MoE

National Solid Waste Management Program

Lot B: Governorate of Kafr El-Sheikh and Governorate of Gharbia

Strategic Master Plan for Other Wastes (Final)
Governorate of Gharbia
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Lot B implemented by

COWI A/S

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ACKNOWLEDGEMENTS AND DISCLAIMER

This document has been prepared with inputs from the Solid Waste Management Unit (SWMU) and other stakeholders in Gharbia Governorate. The assistance of the SWMU and other stakeholders is gratefully acknowledged.

Notwithstanding the assistance of others, this document and its contents are the responsibility of the Consultant for Project Implementation for Lot B: Governorate of Kafr El-Sheikh and Governorate of Gharbia, National Solid Waste Management Project.

LIST OF ABBREVIATION AND ACRONYMS

EEAA	Egyptian Environmental Affairs Agency
EPR	Extended producer responsibility
ESWA	Water and Wastewater Regulatory Agency
KPI	Key performance indicator
NaCH	Sodium hydroxide
SWMU	Solid waste management unit
WMRA	Waste Management Regulatory Agency

1.0 INTRODUCTION

1.1 Purpose

This document presents a "Strategic Master Plan" for the management of wastes in Gharbia Governorate that should be managed wholly or partly outside the system for the management of household wastes. The Strategic Master Plan sets out the main considerations and directions for the management of the identified wastes with respect to legal and institutional considerations, technology options, financial considerations and capacity development.

1.2 Context

This document has been prepared in the context of the methodology set out in the Terms of Reference for this assignment:

Using available information, estimates based on proxy indicators or literature data, the consultant shall carry out an approximate assessment of the types and amounts of the different waste streams generated in the two Governorates. The objective is rather to have an overview of the dimension of the problem than to receive 'exact' data. In a second step the consultant shall sketch possible conceptual and technical options on how to deal with the different waste streams. The objective is not to develop solutions 'ready for implementation' but to delineate possible paths on

- *How (conceptual and technical approach)*
- *Who (institutions and responsibilities)*
- *With which means (legally and financially) appropriate solutions should be developed in future.*

In order to support the decision making process the consultant shall concisely outline the required frame conditions for the sustainable implementation and operation of suitable technologies using maybe generic form-sheets for each waste type. The sheets shall in particular contain proposals and recommendations on:

- *SWM policy & legal framework*
- *Proposed institutional set-up and responsibility split on national, Governorate and local level*
- *Needed administrative capacities for management and supervision*
- *Required institutions and capacity development*
- *Suitable technical and conceptual solutions*
- *Rough estimates of cost*
- *Financing of investments*
- *Bearer of running cost and suitable cost covering instruments*

1.3 Scope

The scope of this document includes the management of the following wastes, which together represent the major "non-municipal" wastes that are generated in Gharbia Governorate:

- Agricultural wastes
- Wastes excavated/dredged from canals and drains
- Non-hazardous industrial wastes
- Construction/demolition wastes
- Water and wastewater treatment sludge and waste
- Healthcare wastes, including wastes from hospitals and clinics

- Hazardous wastes including e-wastes, lead acid batteries, used oil
- Slaughterhouse waste
- Waste tyres

1.4 Limitations of the Document

The implementation of measures identified in this document is subject to the following:

- Data on waste quantities is not available for very many of the wastes addressed in this document. Where possible, waste quantities have been estimated based on secondary criteria, as identified throughout the document.
- In many cases, management of the wastes addressed in this document requires policy/regulatory action at the national level to create the framework conditions for effective action at Governorate and local levels.
- While this document identifies directions for the management of the wastes that it addresses, detailed work will be required in each case to design and implement the specific actions that are required. In many cases this can involve parallel actions by the private sector.

1.5 Linkage to Economic Development

Many of the wastes that are addressed in this document can be managed through recycling, composting and/or energy recovery strategies. The management of wastes in these ways will create employment and will contribute to the development of local economies. The achievement of this objective, however, fundamentally depends on changing the behaviour of waste generators from a disposal orientation to an orientation in which they make wastes available to others for treatment and processing. Overarching strategies are therefore required at national level to achieve this objective. The benefits will include not only local economic development, but also reduced public sector expenditures for waste management as wastes are increasing managed as resources.

1.6 Format

The Strategic Master Plan for the management of each waste is presented in Table format that identifies:

- **Current management situation** This includes estimates of how much waste is generated, who generates the waste, how it is managed, the health and environmental impacts in the Governorate of the current management practice and the main barriers to improved management.
- **Targetted change** This identifies the changes that should be targetted for the management of the wastes and the key policy/legal actions necessary to achieve the targetted changes. In addition, roles and responsibilities of implicated entities are identified, together with key capacity development actions that should be taken in support of the targetted change.
- **Financing and cost recovery** Preliminary guidance is provided on the cost of the targetted change, who will pay the costs and how cost recovery will be achieved. Capital costs are expressed on a relative basis because actual costs are highly specific to individual initiatives that cannot be specified at this time. The symbol "$" is used to indicate the anticipated capital cost of equipment to manage the wastes generated n the Governorate as follows :

$	Less than 10 million EGP
$$	10 - 20 million EGP
$$$	20 - 30 million EGP
$$$$	40 - 50 million EGP
$$$$$	Over 50 million EGP

Commonly, the symbols identify a range of capital cost. This indicates that there are multiple possible ways to achieve the targetted changes, and that some of these carry a significantly lower capital cost than others. Lower capital costs, however, may require increased operating costs or may bring disadvantages related to less quality control, for example. Higher capital costs may be associated with greater opportunity to obtain high quality energy or material outputs that command a higher revenue stream.

- **Actions and timing** Actions and related timing are identified for achieving the targetted change, together with the entity(ies) that will be responsible for the identified actions.

The "actions and timing" assumes that Waste Management Regulatory Agency (WMRA) will play the key policy role in setting waste management policy and strategy for the management of wastes. In some cases, this responsibility will be shared with other entities, based also on the mandates of those entities.

The "actions and timing" that are shown display an aggressive program to restructure the management of the wastes that are addressed in this document. However, the ability of WMRA to act as rapidly as shown proposed in this document will depend on the extent to which it can mobilize the capacities (technical, administrative and financial) over a short time frame. WMRA will need to establish priorities In the event that it is not feasible to address the management of these wastes over the time-frames that are proposed in this document, and to adjust the implementation timing accordingly.

2.0 AGRICULTURAL WASTE

Current Situation		
Estimated waste generation (Ton/Yr) *701,000 (2015)(Note 1)*	**Main source(s)/ Generator(s)** *Farms*	**Current practice for managing the waste** *175,000 tons of rice straw managed through animal feed and composting* *Large quantities of waste burned*

Health, environment, other problems caused by current management practices *Burning of wastes has negative effects on the environment (e.g. air pollution) and impacts human health (e.g. respiratory problems linked to particulate matter)*	**Main barriers to improved management of the waste** *Collection systems not adapted to collection of small quantities of materials from large number of generators* *Lack of financial incentive to collect materials* *Low level of awareness of technology options to utilize the wastes*

Targetted Changes	
Management objective(s) *Promote recovery of wastes for energy generation and/or manufacture of products*	**Key policy/legal actions to achieve objectives** *Develop financial frameworks to support collection of wastes and link to appropriate infrastructure* *Establish standards to achieve collection of high quality, uncontaminated agricultural wastes materials*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	**Roles/responsibilities**	**Administrative capacity needs**	**Capacity development priorities**
Waste Management Regulatory Agency	*Develop and implement policy frameworks to promote recovery of agricultural wastes*	*Policy options to promote organizational frameworks and technology applications to collect/ utilize agricultural wastes*	*Policy mechanisms to promote greater use of agricultural wastes*
Egyptian Environmental Affairs Agency	*Achievement of policy objectives through effective implementation strategy, including monitoring, enforcement and other actions*	*Development of operational strategy to maximise utilization of agricultural wastes*	*Development of a compliance tool kit that targets achievement of policy objectives through non-regulatory and regulatory actions*
Governorate	*Development / implementation of local legal framework to address local priorities and opportunities*	*Control over waste collection and disposal systems to prevent disposal of agricultural wastes*	*Organizational capacity to supervise proper management of agricultural waste for materials recovery, energy and other values* *Actions to link agricultural wastes to existing organic materials processing facilities*
Markaz/Local Unit	*Ensure agricultural wastes are streamed to utilisation for materials and/or energy values*	*Knowledge of opportunities and mechanisms to further develop the utilisation of agricultural wastes*	*Knowledge of local sources of agricultural wastes and key actions to ensure their utilisation.* *Actions to link agricultural wastes to existing organic materials processing*

			facilities
Private Sector	*Invest in and/or operate systems to collect and/or process agricultural wastes*	*Available and acceptable financing opportunities* *Reliable and predictable regulatory and contract frameworks*	*Case studies / examples of effective and appropriate agricultural residue projects.*
Ministry of Agriculture	*Facilitate productive potential of agricultural sector*	*Develop / maintain database on agricultural waste* *Provision of data / information on agricultural wastes and investment opportunities*	*Organizational and financial frameworks for agricultural waste utilization*

Good practice solutions

Ensure waste does not enter disposal; establish collection/processing infrastructure

Process agricultural wastes for economic benefits; examples include: (i) compost; (ii) animal feed; (iii) energy; (iv) paper. Incorporation of processed fish waste into animal feed made from rice straw brings substantial increase in the nutrient value of the feed.

Financing and Cost Recovery

Approx. capital cost (preliminary)	***Cost recovery***	
	Who pays?	**Cost recovery mechanism**
$$ - $$$$$	*Processor pays generator for materials* *End-user pays market price for products or energy developed from waste*	*Payment based on: (i) quantity (weight)/ quality of material delivered to collection system or processor; (ii) value of product or energy developed from the waste*

Recommended Actions and Timing

Action	**Timing**																				**Responsibility**
	2018				*2019*				*2020*				*2021*				*2022*				
Review/enhance legal framework																					*Waste Management Regulatory Agency*
Promote frameworks to utilize agricultural wastes																					*EEAA, Ministry of Agriculture, Governorate,*
Develop database on agricultural waste																					*Ministry of Agriculture*
Provide data / information on opportunities to use waste																					*Ministry of Agriculture, EEAA*
Develop case examples of investment in waste use																					*Ministry of Agriculture*
Ensure agricultural waste does not enter disposal																					*Governorate, markaz, local unit*
Capacity building																					*EEAA, Ministry of Agriculture, Governorate*

Note 1

Estimate based on pro-rating detailed agricultural waste quantities in Kafr El-Sheikh Governorate.

Annex A estimates the major categories of agricultural waste in each markaz.

There is a wide variety of potential applications of agricultural wastes. The most common include the application of the wastes directly to the land, composting, or used an energy source. In some cases, agricultural wastes may be used for animal feed. Potential applications of agricultural wastes are described below. Specific options are then provided for rice straw and cotton wastes, both of which are generated in large quantities in the Delta region.

Direct Application to the Land
Agricultural wastes (e.g. fruit and vegetable wastes) that are high in moisture and low in fibre may be applied directly to the land. These types wastes break down rapidly, and return nutrients directly to the soil. Best results may be obtained when these wastes are ploughed into the soil, and not left on the surface of the soil. Simple processing of the wastes (e.g. chopping or cutting the wastes into pieces) speeds up the break down of the wastes, and promotes a rapid incorporation of the wastes into the soil.

Agricultural wastes that are high in fibre and low in moisture (e.g. rice straw) do not break down easily. These types of waste may be processed (e.g. by composting) before being applied to the soil.

Composting
Composting is an aerobic process for managing organic wastes, including agricultural wastes. Agricultural wastes are arranged into a pile. The wastes break down over time as a result of natural decomposition processes. The speed of the decomposition is optimized though careful management of moisture and oxygen levels within the pile, and may be further increased if manure is mixed into the agricultural wastes.

Composting of agricultural wastes is undertaken as a commercial activity in Egypt. However, the availability of agricultural wastes to commercial (or other) composting operations is limited by poor collection systems. Compost manufactured from agricultural waste brings extensive benefits to agricultural soils, including the addition of structure to the soil, the retention of water, and the release of moisture of plants. Compost has particular value in these regards in the reclaim of desert soils for agriculture.

Energy
Agricultural wastes may be used to generate energy. There are two main options:

- Anaerobic processing A wide variety of agricultural wastes can be managed through anaerobic processing including rice straw, corn (maize) and other wastes. Anaerobic processing may also be used to manage manure. Some agricultural wastes require more time than others to process; high levels of lignin result in longer time periods to process rice straw than are needed for many other types of agricultural waste. An output of an anaerobic treatment is methane, a high calorific-value gas that can be recovered for energy use either directly (e.g. burning for heat) or indirectly (e.g. to drive a generator to create electricity)[1]. Some anaerobic processes can be undertaken at a scale as small as an individual household or at a commercial scale. Capital costs for most processes are high; operating costs are low but an effective operation depends on careful control of feedstocks.
- Refuse-derived fuel (RDF). Agricultural wastes may be directly burned for their fuel value. Wastes require collection and (typically) mechanical processing so that they have a form that minimizes transport costs, and so that can be readily fed to a thermal energy facility. Processing may require simply chopping the wastes to an acceptable dimension, or may

[1] Methane is also a potent greenhouse gas and it is therefore important that anaerobic digestion systems prevent the release of methane to the atmosphere.

require additional steps (e.g. pelletizing). In principle, all dry agricultural wastes may be considered for RDF, but the most attractive candidates are wastes that are dry (e.g. straw) and with a high lignin/fire content. Rice straw meets these criteria, but the high levels of silicate in rice straw causes the blades of processing equipment to become dull and this reduces the ability of equipment to process the straw.

In Sharqiya Governorate rice straw has been converted into briquettes. This densifies the straw and results in easier and lower cost transportation, and easier handling. The briquettes are burned for their fuel value.

Animal Feed
Agricultural wastes may have potential for use as animal feed. Different agricultural wastes have different possibilities in this regard, depending on:

- Nutritional value. Different agricultural wastes vary widely in their nutritional value, and wastes that have low nutritional value are not attractive as a food source for animals.
- Digestability. Fibrous agricultural wastes (e.g. corn, rice straw) may not be easily digested by animals, and this will reduce their ability to metabolize the nutrients that are contained in the waste.

In some cases a simple treatment can bring about chemical changes in the waste material that can improve the nutritional value of an agricultural waste

Rice straw and cotton wastes are two of the most important agricultural wastes in the Delta. The potential for use of these wastes as animal feed is outlines below:

<u>Rice Straw</u> Burning is a common way of disposing of rice straw. However, this approach not only pollutes the atmosphere, but it releases nutrients to the atmosphere that could otherwise be utilized in agricultural practices including compost or animal feed.

Effective use of rice straw for animal feed requires consideration of:

- The nutritional quality of the straw
- The handling of the straw
- The ability of animals to metabolize the straw.

Nutritional Quality The nutritional quality of rice straw can vary considerably, with crude protein ranging from 2-7% and acid detergent fiber (ADF) ranging from 41-56% on a dry matter basis. Recommended nutritional criteria for the use of rice straw as forage include:

- Crude protein: 4.5% or higher on a dry matter basis
- ADF: 50% or lower on a dry matter basis

Metabolizing Rice Straw
Rice straw has a low digestibility due to high silica content and high lignin content; as much as 70 percent of rice straw may not be digestible.

A treatment of rice straw with sodium hydroxide (NaOH), ammonia or urea increases digestibility. Small scale use of urea to improve the digestibility of rice straw is undertaken by farmers in the Delta region, but may have wider sale applicability.

Rice straw also contains oxalate, a compound that decreases the absorption of calcium. The promotion of the use of rice straw as animal feed may therefore need to also consider the need for a calcium supplement if alternative sources of calcium (i.e. calcium-rich types of feed) are not available.

Cotton Waste

Cotton waste has excellent potential as a substitute for hay, or as a bulking ingredient in higher protein supplements for lactating cows and growing calves. In addition, the high water retention capacity of cotton waste combined with its sufficient carbon to nitrogen ratios and low heavy metal content make cotton waste viable for direct land application and for composting.

Cotton stalks may be useful as animal feed. Alternatively, cotton stalks may be composted or converted to cellulose or charcoal. Charcoal produced from cotton stalks is used in the food industry for refining sugar cane, making soft drinks and purifying water for drinking.

3.0 DREDGED MATERIALS

Current Situation		
Estimated waste generation (Ton/Yr) *Amount estimated to be equal to 22% of solid waste generated by adjacent communities, plus sediments (see Note 1)*	**Main source(s)/ Generator(s)** *Materials dredged from irrigation and drainage canals*	**Current practice for managing the waste** *Dredged materials are dumped along irrigation and drainage canals on land under responsibility of local units. This places an uncontrolled liability of local units, who do not have the resources to pay for the removal of the wastes.*

Health, environment, other problems caused by current management practices	**Main barriers to improved management of the waste**
Dredged materials may be contaminated with sewage and other materials. These wastes may attract vermin and disease-carrying organisms and threaten public health *Unsightliness of dumped materials is inconsistent with tourism values*	*Inadequate accountability for management of the wastes*

Targetted Changes	
Management objective(s) *Removal, remediation and reutilisation of contaminated materials* *Direct reutilisation of other materials*	**Key policy/legal actions to achieve objectives** Strengthening of legal framework to ensure inclusion of proper management of dredged materials in dredging activities

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Development / implementation of legal requirements to ensure proper management of dredged materials*	*Capacity to coordinate proper management of dredged materials with Ministry of Water Resources and Irrigation*	*Policy mechanisms to promote productive utilization of dredged materials*
Egyptian Environmental Affairs Agency	*Achievement of policy objectives through effective monitoring, enforcement and other actions*	*Development of operational strategy to maximise utilization dredged materials*	*Development of a compliance tool kit that includes mechanism to ensure proper management of dredged materials and which links the quality of dredged materials with reutilization options*
Governorate	*Identify land in each markaz for remediation of contaminated dredged materials*	*Coordination with Ministry of Water Resources and Irrigation to ensure proper management of dredged materials*	*Technical knowledge on dredged materials management options, including productive reutilisation and use as landfill cover / cover for dumpsites to be closed*
Markaz/Local Unit	*Monitor that dredged materials are not placed on land under the administration of local*	*Procedures for reporting dredged materials that are dumped on land administered by the*	*Knowledge of dredged materials, their public health and environmental impacts and options for*

	units *Report dumping of dredged materials to EEAA*	*markaz/local unit*	*their management.*
Private Sector	*Respond to opportunities to remediate contaminated dredged materials.* *Use clean materials in development projects*	*Available and acceptable financing opportunities* *Reliable and predictable regulatory and contract frameworks*	*Technical skills in remediation of contaminated dredged materials.*
Ministry of Water Resources and Irrigation (MWRI)	*Develop and implement policy frameworks that includes proper management of dredged materials as part of work to maintain irrigation and drainage canals*	*Creation of dredged materials management program*	*All aspects of management of dredged materials*

Good practice solutions

Reutilization of dredged materials, either directly or following reutilization; use of dredged materials for landfill cover or cover for dumpsites to be closed

Financing and Cost Recovery

Approx. capital cost (preliminary)	***Cost recovery***	
	Who pays?	**Cost recovery mechanism**
$$ -$ $$	*Management of dredged materials is included as a cost of maintaining irrigation and drainage canals*	*Budget of measures to maintain irrigation and drainage canals; sale of materials for reutilisation*

Recommended Actions and Timing

Action	**Timing**																				**Responsibility**
	2018				*2019*				*2020*				*2021*				*2022*				
Amend legal frameworks to ensure proper management	■	■	■																		*Waste Management Regulatory Agency, MWRI*
Coordinate s management activities with MWRI	■	■	■	■	■																*Waste Management Regulatory Agency, MWRI*
Organize EEAA to monitor/ report on dredged materials	■	■	■	■	■																*Waste Management Regulatory Agency, EEAA*
Identify land for management of dredged materials				■	■																*Governorate*
Monitor that dredged materials are not dumped				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*EEAA, markaz, local units*
Utilize dredged materials in productive applications	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Public and private sector investors and developers*
Capacity building	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Waste Management Regulatory Agency, EEAA, MWRI*

Note 1

Amount of solid waste that is disposed of in irrigation canals and drains is estimated to be the total of: (i) 22% of waste generated by adjacent communities (see *Integrated Irrigation Improvement and Management Project* - Environmental Assessment, Ministry of Water Resources and Irrigation, World Bank, 2005 : p.14 [http://documents.worldbank.org/curated/en/553771468021591400/pdf/E11060rev0IIIMP1EA1EMP.pdf]), plus (ii) waste dumped into canals/drains from other communities, plus (iii) sediments.

Dredged materials have high potential for reutilization provided they meet criteria for the protection of public health and the environment. Clean materials have a wide variety of applications:

- Utilization for agriculture, either existing agriculture of the reclamation of desert land
- Landscaping
- Creation of recreational areas (e.g. football fields)
- Construction applications.

Dredged materials that are contaminated, however, require management that ensures the contaminated materials do not impact public health. In these cases, the utilisation of dredged materials that are not treated should be limited to applications in which human contact is prevented:

- Cover material for remediation of disposal sites and/or daily cover for active landfill sites.
- Landscaping, provided that a layer of clean material at least 15 cm thick is placed over the contaminated materials
- Construction applications, provided that the contaminated materials are covered with concrete , asphalt or other materials that isolates the dredged materials from human contact.

Contaminated materials should not come into contact with soils used for food production.

The definition of what is a "clean" dredged material and what is a "contaminated" dredged material can be complex:

1. <u>Clean Materials</u> Materials that have been dredged from an irrigation canal may be considered "clean" unless there are specific reasons to believe that contamination may have occurred (e.g. the presence of household waste in the dredged material, or an oily or chemical odour associated with the dredged materials).

2. <u>Contaminated Materials</u> Materials that have been dredged from a drainage canal should be considered "contaminated" for one - or both - of the following reasons:

   - The dredged material is physically contaminated by solid wastes that may have been generated by households, hospitals or industry. This type of contamination is visible and obvious.
   - The dredged material is contaminated by elevated levels of elements or compounds that are contained in liquid or solid wastes that have been dumped on the ground. This type of contamination is not visible and requires sampling and analysis to determine whether contamination is present.

   Materials that have been dredged from a drainage canal should be tested to determine whether elevated levels of elements or compounds are present. The sampling and analysis that is undertaken should be designed to **<u>generally</u>** characterize the dredged materials; the need for further testing can be determined based on initial results. Dredged materials that are shown to have elevated levels of elements or compounds should be managed as identified above, or should be disposed of in disposal sites.

   On the other hand, materials that are not characterized by elevated levels of elements or compounds may be considered "clean", provided that any solid wastes that may be present are removed (e.g. by screening).

4.0 NON-HAZARDOUS INDUSTRIAL WASTES

Current Situation		
Estimated waste generation (Ton/Yr) *No data available (see Note 1).*	**Main source(s)/ Generator(s)** *Agro-processing, textiles, and chemical industries*	**Current practice for managing the waste** *Delivery of waste to licensed facilities is uncertain; waste may be disposed of at dumpsites or into the environment.*

Health, environment, other problems caused by current management practices *Disposal of wastes in dumpsites or into the environment contributes to negative environmental effects (e.g. impacts on air quality from burning waste) and related public health effects (e.g. respiratory problems linked to particulate)*	**Main barriers to improved management of the waste** *Cost of transportation to disposal site* *Lack of monitoring and enforcement of regulatory requirements*

Targetted Changes	
Management objective(s) *Maximize recovery/reutilization of wastes* *Ensure proper management of residual wastes*	**Key policy/legal actions to achieve objectives** *Establish legal responsibility of generator to ensure proper management of wastes* *Introduce tracking system to ensure disposal of wastes at licensed facilities (and not at an unregulated intermediate location).*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Strengthen legal framework to require tracking of industrial non-hazardous wastes*	*Supervision of waste tracking system*	*Options and experience in legal frameworks for tracking non-hazardous industrial wastes*
Egyptian Environmental Affairs Agency	*Design/implementation of waste tracking system*	*Electronic and related tools to administer waste tracking system*	*Options and experience in tools for tracking non-hazardous industrial wastes*
Governorate	*Fee-based acceptance of non-hazardous industrial wastes at publicly-owned treatment and disposal facilities*	*Financial and planning capacity to integrate industrial non-hazardous wastes into waste management system*	*Creation and implementation of planning and financial frameworks that accommodate private sector wastes and fees*
Markaz/Local Unit	*Offer waste collection/management services to industry on fee-for-service basis*	*Monitor waste dumping; report/tke action against companies that dump waste*	*Waste dumping monitoring, and reporting procedures*
Private Sector	*Contract with industry to transport non-hazardous wastes* *Comply with tracking requirements*	*Capability to manage a waste services contract and to participate in a waste tracking system*	*Contract management and implementation of a waste management tracking system*

Good practice solutions

Ensure waste is not disposed of indiscriminately into the environment

Define and implement the accountability of larger industrial/commercial entities to be responsible for the proper management of the wastes they generate.

Financing and Cost Recovery		
Approx. capital cost (preliminary) *$$ - $$$$*	***Cost recovery***	
	Who pays? *Generators of the waste*	**Cost recovery mechanism** *Payment to service provider against invoice for service* *Fees paid to owner of treatment/disposal facilities based on quantity of waste treated/disposed*

Recommended Actions and Timing						
Action	**Timing**					**Responsibility**
	2018	*2019*	*2020*	*2021*	*2022*	
Amend legal framework to require waste tracking						*Waste Management Regulatory Agency*
Design waste tracking system tools						*EEAA*
Implement waste tracking system						*EEAA*
Monitor waste tracking system						*EEAA*
Review and update waste tracking system						*EEAA*
Capacity building						*EEAA, industrial / commercial entities*

<u>Note 1:</u>
Industrial waste quantities (and types of waste) vary very widely according to the different types of industry. Sufficient data have not been available to estimate non-hazardous waste generation by industry in the time frame for this document.

As far as possible, non-hazardous industrial wastes should be reutilized in order to capture the material and energy values of the waste. Traditionally, the following options may be most commonly considered:

- Recycling
- Composting
- Recovery for energy value

Uses for various types of non-hazardous industrial wastes have been identified in recent years, and relevant aspects of this are addressed below, together with disposal of residual materials.

Traditional Options for Reutilization of Non-Hazardous Industrial Wastes
<u>Recycling</u> Many waste materials that are generated by industry are similar to those that are generated by households, and can be recycled in similar ways. Cardboard, paper, metals, glass and plastics, for example, can all be recycled through the same infrastructure that is used to recycle these materials from households. Industries may generate large quantities of these materials, however. Therefore these materials should be separated at source by the industry.

<u>Composting</u> Organic materials that are generated by industry may be suitable for composting. Agricultural and food processing industries, in particular, generate large quantities of organic materials that are suitable for composting. These materials should be separated at source.

<u>Recovery for Energy Value</u> Combustible materials may be recovered for their energy value. This may be an attractive option for combustible materials that do not have sufficient value in the recycling market. The most common opportunities for the recovery of materials for energy value include low value plastics (e.g. film plastics) and low grade paper/cardboard. Some types of agri-food waste may also be attractive for the recovery of energy (e.g. corn stalks).

Recent Relevant Initiatives
Recent relevant initiatives for the reutilization of specific non-hazardous industrial wastes include the following:

<u>Cotton Waste</u> Waste from cotton processing includes:

- Comber noil: Cotton comber or comber noil is a by-product of the yarn spinning industry and is produced when the cotton is combed to remove short fibres. Because it is trash free, is can be used for high quality and security paper and in the medical industry, where it is used for cotton balls and bandages. This waste is also used as a blend cotton in spinning.
- Cotton dropping: Obtained during yarn manufacturing, its high trash, low cost, and low fibre content make it suitable for spinning low count yarn.
- Clean likkerin: Also a by-product of yarn manufacturing, this is also suitable for low count yarn spinning.

A new use for cotton gin waste is the manufacture of biodegradable packaging. The process involves combining cotton gin waste and fungi to create a biodegradable alternative to polystyrene foam packaging.

<u>Sugar Beet Waste</u> The waste from sugar beet processing may be pelletized and sold as animal feed. However, a recent innovation exploits the cellular structure of sugar beets (including sugar beet waste) to create a cellulosic product that is characterized by both high strength and high viscosity. The product is used in the manufacture of items as varied as paint, cosmetics, composite materials in the aerospace sector, and concrete[2].

[2] http://www.reuters.com/article/us-suger-beet-idUSKCN0RG29I20150916

Disposal of Non-Hazardous Industrial Wastes
Non-hazardous industrial wastes may be disposed of in the same disposal facilities as household wastes.

Financial Management of Non-Hazardous Industrial Wastes
It is common for non-hazardous industrial wastes to be managed through infrastructure owned by a public entity. In this case, however, a fee should be charged to the industry for the use of the infrastructure. At a minimum, the fee should be calculated to cover the pro-rated capital, operating and maintenance costs of the infrastructure. In many countries, industrial users of public waste infrastructure are charged a premium in order to: (i) provide an incentive to the industry to reutilize the waste; and (ii) generate revenue that can be used for other waste management purposes, or to subsidize the cost of managing household waste.

5.0 CONSTRUCTION AND DEMOLITION WASTE

Current Situation		
Estimated waste generation (Ton/Yr) 362,000 *(See Note 1)*	**Main source(s)/ Generator(s)** *Construction projects*	**Current practice for managing the waste** *Disposed of on roof-tops, on vacant land or in dumpsites; may be used as fill for construction projects.*

Health, environment, other problems caused by current management practices *Unsightliness is inconsistent with tourism development values*	**Main barriers to improved management of the waste** *Weak regulatory/enforcement framework* *Absence of facilities/infrastructure for productive management* *Absence of incentives for productive management*

Targetted Changes	
Management objective(s) *Collect/process wastes to maximize productive uses and create employment*	**Key policy/legal actions to achieve objectives** *Establish construction and demolition waste processing facilities* *Require construction and demolition wastes to be delivered to a processing facility* *Link waste management obligations of the developer to the permit that allows development* *Enforce legal obligations*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Establish, as necessary, requirement for construction / demolition waste to be managed at licensed/permitted locations* *Require permits for development to include requirements for waste management; require developers to implement waste management requirements of the permit*	*Linkages with Ministry of Local Development, Governorate entities and other public entities with development/construction responsibilities*	*Policy options for management of construction/demolition waste* *Policy coordination with other public entities*
Egyptian Environmental Affairs Agency	*Monitor developments and enforce waste management requirements*	*Supervision of monitoring/ enforcement activities* *Reporting monitoring and enforcement actions* *Implementation of enforcement procedures*	*Monitoring procedures for construction/demolition waste* *Preparation of construction/demolition waste monitoring reports* *Procedures for enforcing construction/demolition waste management requirements*
Governorate	*Issuance of development permits to include provisions for management of construction/demolition waste* *Provision of sites in each markaz for management of construction/demolition*	*Procedures for issuance of development permits to include provision for management of construction/demolition waste*	*Provision of templates that integrate construction/demolition waste management with development permits* *Opportunities for processing/reutilization of construction/demolition waste*

	waste		
Markaz/Local Unit	*Report violations of construction/demolition waste management requirements to enforcement entities*	*Template for reporting violations of construction / demolition waste management to enforcement entities*	*Opportunities for processing/reutilization of construction/demolition waste*
Private Sector	*Developers to comply with requirements to ensure proper management of construction/demolition waste*	*Proper supervision of contractors to ensure that construction/demolition waste management requirements are implemented* *Utilization of processed construction/demolition waste in development projects*	*Contractor supervision for management of construction/demolition wastes* *Opportunities for processing/reutilization of construction/demolition waste*

Good practice solutions

Require proper management of wastes as part of construction permit

Process construction and demolition waste for reutilization

Financing and Cost Recovery

Approx. capital cost (preliminary)	***Cost recovery***	
	Who pays?"	**Cost recovery mechanism**
$$$ - $$$$	*Generator*	*Waste management costs included in cost of development projects*

Recommended Actions and Timing

Action	**Timing** 2018				2019				2020				2021				2022				**Responsibility**
Specify legal requirements	■	■	■																		*WMRA*
Establish coordinating mechanisms				■	■																*WMRA*
Develop administrative procedures						■	■														*WMRA, EEAA, Governorates*
Identify processing sites / procure equipment								■	■	■											*Governorates*
Develop monitoring/ enforcement templates								■	■	■											*EEAA, markaz*
Undertake capacity development								■	■	■											*WMRA, EEAA, Governorates, markazes*
Communicate with private sector		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*EEAA, Governorates*

<u>Note 1</u>

Pro-rated according to population based on data developed in Kafr El-Sheikh

Concrete and brick comprise the majority of construction and demolition waste; plastics, wood and glass comprise the main remaining materials.

Construction and demolition waste is widely used in the Governorate as a fill material to raise the level of ground for construction projects. These wastes are well-suited for this purpose:

- They are inert (except for wood). Therefore they do not degrade, or create gas or leachate.
- They can be compacted to suit the needs of construction projects.
- They form a stable base for construction.

Other applications of construction and demolition waste include:

- Concrete and brick can be crushed to meet general or specific specifications for use as aggregate or in concrete; in some countries, the use of aggregate manufactured from concrete and brick is widely used in road construction.
- Wood can be chipped and used as a bulking agent to facilitate composting of household (or other) organic materials, or may be used as a refuse-derived-fuel.
- Glass can be crushed and used to promote drainage, or used in asphalt (where it has been shown to increase the life of asphalt) or paint (where it increases reflectivity and improves visibility of, for example, painted road markings). Construction glass has different qualities as compared to glass packaging and may not be recyclable through those infrastructures.
- Plastics may be recycled or used as a refuse-derived-fuel.
- Construction and demolition waste may be crushed and used as landfill cover.

Large quantities of construction and demolition waste are not collected or used. Partly, this is because of an absence of collection infrastructure, and partly because the supply of construction and demolition waste exceeds demand. A case study from India illustrates how both of these issues can be addressed:

Case Example: Construction and Demolition Waste Collection/Processing in new Delhi, India
In June 2012, the Ministry of Urban Development directed States to set-up construction and demolition recycling facilities in all cities with populations greater than 1 million people. At that time, a pre-existing facility in Burari, New Delhi, was expanded to process 2000 tons/day of construction and demolition waste. The site is owned by the Municipal Corporation of Delhi and operated by a private sector entity: Infrastructure Leasing & Financial Services (IL&FS). The facility receives construction and demolition waste from 28 designated points in three zones of the North Delhi Municipal Corporation (out of a total of 168 collection points in New Delhi).

The waste is segregated into (i) large concrete pieces, (ii) mixed waste categorized according to size, and (iii) “unrecyclable” materials including plastic and wood, which are sent to a waste-to-energy plant. The facility uses manual segregation for large plastic pieces and a magnetic separator for metals. Concrete and brick is crushed (using a wet process to control dust), washed, and used to make concrete, curb stones, cement bricks, pavement blocks, hollow bricks, and manufactured sand.

A second recycling plant was opened in 2015 to process an additional 500 tons/day from 20 collection points.

Generators of construction and demolition materials are responsible for the delivery of the materials to the collection point; IL&FS undertakes the transportation of the materials from the collection points to the processing facilities.

Generators can be required to deliver construction and demolition wastes to a collection point by making this a condition on the permit for the project, and providing for a financial penalty to be imposed on those who do not deliver the construction/demolition materials accordingly.

6.0 HEALTH CARE WASTE

Current Situation		
Estimated hazardous healthcare waste quantity *Hospitals: 3,049 kg/day* *All health-care facilities: 23,893 kg/day* *(See Note 1)*	**Main source(s)/ Generator(s)** *Hospitals, clinics, laboratories*	**Current practice for managing the waste** Disposal: (i) at incinerators at Sadat landfill site (incinerators to be closed in 2017); (ii) on-site by burning; or (iii) with solid waste

Health, environment, other problems caused by current management practices *Inadequate management practices risk spreading disease either directly or by attraction of vermin, rodents and disease-carrying organisms*	**Main barriers to improved management of the waste** *Inadequate collection and disposal infrastructure.* *Absence of separation of hazardous from non-hazardous health care waste; all health care waste is therefore considered hazardous*
Targetted Changes	
Management objective(s) *Separation of hazardous from non-hazardous health care wastes* *Phased implementation of effective storage, collection and disposal for all hazardous health care waste, beginning with hospital wastes and including definition and separation of hazardous wastes*	**Key policy/legal actions to achieve objectives** *Specification of standards for health-care waste management, supported by planned sector investment and operational budgeting, and effective enforcement*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Establish regulatory standards for health care waste management*	*Coordination of health-care waste management program with Ministry of Health*	*Policy and implementation alternatives for health care waste management*
Egyptian Environmental Affairs Agency	*Monitor and enforce legal requirements*	*Management and reporting of monitoring records.* *Procedural capacity for monitoring and enforcement*	*Technical capacity to monitor health care waste treatment facilities and report data and findings* *Procedures for monitoring and enforcement*
Governorate	*Not Applicable*	*Not Applicable*	*Not Applicable*
Markaz/Local Unit	*Not Applicable*	*Not Applicable*	*Not Applicable*
Private Sector	*Operation of health care waste treatment systems*	*Documentation of proper health care waste management*	*Operational capacity to implement health care waste management system/technology*
Ministry of Health	*At Central Level* *Include health care waste management in sector budgets* *Ensure health care facilities implement/ operate proper health care waste management systems*	*Central Level Capacity to create, coordinate and monitor health care waste management system* *At Local Level* *Capacity to plan health-care waste management systems* *Capacity to tender, select and manage health care waste management contractors*	*Central Level Technical planning and implementation of health care waste management.* *Local Level Administrative supervision of health-care waste management reporting, trouble-shooting and maintenance of proper health care waste management systems.*

Good practice solutions Separation of hazardous wastes from non-hazardous wastes Treatment and safe disposal of hazardous wastes	

Financing and Cost Recovery

Approx. capital cost (preliminary)	***Cost recovery***	
This can be expressed as a range	**Who pays?** *Health care facilities*	**Cost recovery mechanism** *Health-care budgets*

Recommended Actions and Timing

Action	**Timing**																				**Responsibility**
$$$ - $$$$	*2018*				*2019*				*2020*				*2021*				*2022*				
Establish sector waste management standards	■	■	■																		*WMRA, Ministry of Health*
Plan health care waste management system			■	■	■																*Ministry of Health*
Establish administrative/ reporting framework						■	■	■													*EEAA*
Invest in treatment technology						■	■	■													*Ministry of Health*
Monitor/enforce legal requirements									■	■	■	■	■	■	■	■	■	■	■	■	*EEAA*
Capacity building	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	WMRA, Ministry of Health (all levels), EEAA

<u>Note 1</u>
Data taken from *Annual Statistical Book*, National Center for Health and Population Information, Ministry of Health and Population, Cairo, 2016

Waste segregation is an important first step towards good management of healthcare waste (HCW). Approximately 75% of HCW is general non-hazardous waste, and can be managed in the same way as household waste provided it is separated from - and managed separately from - hazardous HCW.

Hazardous HCW includes the following, as defined by the World Health Organization:

- *Infectious waste* These wastes contain – or may contain – pathogens in sufficient number to cause disease in hosts.
- *Pathological waste* These wastes include tissues, organs, body parts, human fetuses and animal carcasses, blood, and body fluids.
- *Sharps* Sharps are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpel and other blades, knives, infusion sets, saws, broken glass, and nails.
- *Pharmaceutical waste* These wastes include expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required together with discarded items used in the handling of pharmaceuticals, such as bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials; genotoxic pharmaceuticals are included in this category of wastes.
- *Chemical wastes* Chemical waste consists of discarded solid, liquid, and gaseous chemicals including, but not limited to, formaldehyde, solvents, oils, cleaning agents, oxidants, reducing agents and wastes with a high content of heavy metals.
- *Pressurized containers* These may include containers used for anaesthetic gases, oxygen, compressed air or other gases.
- *Radioactive waste* These wastes include any waste substances or materials that may have been used in diagnostics, imaging, research or therapy that display radioactivity.

The most immediately important of these hazardous wastes in terms of their quantity and their potential impact on public health and the environment are infectious and pathological wastes, and sharps. Based on technology availability today, the technologies that have the greatest potential for treating these wastes in the Delta region are considered to be:

- Double chamber incinerators
- Chemical treatment
- Advanced autoclave treatment
- Microwave treatment

The central function of these technologies is to be able to achieve a high level of sterilization of infectious waste, including sharps, and pathological waste. However, the capital costs associated with these technologies and their operating costs vary widely, as does the reliability of their performance. Traditionally, incineration of hazardous HCW has been undertaken, but this is now being phased out by the Government of Egypt. Advanced autoclave technology is emerging as a preferred alternative to the incineration of hazardous HCW, and this is already applied in several locations in Egypt (e.g. hospitals in Benha, Damietta, Ismailaya, Menoufeya, Cairo and Awan). The technology brings the advantages of reliably high performance, moderate capital and operating cost and no emissions to cause concern in local communities.

The organization of treating hazardous HCW has an important impact on costs. Treatment facilities that are dimensioned to serve several hospitals can be located at either a single hospital that serves a regional waste treatment function, or at a central location in a markaz. This approach reduces costs as compared to the transportation of all wastes to a treatment centre that is located at a waste disposal site.

The management of other types of hazardous HCW can be integrated into the industrial hazardous waste management system.

7.0 WATER AND WASTEWATER TREATMENT SLUDGE AND SEPTAGE

Current Situation		
Estimated waste generation *100.1 dry tons/day* *(See Note 1)*	**Main source(s)/ Generator(s)** *Wastewater treatment plants; other sources of wastewater sludge not considered)*	**Current practice for managing the waste** *Sludge: land application, disposal in drains* *Septage: Disposal in drains and canals*

Health, environment, other problems caused by current management practices *Pathogens in untreated sludge and septage may threaten public health.*	**Main barriers to improved management of the waste** *Absence of sludge/septage management strategy. Proper management of sludge not integrated into overall treatment plant management plans or budgets. Absence of effective septage monitoring*

Targetted Changes	
Management objective(s) *Obtain energy or nutrient value from treated sludge; safe management of sludge that does not meet environmental standards*	**Key policy/legal actions to achieve objectives** *Integrate management of sludge into drinking water and wastewater treatment strategies and investments; extend sewerage/treatment systems and ensure proper treatment/management of sludge*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Develop/implement legally-enforceable strategy for managing sludge (agreed with Water and Wastewater Regulatory Authority)*	*Key performance indicators (KPI's) for effective sludge management* *Implementation programme to achieve KPI's*	*Technical and financial strategies for sludge management*
Egyptian Environmental Affairs Agency	*Monitor and enforce legal requirements*	*Supervision and implementation of monitoring*	*Tools, techniques and technologies for monitoring*
Governorate	*Adoption of decrees, as necessary to support national framework for managing sludge/septage* *Provide land for treatment facilities*	*Information-sharing procedures, particularly with ESWA*	*Identification of governorate-specific priorities for sludge management*
Markaz/Local Unit	*Facilitate construction of treatment facilities, use of recovered energy and resources*	*Information sharing procedures, particularly with ESWA*	*Local public awareness of benefits of sludge treatment and use*
Private Sector	*Development of value-added products based on sludge reutilisation*	*Pro-forma business scenarios based on sludge utilization*	*Product development opportunities*
Other (specify)	*Operation of water and wastewater treatment facilities*	*Integration of sludge management into operational activities and financial planning/cost recovery*	*Technical and financial strategies for sludge management* *Effective monitoring of sludge quality and management*

	Develop/implement legally-enforceable strategy for managing sludge (agreed with Waste Management Regulatory Agency)	*Key performance indictors for effective sludge management* *Implementation programme to achieve KPI's*	*Tools, techniques and technologies for monitoring*

Good practice solutions

Treatment of sludge to recover energy

Application of residual waste from treatment to the land if it meets environmental criteria

Management of residual waste at landfill if it does not meet criteria for application to land

Financing and Cost Recovery

Approx. capital cost (preliminary)	***Cost recovery***	
$$ - $$$$$, depending on selected solutions	**Who pays?** *User of water/wastewater services*	**Cost recovery mechanism** *Cost recovery mechanism used for water/wastewater services.*

Recommended Actions and Timing

Action	**Timing** 2018				2019				2020				2021				2022				**Responsibility**
Develop sludge/septage strategy			■	■	■																*WMRA, ESWA*
Implement sludge/septage strategy						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Monitor and enforce legal requirements										■	■	■	■	■	■	■	■	■	■	■	*ESWA, EEAA,WMRA*
Adoption of local decrees						■	■	■													*Governorate*
Provide land for treatment facilities						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Governorate*
Facilitate construction of treatment facilities,						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Markaz*
Development of value-added products based						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Private sector*
Operate treatment facilities/manage sludge						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	HCWW and subsidiaries

Note: Data taken from Fayez Badr, *Assessment of Wastewater Services and Sludge in Egypt*, GIZ Cairo, 2016 (http://cairoclimatetalks.net/sites/default/files/assessment%20of%20wastewater%20services%20in%20Egypt1%20%281%29.pdf)

There are numerous options for the management of wastewater treatment plant sludge and similar wastes from water treatment facilities. Common approaches include the following:

- Recovery of energy
- Composting
- Incineration
- Landfilling

Recovery of Energy
Sludge is widely treated through anaerobic digestion. The technology generates methane, a high calorific-value gas that can be recovered for energy use either directly (e.g. burning for heat) or indirectly (e.g. to drive a generator to create electricity)[3]. Anaerobic digestion can be undertaken at a scale as small as an individual household or at a commercial scale. Capital costs are high; however, operating costs are low but an effective operation depends on careful control of the process.

A residual material is generated by the process, and this can be beneficially applied to agricultural or other land provided that it meets environmental criteria. These criteria relate to heavy metals and other parameters that should not be present at concentrations that exceed prescribed levels.

Composting
Sludge may be aerobically composted in windrows. However, the sludge requires dewatering before this process is undertaken, which is energy-intensive if undertaken mechanically, or requires large areas of land if undertaken by natural processes. Effective composting of sludge also requires the addition of large quantities of material with a large particle size in order to allow air to permeate the composting mass; agricultural waste can be used for this purpose. Capital and operating costs are low for this process, but it requires a large land area as compared to the option of anaerobic digestion. Similar to the residual waste from anaerobic digestion, finished compost can be beneficially applied to agricultural or other land provided that it meets environmental criteria. These criteria relate to heavy metals and other parameters that should not be present at concentrations that exceed prescribed levels. Composting does not allow the recovery of energy from the sludge because the process does not produce methane.

Incineration
Sludge may be incinerated. This process reduces the volume of sludge that requires disposal. However, the process requires that sludge is dewatered (see "composting", above) and is highly energy intensive. Capital and operating costs are high. The opportunity to offset costs with revenues from energy recovery or sale of material (i.e. ash) is limited.

Landfilling
Sludge may be disposed of in a landfill. The sludge should be dewatered (see "composting", above) before being placed in a landfill. Alternatively, dewatered sludge may be used as a landfill cover material.

Other Technologies
A variety of additional technologies (e.g. gasification, thermal hydrolysis, thermal depolymerzation) have been developed that may also be considered for treating sludge. Generally, these focus on the recovery of energy. These are not considered to have been sufficiently proven in a context relevant to Egypt and are not considered further. Technology and applications are developing quickly, however, and these or other technologies may become attractive over time.

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[3] Methane is also a potent greenhouse gas and it is therefore important that anaerobic digestion systems prevent the release of methane to the atmosphere.

8.0 TIRES

Current Situation		
Estimated waste generation *712,000 tires*	**Main source(s)/ Generator(s)** *Cars, commercial vehicles*	**Current practice for managing the waste** *Discarded to the environment, burned for fuel/ recovery of metal*

Health, environment, other problems caused by current management practices	**Main barriers to improved management of the waste**
Tires can become a breeding ground for mosquitoes if water accumulates in them. *Uncontrolled burning releases toxic substances that may impact public health and air quality*	*Absence of formal-sector management system for tires*

Targetted Changes	
Management objective(s) *Introduction of used tire collection/management system*	**Key policy/legal actions to achieve objectives** *Creation of incentive-based framework to achieve recovery of used tires* *Investment in processing technology to recover value from used tires*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Regulatory definition of objectives and framework to support extended producer responsibility (EPR) system to incentivize recovery of used tires*	*Collaborative working arrangements with private sector suppliers of new tires*	*Options for the design of EPR systems in the tire sector*
Egyptian Environmental Affairs Agency	*Monitoring of tire management activities*	*Creation of monitoring and reporting framework, agreed with private sector*	*Administrative frameworks for EPR*
Governorate	*Not Applicable*	*Not Applicable*	*Not Applicable*
Markaz/Local Unit	*Not Applicable*	*Not Applicable*	*Not Applicable*
Private Sector	*Creation of EPR system for used tires*	*Creation of monitoring and reporting framework, agreed with EEAA, and implementation*	*Options for the design of EPR systems in the tire sector* *Monitoring and reporting or EPR*

Good practice solutions

Recovery of tires and processing for beneficial utilization based on extended producer responsibility model

Financing and Cost Recovery		
Approx. capital cost (preliminary)	***Cost recovery***	
	Who pays?	**Cost recovery mechanism**
\$\$\$ - \$\$\$\$	Purchasers of new tires, but system should be cost neutral at a minimum	Costs included in price of new tires, but system should be cost neutral at a minimum

Recommended Actions and Timing																					
Action	**Timing**																				**Responsibility**
	2018				*2019*				*2020*				*2021*				*2022*				
Define EPR objectives and framework																					*WMRA, private sector suppliers of new tires*
Design EPR system for management of used tires																					*EEAA, private sector suppliers of new tires*
Develop monitoring and reporting framework																					*EEAA, private sector suppliers of new tires*
Implement EPR for used tires																					*WMRA, private sector suppliers of new tires*
Capacity development																					*WMRA, EEAA, private sector*
Communication																					*WMRA, EEAA, private sector*

<u>Note 1</u>

Quantity of tires estimated based on registered vehicles and an average tire life of 65,000 kms and average use of 39,000 km/year (Elkafoury, A., and Negm, A., *Assessment Approach of life Cycle of Vehicle Tires on Egyptian Road network*, Periodica Polytechnica Transportation Engineering 44(2) pp. 74-79, 2016)

Options for the environmentally safe management of tires include:

- Tire-derived fuel (TDF)
- Tire-derived aggregate (TDA)
- Crumb rubber

Tire-Derived Fuel (TDF)
Tires have a high energy value (generally between 6500 - 8000 kCal/kg). Accordingly, energy-intensive industries have an interest in the use of tires as an alternative fuel.

Tires may require shredding to convert whole tires to chips before they can be used as a fuel. Processing requirements depend on the boiler/furnace/kiln of the industry that uses the tires as fuel, and its associated feed system. Tires contain numerous substances that are hazardous to public health and to the environment if they are released into the atmosphere (i.e. as a result of burning the tires). It is therefore highly important that the operating temperature of a boiler/ furnace/kiln is high enough to destroy these substances, and/or that a TDF user has the proper pollution control equipment to prevent harmful substances from being released to the atmosphere.

Tire-Derived Aggregate (TDA)
Used tires have found beneficial application in use as tire-derived aggregate. In this application, tires replace conventional rock aggregate. A simple processing (shredding) of the tires is required to produce TDA: used tires are shredded to the particle size that is needed for a specific application. The TDA is used in a similar manner to conventional rock aggregate. TDA has been shown to have the following advantages over TDA: cushioning of vibration, reduced settling, reduced hydrostatic pressure, and light weight.

Crumb Rubber
Crumb rubber is produced by removing the steel and fabric reinforcing materials from tires and grinding the remaining tire material into a uniform (usually granular) particle size. The resulting crumb rubber is used to manufacture rubberized mats and as a base material in artificial turf used for sports-fields. Crumb rubber is also used extensively as an additive to asphalt in road construction; the rubber provides increased flexibility to asphalt, which helps the asphalt to withstand expansion/contraction caused, for example, by traffic or climate.

Other Technologies
Research and development is on-going into other technologies to achieve the reutilization of tires. One of these is “de-vulcanization”, a process that reverses the chemical bonding process that is necessary to manufacture tires. Devulcanization may allow rubber from used tires to be directly used in the manufacture of new tires.

9.0 HAZARDOUS WASTES INCLUDING ELECTRONIC WASTES, LEAD-ACID BATTERIES AND USED OIL

Current Situation		
Estimated waste generation (Ton/Yr) *Lead acid batteries: 135,000 - 225,000 batteries in 2016* *Used Oil: 3.3 - 5.5 million litres in 2016* *Electronic wastes: 108 tons* *(See Note 1)*	**Main source(s)/ Generator(s)** *General hazardous wastes: Industry* *Electronic wasters: Offices* *Used oil, lead-acid batteries: Vehicle service stations*	**Current practice for managing the waste** *Less than 1% of hazardous waste nationally is recorded as being properly treated; fate of remaining hazardous wastes is not known*

Health, environment, other problems caused by current management practices *Contamination of land where wastes are deposited; potential for widespread contamination of surface water and groundwater* *Potential for severe public health impacts when people are in contact with hazardous wastes*	**Main barriers to improved management of the waste** *Inadequate legal framework: inadequate accountability of stakeholders, insufficiently developed institutional framework, lack of monitorable/enforceable controls, absence of sector strategy, insufficient treatment facilities, lack of capacity.*

Targetted Changes	
Management objective(s) *Recovery of material and energy value where feasible; environmentally safe disposal of remaining materials*	**Key policy/legal actions to achieve objectives** *Enhanced legal framework that assigns enforceable responsibilities to stakeholders*

Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements

Entity	Roles/responsibilities	Administrative capacity needs	Capacity development priorities
Waste Management Regulatory Agency	*Develop/adopt enhanced legal framework*	*Application of the waste hierarchy, sector strategy development*	*Sector policy and legal options* *Lessons learned elsewhere*
Egyptian Environmental Affairs Agency	*Education/enforcement of legal framework*	*Hazardous waste monitoring and tracking* *Sector education and enforcement strategies*	*Hazardous waste management facility planning* *Design/implementation of monitoring/tracking system* *Education and enforcement*
Governorate	*Support implementation of hazardous waste collection/storage system*	*Monitoring local priorities for hazardous waste management* *Hazardous waste emergency response plan*	*Hazardous waste monitoring* *Emergency plan preparation and implementation readiness*
Markaz/Local Unit	*Not Applicable*	*Not Applicable*	*Not Applicable*
Private Sector	*Generators: Ensure proper management of hazardous wastes* *Facility Operators: Invest in/operate treatment facilities*	*Reporting to regulatory entities* *Financial management to ensure environmental security of operations*	*Certification of proper operation of facilities* *Monitoring and reporting of operations*

Good practice solutions

Industrial Hazardous Waste: Classification of waste; accountability of generators for the management of their wastes; tracking waste generation and movement off wastes; recovery of wastes for recycling and/or energy

value, where feasible; secure treatment and disposal of residual wastes *E-Wastes, lead-acid batteries, used oil: Application of extended producer responsibility frameworks at the national level and implementation at Governorate level*		
Financing and Cost Recovery		
Approx. capital cost (preliminary)	***Cost recovery***	
$$ - $$$ *(Note: assumes that treatment/ disposal facilities are located in another Governorate close to major industrial production)*	**Who pays?** *Industrial hazardous wastes, used oil: Generators* *E-waste, lead-acid batteries: Producers*	**Cost recovery mechanism** *Industrial hazardous wastes, used oil:* Fee for service *E-waste, lead-acid batteries:* Extended producer responsibility framework

Recommended Actions and Timing

Action	Timing					Responsibility
	2018	*2019*	*2020*	*2021*	*2022*	
Develop sector strategy						*WMRA*
Develop enhanced regulatory framework						*WMRA*
Strengthen institutional framework						*WMRA. EEAA*
Prepare emergency response plan						*Governorate*
Development of facilities						*EEAA, private sector*
Phased implementation of enhanced management						*EEAA, private sector*
Capacity development						*WMRA, EEAA,*
Communication						*WMRA, EEAA, private sector*

Note 1
Consultant's calculations based on:

Lead acid batteries assumes: (i) a lead acid battery has a life equal to the life of a vehicle; (ii) vehicles on the road in 2006 had an average remaining life of 10 years; 217,000 registered vehicles in Gharbia in 2006 (estimated from CAPMAS data). Estimate is expressed as "plus/minus 25%" .

Used oil assumes: (i) 1 oil change every 15,000 kms/vehicle; (ii) 5 litres of oil per vehicle; (iii) average distance of travel: 39,000 km/year; 339,800 vehicles in Gharbia in 2016 (estimated from CAPMAS data). Estimate is expressed as "plus/minus 25%".

Electronic waste is assumed to be 0.01 percent of total municipal waste estimated to be generated in Gharbia (1,080,513 tons - see ISWM Options Report: Gharbia (Draft))

Lead-Acid Batteries, Used Oil and E-Waste

Electronic wastes (e-waste) and lead-acid batteries can be effectively managed through extended producer responsibility (EPR) programs. These programs assign responsibilities to "producers" of the products (usually including manufacturers, importers and distributors) to participate in the management of the products at the end of their life. These responsibilities typically include establishing a system for the collection of the products together with incentives that motivate people to return the products to the collection system when the products are no longer required. Producers may then be responsible for ensuring that the returned products are properly managed, either through recycling, energy recovery or environmentally sound disposal. EPR programs should be designed and implemented at the national level.

10.0 SLAUGHTERHOUSE WASTE

Current Situation			
Estimated waste generation (Ton/Yr) *2,534*	**Main source(s)/ Generator(s)** *Slaughterhouses*	**Current practice for managing the waste** *Discarded with solid waste or into the environment*	
Health, environment, other problems caused by current management practices Slaughterhouse waste attracts disease carrying organisms and vermin, and threatens public health if it is not properly managed		**Main barriers to improved management of the waste** *Lack of public awareness about public health risks of slaughterhouse wastes* *Absence of strategy for managing the waste*	
Targetted Changes			
Management objective(s) *Recovery and processing of wastes for beneficial applications*		**Key policy/legal actions to achieve objectives** *Strategy to promote treatment of wastes* *Prohibition on disposal of wastes as treatment infrastructure is developed*	
Institutional roles/responsibilities to achieve objective, administrative capacity needs and capacity development requirements			
Entity	**Roles/responsibilities**	**Administrative capacity needs**	**Capacity development priorities**
Waste Management Regulatory Agency	*Develop strategic framework for management of slaughterhouse wastes*	*Identification/organization of strategic management options*	*Sector policy and legal options* *Lessons learned elsewhere*
Egyptian Environmental Affairs Agency	*Education/enforcement of legal framework*	*Monitoring of compliance with legal framework* *Implementation and documentation of enforcement actions*	*Tools to facilitate education, monitoring, and implementation/ documentation of enforcement*
Governorate	*Not applicable*	*Not applicable*	*Not applicable*
Markaz/Local Unit	*Not applicable*	*Not applicable*	*Not applicable*
Private Sector	*Investors Invest in treatment facilities* *Generators Comply with legal requirements*	*Management information system to: (i) For investors: track receipt/treatment of wastes (ii) For generators: ensure wastes are delivered to treatment facility*	*Tools to facilitate design/ implementation of management information systems.*
Good practice solutions *Prohibit disposal of wastes that have not been sterilized* *Create strategic framework to ensure that wastes re collected and processed into products*			
Financing and Cost Recovery			
Approx. capital cost (preliminary) *$ - $$*	***Cost recovery***		
	Who pays? *Generator of waste*	**Cost recovery mechanism** *Fee for service*	

Recommended Actions and Timing																					
Action	**Timing**																				**Responsibility**
	2018				*2019*				*2020*				*2021*				*2022*				
Develop strategy																					*WMRA*
Implement strategy																					*WMRA, EEAA*
Attract investment in treatment facilities																					*EEAA*
Monitor/enforce legal requirements																					*EEAA*
Capacity building																					*WMRA, EEAA, private sector*

Slaughterhouse waste includes the fluids and solid wastes that remain following the slaughter and butchering of animals. The discard of these materials on land or in dump sites results in the rapid decomposition of the wastes, which attracts vermin and disease-carrying insects. The environmental characteristics of the fluids (e.g. BOD typically 1000-4000 mg/l, COD typically 2000-10,000 mg/l, suspended solids 200-1500 mg/l) means that they may disrupt wastewater treatment plant operations if they are discharged to a sewer, and they will cause negative effects to surface water if they are discharged without treatment. Accordingly, proper management of these materials is necessary to ensure protection of public health and the environment.

Slaughterhouse wastes can be "rendered" into a wide variety of materials that are used in products as varied as cosmetics, soil amendment and animal feed. Rendering is typically undertaken by an enterprise that is separate from, and separately located from, the slaughterhouse. The effective implementation of this approach to managing solid slaughterhouse waste depends on: (i) the availability of a rendering plant; (ii) a rapid and appropriate transportation of wastes from the slaughterhouse to the rendering plant to ensure that the waste does not decompose, attract vermin/insects or cause social discomfort.

Solid slaughterhouse wastes may also be treated to achieve the sterilization of the waste; this should also include processing to make individual wastes unrecognizable. Solid slaughterhouse wastes may be treated using similar technologies as are used to treat hazardous healthcare wastes:

- Chemical treatment
- Advanced autoclave treatment
- Microwave treatment

Large slaughterhouses may incorporate treatment technology into their overall site investment. In these cases, treatment of the wastes would take place at the same site as the production operations. Centralized processing facilities may be established to serve smaller slaughterhouses, and these would provide treatment on a fee-for-service basis. Following treatment, the sterilized wastes have high potential to be "rendered", as described above.

Fluids generated by slaughterhouses should be treated on-site. Numerous aerobic and anaerobic technologies are available for treating fluids generated by slaughterhouses, and including configurations in lagoon, tank and enclosed reactor formats.