.1 POLICIES

The National Environment Management Policy, 1994

Its overall goal is the promotion of sustainable economic and social development that enhances environmental quality without compromising the ability of future generations to meet their own needs. The policy clearly states that an EIA should be conducted for any policy or project that is likely to have significant adverse impacts on the environment.

The National Policy for the Conservation and Management of Wetland Resources 1995

This was put in place to curtail on the rampant loss of wetland resources and ensuring that benefits from wetlands are sustainable and equitably distributed to all people of Uganda. The wetland policy calls for undertaking environmental impact assessment on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed. Development of this landfill and waste composting site has to take into consideration this policy since its going to be developed adjacent the Kagezi wetland which therefore calls for undertaking an EIA to ensure that any likely leachate from the landfill and composting operations does not impact on the wetland ecosystem.

National Water Resources Policy 1999

The policy caters for safeguarding water sources. It also stipulates that the quality of drainage water shall be such as not to pollute the receiving water or ground water and that all measures must be taken by the users to prevent increase in salinity levels in receiving waters, to prevent the accumulation of dangerous or toxic compounds in the subsoil, capable of contaminating underground waters. Considering the nature of activity to take place in addition to the likely attributes such as leachate, this policy offers guidance on how to execute the project diligently and cautiously.

2.2 THE LEGAL AND REGULATORY FRAMEWORK

2.3.1 The Uganda Constitution (1995)

The Uganda Constitution of 1995, Articles 39 and 41 provide that everyone has a duty to maintain and enjoy a sound environment. Every person in Uganda has a right to a clean and healthy environment and as such can bring action for any pollution or disposal of wastes. It states that government will promote development, utilisation and public awareness of the need to manage land air and water resources in a balanced and sustainable manner for present and future generations. The constitution vests all land in the country in the citizens of Uganda, and protects property and other individual rights. The government, or local government, may acquire land in the public interest, subject to provisions of Article 26 of the Constitution. This gives every person in Uganda the right to own property, and stipulates that the land or property cannot be compulsorily acquired unless prompt, prior and adequate compensation has been paid to the owner of the land/property.

2.3.2 The National Environment Act Cap 153 and Regulations

Section 19(1): This provides for a developer of a project described in the third schedule to this Act to submit a project brief to the lead agency, in the prescribed form and giving the prescribed information. Where a project/an activity is out of character with its surroundings; any structure of a scale not in keeping with its surroundings; and likely to lead to changes in land use. The EIA Regulations specifies the projects to be subjected to EIA. These are:

Where an environment impact review shall be required for small-scale activities that may have significant impact;
Where environmental impact evaluation for activities that are likely to have significant impacts; and
Where environmental impact study for activities that will have significant impacts

Third schedule of the EIA regulations lists waste disposal sites as projects requiring EIA's.

The National Environment (Waste Management) Regulations S.I. No. 52/1999
Section 5 provides for a person who owns or controls a facility or premises, which generate waste, to minimise the waste generated by adopting cleaner production methods.
Subsection 1(b) (i): identifying and eliminating potential negative impacts of the product/waste.
(c): incorporating environmental concerns in the design and disposal of a product.

Section 6 makes it a requirement for a licence from the Authority for transportation or storage of waste upon fulfilment of standards described in section 7 including adequacy of facilities.

Section 13 provides for the requirement for a licence to operate a waste treatment plant or waste disposal site.

Fort Portal Municipal Council has already applied for these licences issuance of which awaits this EIS.

The National Environment (standards for discharge of Effluent into Water or on Land) Regulations, S.I. No. 5/1999
This regulation provides the standards or maximum permissible limits of effluents discharged into the natural environment, and makes it an obligation to mitigate pollution through installation of waste treatment facilities. This regulation has been considered considering the likelihood of leachate generation.

The National Environment (Wetlands, River Banks and Lake Shores Management) Regulation, S.I. No. 63/2000
Section 34(1) highlights the fact that any developer desiring to conduct a project which may have significant impact on a wetland, river bank or lake shore shall be required to carry out an environmental impact assessment in accordance with sections19, 20, and 21 of the Act.

The National Environment (Noise Standards and Control) Regulations, 2002
The regulation provides standards for the maximum permissible noise levels to which a person may be exposed from a facility or activity, control of noise and for mitigating measures for the reduction of noise levels.

Section 5 (10) provides for the maximum permissible noise levels to which a person may be exposed from any area;
Section 6 (1) No person shall emit or engage in any activity that emits or likely to emit noise above a maximum permissible level specified in regulation 5 of these Regulations, unless permitted to do so by these Regulations;
Section 7 (1) emphasises the fact that it shall be the duty of the owner or occupier of a facility or premise or machinery to use the best practicable means of ensuring that the emission of noise from those facilities/premises do not exceed the standards and limitations set in these regulations.

2.3.3 The Town and Country Planning Act 1964

The Act provides for the orderly planning in urban and rural areas and establishes guidelines for planning schemes, acquisition of land and compensation for acquired lands, as well as considerations to safe guard the natural environment.

2.3.4 The Public Health Act

The Act consolidates the law in the respect of Public health and places duties on the Urban and local authorities in matters pertaining to public Health. It provides for measures to minimise water, air and noise pollution and empowers local authorities to take lawful, necessary and reasonably practicable measures for the prevention of any pollution dangerous to health of any supply of water, which the public within its district has a right to use, and does use for drinking or domestic purposes.

2.3.5 The Water Act Cap. 152

Section 5: All right to investigate, control, protect and manage water in Uganda is vested in the Government and in Section 31, it makes it an offence to pollute or cause risk of water pollution.

2.3.6 The Uganda Wildlife Act Cap 200

Under the Wildlife Act, any person desiring to undertake any project, which may have significant effect on any wildlife species or community shall undertake an environmental impact assessment in accordance with the National Environment Act.

2.3.7 The Local Governments Act, 1997

This act provides for a district-based system of local governments. This system provides for elected councils that have both legislative and executive powers. Thus the district councils

play an important role in land administration, land surveying, physical planning, and management of forests, wetlands, environment and sanitation services that are not the responsibility of the central government. They are therefore charged with the crucial role of acquisition of land for development/construction purposes and in the sensitisation and mobilisation of the local communities.

All the above regulations and policies are applicable to the proposed landfill development project and have been taken into consideration and will be observed during the construction and operations phases.

2.4 Institutions

2.4.1 Ministry of Water Lands And Environment

The ministry is the institution responsible for the formulation of policies that govern environmental management in Uganda hence responsible for environmental issues in the country.

2.4.2 National Environment Management Authority

This is the principal agency in Uganda responsible for the management of environment and is charged with the coordination, supervision and monitoring of all activities related to environmental management.

2.4.3 The Uganda Land Commission

It is responsible for sustainable management of land in Uganda especially holding and management of land, which is vested in or acquired by the government in accordance with the constitution.

2.4.4 The Municipal and Country Planning Board

The board provides for the orderly planning in urban and rural areas. It defines building operations and development in relation to any land.

2.4.5 The District Land Board

This (Fortportal District Land Board) is charged with the responsibility for land issues at the local government level.

2.4.6 Fort Portal Municipal Council

The Municipal Council is headed by His Worship the Mayor (LCIV – Chairman), who is assisted by the Council that acts as the legislative body. The Executive head is the Town Clerk (the Accounting Officer) and all departmental heads are answerable to him/her and is assisted by the Deputy Town Clerk. The departments/sections/offices that are directly involved in this project include the Municipal Environment Office, the Municipal Council Health Services Section, and the Planning and Engineering Departments.

Though NEMA is charged with the coordination of sectoral environmental issues, FMC must ensure that environmental and social impact assessments for this landfill and waste composting plant is adequately carried out, mitigation properly incorporated and the construction process is environmentally and legally compliant.

3.0 PROJECT SITE ENVIRONMENTAL BASELINE CONDITIONS

3.1 The Project Area

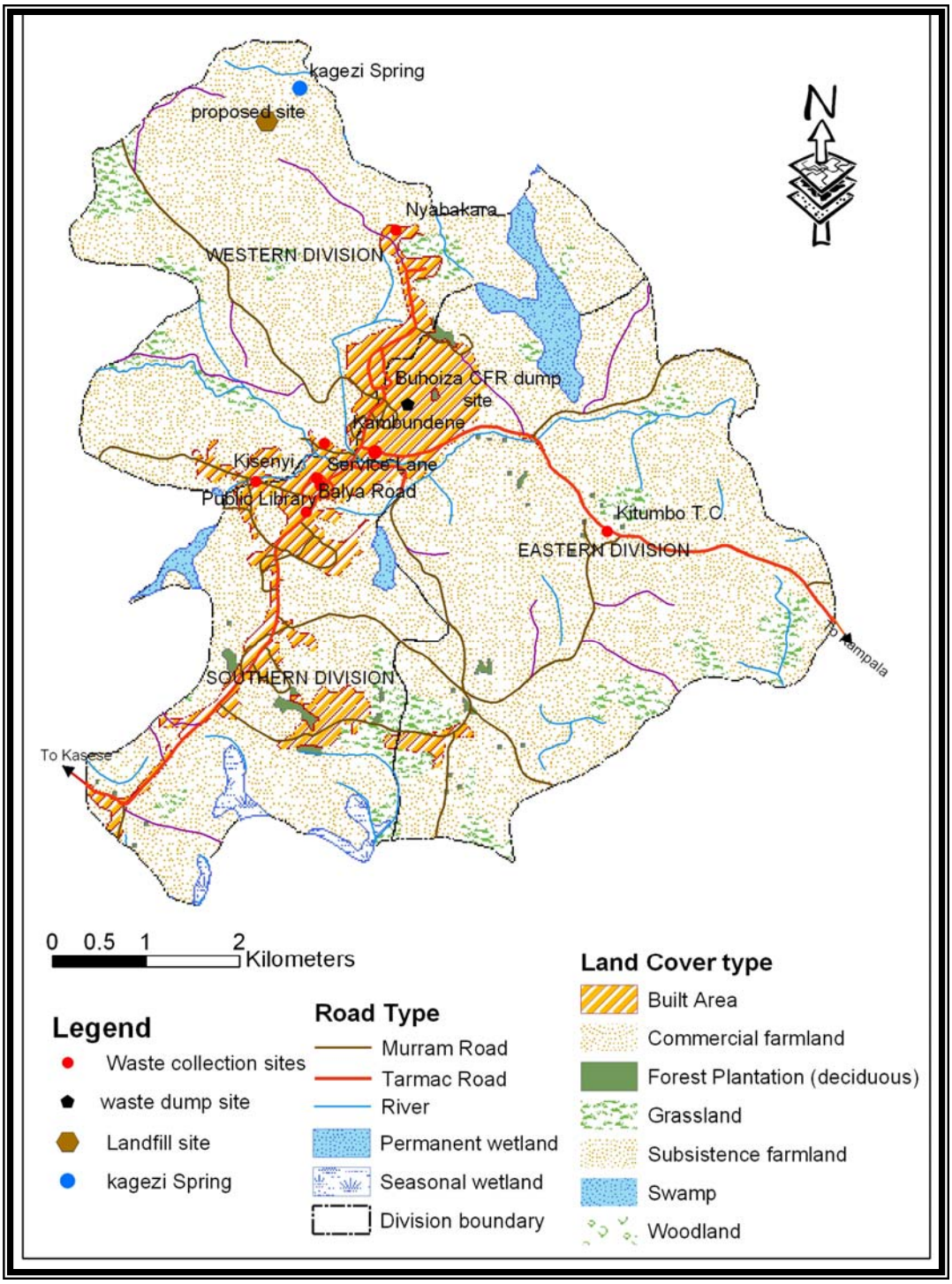
The proposed landfill and waste composting site is at Kiteere Village, Kibimba Parish, West Division. It measures 6 acre and is 5.6 km from the Central Business District. The site has previously been under agricultural use, with crops such as bananas and fruit trees including avocadoes still present. There are no settlements on this site and the immediate neighbourhood is sparsely populated. Within a radius of 200m there are 4 settlements, mainly to the southeast and east. The western neighbourhood has the premises of Muhoti Barracks. The northern neighbourhood is open land and the south is occupied by the Kiteere Hill. Eucalyptus trees occupy the immediate east of the proposed landfill site. The site is accessible by an earth road, which passes through Booma to Nyabukara up to Kibimba Kiteere Village.

The pictures below provide an impression of the site and its neighbourhood land use.

	
Access to the site at Kitere	The Muhoti barracks, north west of the site

	
The North eastern neighbourhood	The Kitere site and part of the southern neighbourhood

Map of Fort Portal Municipality, showing land use and location of Kiteere landfill and composting site



3.2 Geology and soils

The geology of the area is presumed to be similar to that of Kabarole district. Soils are mainly red sandy loams on undifferentiated pre-Cambrian rocks.

The area is mainly of the basement complex geology comprising of undifferentiated gneisses including elements of partly granitised and metamorphosed formations. Argillites with basal quartzites and amphibolites of the Buganda-Toro system forms part. A small area of the project area in the southern part is comprised of volcanic tuffs and lavas of the western rift valley system. (Refer to appendix)

3.2.3 Soil distribution

There are nine soil units in Kabarole district. These include seven soil series, one soil catena and a papyrus peat. This classification is both generic as well as morphological since it takes into consideration intrinsic chemical properties as well as field characteristics.

3.3 Geomorphology and Drainage

Drainage

The area around the site is well drained. The existing drainage system is attributable to the general topography of the district. Storm water from the project site drains to the lowest point to the east ultimately finding its way to Kagezi stream far east of the site. The project area is part of the Mpanga river catchment, the river itself located approximately 1 kilometre to the south of the project site.

Baseline water quality analysis was undertaken for water samples taken from Kagezi stream, the results of which are presented in the appendix. The analysis indicates water suitability for drinking but after boiling.

	
The Kagezi spring, proposed protected water source	Cattle: these depend of the Kagezi water source

3.4 CIimate

3.4.1 Rainfall

Rainfall:

The district experiences bimodal rainfall pattern with the principal peak running from August to November while short rains are experienced from March to April. Annual rainfall ranges between 1250mm to 1750mm

3.4.2 Temperature

The district records an annual average temperature of 22 degrees centigrade with minimum and maximum averages of 15 and 27 degrees centigrade, respectively.

3.5 Terrestrial biodiversity

To study the vegetation structure and composition in the area a transect was established to cover the entire project area. Circular plots located every 50 meters were used to assess the plant diversity and abundance. Herbs and shrubs were enumerated in a radius of 2 meters with all individuals counted and recorded while trees were enumerated in 10m radius from the centre of the plots and numbers recorded. Opportunistic sampling was done to record other species that were not recorded within the plots to come up with a complete species list of the site. Effort was made to capture as many distinct vegetation communities as possible and also to capture as many habitats as possible.

Specimen collection and identification

For identification to be complete, a voucher specimen of every species that could not be identified in the field was collected and given a unique number and compared with the specimens at the National Herbarium at Makerere University. Details of specimen that could not be identified in the field were recorded by reference to the specimen number to help in identification at the Herbarium.

Data analysis and presentation

A species list was compiled for the site, which showed the relative abundances using the encounter rate. Their respective life forms and families are also indicated (see appendix attached).

General overview

A total of 122 species were recorded in the study site as presented in the checklist. Species recorded include: 50 herbaceous species, 25 grasses, 30 shrubs and 12 tree species, and 5 climber species. The species recorded belonged to 32 families of which Poaceae ranked highest with 21 genera followed by Fabaceae with 18 genera. Ecologically, the proposed garbage collection site can be divided into two major habitats basing on the species dominance of the assessed area. This site had;

Cultivated land

The site lies in a cultivated area with over 55% land cover changed from woodland to banana plantation and 25% that was wetland has been reclaimed to farmland and grazing area. Some of the crops that are relics of cultivation include Bananas, *Persia americana* (Avocado), Yams, Maize, *Carica papaya* (Pawpaws) and weeds to include *Oxalis Latifolia, Oxalis corniculata, Conyza floribunda and Bidens pilosa.*

Fallow land

Fallow area constitutes about 20% with mainly grass and scattered shrubs of *Acacia hockii, Acanthus pubsens, Cloredendrum capitata and Triamufetta rhomboidea, Setaria kagerensis, Phytolacca dodecandra.* The site is in a valley potentially rich in species but has been reduced to farming area with barely any unique species left to be lost due to any activities.
In the neighbourhood of the site, there is a eucalyptus plantation on the down slope which covers twice as big the area that has been planned for the garbage collection. The crops is healthy and vigorous, this can be used in future to identify the levels of toxic materials released to the environment.

3.6 Social Baseline

3.6.1 Land Tenure and Existing Land Use

Land Tenure, Social Services, and Existing Infrastructure

The predominant land tenure in the municipality is leasehold. The municipal council surveyed the area for the proposed development after the purchase of the site.

The site being off the main planned commercial area is devoid of the basic utilities associated with urban centres. However the national electricity grid and piped water lines are close to the site and can be tapped. The proposed project site neighbourhood is predominantly under agriculture.

3.6.2 Economic Activity

Like any other urban setting in the country, the major source of livelihood in Fort Portal Municipality is employment income followed by trading and property income. The proposed site for the landfill and composting activities is 5.6 kms away from town and mainly subsistence agriculture is undertaken. Matooke, sweet potatoes and fruits are manly produced around the area and sold in Mpanga, Kihondo, Kayagusa and Rugongo markets.

3.6.2 Fort Portal Municipality: Extent, population and administrative structure

Population Characteristics

The 2002 population and housing census put Fort Portal Municipality at 41253 persons. West division where there is proposed landfill and composting site was the least populated at

13529 persons. The Batooro form the largest tribe in the municipality with Rutooro, English and Swahili being the main languages used.

Table: Population per division in Municipality

Division name	No. of Households	Total Population
South	3353	13629
West	3007	13529
East	3375	14095

Source: UBOS, 2002

3.6.3 Administrative structure

FMC is a lower local Government under Kabarole District Local Government. A Mayor heads the political wing and the Town Clerk heads the technical wing. The Municipality comprises four Division Councils namely: - West, East and South Divisions as lower local governments under the Municipal Council. Each Division is headed by a Chairman who heads the political wing and an Assistant Town Clerk who heads the technical wing. Under these Divisions are lower Councils numbering 11 parishes or wards (LC II).

3.6.5 Sources of income for Town residents

The main source of livelihood for the Municipal council population is employment, trading, and other sources. The Municipal council is a centre for economic and industrial activities, with better social services and this has attracted a large population.

3.6.6 Human Settlements and Housing

3.6.7 Social services and Physical Infrastructure

The provision of social and infrastructure services plays a vital role in supporting accelerated and sustainable social, political and economic development. Social and physical infrastructures in FMC are relatively more developed than any other part of the district.

Access to safe Water and Health Services

The main water source for FMC is NWSC piped water, in addition to springs, open wells rainwater and boreholes. The major water requirement is for domestic and industrial use. FMC enjoys the services of both government and privately owned health facilities. The main

health facilities include a Regional Referral hospital, several private clinics and one privately owned hospital.

The major health concerns of the Municipal council now include malaria, waterborne diseases such as cholera and dysentery, and respiratory diseases (a consequence of air pollution particularly from fossil fuel combustion and waste burning) and HIV/AIDS. Others include human resources for health services, funding for health projects and inadequate health infrastructure.

Transport and communication

FMC has an extensive road network, transport terminals and parking facilities.
FMC has some roads covered by bitumen while others are under murram/gravel and loose surface. The concentration of good roads in the Municipal council has a direct impact on traffic, with most cars having to pass through the Municipal centre. This bears the results of an increased vehicle volume beyond the carrying capacity of its narrow streets. The un-paved 5 kilometres to the proposed landfill site need to be well maintained upgraded once the site becomes operational.

The Municipal council and district enjoys good coverage of the entire three mobile telecommunication networks providers; MTN, UTL and Celtel. UTL landline network covers the area.

Energy supply

The major sources of energy in FMC and the district are charcoal, electricity, firewood, solar energy and petroleum products (fossil fuels) like Kerosene, petrol and diesel. Charcoal and firewood are mainly used for cooking while electricity is basically used for lighting. Use of biogas, wind energy and other renewable energy forms are not yet well developed in FMC and the district in general.

Electricity

There is reasonable coverage of electricity though there are still few areas not yet connected to electricity. Electricity is mainly used for household lighting, used in medium scale industries and street lighting. However, due to high charges per unit of electricity, and high cost of electrical appliances most households still prefer to use alternative sources for cooking e.g. charcoal and firewood, which have left their toll in the district forest resources.

3.6.8 Historical/cultural Sites

There are exists various historical sites in the Municipality owned by the Tooro Kingdom. The currently used Bukwali dumpsite is also a graveyard hence the pressure to relocate waste dumping form here.

3.7 Solid waste management in Fort Portal Municipality

The responsibility for solid waste management lies with the Municipal Council. The departments involved include Engineering for maintenance and provision of trucks, Health and the Environment. Up to 24 staff are involved in waste collection and general management, and include the HEALTH Inspector (1), the Principal Engineer (1), Health Assistants (3- supervision and reporting), Health Orderly (6 – Hygiene education), Driver (1), Turn boy (1), and ward agents (11). The Divisions supervise and are responsible for payments to waste collection contractors, while the Municipal headquarters is responsible for vehicles and maintenance of trucks.

Several waste disposal sites have been used in the past including Buhoiza Central Forest Reserve, at Booma – a residential area, and Bukwali pit – in a grave yard, currently used and already filling up. Attempts to acquire waste disposal sites have been futile, but with the acquisition of 6 acres at Kiteere within the less populated West Division, approximately 5.6 km from the Town Centre, presents an opportunity for the Municipality to ensure this disposal site is developed to have a longer lifespan.

To date, participation of the private sector in waste collection is limited, and waste collection is yet to be seen as an economic venture. Only 42% of generated waste is collected, and only 2 trucks are available for waste collection. The budget allocation for waste management in the Municipality has bee limiting as well, up to thirty two million per year. Waste segregation is hardly practiced and there is no byelaw on waste management, except Municipal council resolutions.

The pictures below portray the solid waste management in the Municipality

	
Waste dump at Buhoiza CFR	Waste dump at Bukwali pit

	
The two waste collection trucks packed at the Engineering department	Waste collection point at Mpanga Market

4.0 PROJECT DECRIPTION

4.1 Introduction

Open dumps are the most widely used waste management method for municipal solid waste in Uganda. The improved versions are controlled dumps, however in both cases despite the low cost, the sites are unsightly, have short lifespan and the risk of environmental pollution is high. Sanitary landfills are better planned and reduce nuisances or hazards to public health or safety, by utilising the principles of engineering to confine the refuse to the smallest practical area, reducing it to the smallest practical volume, and having it covered with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary.

The Municipality has not had an appropriate disposal site. The site at Buhoiza was in a CFR, and the one currently used at Bukwali pit is in a sensitive neighbourhood: Mpanga river and Mpanga Secondary School. The foul smell, pollution from leachate, and the health risks to children accessing these sites is high. Besides economic sustainability of waste management operations is questionable given the low locally generated revenue by the Municipality. The proposed Kiteere site is the most spacious so far acquired by FMC. It is also in a sparsely populated neighbourhood, and rather close to the Municipality CBD – 5.6km. The challenge to the FMC is to ensure its sustainable development based on appropriate engineering considerations.

Much of the generated waste from FMC and the immediate catchment is composed of about 80% food remains and related vegetable matter with the rest (tree cuttings, street debris, glass, paper, plastics especially low-density polyethylene, metal and wood shavings/saw dust) accounting for nearly twentypercent.

4.2 Project Site and Location

The proposed site, which measures approximately 6 acres, is located in Kiteere Village, Kibimba Parish, West Division 5.6 km from the CBD. It is under secondary vegetation as a result of previous agricultural activity. The nearest homesteads to the southeast and eastern directions are approximately 200m away. The nearest water source is the Kagezi spring and stream, used by the local community and domestic animals. The immediate northeast is planted with eucalyptus, and the south is the Kiteere hill. An earth road exists adjacent to this site, but with the site preparation works will be required to create the access roads.

4.3 Waste disposal site Development Options

In this section we look at the various development options of the proposed waste disposal site at Kiteere, including an open dump as has been the practice on other sites in the Municipality, as compared to a sanitary landfill and waste composting. The option of a sanitary landfill and methane tapping, as well as energy generation from the waste have not been considered due to the small volumes of waste required to sustain such projects, and high costs involved in their development.

4.3.1 The Open/controlled dump option

The general practice in the Municipality has been to find open space where waste collected in the CBD can be dumped. This has in the past raised concerns due to the foul smell, generated leachate, loss of aesthetics, and several sites used as they fill up.

Development of an open dump will be at a less cost in the short term, but with several impacts on the environment including contamination of water sources downstream and great health risks to the local community. It will also lead to a social outcry due to the foul smell, littered waste blown by wind, and vermin attraction, and sacrifice of the benefits that would have accrued as a result of developing a sanitary landfill coupled with waste composting.

4.3.2 Clinical and chemical waste

There are a number of possible clinical and chemical sources points within the municipality. There will be no clinical or chemical waste that will be allowed at the disposal site; such waste will be incinerated away, from the already existing incinerators in the municipality. This will be in addition to such varied measures as fines to health centres and any suspect source points, where such waste is found on the nearby skips;

4.3.3 Development of the landfill and waste composting plant

Given the quantity of organic waste generated, development of a waste composting plant together with a landfill is an admirable option. The organic waste generated per day, will be adequate for the proposed composting plant capacity, (refer to attached engineering designs) to generate requisite compost manure for the market. This will go with the embedded opportunity of reducing GHG emissions and to trade under the CMD. The design also provides for a leachate treatment plant allaying fears of water source contamination.

The landfill development requires proper planning, siting, designing, construction, operation, environmental monitoring, closure and post-closure. The challenge will be improved waste

segregation at source and at the landfill, improved capacity for landfill and composting plant management, and ensuring good relations with the local community, and site restoration planning will be undertaken.

The local issues raised during consultations include extension of piped water and electricity, improvement of the access road to 1st Class murram, and employment opportunities.

4.4 Design considerations

4.4.1 Area Hydro-geology;

The area hydro-geological investigation results indicate excavations up to 30 m are possible. The population growth rate of 3%, and waste generation of 89tons, 80% of which is organic. Over twenty five years 99166m3 of landfill waste (segregated from the organic waste) will be produced. With excavation to 10m, a total area of 2.45 acres will be required for land filling. The life span for the 6 acres would then be over 25 years if waste segregation is well practiced, and appropriate designs for the landfill cells developed. The excavated material during construction will be stored and used as cover material at the landfill.

4.4.2 Design and operations of the composting plant

The composting plant will utilize windrow technology. Its capacity is 70 tons of organic waste per day. The major equipment used here will include a back hoe and forklift for turning waste and moving it to the next windrow, but waste sorting will be undertaken manually. Up to 20 persons will be employed at the site. Piped water will be used to maintain the required moisture content in the waste being composted. The plant will be designed to slope towards the leachate treatment plant, with treated leachate or slurry recycled to improve moisture content of the decomposing waste.The primary leachate collection and removal system will consist of a series of drains and pipes designed to collect all of the liquid leachate, which has drained through the waste mass and each windrow. The leachate treatment plant components include a leachate trap/pond, leachate recovery pumps, equalisation tanks, pre-settling tank, aeration tanks, a final settlement tank, and secondary treatment lagoon from where the leachate can be recycled. As an environmental monitoring measure, the springs downstream of this site will be developed and used for monitoring groundwater quality.

4.4.2 Design and Construction of the Landfill

Combining waste composting with land filling implies a much-reduced requirement for land filling space. Initially Fort Portal Municipal Council will develop one landfill cell of capacity 40,000m^3 after excavation. The bottom will be lined with an impervious layer (HDPE) to ensure that any run off water is directed to the leachate treatment plant.

4.4.3 Construction of the Storm Water Drainage System

When developing the site, there is need to ensure that minimal storm water finds its way into the landfill. This will be effected by putting in place a drainage system around the proposed site to deter storm water invading the landfill and enhancing leachate development. Surface water diversion is an important matter as not only will it significantly reduce leachate quantities but it also removes flooding by surface water, which can destabilise the site embarkments.

A drainage system will be constructed for proper direction of storm water from the upper area past the landfill in the northern direction.

4.4.4 Vermin and litter control

Vectors and vermin common to dump sites include insects, rodents and birds. The proposed windrow shade, and waste composting activity will greatly limit vermin at this site. Covering transportation trucks or proper securing of transported waste will be emphasised.

4.4.5 Record Keeping and waste information system

Record keeping at the landfill and waste composting site will be part of the larger waste information system for the municipality. At the landfill site, there will be a weighbridge to track quantities of waste deposited and manure leaving the composting plant. Other records that must be kept include equipment status and maintenance; Daily operation schedules and activities; Environmental monitoring; Personnel matters; and Financial revenues and expenditures.

Initially, the major waste collection points in the Municipality have been mapped. But this will be related with waste generation rates, waste generation factors, land use and economic activities and utilised in waste management planning.

4.4.6 Site Security

A fence will be erected around the landfill and waste composting site to restrict access by animals and to prevent unauthorized entry. The site itself will be accessed by a gate.

4.4.7 Connecting the Site to Electricity And Piped Water

There is need for power and water supply on the site. The likely national grid connection point is only 2km away, and NWSC water pipes only 500m away.

4.4.8 Site Landscaping

Not all the acquired 6 acres will be utilized over a long period of time if the waste composting activity succeeds. Up to 3 acres of the land can be planted with trees and grass as part of the landscaping process. This will help in aesthetic improvement of the area, provide a buffer for migration of landfill gas and hold any windblown waste.

4.4.9 Site Restoration

As part of the restoration process a final cover will be placed over the waste at the end of the active life of the landfill. This is intended to isolate the waste from direct contact with the environment in addition to complementing the visual aesthetics as a result of the introduced

vegetation cover. The final cover to be introduced will include murram gravel, and humic soils to be planted with grass and suitable tree species.

4.5 Strategy for improved waste management

Arising from this study, and consultations with stakeholders in particular, the following strategies and priority areas of action are proposed in this section for improved solid waste management in Fort Portal Municipality. The following are the priority initiatives that the Municipality ought to take into consideration.

4.5.1 Integrated waste management planning

The primary objective of introducing an integrated waste management planning system is to integrate and optimise waste management so that the efficiency of the waste management system is maximised and the impacts and financial costs associated with waste management are less. Integration will be addressed within institutional arrangements and in all waste generating sectors and throughout the "waste life-cycle".

A number of stages are addressed in the integrated waste management planning process, which takes into account the need to develop clear objectives, while maintaining the existing system and investigating possible alternatives and selecting the most appropriate waste management system. The stages that will be followed in implementing the waste management planning process include: identifying baseline needs; review of existing legislation; establishing objectives and system components; and developing and implementing a waste management plan.

Chapter 3 outlines the baseline waste management gaps, and chapter 2 the existing legislation and institutional framework for waste management. However Fort Portal Municipality is yet to develop a waste management ordinance that would clearly spell out institutional roles including roles for the Municipal headquarters, the Divisions, and Local administrative Units (Parish, Village Councils, Local Environment Committees), as well as the private sector. It would as well be the basis for turning waste management into an economic activity, with fees paid for waste generated and the use of disposal sites.

The headquarters would then maintain the planning, monitoring and coordination roles and technical advise leaving actual activities (such as waste collection) to the Division and Local Administrative Units, and the private sector. However, the lower levels will make a useful input in terms of preparation of local waste management plans, updating the waste

information system, staff capacity building, and in the review and enforcement of regulations such as the waste management ordinance.
This strategy stresses public and private participation for its success. Multi-sectoral workshops, awareness campaigns, public hearings and presentations may be used to ensure the participation of a broad spectrum of the public. It is crucial that stakeholders are involved during the development of waste management plans, particularly at the level of the local administrative units and divisions by those communities that will be directly affected, and appropriate public participation programs will be initiated for this purpose. Coordination of these planning activities should be encouraged and linked to similar ones like environmental and health management plans.

Understanding of the principles of solid waste planning is a pre-requisite for effective participation. To achieve this aim, information and public awareness campaigns will be developed by the FMC headquarters and implemented by the Divisions and administrative units. Partnerships in waste management planning will be encouraged and facilitated, including public-private and public-public partnerships.

Waste management plans for major waste generators such as institutions, industries, hotels and other businesses should be prepared by developers/owners and submitted to Divisions/Municipal headquarters for review and approval. The developers/owners of such facilities will be required to comply with the waste management regulations, particularly the requirement to keep an inventory on wastes generated and on cleaner production practices.

4.5.2 Waste information system

Initially, a WIS will serve the purpose of developing waste management plans and guiding waste management operations. The information required for general waste plans includes the waste category, as well as the amount of waste generated, collected, transported, recycled, treated and disposed off. The WIS will also supply information on the amount of hazardous waste generated to assist in the planning and the siting of hazardous waste treatment facilities.

However this strategy has taken into account spatial issues related to waste management, including the need for mapping of locations of major waste sources, land use and physical plans, property developments, and waste generation factors in order to optimize required waste management infrastructure, sites of gazzetted waste collection points and transfer stations.

A Geographical Information System (GIS) output from the system is not a short-term goal and will require broader participation from the other departments such as physical planning, works, health, environment and development partners. The UN-Habitat is piloting the Local Urban Observatory and this opportunity will further be explored by the Municipality.

In the short term however, the information required for the WIS will include:
Mapped solid waste facilities – location, owner, operator, operations, transportation/pick up frequency, regulatory status (waste skips, transfer stations, waste bunkers, incinerators, landfills, waste dumps);
Waste sources, and generation rates;
Waste flow diagrams including waste categories, origins and quantities, materials recovered, disposed, composted, and land filled.

The WIS will also be helpful in the implementation of the proposed waste management byelaw, such as collection of service fees linked to property development and business licenses. However for the success of the WIS, guidelines describing details and operation of both the WIS database and its reporting structures need to be well defined by the Municipal headquarters. The focus of the WIS Guidelines is to ensure that all people submitting information to the WIS understand why they are being required to report, what their responsibilities are, the formats for the information, and what will happen to the information.

The waste management byelaw implementation guidelines should as well spell out clearly the requirement to provide waste specific information to the Local Authorities who will be responsible for entering it into the WIS. The Municipal headquarters will be responsible for WIS implementation and operation, as well as data processing and quality assurance.

Sufficient capacity is currently not available for the implementation and operation of the WIS, although limited capacity for data collection does exist at the Municipal headquarters, Divisions, as well as in the private sector. FMC will define the responsibility and the competency profile required for staff who will be involved with the WIS, as well as identify the shortfall of skills and develop an appropriate capacity development programme. The necessary skills may be acquired through attendance of specialised courses, as well as through the transfer of expertise by for example the seconding of trained staff between similar local governments in the region implementing WIS.

Non-governmental organisations and the general public will also be informed about the WIS, to enable them to understand the issues of integrated waste management and the need for their participation. Public awareness programmes may include the regular distribution of reports on the WIS in the printed media and broadcast media.

4.5.3 Waste minimization and segregation

Waste minimisation comprises any activity to prevent the formation of waste or reduce the volume and/or environmental impact of waste that is generated, treated, stored or disposed of. The strategy aims at reducing waste at source by generators, also limit what will be land filled through recycling, reuse, segregation and composting.

Fort Portal Municipality has little waste from industries. However for other waste sources such as households, markets, hotels, shops, petrol stations and institutions (clinics, schools, hospitals, offices), waste segregation has been suggested. This requires provision of waste collection facilities including coded poly bags, coded waste bins and waste skips, and their strategic placement near waste generation points. There should be an emphasis of placement of coded waste bins along streets, in institutional premises, public places, among others.

Success of waste segregation practices will require clarity on waste categories, and enabling instruments including public awareness, initial funding for required infrastructure, and strengthening waste segregation provisions in the Municipal waste ordinance. The ordinance should also emphasise regulations requiring waste minimisation assessments and plans as part of specified business permits, phasing out and/or prohibition of the creation, use or transfer of certain priority pollutants such as polythene bags. Guidelines for sorting and management of medical and other hazardous wastes should be developed.

4.5.4 Waste collection: improving service coverage and waste collection

A major concern raised during a survey of stakeholders in the Municipality indicated dissatisfaction with service coverage and waste collection, and limited resources. There is also limited infrastructure to aid waste collection, and little provision for transportation. Private sector participation has as well not been successful in collecting and transporting waste.

Given the environmental and health risks posed to the community by uncollected waste, the central business district identified high waste generation points and high population density residential areas will be prioritized in providing waste collection services. These areas will have coded waste skips where households can take their waste. For low-density areas, door-to-door collection has been suggested.

For high waste generation sources, such as markets, coded waste skips will be used and their numbers and services improved. Institutional waste collected in coded waste bins will be emptied into coded waste skips prior to transportation to transfer stations or landfill.

The long-term objective for hazardous domestic waste is to provide central waste collection facilities at the local level. Separation of the hazardous component from domestic waste will enhance the sustainability of recycling projects and render domestic waste collection and disposal a safer process.

Participation of the private sector in waste collection and transportation needs to be supported and emphasized. Waste should be collected at a fee, and it is suggested that the Municipality purchases at least two trucks to be rented out to the private sector to help in waste transportation.

4.5.5 Waste treatment and disposal

Infrastructure for treatment of generated or collected waste, and its eventual disposal needs to be addressed. Given the scope of this strategy, treatment has been considered for hazardous solid waste and composting for organic waste.

First, segregation practices have to be emphasised to ensure hazardous and non-biodegradable waste does not mix with other waste. Secondly siting of incinerators meant to provide thermal treatment should limit impact of their operations on the environment. Other options for treatment of hazardous waste include solidification, immobilisation and cementation, which reduce the leachability and mobility of hazardous constituents. Purchase of an incinerator is a preferred option and it is proposed it is located at Kiteere Landfill. The status of existing incinerators for medical waste should also be reviewed, and possibility of utilizing a centralized system looked into for the Municipality.

The earlier sections of this chapter (4.3, 4.4) describe the landfill and waste composting components. The long term waste management strategy enabling instruments include

increased public awareness, Institutional strengthening and capacity building, Increased involvement of Private Sector and Civil Society, development of waste management bye laws and Review and enforcement of legislation/regulations and sustainable funding for waste management.

4.6 Waste composting and compost product market

The waste composting plant at Kiteere is expected to utilise 70 tons of organic waste per day. Fort Portal Municipal Council has identified the major consumers of this manure as Kyembogo District Farm Institute, Rwenzori Commodities, Mabale, Mpanga, and Finlays tea estates and other out growers. The tea growers are optimistic to the project in reducing the costs associated with the importation of the currently utilised manure on the estates. The Municipal Botanical garden and banana farmers are eager to improve their produce as advocated for under NAADS.

Improved soil productivity with organic manure under NAADS. Picture taken at Ny kabara

4.7 Funding for waste management

Given the range of suggested priority initiatives for improved waste management in the Municipality, funding requirements will rise, hence modalities need to be worked to ensure effective implementation of this strategy. FMC will have to look into the possibilities of increased funds from Central Government, Local Government allocations, Donor funding, NGO's and user fees, taxes, fines, licences all related to the waste management chain.

The table below provides some of the likely source of funding for the waste management strategy.

Funding sources	Programmes	Priority initiatives
LGDP II	Capacity building Infrastructure improvement	Waste treatment and disposal Integrated waste management planning Development of a Waste information system
PMA	SFG	Increased involvement of Private Sector and Civil Society
UN-Habitat	Local Urban Observatory (LUO)	Development of a Waste information system
UNDP/UN-Habitat	Urban Ecosystems Programme	Waste treatment and disposal
GEF, DFID	Cleaner Development Mechanism (CDM) Carbon trading	Waste treatment and disposal
NGO's	Public awareness and capacity building	Waste minimisation and segregation Public awareness
Local Government sources	Property Tax Fees and Fines Development Tax Market dues Trading licences	Improved waste collection

5.0 EVALUATION OF SIGNIFICANT ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 Introduction

This chapter identifies and evaluates significant environmental consequences related to the development of Kiteere Landfill and Waste Composting Plant. The EIA team recognizes that this project can have reversible and irreversible impacts on the environment. The positive aspects should be enhanced and relevant mitigation measures should be put in place to minimize adverse environmental impacts predicted.

The interaction of the landfill and composting activities with the environment will result in environmental impacts, which are categorized as follows:

- Direction- Positive or Negative
- Duration- Long or short term
- Location- Direct or Indirect
- Magnitude- Large or small
- Extent- wide or local
- Significance- Large or small.

To systematically evaluate the impacts associated with the proposed project, an impact matrix has been constructed as per the categories identified.

Impact Matrix for landfill and waste composting plant development and Operations

Activity / Impact	Direction	Duration	Magnitude	Extent of impact	Overall assessment
1. Site Preparation					
Vegetation clearance	Negative	Short	Minor	Local	Low
Landscaping, cut and fill	Negative	Medium to short	Major	Medium	Medium
Increased erosion	Negative	Medium to short	Medium to minor	Local	Low
Dust and noise	Negative	Short	Medium to minor	Local	Low
Traffic increase	Negative	Medium to short	Medium to minor	Local	Low
Effects of generated solid waste	Negative	Medium	Minor	Local	Medium to low
Wear and tear of access roads	Negative	Medium to short	Medium to minor	Local	Medium to low
Silting of Kagezi stream	Negative	Medium to short	Medium to minor	Local	Insignificant
Loss of habitats	Negative	Short	Minor	Site specific	Insignificant
Loss of threatened species	Negative	Short	Minor	Site specific	Insignificant
Injury to workers	Negative	Medium to short	Minor	Site specific	Low
Loss of agricultural land	Negative	Medium to short	Medium to minor	Local	Low
2. Construction					
Solid waste and debris generation	Negative	Short	Minor	Site specific	Low
Wear and tare of access road	Negative	Medium to short	Minor	Local	Low
Noise and dust generation	Negative	Medium to short	Minor	Local	Low
Job creation	Positive	Medium to short	Medium	Wide	Medium positive
Wetland siltation	Negative	Medium to short	Minor	Local	Low
Increased erosion	Negative	Medium	Minor	Local	Low
Improved drainage	Positive	Long term	Major	Local	Medium positive
3. Operations					
Increased traffic	Negative	Long-term	Major	Wide	Medium
Noise	Negative	Long term	Medium	Local	Significant
Pollution of surface and ground water	Negative	Long term	Medium	Local	Significant
Disturbance to fauna	Negative	Long term	Medium	Site specific	Medium
Improved aesthetics	Positive	Long term	Major	Wide	Significant
Loss of livelihoods for dependent communities	Negative	Long term	Medium	Local	Low
Loss of access routes for livestock	Negative	Long term	Medium	Local	Medium to low
Improved infrastructure including roads, electricity and piped water	Positive	Long term	major	Wide	Significant
Jobs creation	Positive	Long term	Major	Wide	Medium positive
Increased environmental awareness	Positive	Long term	Major	Wide	Medium positive
Economic opportunities	Positive	Long term	Major	Wide	Significant

5.2 Physical Environment

5.2.1 Loss of Vegetation and Tree cover during site clearance

Site development activities such as site excavations and levelling, construction of major infrastructure including access roads, office blocks, landfill, will lead to clearance of some of the existing greenery as well as loss of the attributes associated with the greenery and vegetation cover. FMC intends to compensate for such loss by plant almost half the acquired land with trees such as *Eucalyptus grandies*.

5.2.2 Effects of cut and fill activities during site preparation and construction

Part of the site is quite steep with a slope of up to 10%. Cut and fill activities will be carried out that are likely to generate significant amounts of construction debris while landscaping. The soils excavated will be used in landscaping activities on the site, and for covering of land filled waste. Spoil will also be generated in the construction of access roads, water and energy supply facilities. Efforts will be made to ensure protective barriers are in place to prevent the excavated soils from being eroded into the Kagezi wetland.

5.2.3 Increased rates of erosion of loose soils and slope instability

With removal of tree cover, and cut and fill activities for the steep slopes, and high rainfall and landslides characteristic of Kabarole district, there is a likelihood of increased erosion of soils to the south of the site. Stabilisation of embankments will be of priority, and these will be planted with grass and trees, and maintained.

5.2.4 Effects of extraction and transportation of raw materials from source points to the site

Most of the materials required for construction purposes will be procured locally, including sand, bricks, timber, poles, marrum gravel and cement. The effects of extraction of these materials will be managed by the suppliers. However, FMC will ensure these materials are obtained from licensed suppliers and sustainable sources.

5.2.5 Natural hazards: landslides and flooding

With increased run-off volumes due to an increased paved surface, the low lying valley will be susceptible to flooding. The raised parts of the slopes could as well give way. An emphasis will be placed on improved drainage and embankments stabilisation as described in section 4.

5.3 Biological Environment

5.3.1 Ground water contamination by leachate

If not well developed and managed the waste composting operation and landfill will generate significant amounts of leachate, which contain various pollutants that can contaminate surface and ground water sources. The pollutants in the largest volumes in leachate are carboxylic (fatty acids) which come from microbial decomposing of waste. Other pollutants include:

- Heavy metals such as manganese, chromium, nickel, lead and cadium;
- Microbiological components, leading to high coliforms levels in receiving waters;
- A wide variety of organic compounds including carboxylic acids, which are usually measured as Total Organic Carbon (TOC);
- High BOD and COD levels; and
- Major elements and ions such as calcium, magnesium, iron, sodium, ammonia, carbonate, sulphate and chloride.

The design of the waste composting plant provides for a leachate treatment facility, which will be recycled to the composting section to increase the moisture content of the decomposing waste. For the landfill, an impervious underground lining has been proposed which will trap any run-off water and will be directed to a sump and pumped back to the leachate treatment plant.

Besides site geophysical investigations reveal an overburden of up to 40m of topsoil, sandy clay and clay seated above the bedrock. Therefore the chances of contamination of the deep-seated aquifers are remote.

5.3.2 Effects of Landfill Gas eliminated

One of the major advantages of waste composting alongside land filling is elimination of methane emissions and carbon dioxide. The primary concern is methane gas, a potent green house, which is normally produced in concentrations of up to 65% of the landfill gas and is potentially explosive at concentrations of between 5 and 15% methane in air on confined spaces. With waste composting, the methane will be oxidised, an opportunity arises for carbon trading for a 70-ton capacity composting plant.

5.3.3 Pollution: air, dust, noise

Pollution of air, dust, and noise will mainly be from daily transportation of the waste to the landfill by the delivery trucks, periodic or daily excavations and covering of the waste using mechanical means. During the construction and operation phase the equipment used will cause a lot of the noise and generate dust.

The construction works will involve a limited number of machinery and vehicles to significant amount of emissions of noise. Upon completion of the landfill construction process, noise will mainly be coming from the increased vehicular volumes of the waste delivery trucks accessing and utilising this landfill. Dust will be of concern at the site and along the roads due to transportation of waste. Fugitive dust has the potential of affecting the health of the workforce and area resident population

Upon completion of the landfill construction process, noise will mainly be coming from the increased vehicular volumes of the waste delivery trucks accessing and utilising this landfill.

The transportation of waste and activities at the landfill and composting site will be restricted to daytime. Air pollution or foul smell that would arise mainly from landfill gas emissions will be highly localised and minimised by waste composting.

5.3.4 Loss of site biodiversity, habitats

The Site having been previously utilised for agriculture has relics of cultivation include Bananas, *Persia americana* (Avocado), Yams, Maize, *Carica papaya* (Pawpaws) and weeds to include *Oxalis Latifolia, Oxalis corniculata, Conyza floribunda and Bidens pilosa.* The Fallow area constitutes about 20% with mainly grass and scttered shrubs of *Acacia hockii, Acanthus pubsens, Cloredendrum capitata and Triamufetta rhomboidea, Setaria kagerensis, Phytolacca dodecandra.* No species of conservation concern were observed during the biodiversity counts, and no significant habitats at the project site.

Development of this site presents an opportunity to save the Buhoiza Central Forest Reserve, which has previously been used for dumping. During landscaping, up to 3 acres of the site will be planted with indigenous tree species such as *Pennisetum papureum, Euphorbia trucalii, Persia Americana, Ficus natalensis* and *Makhamia lutea* and *Paspalum notatum*. These will restore the ecological roles of the original vegetation prior to conversion for agriculture.

5.4 Socio-economic and Cultural Environment

5.4.1 Social Order Disruption

The experience of the neighbouring communities to open dumps within Fort Portal Municipality has bred hostility to waste disposal hence the difficulty in finding an appropriate site for the landfill and waste composting. The major concerns raised were foul smell from the decomposing waste, attraction of vermin and vectors, noise and dust generation, litter in the neighbourhood of wind blown waste, and accidents from waste transportation trucks.

The foul smell arises from landfill gases, but if the composting works are well managed, these gases will be eliminated by aerobic activity aided by daily mechanical and manual turning in the windrows. Foul smell will be highly localised to the plant premises. The composting works for a design capacity provided for and periodic mechanical turning implies little room for vermin and scavenging birds.

Litter due to wind blown waste will be avoided by having roofs over the windrows. The sorted non-biodegradable waste will be land filled. It is proposed that the FMC acquires an incinerator that could be used to burn hazardous wastes, including polyethylene bags likely to litter the area. In the long term, the proposed FMC waste management ordinance should come out against the use of polyethylene bags.

Transportation guidelines should be developed for delivery of waste including speed limits and use of netting on trucks to avoid waste dropping off the trucks and accidents. The engineering department should as well concider-having humps along the delivery route to Kiteere.

The construction activities will be undertaken by a contractor to be supervised by the municipal authorities under the supervision of NEMA, the guidance of the architectural designs team, and intensive labour will manly be preferred, which will do away with any possibility of workers camps. The Municipal Council authorities in addition to awareness, demarcation of safe settlement distance from the landfill and composting project site, together with other monitoring groups that include the local authorities and NEMA should be constantly on look out for any changes in settlement numbers around the project site and try to ascertain the cause of any significant changes. This will do away with any likelihood of social order disruption.

5.4.2 Current waste utility,

Organic waste in the whole of Fort portal municipal council is deposited on the municipal skips, designated collection points or remains unutilised in the backyard of dwelling places. No valuable use was reported, thus no dependent communities will be affected as a result of this project.

5.4.3 Loss of aesthetics, property value

A major concern raised during consultations with the local communities is the loss of aesthetics and property value around the landfill and waste composting site. This however is associated with open dumps or landfills per se, and not with modern waste disposal facilities as proposed in this EIS. Fort Portal Municipal Council has been keen on community involvement in finding a waste site through invitation of offers for sites from the public, selecting and final purchase of the proposed project site, thus avoiding any conflict relating to location.

The Municipal Authorities ought to ensure that the proposed Environmental Monitoring and Management Plan for this site is well implemented to ensure a good relationship with the locals. Besides, FMC will endeavour to improve infrastructure in the area, including extension of piped water and erection of water kiosks, extension of electricity from the national grid, and improvement of access roads. These when undertaken will see the value of properties such as land go up.

5.4.4 The safety and health of the workforce, and neighbourhood community

This landfill will employ up to 20 persons, including casual labourers. The kind of activities to be undertaken including waste sorting, mechanical turning of compost, effluent treatment and sorted wasteland filling require appropriate equipment and PPE. The equipment to be used will include a backhoe, spades, rakes, a forklift, wheelbarrows among others. The required PPE has to cater for eye, ear, nose, head, feet and hands protection, and will include eye glasses, ear murphs, respirators, gumboots, gloves, and where necessary helmets. Given the possibility of accidents at the landfill, a first Aid kit will be maintained at the site, and any major incidences referred to the main Hospital.

The area has in the past been traversed by local animals for grazing and used to access water down stream. During construction this site will be isolated, and an alternative route provided for the animals.

5.4.5 Other social benefits

Extension of dumpsite life: the quantities of materials, which require disposal at the landfill will be significantly reduced once the bulk of the largely organic waste is composted. This also means that the area required for composting operations is a smaller fraction of the area required for landfill disposal, and hence also easier to manage. Thus the waste dumpsite puzzle that has for long haunted the Municipality will be resolved.

The possibility for revenue generation through sale of compost makes the project rather attractive in economic terms. The local community will be particularly eager to benefit from the compost plant manure product to improve productivity of their banana plantations.

The waste composting project also provides an opportunity for improved waste collection within the Municipality. This being an economic activity, privatisation of waste collection, transportation and management of the waste composting site will be possible. This will save the town from previous scenes of delayed collection of waste.

6.0 ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

6.1 Social and Environmental monitoring

This section emphasises the need for a monitoring regime to check progress and impacts resulting from development of Kiteere Landfill and Waste Composting Plant throughout its lifespan. It should also include regular reviews of the impacts that cannot be adequately assessed before its development, or which arise unexpectedly. In such cases, appropriate new actions to mitigate any adverse effects should be undertaken.

It is recommended that FMC designates an officer to undertake environmental monitoring of this site. This Officer will work in liason with contractors, and lead agencies such as NEMA, Water Resources Department, WID, Local Environment Committees, the Department of Labour and Occupational Safety, the District Natural Resources Department, and also coordinate other Municipal Departments Involved.

FMC should ensure that Environmental audits for this site are carried out annually, and regular inspections undertaken.

6.2 The Impact-Mitigation-Monitoring Responsibility Matrix

The EIA team has proposed an Impact-Mitigation-Responsibility Plan for FMC to ensure sustainable development of the Landfill and Waste Composting Plant operations. Indicators of social and environmental impacts due to the project activities have been identified and the frequency of monitoring them suggested. Regular inspections will be conducted by FMC to ensure the proposed mitigation measures are well implemented. Lead agency involvement in monitoring has been emphasized to ensure that the development of this site and its eventual operations are implemented in an environmentally sound manner. Environmental monitoring is also helpful in the sense that where on-going activities are being implemented to the contrary of sustainable development concerns, express and expert advice is given accordingly.

Social and Environmental Monitoring and Management Plan

Impact issues	Indicators	Mitigation	Frequency	Responsibility
Monitoring the physical environment				
Soil and slope instability	Erosion of loose soils Increased turbidity of Kagezi stream	Undertaking site geo-technical investigation prior to development; Planting of grass and trees on embankments and in stabilised areas	At least twice a year during site preparation, construction and operations	Contractor FMC
Land quality, aesthetics, litter	Dissection and loss of land cover Sites of littered waste blown by wind New structures and campsites	Proper landscaping after construction; Construction of shade over windrows to avoid wind effects; Follow approved site development plan	Once before construction Quarterly monitoring in liaison with District Authorities Weekly site inspection protocols	Contractor FMC Kabarole District Local Government
Air quality	Odour from poorly managed waste, composting works Dust particles from earth moving equipment	Develop operation guidelines for waste composting plant Limited use of earth moving equipment Have in place construction and transportation guidelines	Once before site development Quarterly monitoring in liason with District Authorities Put in place weekly site inspection protocols	Contractor FMC Kabarole District Local Government
Monitoring the biotic environment				
Loss of vegetation, tree cover	Number of trees cut Extent of grass cover lost	Map out land use and land cover prior to site development	Once before site development, quarterly	Contractor FMC

	Endangered species lost Forest succession	Undertake biodiversity counts before site development Prepare site plan and seek planning Authority Approval Limit site clearance to specific infrastructure sites Plant embankments and steep area with indigenous	during construction and operations	Kabarole District Local Government
Site fauna, such as avifauna disturbed	Change in type of birds Loss of habitats Noise levels beyond acceptable levels Disruption to breeding habits	Limit site clearance to specific infrastructure sites Restore preferred natural habitat e.g indigenous tree species Limit mechanised works	Once before site development, quarterly during construction and operations	Contractor M/s Beach Side Development Services Ltd NFA
Pollution of aquatic environment, ground and surface water sources	Deterioration in down stream spring water physico-chemical and biological parameters Discharge of untreated leachate into the natural environment	Ensure construction of leachate plant as per plan Put in place an impervious lining at bottom of landfill, and construct a sum to trap resulting run-off; Construct water borne toilets for use by staff; Undertake baseline water quality analysis	Quarterly water quality monitoring at Kagezi stream downstream	Contractor FMC Kabarole District Local Government DWD
Monitoring socioculture and economic environment				

Increased traffic	Number of accidents Wear and tare of access roads Noise and dust pollution	Put in place signage to guide traffic Have a parking yard for vehicles Improve access roads to site and ensure their maintenance Develop road safety guidelines for truck drivers	Once before project implementation, and thrice every year during implementation	Contractor FMC Kabarole District Local Government
Public Health, OHS for workers and local community	Polluted water sources Disease occurrence related to landfill occupational hazards	Extend piped water and construct water kiosks for the Kiteere community; Provide appropriate PPE for the workers Ensure a functional First Aid Kit on site	Once before commencement of operations, quarterly during operations	Contractor FMC (Health Inspector) Kabarole District Local Government
Loss of area aesthetics, property value	Lower sale rates for land, houses Number of immigrants	Improve infrastructure in area including piped water, roads and electricity	Once before project implementation, and during implementation	Contractor FMC (Planning nd Engineering Department) Kabarole District Local Government
Attraction to idlers and thieves around the facility	Record of thefts and attacks by thugs	Ensure proper lighting around the facility Employ guards to ensure safety of the facility workers Liase with local security for any incidents	Once before project implementation, and daily when in operation	Contractor FMC Kabarole District Local Government

Natural Hazards: floods, earthquakes and landslides	Destruction due to natural hazards	Stabilise foundation for administrative block to withstand strong earthquakes Utilise geotechnical investigation findings and recommendation about the site geological profile; Put in place flood protection structures; Ensure drainage construction to direct water downstream away from landfill	One before and during operations per year	Contractor FMC Kabarole District Local Government
Loss of access to grazing land, water source	Site fenced off	Provide alternative route for animals and water source points	Once before commencement, quarterly during operations	Contractor, FMC Kabarole District Local Government (Production department)
Risk of fires	Records of fire occurrences; Obstacles free fire escape route;	Fire emergency plan should guide operations during fire outbreaks; Installation and proper maintenance of fire fighting equipment; Training employees in basic fire-fighting methods and ensure that the fire escape routes are always free from any obstacles.	Twice a year	Contractor FMC Kabarole District Local Government

7.0 MAIN FINDINGS AND RECOMMENDATIONS

Fort Portal Municipal Council intends to improve waste management within the Municipality. This coves the whole waste trajectory right from the source to the final disposal site. Section 4 presents options for waste disposal and recommends a combination of waste composting alongside land filling. Waste composting in particular provides the advantage of a longer lifespan for the landfill, eliminates odorous landfill gases and presents an opportunity for carbon trade under CDM, as well as trade in manure.

The waste management strategy in section 4 also presents required priority initiative, both short term and long term for improved waste management in the municipality. These include integrated waste management planning, waste segregation, waste information system, infrastructure and human resources for improved waste collection, sustainable funding sources, and the need for a bye-law for waste management initiatives.

Section 5 identifies the social and environmental impacts associated with landfill and composting plant development at Kiteere. However, sustainable development and implementation will require vigilance in implementation of the social and environmental monitoring and management plan provided in section 6. Multi-stakeholder involvement both in strategy implementation and monitoring impacts of the landfill is emphasised.

8.0 References

1. The National Environment Act cap 153
2. Environment Impact Assessment Guidelines, 1997.
3. Environment Impact Assessment Regulations, 1998
4. The National Environment (Waste Management) Regulations, 1999
5. The National Environment (Noise) Regulations, 2002
6. Kabarole District Environment Profile, 1997.
7. Three Year Development Plan for Lira Municipality
8. State of Environment Report for Uganda, 2002/2003
9. Environment Standards and Preliminary Environment Impact Assessment For Water Quality And Discharge Of Effluent Into Water and Land, 1998.
10. Forestry Department (2003). National Biomass Study: Technical Report. Kampala, Uganda.
11. Howard, P.C. 1994. An annotated checklist of Uganda's Indigenous trees and shrubs. Uganda Forest Department, Kampala.
12. Katende, A.B., Birnie, A and Tengnas, B. 1995. Useful trees and shrubs of Uganda. Regional Soil Conservation Unit, Nairobi.

9.0 Appendices

- Site Geophysical measurements Report
- Site biodiversity count
- Engineering Designs for the proposed landfill
- Consultees contacted during the study
- Baseline water quality analysis results for Kagezi spring/stream
- Land lease Offer
- Land Purchase Agreement
- Site Inspection Report by the District Environment Officer
- Minutes of Consultative Meeting Between the Municipal Council and Kiteere Village Residents
- Terms of reference an EIA for the proposed Fortportal Waste Composting and Dumping site

Appendix 1

Site Geophysical measurements Report

Introduction

In order to assess the impact of the refuse damp on the surrounding environs and the subsurface, geophysical measurements were performed at randomly selected points within the proposed refuse damp. The geo-analyses performed will identify the different soil types existing, the physical qualities of the soil types and their possible use in the development of any mitigation measures that may be necessary to alleviate negative impacts on the environment. Particular emphasis will be placed on the groundwater occurrences at this location, as any disturbance on the groundwater balance and quality will adversely affect the surrounding communities.

Location and Geography

The proposed refuse damp is located about 4km out of Fort-Portal town in the village of Kitere, Kabarole district. The coordinates of the site are, 192029E and 76591N. The area generally consists of steep slopes dipping SE-NW to a narrow valley trending in the E-W direction. The thin soil cover is of loamy dump topsoil underlein by sediments of volcanic ashes over the expected location of the refuse damp.

The area has very few scattered homes in a close range. Only a military barracks is located north west of the proposed site. The main economic activity that is taking place in the immediate vicinity of the refuse damp is subsistence farming of food crops on the valley slopes.

Geology

The area is mainly of the basement complex geology comprising of undifferentiated gneisses including elements of partly granitised and metamorphosed formations. Argillites with basal quartzites and amphibolites of the Buganda-Toro system forms part. A small area of the project area in the southern part is comprised of volcanic tuffs and lavas of the western rift valley system.

Methodology

The soil types, their depths relative to each other and some of their physical properties have to be known in order to make a viable assessment of the possible impacts of the refuse damp on the environment and create mitigation measures to avert them. This was achieved by doing a geophysical survey over the proposed refuse-damping site using an instrument known as a terrameter. This instrument sends electric current into the ground and measures the different resistivities of the soil layers underground. From the resistivity variations of the different soil or rock types, the soil or rock types can be differentiated.

Vertical Electrical Soundings (VESes) to a depth of 83m were performed at various points over the proposed refuse damping site. The VES were then interpreted both in the field and using the ResSound and ResixP computer soft wares and compared. A stratigraphic column (soil profile) of the area was then generated. From this column, the possible transmissions of the leachet into the ground to contaminate water sources both under and above ground can be studied and solutions devised to alleviate this.

Work done and Analysis of Measurements

Three points in a triangular array at the centre of the proposed damping site were sounded and can provide an overall picture of the underneath of the refuse pit because the refuse pit area is very small such as to make a very big difference in geology.

VES 1

It was done at the centre of the valley and in the direction of the valley structure. Both the field data and the computer modelling of the field data showed a similar gradual decrease in the apparent resistivities of the formation layers with depth. The interpretation of the VES curve gives a 4-layered model. This progressive decrease in resistivities with depth is a sign that compaction levels were decreasing with increasing depth and therefore the soil layers were becoming increasingly pervious with depth. The generated stratigraphy at that point is; Top loam soils to 2m deep, sandy clay

from 2m-9m. Moist clays from 9-30m followed by a weathered formation from 30-40m. Hard rock is indicated by a sharp increase in resistivities from 40m and above.

VES 2

This was done on the lowest slope to the valley in the direction of the valley structure. There is no difference in resistivity variations between VES 1 and VES 2 as indicated from the VES curves. Both the field data and the computer modelling of the field data showed a similar gradual decrease in the apparent resistivities of the formation layers with depth. The interpretation of the VES curve gives a 4-layered model. This progressive decrease in resistivities with depth is a sign that compaction levels were decreasing with increasing depth and therefore the soil layers were becoming increasingly pervious with depth. The generated stratigraphy at that point is; Top loam soils to 2m deep, sandy clay from 2m-9m. Moist clays from 9-30m followed by a weathered formation from 30-40m. Hard rock is indicated by a sharp increase in resistivities from 40m and above.

VES 3

This vertical electrical sounding was done at the valley centre as VES 1.It indicates similar resistivity variations as the rest of the soundings except that it has a wider weathered zone. Both the field data and the computer modelling of the field data showed a similar gradual decrease in the apparent resistivities of the formation layers with depth. The interpretation of the VES curve gives a 4-layered model. This progressive decrease in resistivities with depth is a sign that compaction levels were decreasing with increasing depth and therefore the soil layers were becoming increasingly pervious with depth. The generated stratigraphy at that point is; Top loam soils to 2m deep, sandy clay from 2m-9m. Moist clays from 9-30m followed by a weathered formation from 30-50m. Hard rock is indicated by a sharp increase in resistivities from 40m and above.

Dark top loam soil (0-2m)

Sandy clay (2-9m)

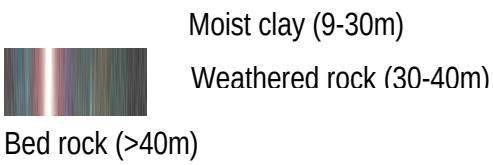


Fig 1: Soil Profile over the proposed refuse-damping site

Conclusion and recommendations

Percolation of surface water into the groundwater aquifers takes place especially where the overlying formations to the bedrock are so pervious or the bedrock is close to the surface (<14m). In this case of the For Portal Municipality Refuse damping site, there is a thick clay layer that impermeable to water that acts as a seal above the weathered and bed rocks. Therefore it is not possible to contaminate the deep-seated aquifers as the bedrock is beyond 40m deep.

Over the proposed damp site exist an average thick overburden of 30m comprised of topsoil, sandy clay and clays. This overburden is soft and exhibits no difficulties in excavations. There are no hard Laterites (murram) in the area. Excavation of damping pits will have to be done before the garbage damping starts.

The upper slopes to the valley (the proposed damping site) are being used for subsistence farming. The valley will be good ground for leachet accumulation. Use of an impervious lining for the landfill, and construction of a leachate collection sump will be a good mitigation measure here.

Appendix 2

Site biodiversity count

Terrestrial and Wetland Biodiversity

Method of study

To study the vegetation structure and composition in the area a transect was established to cover the entire project area. Circular plots located every 50 meters were used to assess the plant diversity and abundance. Herbs and shrubs were enumerated in a radius of 2 meters with all individuals counted and recorded while trees were enumerated in 10m radius from the centre of the plots and numbers recorded. Opportunistic sampling was done to record other species that were not recorded within the plots to come up with a complete species list of the site. Effort was made to capture as many distinct vegetation communities as possible and also to capture as many habitats as possible.

Specimen collection and identification

For identification to be complete, a voucher specimen of every species that could not be identified in the field was collected and given a unique number and compared with the specimens at the National Herbarium at Makerere University. Details of specimen that could not be identified in the field were recorded by reference to the specimen number to help in identification at the Herbarium.

Data analysis and presentation

A species list was compiled for the site, which showed the relative abundances using the encounter rate. Their respective life forms and families are also indicated (see appendix attached).

General overview

A total of 122 species were recorded in the study site as presented in the checklist (Appendix 1). I recorded 50 herbaceous species, 25 grasses, 30 shrubs and 12 tree species, and 5 climber species. The species recorded belonged to 32 families of which Poaceae ranked highest with 21 genera followed by Fabaceae with 18 genera. ecologically, the garbage collection site can be divided into two major habitats basing on the species dominance of the assessed area. This site had;

Cultivated land

The site lies in a cultivated area with over 55% land cover changed from woodland to banana plantation and 25% that was wetland has been reclaimed to farmland and grazing area. Some of the crops that are relics of cultivation include Bananas, *Persia americana*

(Avocado), Yams, Maize, *Carica papaya* (Pawpaws) and weeds to include *Oxalis Latifolia, Oxalis corniculata, Conyza floribunda and Bidens pilosa.*

Fallow land

Fallow area constitutes about 20% with mainly grass and scttered shrubs of *Acacia hockii, Acanthus pubsens, Cloredendrum capitata and Triamufetta rhomboidea, Setaria kagerensis, Phytolacca dodecandra.* The site is in a valley potentially rich in species but has been reduced to farming area with barely any unique species left to be lost due to any activities.

In the neighborhood of the site, there is a eucalyptus plantation on the down slope which covers twice as big the area that has been planned for the garbage collection. The crops is healthy and vigorous, this can be used in future to identify the levels of toxic materials released to the environment.

Likely impacts and proposed mitigation

Environmental Impacts on the garbage processing site likely to be generated during the development, operation and decommissioning of various components of the garbage processing plant will include erosion, pollution by garbage effluents;

Site preparation and construction phase

The most likely impact to arise during site preparation and construction phase of the processing plant is loading the wetland with soil and other materials generated by the cut and fill process. This impact is rated significant especially during heavy downpour in view of the high gradient of the garbage site, which will aggravate run off rate and soil erosion.

Proposed Mitigation measures

- Landscaping by the developer to reduce the effect of the slope on soil erosion;
- Buying off of the land with the eucalyptus to increase the size of the buffer zone for the garbage processing plant

Impacts during operation phase

Pollution carried by runoff and garbage effluents is the most likely source of impact to the vegetation in valley down the slope toward Mpanga river during the project operation phase. Decomposition of garbage is always associated with release of gasses, which can be toxic to both plants and other biological life. When the processing of garbage into manure is halted for some time due to technical problems this may result in accumulation of polythene waste which does not decompose hence changing the structure and properties of the soil thus affecting the available living organism. It is recommended that

the developer puts in place mechanism to handle the different types of garbage ranging from biodegradable to non degradable such as polythene material which can be disposed off by incineration.

It is also recommended that the developer buys the land next to the site down steam which should act as the buffer zone to filter the effluents before the run to the river down slope

Species of conservation concern

There were no species of special conservation concern (IUCN, 2000) recorded however, the site appeared to be valuable to the local people in terms of agricultural use and cattle keeping. The likely plants to be affected are the eucalyptus trees which belong to an independent farmer. If this area is not developed into a garbage processing plant, there will be continued utilization of this area for cultivation and cattle grazing. However, there is likely to be an increase in fruit trees, *Persea americana* (Avocado) and eucalyptus as it is doing very well in the neighbourhood. When this area is curved into a garbage processing site the forest which is being encroached upon near the town will be saved, but decrease in indigenous and exotics at the site.

Specific conclusion and recommendations

Owing to the fact the species richness and abundance in the plant taxa is small, there is bound to be a continued and substantial decrease in the flora due to the on-going farming practices. However, if this is to be converted into a garbage processing plant, the projected loss of biological diversity can be reduced if the mitigation measures suggested are adhered to. There will be need to preserve and plant 'trees of indigenous species on the slope and around the site in addition to buying the woodlot adjacent to the project sit. Some of the species that can be planted include *Pennisetum papureum, Euphorbia trucalii, Persia Americana, Ficus natalensis* and *Makhamia lutea* and *Paspalum notatum*.

Plant list

FAMILY	Identification	Climber	Grass	Herb	shrub	Tree
Euphorbiaceae	*Acalypha bipartita*				1	
Mimosaceae	*Acacia hockii*					1
Acanthaceae	*Acanthus pubescens*				1	
Amaranthaceae	*Achyranthes aspera*			1		
Amaranthaceae	*Aerva lanata*			1		
Asteraceae	*Ageratum conyzoides*			1		
Amaranthaceae	*Amaranthus dubius*			1		
Amaranthaceae	*Amaranthus graecizans*			1		
Commelinaceae	*Aneilema beniniense*			1		
Acanthaceae	*Asystasia gangetica*			1		

FAMILY	Identification	Climber	Grass	Herb	shrub	Tree
Acanthaceae	*Asystasia mysorensis*			1		
Asteraceae	*Bidens pilosa*			1		
Poaceae	*Bracharia brizantha*		1			
Euphorbiaceae	*Bridelia micrantha*					1
Caricaceae	*Carica papaya*					1
Caesalpiniaceae	*Cassia didymobotrya*				1	
Caesalpiniaceae	*Cassia floribunda*				1	
Caesalpiniaceae	*Cassia kirkii*				1	
Caesalpiniaceae	*Cassia mimosoides*			1		
Caesalpiniaceae	*Cassia obtusifolia*				1	
Caesalpiniaceae	*Cassia occidentalis*			1		
Apiaceae	*Centella asiatica*			1		
Poaceae	*Chloris pycnothrix*		1			
Commelinaceae	*Commelina africana*			1		
Commelinaceae	*Commelina benghalensis*			1		
Boraginaceae	*Cordia monoica*				1	
Fabaceae	*Crotalaria axillaris*				1	
Fabaceae	*Crotalaria glauca*				1	
Fabaceae	*Crotalaria incana*				1	
Poaceae	*Cynodon nlemfuensis*		1			
Cyperaceae	*Cyperus latifolius*		1			
Cyperaceae	*Cyperus rubicundus*		1			
Poaceae	*Dactyloctenium aegyptium*		1			
Fabaceae	*Desmodium repandum*				1	
Fabaceae	*Desmodium salicifolium*					1
Poaceae	*Digitaria longiflora*		1			
Poaceae	*Digitaria velutina*		1			
Acanthaceae	*Dyschoriste radicans*			1		
Poaceae	*Echinochloa haploclada*		1			
Asclepiadaceae	*Ectadiopsis oblongifolia*					1
Poaceae	*Eleusine indica*		1			
Poaceae	*Eragrostis cilianensis*		1			
Fabaceae	*Eriosema parviflorum*			1		
Fabaceae	*Erythrina abyssinica*					1
Euphorbiaceae	*Erythrococca*				1	

FAMILY	Identification	Climber	Grass	Herb	shrub	Tree
	bongensis					
Myrtaceae	*Eucalyptus grandis*					1
Euphorbiaceae	*Euphorbia cyathophora*			1		
Euphorbiaceae	*Euphorbia hirta*			1		
Euphorbiaceae	*Euphorbia tirucali*					1
Moraceae	*Ficus natalensis*					1
Euphorbiaceae	*Flueggea virosa*				1	
Asteraceae	*Galinsoga parviflora*			1		
Convolvulaceae	*Hewittia scandens*	1				
Malvaceae	*Hibiscus ovalifolius*				1	
Lamiaceae	*Hoslundia opposita*					1
Poaceae	*Hyperrhenia filipendulum*		1			
Poaceae	*Hyperrhenia ruffa*		1			
Fabaceae	*Indigofera arrecta*				1	
Fabaceae	*Indigofera congesta*			1		
Fabaceae	*Indigofera dendroides*			1		
Fabaceae	*Indigofera emarginella*				1	
Fabaceae	*Indigofera hirsuta*			1		
Fabaceae	*Indigofera simplicifolia*			1		
Fabaceae	*Indigofera spicata*			1		
Fabaceae	*Indigofera trita*			1		
Asteraceae	*Inula paniculata*				1	
Acanthaceae	*Justicia exigua*			1		
Acanthaceae	*Justicia flava*				1	
Rubiaceae	*Kohautia coccinea*			1		
Cyperaceae	*Kyllinga bulbosa*		1			
Cyperaceae	*Kyllinga erecta*		1			
Cucurbitaceae	*Lagenaria sphaerica*	1				
Verbenaceae	*Lantana trifolia*				1	
Poaceae	*Leersia hexandra*		1			
Lamiaceae	*Leonotis nepetifolia*			1		
Lamiaceae	*Leucas martinicensis*			1		
Euphorbiaceae	*Margaritaria discoidea*				1	
Convolvulaceae	*Merremia tridentata*			1		
Asteraceae	*Microglossa afzelii*			1		
Cucurbitaceae	*Momordica foetida*	1				
Lamiaceae	*Ocimum americanum*			1		
Rubiaceae	*Oldenlandia lancifolia*			1		

FAMILY	Identification	Climber	Grass	Herb	shrub	Tree
Oxalidaceae	*Oxalis corniculata*			1		
Oxalidaceae	*Oxalis latifolia*			1		
Poaceae	*Panicum maximum*		1			
Poaceae	*Panicum repens*		1			
Poaceae	*Pennisetum purpleum*		1			
Lauraceae	*Persia americana*					1
Poaceae	*Phragmites mauritianus*		1			
Phytolaccaceae	*Phytolacca dodecandra*			1		
Euphorbiaceae	*Phyllanthus nummulariifolius*			1		
Euphorbiaceae	*Phyllanthus ovalifolius*				1	
Solanaceae	*Physalis peruviana*			1		
Polygonaceae	*Polygonum pulchrum*			1		
Polygonaceae	*Polygonum salicifolium*			1		
Portulacaceae	*Portulaca oleraceae*			1		
Portulacaceae	*Portulaca quadrifida*			1		
Piperaceae	*Pothomorphe umbellata*				1	
Fabaceae	*Rhynchosia minima*	1				
Acanthaceae	*Ruellia patula*			1		
Dracaenaceae	*Sansevieria parva*			1		
Poaceae	*Setaria kagerensis*		1			
Poaceae	*Setaria sphacelata*		1			
Malvaceae	*Sida alba*				1	
Malvaceae	*Sida ovata*				1	
Solanaceae	*Solanum incanum*				1	
Rubiaceae	*Spermacoce pusilla*			1		
Asteraceae	*Spilanthes mauritiana*			1		
Poaceae	*Sporobolus pyramidalis*		1			
Poaceae	*Sporobolus stapfianus*		1			
Commelinaceae	*Stanfieldiella imperforata*			1		
Menispermaceae	*Stephania abyssinica*	1				
Asteraceae	*Tagetes minuta*			1		
Fabaceae	*Tephrosia nana*			1		
Fabaceae	*Tephrosia pumila*				1	

FAMILY	Identification	Climber	Grass	Herb	shrub	Tree
Poaceae	*Tragus berteronianus*		1			
Tiliaceae	*Triumfetta brachyceras*				1	
Asteraceae	*Tridax procumbens*			1		
Tiliaceae	*Triumfetta rhomboidea*				1	
Asteraceae	*Vernonia amygdalina*					1
Asteraceae	*Vernonia auriculifera*				1	
Asteraceae	*Vernonia smithiana*				1	
		5	25	50	30	12

Appendix 3

Engineering Designs for the proposed landfill

Appendix 4

Consultees during the study

NO	NAME	DESIGNATION	INSTITUTION	COMMENTS
1	Mr Richard Mande	Town Clerks Office	Fort portal municipal council	In Support of the project
2	Mr. Asaba Edison	Mayor	Fort portal municipal council	In Support of the project
3	Mrs. Magret Kihiika	Deputy Mayor	Fort portal municipal council	In Support of the project
4	Mr.Mbaine Gilbert	Senior Health Inspector	Fort portal municipal council	In Support of the project
5	Col. Bakasumba Jack	Brigade Commander	55th Battalion, UPDF- in charge of Muhoti Barracks	Okay, no problem with the project.
5	Mr.Kamanda Patrick Isagara	Environmental Inspector	National Environment Management Authority (NEMA)	Site was allowed pending an EIA
6	Mr.Mugenyi Francis	Secretary for Health and Education	Fort portal municipal council	In Support of the project
7	Mr. Alex Winyi	District Environment officer	Kabarole district	Assisted council in locating a suitable site
8	Ms. Olivia Bahwayo	Municipal physical planner	Fort portal municipal council	Led the mapping and surveying of the proposed project site.
9	Mr. Kahuma Adolph	Municipal Engineer	Fort portal municipal council	In Support of the project
10	Mr. Kagaba Geoffrey	Assistant Engineer in charge of roads	Fort portal municipal council	In Support of the project
11	Mr. Tusiime Clovis	Neighboour	Lives around the proposed project area	In Support of the project
12	Mr.Muwongera Ibrahim	Neighboour	Lives around the proposed project area	In Support of the project
12	Mrs. Kabebe	Neighbour	Lives around the proposed project area	In Support of the project
13	Mr. Paul Ajuna	Mpanga Market vendor	Mpanga Market	In Support of the project
14	Mr. Michael Ayesiga	Mpanga Market vendor	Mpanga Market	In Support of the project
15	Ms Resty Tuta	Neighbour	Lives around the proposed project area	In Support of the project
16	Mr. Byankya Absolom	Neighbour	Sold the proposed site to the municipal council, -	-Would like to sell them additional land In -Support of the project
17	Mr. Ruhweza Joseph	Chairman Local Council 1	Kiteere Village	In Support of the project
18	Mr. Rwabuhinga James	Secretary for defence	Kiteere Village	In Support of the project
19	Mrs. Karyebara Penninah	Secretary L.C1	Kiteere Village	In Support of the project
20	Mr. Mukonjo Clovis	Secretary for works, Fortportal municipal council and councillor from Kiteere	Kiteere Village	In Support of the project
21	Mr. Sanyu Hussein	Neighbour	Kiteere Village	In Support of the project
22	Mr. Kyomuhendo Moses	Neighbour	Kiteere Village	In Support of the project
23	Ms Kalungi Pollyne	Community Development Assistant	Fort portal municipal council	In Support of the project

24	Ms. Martha Kaita	Hotel/restaurant attendant	South division,	In Support of the project
25	Mr. Kalibala Anthony	Neighbour	Current disposal site-cemetery area	In Support of the project
26	Mr. Businge Amon	Neighbour	Current disposal site-cemetery area	In Support of the project
27	Mr. Muhumuza Fred	Resident – shop attendant	South Division	In Support of the project
28	Pastor.Kyamulesire James	Resident evangelist	Banya road	In Support of the project
29	Eng. Aloysius G. Lubowa	Senior structural and building construction engineer	AGL Associates- Project Architects	-Site project specific Architectural designs developed -In Support of the project
30	Mr.Selemba Raymond	Civil engineer	AGL Associates- Project Architects	Site project specific Architectural designs developed. - In Support of the project

Appendix 5

Baseline water quality analysis results for Kagezi spring/stream

Appendix 6

Land lease Offer

Appendix 7:

Land Purchase Agreement

Appendix 8:

Site Inspection Report by the District Environment Officer

Appendix 9:

Minutes of Consultative Meeting between the Municipal Council and Kiteere Village Residents

Appendix 10

Terms of reference an EIA for the proposed Fort portal Waste Composting and Dumping site