

State of Waste Management in Phnom Penh, Cambodia



State of Waste Management in Phnom Penh, Cambodia (Version 2, 2020)

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State of Waste Management in Phnom Penh, Cambodia

June 2018

Executive Summary

Phnom Penh is facing huge challenges in waste management due to population growth, increasing income and consumption levels, expanding urbanisation and inadequate waste management including lack of proper waste collection and treatment facilities, technical staff as well as unclear responsibilities among staff members. In this regard, with the request for support from Cambodia's Waste Management Division of Phnom Penh Capital Hall (PPCH), IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) has been providing technical assistance towards the development of a waste management strategy for Phnom Penh 2018-2035. The strategy is based on a holistic waste management approach. It addresses all waste streams (solid waste, liquid waste/wastewater, and gaseous emissions), primarily focusing on solid waste and but also covering other forms within the mandate of PPCH. In parallel with above, a quick study was done on Phnom Penh's existing waste management systems and current practices including the waste flow, policies and regulations framework, waste management practices challenges, which provides practical recommendations for PPCH and other stakeholders for sustainable waste management in Phnom Penh.

The rapid population growth due to industrialisation, and urbanisation in line with the expansion of the city area has led into a rapid increase in waste production in Phnom Penh. Beside an increase in municipal solid waste, other waste streams such as hazardous waste, industrial waste, medical waste, construction and demolition waste and agriculture waste are also increasing causing enormous challenges to the city about proper collection, treatment and disposal of these kinds of wastes. Moreover, there has been decentralisation of power in the waste sector from the provincial and district level to local levels, and so local authorities are still unaware of their responsibility and struggle in fulfilling their role.

This report confirms that there are many challenges in current waste management in Phnom Penh due to social, technical, economical and institutional restraints. Therefore, the recommendations set out in this report are very important for policymakers and stakeholders in waste management in Phnom Penh for improvement of current waste management.

Contents

Executive Summary	ii
Contents	iii
List of Abbreviations	iv
1. Introduction	1
1.1. Background	1
1.2. Objectives.....	2
1.3. Analytical Framework	2
1.4. Methodology	3
2. Overview of Phnom Penh City	4
2.1. Institutional Framework SWM at Subnational Level and of Phnom Penh	4
2.2. Institutional Arrangement, Roles and responsibilities of Actors in SWM of Phnom Penh	5
3. National and City Waste Management Policies and Legislation	7
4. Municipal Solid Waste Management	9
4.1. Generation	9
4.2. Waste Composition	11
4.3. Waste Collection and Transport	11
4.4. Waste Disposal/Final Treatment.....	11
5. Industrial and Other Waste	17
5.1. Industrial Waste	17
5.2. Medical Waste	17
5.3. Hazardous Waste	20
5.4. Construction and Demolition (C&D) Waste	21
6. Financing Solid Waste Management in Phnom Penh	24
6.1. Financing Solid Waste Management in Cambodia	24
6.2. Financing Solid Waste Management in Phnom Penh	25
6.3. Project Financed by RGC and External Stakeholders	25
6.4. Royal Government of Cambodia	25
6.5. Japan	26
6.6. European Union.....	26
6.7. Asia Foundation	26
7. Major Challenges and Areas for Improvement	27
7.1. Municipal Solid Waste Management.....	27
7.2. Industrial Waste Management.....	28
7.3. Hazardous Waste Management	28
7.4. Medical Waste Management	29
7.5. Construction and Demolition Waste Management	29
8. Conclusions and Recommendation	31
Bibliography	36

List of Abbreviations

BC	Black Carbon
C&D	Construction and Demolition
CAP	Cleansing Authority of Phnom Penh
CCET	IGES Centre Collaborating with UNEP on Environmental Technologies
CEA	Cambodia Environmental Association
DAALI	Department of Agronomy and Agricultural Land Improvement
DEF	Department of Economy and Finance
DOH	Department of Health
DOIH	Department of Industry and Handicraft
DPWT	Department of Public Works and Transport
EDC	Electric du Cambodge
EEE	Electrical and Electronic Equipment
E-Waste	Electronic and Electrical Waste
GHG	Green House Gas
HCW	Health-care Waste
M/D	Municipality and Districts
MOE	Ministry of Environment
MoH	Ministry of Health
MOI	Ministry of Interior
MPP	Municipality of Phnom Penh
MPWT	Ministry of Public Works and Transport
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
MWMU	Medical Waste Management Unit
NGO	Non-Governmental Organisation
PA	Provincial Administration
PAD	Pacific Asia Development
PCDD	Polychlorinated Dibenzo-P-Dioxins
PCDF	Polychlorinated Dibenzofurans
POPs	Persistent Organic Pollutants
PPC	Phnom Penh Cleansing
PPCH	Phnom Penh Capital Hall
PPWM	Phnom Penh Waste Management Authority
RGC	Royal Government of Cambodia
UEEE	Used Electronic and Electrical Waste
UNEP	United Nations for Environment Programme
WEEE	Waste Electrical and Electronic Equipment
WMAD	Waste Management Affair Department

1. Introduction

1.1. Background

Waste management is one of the biggest challenges in developing countries. In particular, developing countries in Asia have serious environmental and public health problems due to large amount of municipal waste being dumped into open dumping sites, roads, drains, water bodies etc. on a daily basis without adequate management. Phnom Penh, the capital city of Cambodia is no exception, and national and local government are facing similar challenges in waste management due to population growth, increasing income and consumption levels, expanding urbanization and inadequate waste management due to a lack of proper waste collection and treatment facilities, technical staff as well as unclear responsibilities among staff members.

Despite great efforts by the municipality to improve the waste collection, collection services are only provided intermittently and are inadequate to cover the entire urban area of the city. Without segregation practices, vibrant recycling industry, or a market for recycled materials, the waste disposal is at a minimum level, with disposal of valuable resources that could otherwise be circulated back into the production chain. Dangkor Landfill Site is where most local municipalities transport and treat collected waste from households, industries, and hospitals, but the management is not designed to comply with global technical standards. Simple pits or large open space area are commonly used as dumpsites without appropriate practices such as covering soil, fire control system, methane gas collection, and leachate

treatment. Unsound waste management has contaminated land, water and air, resulting in serious impacts on public health, ecosystem and global climate, as well as threatening sustainable development in the city of Phnom Penh.

From a global perspective, international community has recently agreed upon two key international agreements: Paris Agreement, and Sustainable Development Goals (SDGs), which now provide a framework for local, national, and global policymaking. Building a low-carbon, resource-efficient sustainable society is imperative for all cities and countries, including Phnom Penh, for attaining sustainable prosperity for its residents, and the waste management sector can play a substantial role.

In this regard, there was a request for support from Cambodia's Waste Management Division of Phnom Penh Capital Hall (PPCH) to the International Environmental Technology Centre (IETC) of the United Nations Environment Programme (UNEP). IETC has been actively working with national and local governments and other institutions to build capacity for waste management and promote the development of effective policy frameworks and strategies. Further, the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET) was selected to provide technical assistance towards the development of waste management strategy for Phnom Penh 2018-2035. The strategy is based on a holistic waste management approach, which addresses all waste streams (solid waste, liquid waste/ wastewater, and gaseous emissions), primarily focusing on solid waste and also covering other forms within the mandate of Phnom Penh Capital Authority.

In parallel with the above, a quick study of Phnom Penh's existing waste management systems and practices was conducted to review the scope and effectiveness of Phnom Penh's current waste management system, and identify key challenges and gaps. The subsequent findings were further used to provide appropriate data for organisation of a series of participatory workshops and consultations with key national and local stakeholders, aimed at drafting Phnom Penh's waste management strategy that addresses the city's waste issues.

period from January 2016 to January 2018. It provides an overview of Phnom Penh's current waste management status, discusses major challenges and obstacles, and suggests a number of policy recommendations for Waste Management Division of Phnom Penh Capital Hall (PPCH) and other key policymakers to consider for efficient waste management in Phnom Penh. The report provide guidance on how Phnom Penh can work towards promoting sustainable waste management systems.

1.2. Objectives

This report aims to present the major findings of a rapid assessment and series of multi-stakeholders workshops and consultations carried out during the

1.3. Analytical Framework

Efficient and effective waste management is still a challenge in both developed and developing countries. Waste management is not only associated with environmental and health issues but with social,

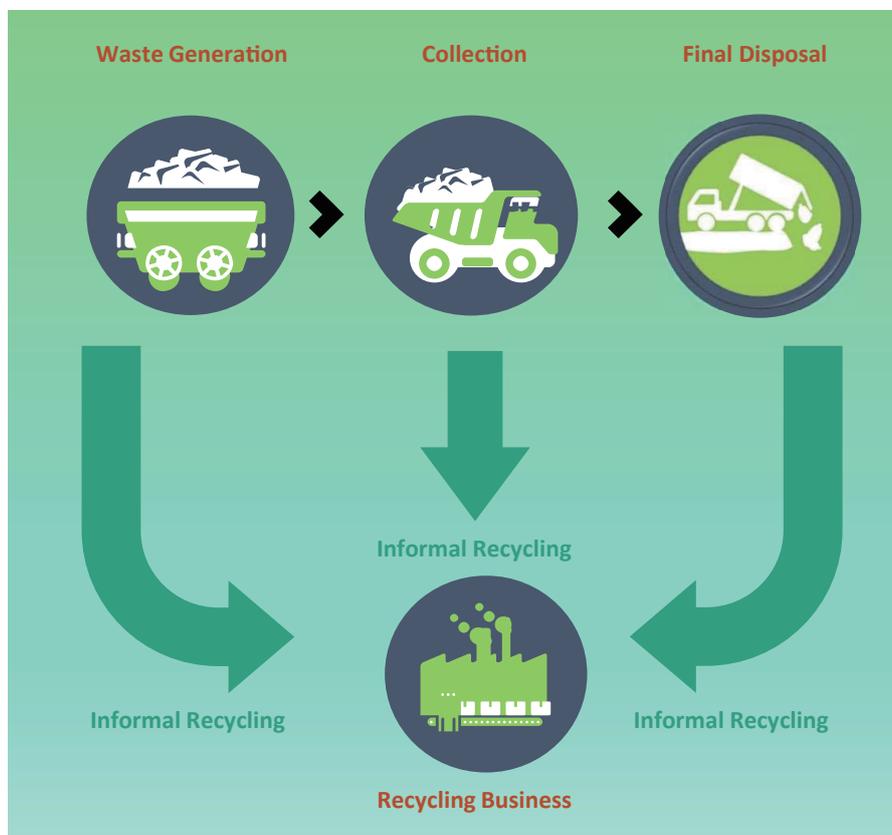


Figure 1 Municipal solid waste flow in Phnom Penh
(Source: Authors)

political, financial and governance issues. The report analyses the current waste management and waste flow from generation until final disposal in Phnom Penh city as shown in Figure 1. The study focus more on municipal solid waste management. In line with waste flow, gap analysis was carried out across the waste management chain with regards to institutions, policies, financing, infrastructure, technology and demarcation of roles and responsibilities among actors, and this analysis was subsequently used to determine and address the waste issues in Phnom Penh.

1.4. Methodology

The report was compiled based on primary and secondary data collection along with a quick study for rapid assessment of current waste management of Phnom Penh and carry gap analysis in existing waste management system, which was carried out in January 2016. In addition to literature review, structured interviews and technical meetings with relevant stakeholders were conducted, together with field visits to relevant waste management facilities.

The study reviews current waste management practices, waste characterisation, waste flow, future waste projection, institutional and policy frameworks, and financing mechanisms, highlighting the challenges in the current waste management. Further, the report provides recommendations to policymakers of Phnom Penh to overcome the challenges and manage the waste in more holistic way.

The preliminary findings were used as a base for organising series of workshops and consultations with relevant stakeholders aimed at raising awareness on current waste management system in the city, as well as organising technical discussions among the stakeholders for the city waste strategy development

process. The first inception workshop was conducted on 20 October 2016 in Phnom Penh, Cambodia with the aim of presenting the proposed project framework and receiving feedback from the participants. The goal of the workshop was also to highlight baseline data on the main waste streams in the municipality of Phnom Penh, and collect stakeholder views on the extent and effectiveness of the existing waste management practices from collection to final disposal. The workshop also aimed to identify constraints and move the city towards a resource-efficient society. A wide range of stakeholders was invited from central and local governments, academia, research institutions, development partners, and NGOs who have been involved in the waste sector. The organisers prioritised the attendance of government officials from Phnom Penh Capital Hall, Phnom Penh city district (khan) representatives as well as relevant department officials from the Ministry of Environment and National Council for Sustainable Development (NCSD). All 12 districts representatives were present at the workshop, which helped the discussion in the workshop to be more interactive in reviewing the current waste management system, identifying challenges and further classifying the necessary steps for efficient waste management in Phnom Penh.

Following the inception workshop, there was a series of consultation and technical discussions and workshops with the help of Nexus and in cooperation with Phnom Penh Capital Hall (PPCH) and the Ministry of Environment (MoE). The findings of the consultations are summarized in this report and also considered in drafting the city waste management strategy and action plans for Phnom Penh (Yagasa, 2018).

2. Overview of Phnom Penh City

Phnom Penh is the capital and largest city of Cambodia with a population of 1,445,902 as of 2014, with the annual population growth of 3.97 (Phnom Penh Department of Planning, 2015). The rapid population growth due to industrialisation, urbanisation along with expansion of city area has led to a rapid increase in waste production in Phnom Penh. Besides the increase in municipal solid waste, other waste streams such as hazardous waste, industrial waste, medical waste, construction and demolition waste and agriculture waste are also increasing, causing enormous challenges for the city for proper collection, treatment and disposal of these kinds of wastes. Moreover, the city has gradually expanded its geographical boundary over the years through four stages (Phnom Penh Capital Hall, n.d.). 1st Stage: Incorporation of Dangkor District; 2nd Stage: Creation of Khan Russey Keo; 3rd Stage: Integration of four

villages from Kanthork Commune, 4th Stage; Integration of 20 communes from five Districts (Ponnhear Leu, Mok Kampoul, Khien Svay, Kandal Steung, Angsnoul) of Kandal Province to Phnom Penh.

2.1. Institutional Framework SWM at Subnational Level and of Phnom Penh

Sub-national Institutional Reform and Decentralisation in Waste Sector

Sub-national governance of Cambodia experienced major transformations in the past few decades. Decentralisation proceeded in two stages: through the *Law on Commune Administration* adopted in 2001

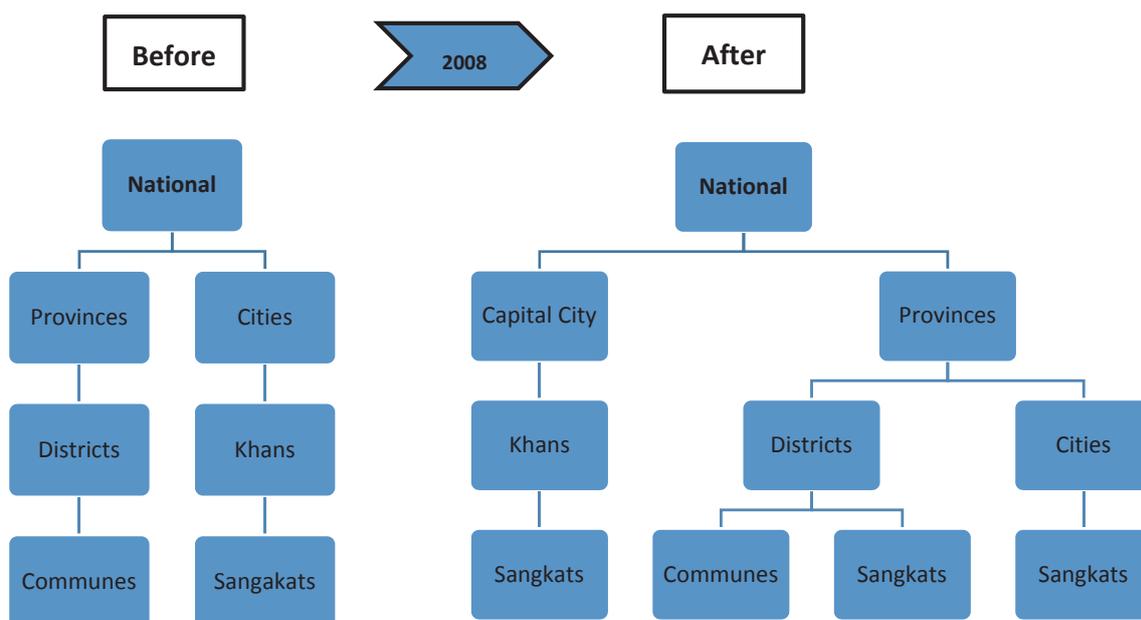


Figure 2 The reform of administrative structure of Cambodia before and after 2008 (Source: Leng, 2013)

which granted administrative functions at the commune level (the lowest administrative layer), and the institutional reform of 2008¹ which also promoted decentralisation at the provincial and district level (Theng, 2012). As a result, the sub-national institutional structure drastically changed (see Figure 2) while administrative power and functions were transferred to the sub-national governments (Theng, 2012; Leng, 2013).

Against this backdrop, decentralisation also proceeded in waste sector, while cooperative relations between subnational governments and line ministries via provincial technical departments were preserved. As indicated by Min (2016), waste management has been gaining increased attention in Municipalities and Districts (M/D) across Cambodia as a priority issue. However, the level of implementation of waste management varied among jurisdictions, and many subnational authorities struggled to fulfil their expected role. In this context, *Sub-decree on Urban Solid Waste Management No. 113* issued in November 2015 clarifying M/D's mandate on solid waste management at the municipal level with the support and coordination by provincial administrations.

In the waste sector, the provincial Department of Environment works on behalf of the Ministry of Environment without further delegation of its work to offices at M/D level due to the limited capacity of M/D line offices. At M/D level, there are two types of line offices: those under the direct control of M/D administrations (often understaffed and under resourced) such as the Office of Finance and Administration, Office of Commune/Sangkat Support and Planning, and Inter-Sectorial Office; and those under the control of provincial departments such as Office of Environment (Min, 2016).

The above offices are branches of the M/D administration and their line department to monitor performance of waste collection company performance, dissemination of relevant legal documents and promotion of community awareness, installation of environmental signs and preparation of relevant reports to the province and provincial department of environment (Min, 2016).

2.2. Institutional Arrangement, Roles and responsibilities of Actors in SWM of Phnom Penh

Figure 3 illustrates the administrative structure of PPCH, which enjoys a government status equivalent to other provinces. The council has legislative and executive decision-making powers to formulate subnational policies including those relevant to waste management, and has a responsibility to ensure that the decisions have been implemented. The Board of Governors has a mandate of four years to give council comments, reports and implementation of the council decision-making.

Of the eight divisions of Phnom Penh Capital Hall (PPCH), the Waste Management Affair Department (WMAD) is responsible for implementing waste management services in Phnom Penh. WMAD has two main offices: i) Technical Environment Impact Monitoring Office and ii) Waste Management Authority Office. The Landfill Management Authority is also established by PPCH to be responsible for operation of Dangkor landfill.

In addition, waste management in Phnom Penh is also supported by municipal technical departments of line ministries, especially through technical assistance by

¹ Sub-national institutional structure was modified under the Law on Administration and Management of the Capital, Province, Municipality, District and Khan adopted in 2008, which was set in line with the national policy introduced in 2005, which acknowledged the strengthening of the protection of environment and natural resource at sub-national level to be the country's long term goal. Before the reform in 2008, the country had four governance tiers with 20 Provinces and 4 Cities; 171 Districts and 14 Khans; 1510 Communes and 111 Sangkats (Leng, 2013; Royal Government of Cambodia, 2008).

the Department of Environment (DoE), Department of Public Works and Transport (DPWT), Department

of Tourism (DoT), Department of Industry and Handicrafts (DoIH), and Department of Health (DoH).

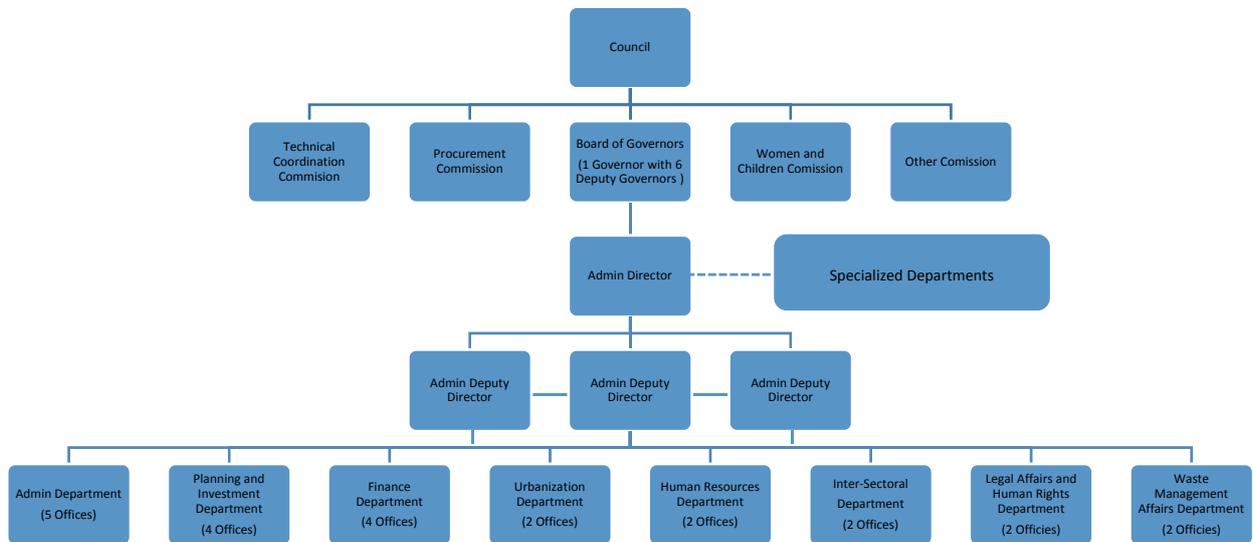


Figure 3 Administrative structure of PPCH
(Source: MPP, 2011)

3. National and City Waste Management Policies and Legislation

Policy and legislations that regulate national and Phnom Penh's solid waste management are listed in Table 1. A new legislation was adopted in 2015 to improve the effectiveness of solid waste management in the Municipality of Phnom Penh (MPP). The sentences below in blue and brown represents national and city waste management laws and regulations respectively.

Table 1 Policy and legislation related solid waste management

General laws and regulations
<p>National</p> <ul style="list-style-type: none"> • Sub-decree on Borey (new house construction area) Management, No. 39 (2011)
Municipal Solid Waste
<p>National</p> <ul style="list-style-type: none"> • Sub -Decree on Urban Solid Waste Management, No. 113 (2015) • Sub-Decree on Solid Waste Management, No. 36 (1999) • Inter-Ministerial Declaration of Ministry of Interior-Ministry of Environment on Waste and Solid Waste Management in Province/ Municipalities of Cambodia, No. 80 (2003)
<p>City</p> <ul style="list-style-type: none"> • Draft Strategy And Methodology For Improving Waste Management And Cleansing, Collection And Transport Of Solid Waste In Phnom Penh Capital • Sechkdey Chun Damnoeng (Notification) On Waste Storage, Cleansing, Waste Discharge And Penalties On Improper Waste Disposal In Phnom Penh Municipality, No. 13 (2013) • Instruction Plan On The Application Of Penalties To Promote Environmental Sanitation Raising In Phnom Penh Municipality, No. 09 (2010) • Instruction Plan On Waste Separation Promotion In Phnom Penh Municipality, No. 08 (2010) • Sechkdey Nainoam (Instruction) On Penalties On Waste Disposal In Public Area, No. 16 (2010)
Industrial Solid Waste
<p>National</p> <ul style="list-style-type: none"> • Guideline on Solid Waste Management at factories, enterprises and companies, No. 11 (2003) • Guideline on Sludge Waste Management at Factories – Enterprises (2000) • Directive on Industrial Hazardous Waste Management, No. 87 (2000) • Sub-Decree No. 446 on the organization and function of the Department of Hazardous Substance Management (2015) • Declaration No. 387 on enforcement to standard level the amount of toxic or hazardous substance that allow to abandoned (2015)
<p>City</p> <ul style="list-style-type: none"> • Declaration on Industrial Solid Waste Collection and Transport in Phnom Penh and Kandal, No. 148 (2002) • Declaration on the permission Sarom Trading to collect and transport industrial wastes from Phnom Penh and Kankal province, No. 156 (2001)

Hazardous Solid Waste, Medical Solid Waste
National <ul style="list-style-type: none"> • Sub-Decree No. 446 on the organization and function of the Department of Hazardous Substance Management (2015) • Declaration No. 387 on enforcement to standard level the amount of toxic or hazardous substance that allow to abandoned (2015)
Street Dust
City <ul style="list-style-type: none"> • Sub-decree on Applying Phnom Penh Land Use Master Plan, No. 181 (2015)
E-waste
National <ul style="list-style-type: none"> • Sub-Decree of E-waste and Electric Equipment (2016)
Medical Waste
National <ul style="list-style-type: none"> • Declaration on Waste Management from Health Care Service in the Kingdom of Cambodia – Ministry of Health (2008) • Decision on creation of Medical Waste Management Unit, No. 96 of Red Cross Cambodia (2009) • National Guide on Waste Management from Health Care Service (2012)

(Source: Compiled by Authors based on interview with MOR and PPCH, 2017)

4. Municipal Solid Waste Management

Municipal Solid Waste is referred as Urban Solid Waste in the Sub-decree 113 and this waste includes waste generated from residents, services or commercial activities, which do not contain toxic substances or hazardous waste (Royal Government of Cambodia, 2015).

The history of waste management in Phnom Penh (Figure 4) represents the transition of service providers of Phnom Penh's municipal solid waste management (MSWM) over the last three decades. After the war, MSWM was the responsibility of the municipal cleansing section of the Department of Public Works and Transport (DPWT) of the Municipality of Phnom Penh (MPP) which remained as a service provider until 1994 (Seng, Kaneko, Hirayama & Hirayama, 2011). During this period, household waste was most commonly burned, buried, or dumped in residents' backyards, and free land areas, due to the absence of appropriate and effective MSWM regulations, where only market waste was collected for ultimate disposal in an open dumpsite.

In order to address the increasing stress to the city's waste management system due to rapid population growth and subsequent growth of waste generated, and to reinforce the limited capacity of the system, MPP outsourced its MSWM service to private contractors with franchise agreements, which included collection, transport and disposal of the municipal waste. The companies were also responsible for (or entitled to) collecting a fee from those who received the service. The service providers have changed repeatedly due to financial difficulties due to unclear tipping fee criteria, inefficient waste collection and fee collection, and willingness-to-pay for the service which remained at low level among the

beneficiaries (B. Seng et al., 2011).

In 2002, an exclusive agreement was signed between the Municipality and CINTRI with the term of 49 years, which gave the operator major responsibilities to provide garbage collection services (Phnom Penh Capital Hall - Urbanization Division, 2011). The company has been successful in covering the cost to sustain its operations up to the present time, by collecting service fees from beneficiaries (residents, businesses etc.) through the electricity bill.

4.1. Generation

Phnom Penh generates around 365,224 t/year of municipal solid waste, with the per-capita-per-day generation of households in Phnom Penh estimated to be 0.498 kg based on a population of 1,445,902 in 2015 (K. Seng, 2015).

Figure 5 exhibits the distribution of generated MSW from each source in Phnom Penh considering six sources: households, markets, shops, offices, restaurants, and hotels/guesthouses. Of all the sources, household waste shared the largest portion of generated waste at around 55.3% of the total. The sources of non-household waste varies from the hotels/guesthouses (16.7%), restaurants (13.8%), markets (7.5%), to shops (5.4%) and offices (1.4%). The study concluded that the largest portion of household waste resulted from the high population and income compared to other sources (K. Seng, 2015).

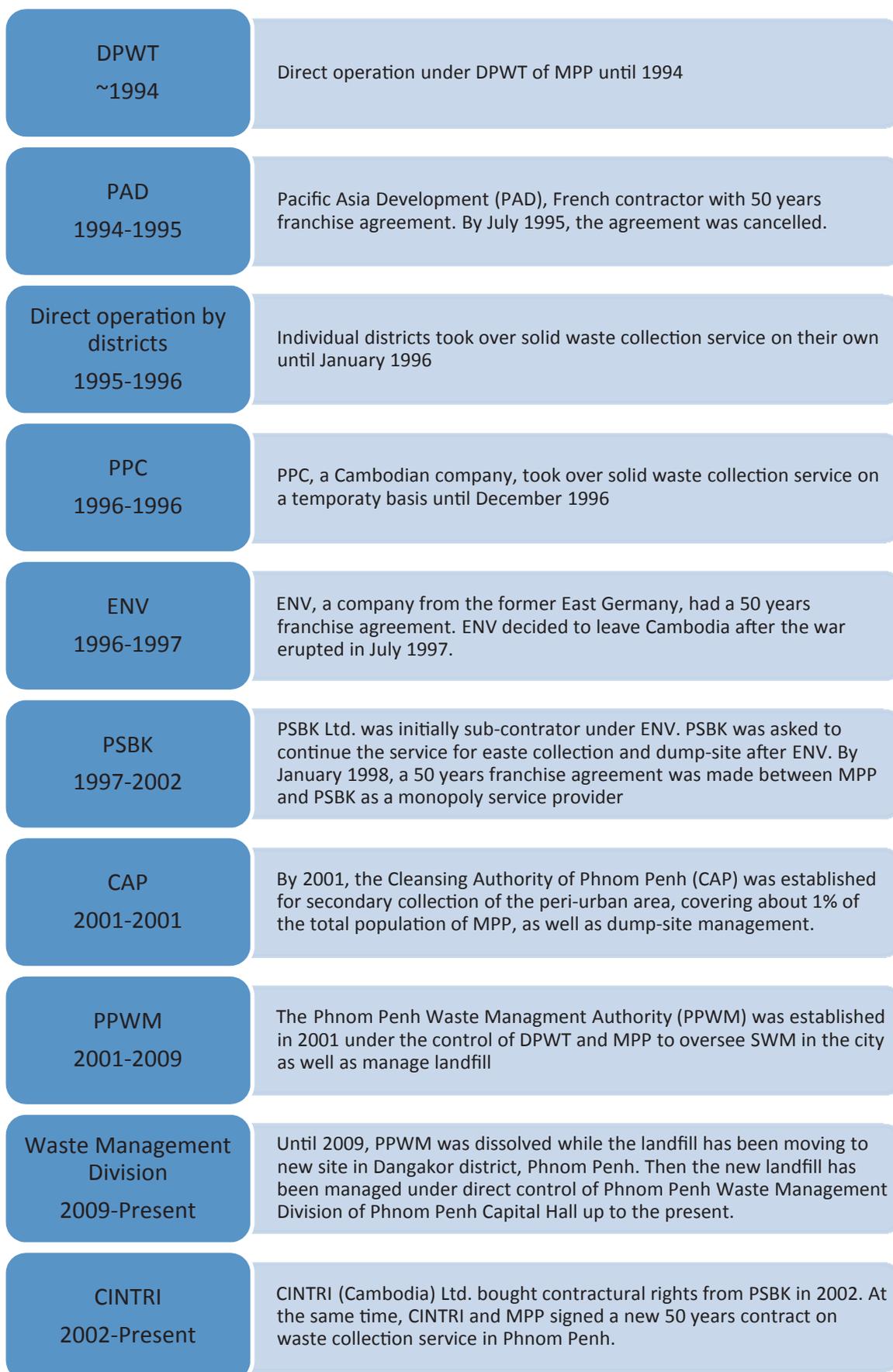


Figure 4 Transition of MSWM service providers in PPCH
 (Source: Adopted from JICA and MPP, 2005; Seng et al., 2011; Uch et al., 2014)

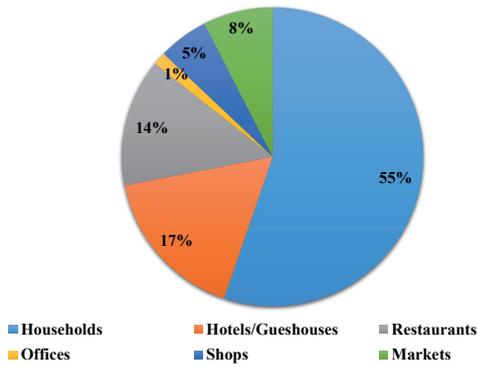


Figure 5 MSW generated by source in Phnom Penh (Source: K. Seng, 2015)

4.2. Waste Composition

Figure 6 shows the MSW composition for PPCH in which organic waste accounted for the largest proportion of about 51.9% of total waste while the second and third largest were from plastic and paper about 20.9% and 9.9% respectively. The remaining waste was grass and wood at about 2.3%, followed by glass—1.6%, metal—1.1%, rubber and leather—0.2%, textiles—2.1%, ceramic and stone—0.5%, other burnable—5.4%, and other un-burnable—4.1% (K. Seng, 2015).

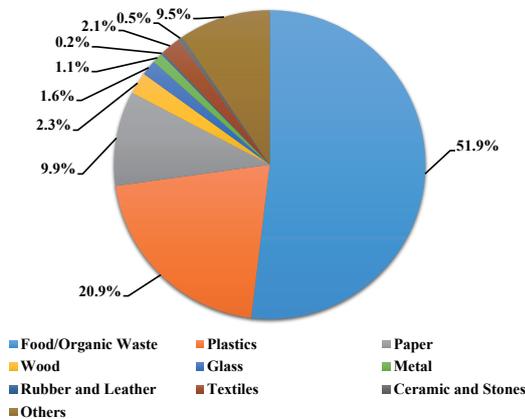


Figure 6 Waste composition in Phnom Penh (Source: K. Seng, 2015)

4.3. Waste Collection and Transport

The private sector plays a critical role in collection and transport of solid waste. Waste collection rate of the city was about 83.3% with 839,500 tons of waste going to Dangkor Landfill in 2015. Currently, under the commission of PPCH, CINTRI is tasked to clean, collect and transport the city's municipal waste (The Asia Foundation, 2016). In 2011, the company's team comprised over 1,190 workers for sweeping, collection and transport operations (JICA and MPP, 2005; Phnom Penh Capital Hall - Urbanization Division, 2011).

Figure 7 shows that the company has two major operational divisions: Cleaning Operation and Collection and Transport Operation. Cleaning Operation applies manual labour using waste carts, bins and brooms during daytime and times of less traffic (at night-time, it is risky due to limited security and safety). There are different ways and means of waste collection and transport, such as using waste carts, dumpster bins and waste trucks divided into daytime and night-time for households, public gardens and markets.

Solid waste management perception and practice are still problematic in Phnom Penh. Feasible waste collection system still needs to be improved. To change people's behaviour is very hard in order to improve public hygiene and sanitation of the city. Although there are, regulations in place on proper management of waste, people still throw waste haphazardly around collection points or around roads as shown in Figure 8.

4.4. Waste Disposal/Final Treatment

Phnom Penh relies almost entirely on Dangkor landfill

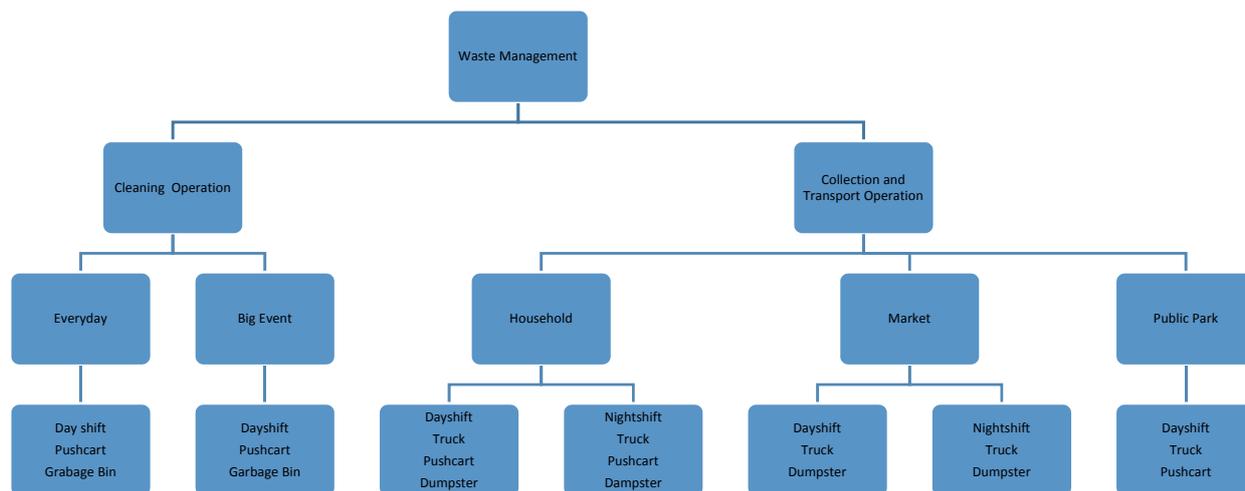


Figure 7 Organization structure of CINTRI
(Source: B. Seng, 2014)



Figure 8 Improper waste discharge, storage and open burning
(Source: COMPED)

Note: Spray sign mentions waste collection time is at 7:00pm; and punishment of 25\$ for improper waste

site for the final treatment / disposal of MSW generated within the jurisdiction. Dangkor landfill site, developed with the assistance by JICA, started operation in July 2009 following the closure of its predecessor Stoeng Mean Chey landfill site which reached full capacity.

There is a substantial gap between the annual amount of waste before 2002 when Stoeng Mean Chey landfill site was in use, and the amount after 2003 using the new landfill site. However, as Figure 9 shows, the amount of municipal solid waste disposal has increased over the years. In 2017, the waste disposal

amount at the landfill was about 808,530 tonnes per year.

Dangkor landfill has been operated by Dangkor Landfill Management Authority (DLMA) under the Waste Management Affair Department (WMAD) of PPCH. The organisational structure at Dangkor Landfill Management Authority is shown in Figure 10. Total human resources consist of 34 staff in 2014.

Since the site started operations in 2009, the waste layers in the landfill area A (see Figure 11) were covered with soil for every 4m of waste, as opposed to the recommended practice put forward by JICA (i) daily

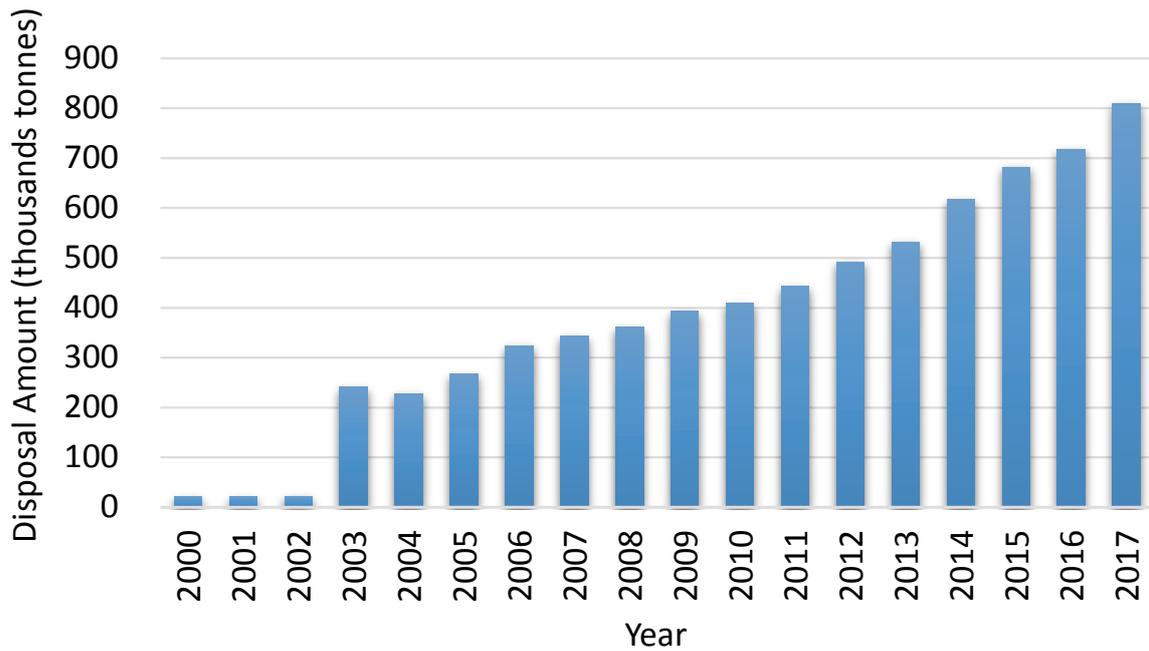


Figure 9 Municipal solid waste disposal at landfill in Phnom Penh
 (Source: Ministry of Environment Cambodia, 2018)

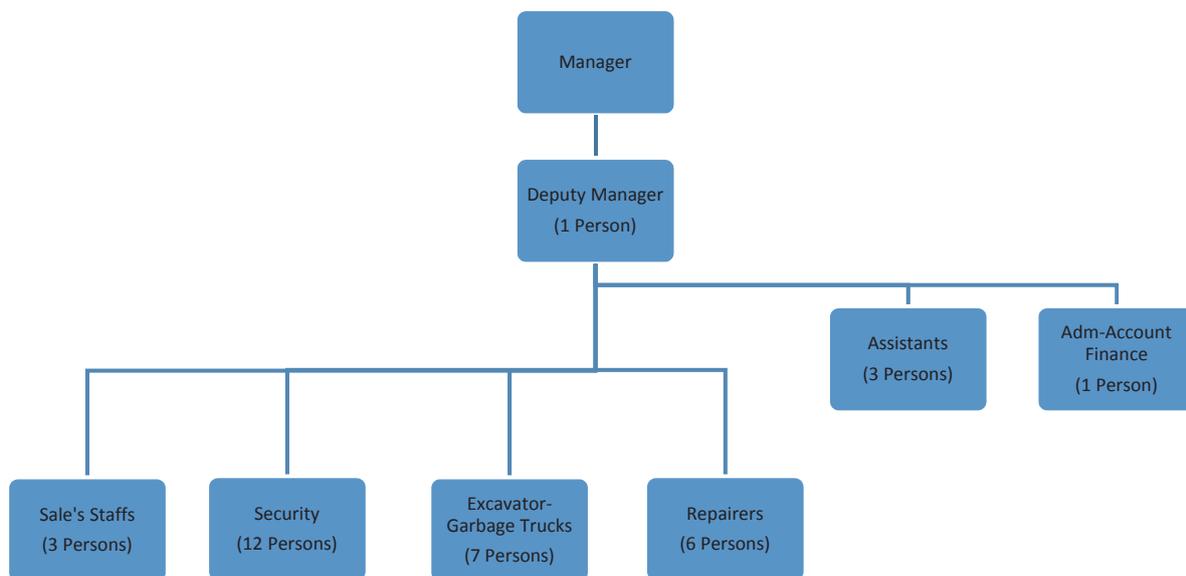


Figure 10 Organizational structure at the Dangkor Landfill Management Authority
 (Source: Uch et al., 2014)

covering soil of 15cm; (ii) intermediate cover soil of 30cm; and (iii) final covering soil of 50cm (JICA, 2005).

Figure 12 shows the actual infrastructure of Dangkor landfill status slightly different from the original

design by JICA as show in Figure 11. The recommended management practice was followed until 2010, when it was discontinued due to serious damage to the site caused by serious flooding, which also affected most regions in Cambodia, and resulted in the collapse of

the landfill pile in both Area A and B (Uch et al., 2014). Without the practice of landfill soil covering the waste, hygiene at the site management deteriorated resulting in offensive odours and breeding of disease vectors and noxious insects, which especially intensified during rainy seasons.

Figure 13 shows the initial phase of the landfill site (left) in 2009, and an overview of the site in 2014 with a waste pile of approximately 8-10m above the rice field in elevation (right) (Uch et al., 2014). The life span of the site tends to be short due to the mixed MSW brought in without any recycling practice (for instance, organic content which constitutes the majority of the

MSW accepted at the site) and the absence of on-site compaction of the waste layers.

Emissions from the landfill

The rough estimation of greenhouse gas (GHG) and Black carbon (BC) emissions at Dangakor Landfill was calculated based on EQT Tool developed by IGES/CCAC as shown in Table 2. The finding estimates that the emission of GHG and BC from the landfill was about 59,715 tonnes per year and 101 tonnes per year respectively in 2015.

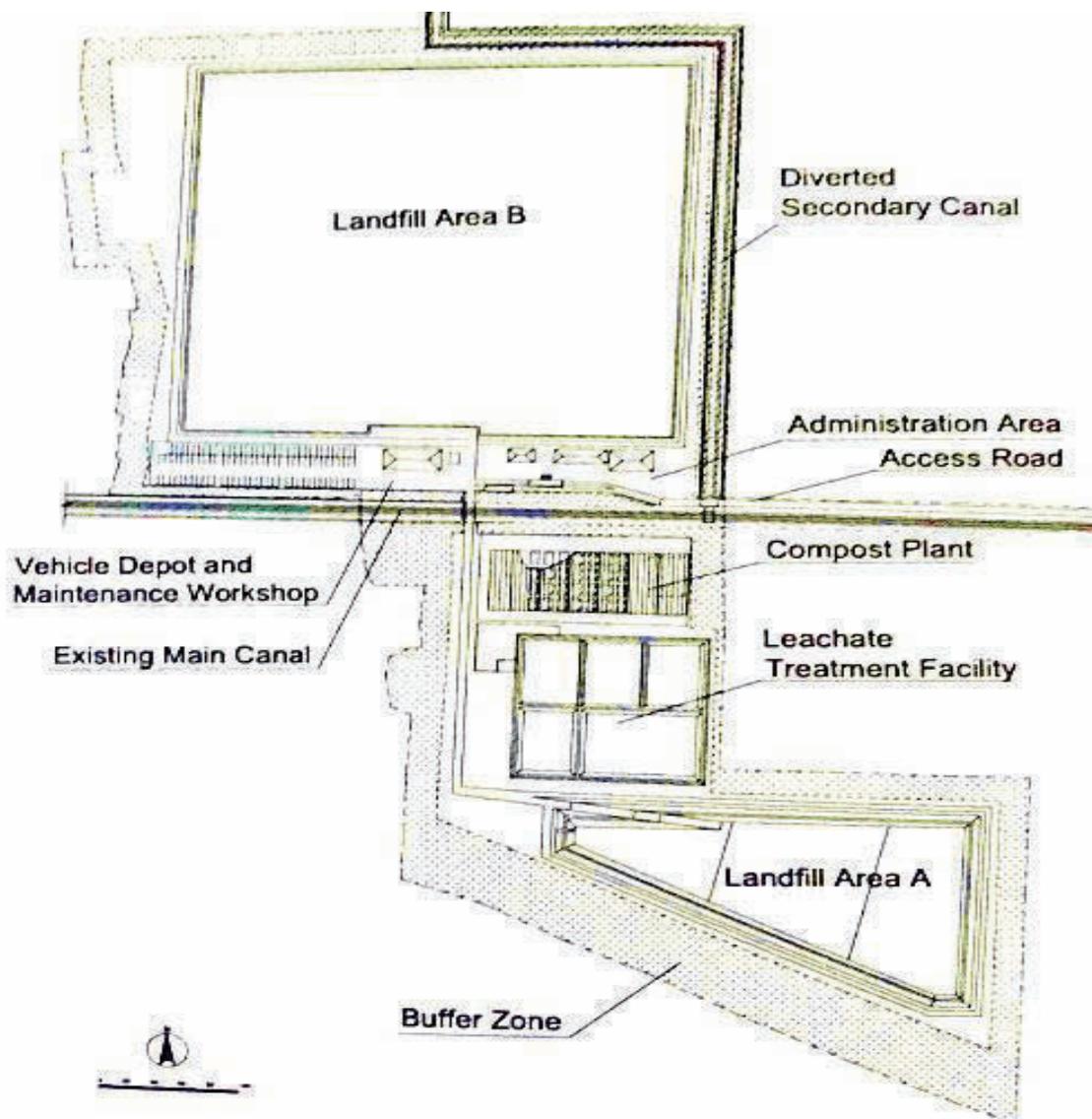


Figure 11 Dangkor sanitation landfill map designed by JICA
(Source: JICA and MPP, 2005)

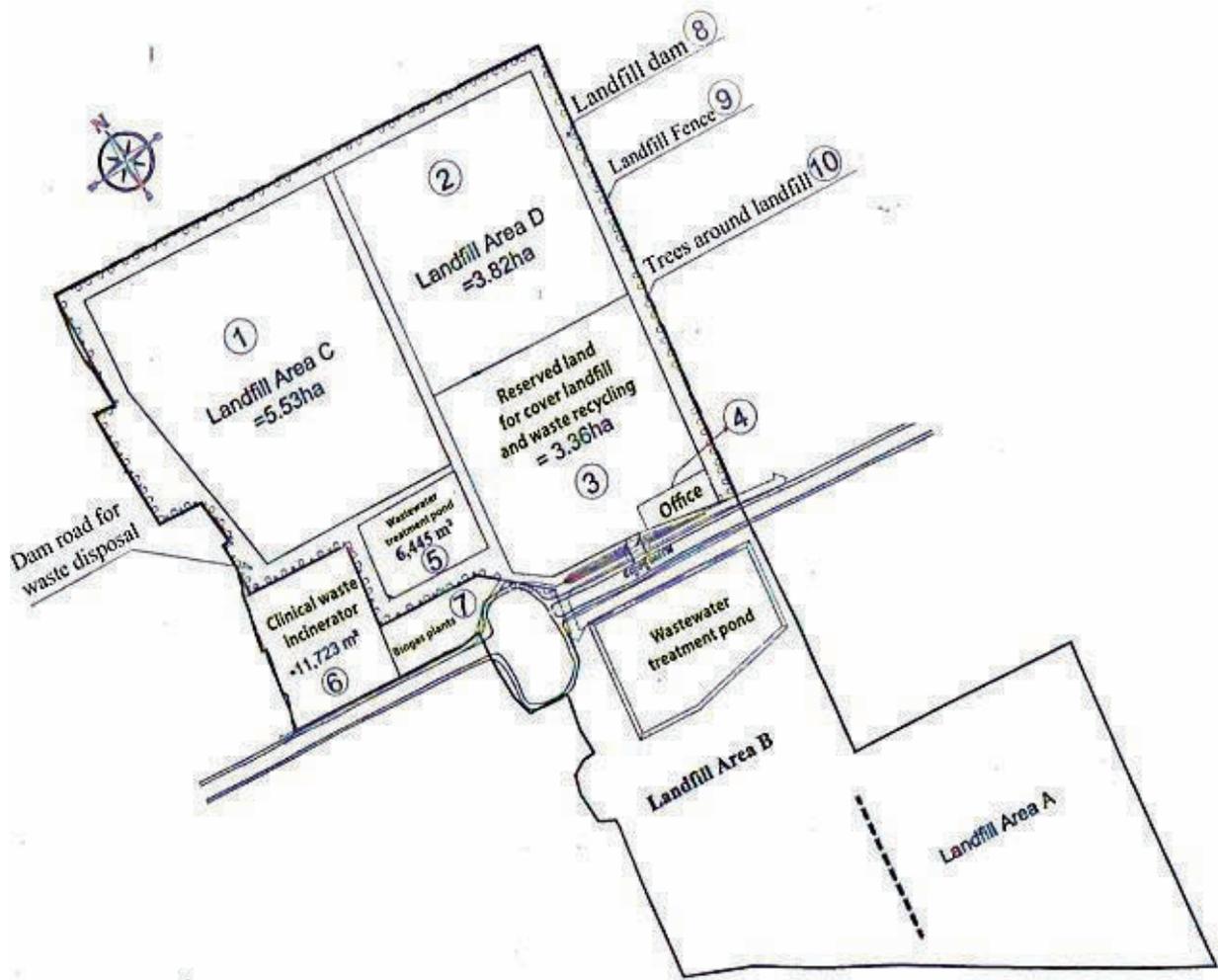


Figure 12 Overview of the actual landfill map in 2014
 (Source: Dangkor Landfill Authority)



Figure 13 Overview of Landfill site in 2009 and in early 2014
 (Source: COMPED)

Table 2 Summary of the GHG/SLCP emissions from Dangkor Landfill Operation in 2015

Description	Technology	Unit	CH ₄	BC	CO ₂	N ₂ O
Waste Collection and transportation by city	Transportation	Kg/month	0	1	8,085	0
Treatment for separate waste	Composting	(unit 'kg' used here to show the magnitude of small amount of emissions)				
	Anaerobic digestion					
	Recycling		0	0	0	0
Treatment for mixed waste	MBT					
	Incineration					
	Landfilling		903,365	8,379	4,072,921	0
Uncollected waste	Open burning/scattered		27,396	0	0	
Net emissions per monthly generated waste		Tonnes/month	931	8	4,081	0
Net BC emissions per monthly generated waste		Tonnes of BC/month	8.38			
Net climate impact from other GHGs per monthly generated waste		Tonnes of CO ₂ eq/month	30,142.34			

(Source: COMPED)

5. Industrial and Other Waste

This section provides an overview of Phnom Penh's current waste management system for industrial solid waste and other waste which includes: i) Hazardous Solid Waste; ii) Medical Solid Waste; and iii) Construction and Demolition Solid Waste.

5.1. Industrial Waste

Industrial solid waste refers to the solid waste remaining or generated from production activities of factories or enterprises, which do not contain toxic substances or hazardous waste (Royal Government of Cambodia, 2015).

In Phnom Penh, the industrial solid waste collection (including sludge from wastewater treatment plants) from factories such as garment factories, leather factories, plastic factories and paper factories by Sarom Trading Company to the industrial landfill located in Por Sen Chey district, Phnom Penh (formerly name in Phum Chambok, Khan Kombol, Srok Angsnuol, Kandal Province). However, specific data on industrial waste generation, or collection and disposal at Sarom's industrial landfill is not available.

The company received a permit to collect and transport industrial waste; and to construct an industrial landfill which is located in Phum Chambok, Khan Kombol, Srok Angsnuol, Kandal Province. As stated by MOE, the company must comply with the law on environmental protection and natural resource management, as well as with the sub-decree on the environmental impact assessment process.

However, in reality addition to industrial waste, hazardous waste and medical waste is also disposed at Sarom Industrial Landfill as below (Ministry of Environment, Cambodia, 2002):

- Semi-dry muddy waste removed from effluent treatment pools
- Coloured fibres and pieces of fabrics
- Plastic waste containing Polyvinyl Chloride
- Rubber waste and vulcanised rubber containing Polymer-Butilin
- Batteries and battery waste
- Left over ashes after the burning of medical waste
- Electronic waste
- Paint waste lacquer and packaged materials
- Insecticide waste used in agriculture and in packaged materials (must be placed in a rubber tub before being dumped)
- Waste resulted from production and utilisation of printing ink
- Expired or sub-standard goods
- Waste resulted from production of medicine and expired medicines
- Waste containing asbestos substance

5.2. Medical Waste

According to the Declaration on Waste Management from Health Care Service in the Kingdom of Cambodia, medical waste is defined as the waste from the health care sector such as public and private hospitals, health centres, clinics, and medical laboratories (Ministry of Health, 2008). Medical waste handling is classified into two types: i) General waste including office

residues, kitchen waste, etc. and ii) Health-care waste including infectious waste (flesh, bandage, blood, etc.), sharp waste, pharmaceutical waste, chemical waste, radioactive waste, etc. (MOE, 2014).

Medical waste has traditionally been treated (or improperly treated) in a decentralised manner: waste was incinerated in major hospitals, although the practice was often discontinued due to problems from limited maintenance and high fuel price, while the majority of waste generated in many private clinics was mixed with MSW and disposed. Currently, medical waste management of Phnom Penh city is managed by Red Cross Cambodia, which provides collection, transportation, intermediate treatment and final disposal.

As of 2011, there are eight national hospitals in Phnom Penh City, 24 provincial referral hospitals, 64 district referral hospitals, 1,097 health centres, as well as 87 health posts located throughout the country according to Department of Hospital Service (Project Coordination Unit, 2014), all generating medical waste.

The total amount of medical waste generated is about 40t/month in Phnom Penh, consisting infectious waste, pathological waste, sharps (i.e. knives and syringes) and pharmaceutical waste (Choeu, 2016). The quantity of medical waste is increasing with the expansion of medical services (Figure 14).

As shown in Table 3, national hospitals in Phnom Penh produced the four most common categories of HCW including infectious waste, pathological waste, sharps and pharmaceuticals waste (Department of Hospital Services, 2006). Infectious waste shares the highest amount of about 33kg/day.

The Medical Waste Management Unit (MWMU) was created under Red Cross Cambodia branch (Phnom Penh) in 2009 to provide services from collection to transport and treatment of medical wastes generated in Phnom Penh. Medical waste is separated and stored at respective health care centres, collected by the MWMU, transported by trucks (Figure 15 (a)) to the incineration plant located in Khan Dangkor, approximately 12 km from Phnom Penh City Centre. The facility covers about one hectare of land area, and

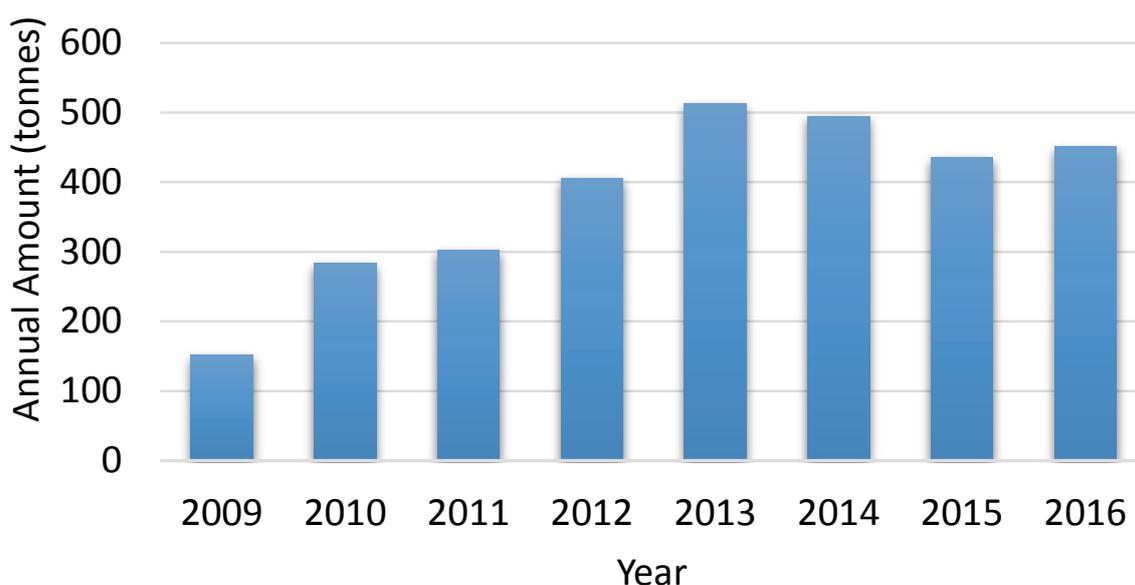


Figure 14 Amount of collected annual medical waste
(Source: Choeu, 2016)

Table 3 Average amount of health care waste generated from National Hospitals in Phnom Penh

Health Care Facilities	Infectious Waste		Pathological Waste		Sharps	Pharmaceutical Waste	
	Kg/day	L/day	Kg/day	L/day	Box/day	Kg/day	L/day
National Hospitals	33.22	1.85	14.83	1.46	12.43	20	0.1

(Source: Department of Hospital Services, 2006)

in located next to the municipal landfill (Choeu, 2016). All of the trucks are equipped with GPS in order to ensure efficient operations (Figure 15 (b)). There are three types of collection containers including, safety plastic bag (Non-PVC), safety sharpness box (recycle paper) and safety bin being used for medical waste. However, the waste separation practice is still limited for some health care centres and many times, it is

found that medical waste is mixed with kitchen waste or ordinary waste.

Treatment of medical waste includes incineration, chemical treatment and wastewater treatment. At MWMU, medical wastes are incinerated at the temperature of up to 1200 degree Celsius using different incinerators as shown in the Figure 16.

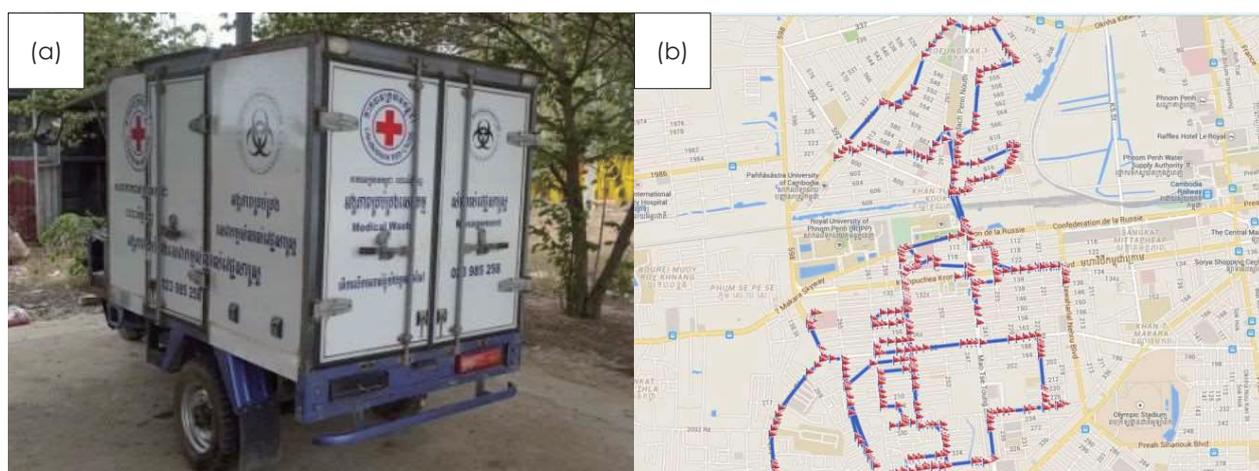


Figure 15 Collection trucks for medical waste (a) and sample of GPS track record for collection of medical waste (b)
(Source: Choeu, 2016)



Figure 16 Incinerator Model FSI-150 (left); Incinerator Model LDF-500 (LDF-100) (right)
(Source: Choeu, 2016)

5.3. Hazardous Waste

Hazardous waste includes any substances which are radioactive, inflammable, infected, oxidation, toxic or other chemical materials (Royal Government of Cambodia, 2015). The new sub-decree No. 113 Annex classifies and regulates the following hazardous solid waste generated from households, public institutions, commercial facilities, industrial and tourism sectors.

- Battery waste
- WEEE/e-waste
- Bottle glass waste or cans spoiled with chemical or agricultural pesticides
- Old vehicle tires
- Used oil
- Waste from paint, dye and respective containers
- Waste from printing ink
- Asbestos waste

In addition, MOE also regulates the management of hazardous waste from other sources such as factories, handicrafts, agriculture and mining.

Further, a rapid increase in e-waste has been observed in Phnom Penh and this amount is expected to grow rapidly as shown in Table 4, which projects the

generated e-waste in Phnom Penh from 2009 to 2019. Many types of second-hand EEE such as monitors, printers, keyboards, CPUs, typewriters, projectors, mobile phones, PVC wires, etc. are imported to Cambodia from various countries. These goods come in all models and sizes, which contain both functional items and junk materials also known as e-waste / WEEE. In terms of weight, TVs are expected to show the biggest increase followed by PCs, refrigerators, air conditioners, washing machines and mobile phones (Ministry of Environment Cambodia, 2009).

Waste pickers and dismantlers play a pivotal role in the collection of e-waste through the market. Waste items are generally purchased from generators for reusable components or material recycling. Valuable components are sold to scrapyard owners for export, and non-valuable components are removed and disposed of as domestic waste. According to 2015 report of Ministry of Environment Cambodia, the amount of e-waste exported from Cambodia to Singapore, one of the major destination countries, came to approximately 3,514 T in 2013 and 1,588 T in 2014.

When there is no waste-collection service, e-waste is brought in, disposed of and incinerated improperly at sites close to or behind the repairing/dismantling

Table 4 Projected E-waste fraction (metric tons)

E-waste Items/E-waste Fractions	2009			2019		
	Reusable	Recyclable	Residues	Reusable	Recyclable	Residues
TV	980.54	792.05	131.37	5,517.54	4,456.88	739.24
PC	1,706.69	964.62	59.39	2,247.85	1,270.48	78.23
MP	26.17	14.22	2.69	90.38	49.09	9.30
Refrigerator	548.70	387.79	62.97	1,716.15	1,212.87	196.94
Air Conditioner	490.83	377.56	19.99	1,908.53	1,468.10	77.72
Washing Machine	525.39	175.13	175.13	842.30	280.77	280.77

(Source: Ministry of Environment, 2009)

shops (MOE Cambodia's Technical Working Group, 2013).

Approximately 3% of residues generated from dismantling, separating and/or sorting process is disposed of, while the remaining 97% is sold to local recycling shops or transported to other recyclers on demand. However, a CEA survey in 2007 found that 80% of e-waste is sold for recycling (MOE Cambodia's Technical Working Group, 2013).

Lack of understanding among operators and junkshops owners on the negative environmental and health impacts of improper treatment / disposal is resulting in the release of hazardous substances from e-waste.

In 2004, Cambodia conducted a survey on 23 Persistent Organic Pollutants (POPs), which included 12 POPs conventionally registered. Moreover, there were 11 POPs additionally registered in 2013 utilising the UNEP guidance and quantification Toolkit for unintentional POPs (version 1 issued in 2003) in order to fulfil the reporting duty under the Stockholm Convention, aiming for eventual phase-out of POPs and minimal human and environmental consequences. This survey was also conducted to achieve Goal No. 7 of the Cambodia Millennium Development Goals

(CMDGs) as well as the current Royal Government Policy on poverty alleviation (Project Coordination Unit, 2014) in which management of POPs was strategically positioned.

5.4. Construction and Demolition (C&D) Waste

Construction and Demolition (C&D) waste most commonly includes paper/cardboard, garden/vegetation, wood/timber, carpets, other textiles, rubber, glass, plastics, metals, hazardous waste, ceramics, soil/rubble, cobbles/boulders, clean soil, concrete, plasterboards, bricks, asphalt/bitumen, cement sheet, insulation and others (UNEP, 2009).

Management of C&D waste in Phnom Penh is currently at the development stage whereby some generated waste is collected, treated and disposed of by the private sector on a contract-basis, some is sold to buyers for reuse (soil, rubble and rock), while other waste is dumped on open land or in remote public areas (based on field observation). There are pressing concerns about the shortage / lifespan of landfill sites and Phnom Penh limiting waste acceptance at final

landfill sites, partially resulting in illegal disposal as shown in Figure 17. Lack of basic data is posing another challenge, making it difficult to delineate the state of the city's C&D waste management system.

There is no official national data or investigation on the exact amount of C&D waste generated. Waste generation can generally be estimated based on the types of property (single family residential; multi-family residential; and commercial & non-residential) with square footage based on the available data. However, such data is not disclosed in Phnom Penh.

UNEP (2009) suggests that waste sampling for estimating C&D waste quantity and composition can take place either at landfill sites (sampling from vehicles entering the waste disposal site) or at

construction and demolition sites. The study conducted a rapid construction waste composition assessment with sampling at several C&D sites in Phnom Penh, and roughly estimated the waste composition: about 60% broken brick, rock, left-over cement and soil; 20% wood; 10% metal; 5% plastic; 5% paper and other waste. Waste sampling at landfill sites was not feasible as no public sites received C&D waste in Phnom Penh according to the landfill authority of the city, making it difficult to obtain reliable figures on waste generation and waste composition.

Landfill site allow the disposal of non-residential bulk waste as shown in Figure 18. It is to be collected and transported by private contractors to the landfill occasionally.



Figure 17 Generation of C&D waste
(Source: COMPED)



Figure 18 Bulk waste for disposal
(Source: COMPED)

Collection and disposal of C&D waste is a major challenge for generators and authorities alike. Sub-decree 113 (Urban Solid Waste Management) stipulates the responsibility of generators of C&D waste and contractors for proper waste management as below:

- Properly store C&D waste to avoid impacts on the public order and environment
 - Clean, collect and transport C&D waste by their own means to urban municipal landfill or use the service of the local urban waste collection company.
- The sub-decree also allows C&D waste to be brought in to public landfill sites for final disposal. However, in practice, C&D waste is not accepted by landfill sites in Phnom Penh as the city attempts to preserve / extend the lifespan of the site, unless brought in by contractors. As a result, while some C&D waste is reused / recycled (only pure bricks, soil, rock and stone) upon demand, mixed C&D waste with no market value is in most cases illegally dumped along the Mekong river or openly burnt if it consists of combustible components (Figure 19).



Figure 19 Illegal dumping and open burning of C&D waste
(Source: COMPED)

6. Financing Solid Waste Management in Phnom Penh

6.1. Financing Solid Waste Management in Cambodia

Cambodia's SWM system has been facing significant challenges over the last several decades. In this context, the country's Fundamental Law on Solid Waste Management (Sub-decree No. 36 on Solid Waste Management (1999)) regulates all activities related to storage, collection, transport, recycling, and disposal of household and hazardous waste (Sang-Arun, Heng, & Al., 2011). In addition, another influential complementary regulation is Cambodia's Inter-ministerial Declaration (*Prakas*) No. 80 (2003) which was written with a view towards improving the responsibility of concerned authorities and involving relevant institutions for promoting the efficient implementation of solid waste management in the country's provinces and cities.

Due to lack of detailed regulations, standards and guidelines, limited capacity of personnel and budgetary constraints of the public sector, private sector actors in Cambodia are serving a central role in addressing gaps in waste management. For instance, local authorities frequently outsource waste collection and transportation services to private companies.

Moreover, most waste collection companies have negotiated with central and subnational governments on provision of services based on profit margin calculations associated with waste fee collections (Min, 2016). Such calculations typically involve an identification of waste sources and on this basis estimating beneficiaries' level of willingness-to-pay

for waste services. Funding for waste management is thus derived from user fees, which is set based on the specification and tenant category of the building, including type of residence number of floors, etc. as well as whether the waste sources are from business establishments, supermarkets, clinics, schools, universities, etc.; notably, however, user fees are not calculated based on waste volumes.

Accordingly, Min (2016) estimates that actual service fees may range between USD 0.8 to USD 30 per month, observing that there is no standardised, customary formula for calculating tariffs uniformly applied in all circumstances; indeed, some cases have been reported where beneficiaries have been charged in excess of tariffs set by regulatory authorities². In all other M/Ds waste tariffs are determined strictly on basis of the type of business or residence concerned.

Private companies contracted to deliver waste management services are expected to provide residential waste collection, without relying on subsidies or financial support from either local or national government. However, many contractors continue to encounter issues with cost recovery from waste collection, as some residents are not willing to pay for such services. This has resulted in environmental challenges including some of the waste being either burned or dumped in public spaces, residential areas, or on private land.

In some M/Ds, private collection companies have no recourse but to develop private landfill sites: this has been observed in cities such as Battambang, Siem Reap, and Champong Cham. Although authorised by provincial or national authorities, such

² In many urbanised municipalities, waste collection fees for 4-5 star hotels could be up to 20 times higher than the set tariff fee.

privately-owned facilities tend to operate without following environmental protocols, demonstrated for example through the use of open pits, the lack of requisite liners, leachate collection and/or treatment systems, as well as frequent open burning of waste.

6.2. Financing Solid Waste Management in Phnom Penh

A significant share of Phnom Penh's waste management services are financed by the private company CINTRI, which provides collection and transportation of MSW based on user fees ranging from USD 1.00 to USD 100. Service fee collection can be considered nominally successful as such tariffs are included in private electricity bills, following cooperative agreement reached between CINTRI and the Electric Department of Phnom Penh City (Electric du Camnodge (EDC) (Sang-Arun et al., 2011).

However, CINTRI's service model continues to face issues in terms of achieving overall financial sustainability; although service fees adequately finance waste collection and transport services, at present there are not sufficient funds to cover additional costs of operations such as street cleaning and final disposal. Consequently, CINTRI's street cleaning service is not meeting expected performance levels, with coverage unable to further expand to other areas of the city without a corresponding increase in revenue.

The company's household waste collection operations are also experiencing difficulties, faced with the need to improve overall performance by, for instance, increasing salaries of its staff, while at the same time addressing criticisms from its users regarding unsatisfactory services received— despite their limited awareness about appropriate waste practices and involvement in formal decision-making processes. Accordingly, local authorities have been considering

eliminating CINTRI's fee contained in users' electricity bills aimed at avoiding public complaints directed at EDC. In this regard, as fees from waste collection represent the main source of funding for the company's waste management services, the removal of service fee is expected to pose a negative impact on the financial sustainability of CINTRI's operations from diminishing income, and consequently result in a further deterioration of the quality of Phnom Penh's waste collection service.

Moreover, the financial viability of the Dangkor landfill site, operated and managed by PPCH, another issue of concern. Currently, the site charges a disposal fee of USD 1.00 for every ton of waste brought onto its premises. However, an analysis of Dangkor landfill site conducted by JICA (2005) suggested that for managing the sanitary landfill to a satisfactory level would require increasing the disposal fee to USD 4.4/t with additional grant assistance, or USD 5.92/t without the grant assistance (JICA and MPP, 2005).

6.3. Project Financed by RGC and External Stakeholders

The Royal Government of Cambodia (RGC) has allocated national budget towards projects intended to build capacity in the country's waste sector; similarly, several donor countries and NGOs have provided technical assistance to RGC, Phnom Penh City and other local stakeholders aimed at enhancing Phnom Penh's waste management system. The section briefly describes the projects conducted both at the national level as well as in Phnom Penh.

6.4. Royal Government of Cambodia

In 2015, Cambodia's Ministry of Environment issued

its Circular Decree on the Implementation of Environmental and Hygiene Service Programme, aimed at improving solid waste and wastewater management for a total of 26 cities across the country. Listed under the national budget as per the Ministry of Economic and Finance, the overall funding of this programme is 5,000 million Riels (USD1.25) for 2015, planned to increase to 9,000 million Riels (USD 2.25) in 2016.

6.5. Japan

Starting in 1997, the Government of Japan has provided several grants to the RGC aimed at enhancing solid waste management in Cambodia. Such funding has been utilised for conducting the following activities, among others:

- JICA study on Solid Waste Management in the Municipality of Phnom Penh (2003-2005)
- JICA project on solid waste management improvement for the municipality of Phnom Penh including capacity building and infrastructure development (October 2006 – March 2008)

The primary objective of these projects was to strengthen Phnom Penh's waste management system in terms of collection and final disposal (B. Seng et al., 2011). In addition, a percentage of the allocated capital USD 13.9 million was also directed towards improving the city's waste management infrastructure (Phnom Penh Capital Hall - Urbanization Division, 2011). However, this initiative was terminated in 2008 due to the fact that certain conditions of support stipulated by JICA, including modification of PPCH and CINTRI service contract³ were not fulfilled (JICA, 2008 in (B. Seng et al., 2011)).

³ The proposed modification included 1) expansion of CINTRI's service area from 3,000 households currently covered to 18 communes in the suburban Phnom Penh, and 2) revision of the tipping fee to secure the appropriate operation cost.

6.6. European Union

The EU-funded project under the framework of ASIA-PRO-ECO-Program was also designed to build the capacity of waste management actors in Cambodia including MOE, MoH, PPWM, CINTRI, as well as to develop technical guidelines on solid waste management in close cooperation with concerned ministries. The completed guidelines include procedures for the development of waste management master plans, the management of bio-waste, the design and operation of landfills, the management of medical waste as well as address issues concerning public education on appropriate waste practices (MOE Cambodia & COMPED, 2006). In this regard, the guidelines support the principle of the 3Rs for promoting conservation and protection of natural resources and environmentally sustainable development, while encouraging the development of waste management plans to this end.

6.7. Asia Foundation

In 2014, with support from the Asia Foundation, a pilot project was conducted in the district of Khan Daun Penh in collaboration with CINTRI and PPCH. The project aimed to optimise waste collection operations through strategic use of GPS and GIS systems with a view to monitor the movement of CINTRI trucks and the collection of kerbside solid waste.

7. Major Challenges and Areas for Improvement

The findings from baseline assessment, discussions in workshops and technical meetings with relevant stakeholders states that there are significant challenges in waste management sector in Phnom Penh. Some of the key challenges in waste management sector are stated below:

7.1. Municipal Solid Waste Management

The rapid increase in waste generation in Phnom Penh is an acute problem due to increasing population and urbanisation as well as expansion of the administrative boundaries of the city, and also leads to public health issues. Cleanliness, sanitation and MSWM issues in Phnom Penh are experienced widely across MPP both in urban and satellite areas. Most residents have a limited general awareness and understanding about correct waste and sanitation methods, and improper waste disposal practices (e.g. piles of waste accumulating on the ground or in the streets) are widely observed. Poor waste separation at source represents the main obstacle to promoting effective waste reduction and recycling activities and as such is driving many MSW challenges, especially at final disposal sites (contributing to problems including open pit dumping, and other environmental issues due to lack of liners, soil cover, treatment of leachate, etc.).

In addition, waste services provided by private companies continue to practice mixed collection, transport and disposal of MSW, especially with regard to hazardous, medical and industrial waste. Local

authorities are experiencing difficulties in locating suitable areas for final disposal sites of MSW due to gaps in the technical and managerial capacity of competent authorities, including in areas such as construction, waste treatment, and operation and management of landfills. A recent report by the Ministry of Environment (MOE) indicates that waste collection has fallen short of expectations and attributes this to a lack of capacity and insufficient funding of authorities in the waste management of the city (Pang 2016). According to CDRI working paper 2016, a senior MOE official states that the three challenges needing serious attention are: 1) renovation of the governance structure for waste management; 2) strategy to reduce, reuse and recycle waste; and 3) strengthening waste collection and transport.

Further, there is limited available data on solid waste management in Phnom Penh such as data related to illegal dumping, total recycled waste volumes, number of recyclers and recycling operations. Therefore, difficulties arise when trying to accurately assess waste management systems and practices in the city. Furthermore, there remain notable inconsistencies in the data on Phnom Penh Municipality issued by different sources.

Although a number of regulations on waste management have been issued, these have yet to be prioritised and local competent authorities are often unclear on what should be enforced in lieu of the central government. In addition to Sub-decree No. 36 on Solid Waste Management adopted on 27 April 1999 and Inter-Ministerial Prakas of MoI and MoE No. 80 on Solid Waste Management in Provinces/ Municipalities in 2003, Sub-decree No. 113 (August 2015), there has been transfer of specific functions of waste

management from sector ministries to municipal and district administrations such as Khans and Sangkats. However, Phnom Penh was not a targeted municipality for receiving national funding to improve solid waste management practices in line with this Sub-decree. Further, the Khans and Sangkats are still unaware of their responsibility in waste management despite the transfer of responsibility from central government.

Although the Inter-ministerial Working Group Decision to Discuss and Facilitate on Garbage and Urban Solid Waste Management Task Transfer, No. 1070 dated on 12 November 2015 and Inter-ministerial Circular on the Implementation of Sub-decree No. 113 on Garbage and Urban Solid Waste Management, No. 1070, dated on 12 November 2015, have been implemented, these sub-decree has yet to be fully enforced by the government.

7.2. Industrial Waste Management

Challenges in Industrial Solid Waste

The industrial factories are mainly clustered in Phnom Penh and nearby provinces as well as other areas. Data estimations on waste volumes are only available in terms of solid waste collection rates measured in cubic metres, the majority of which is garment/textile waste. Total volumes of marketable waste, sold by respective factories, is not available.

The waste collection fee set by Declaration No. 148, Annex 2 of the Ministry of Environment Cambodia, 2002 is currently not achievable and this limits the ability of the private sector to effectively manage and operate waste service companies focused on collection, transport and proper treatment of industrial waste as well as future expansion to other provinces. According to the current inspection

procedure, factories are required to be notified in advance, although MOE faces challenges in coordinating and implementing effective monitoring.

Many industries do not properly store and manage their waste (for example, frequently mixing industrial waste with general waste) requiring high physical exertion on the part of industrial waste worker to collect, load and transport the waste by vehicle. This is because industrial waste treatment requires high investment capital, current overall safety performance remains inadequate (i.e, collection, disposal and leachate management is limited). At the same time, reuse and/or recycling for some waste categories exist both for local consumption or export including cloth scraps, paper, and metal.

Due to a limited number of competent officers with technical and legal understanding concerning industrial waste management, improvements in monitoring and inspection capacities are required both at the national and provincial levels, with a clear demarcation of responsibilities. This would ensure more accurate assessment of the impacts of the industrial sector and enable environmental laws to be enforced more effectively (Chea, 2016). Environmental violations are primarily committed outside of working hours (at night) and holidays, and searches to identify guilty parties are not yet conducted in any systematic manner (Chea, 2016).

7.3. Hazardous Waste Management

Public participation of relevant stakeholders in Phnom Penh concerning proper management of hazardous waste remains limited, especially in terms of awareness among consumers (business as well as households). In addition, national and local authorities lack technically competent officers to monitor and enforce sound hazardous waste management

practices. There are also limited regulatory measures, technical guidelines, methods and budget for implementation of hazardous waste management.

Although various studies on e-waste management in Phnom Penh have been conducted, there have not been many pilot projects focused on e-waste, especially recycling. An absence of reliable information/data, expertise and expertise on the proper management of e-waste, including laws concerning source generation, relevant rules on EEE/UEEE imports and health risks and hazards associated with handling and disposal should be circulated in MPP. Laws and guidelines on formal collection and transportation on e-waste collection and transportation are lacking. Further, Cambodia lacks the requisite technology for testing the safety of imported e-waste, and thus requires tools, resources and capacity for examining safety issues with regard to imported electronics equipment/ devices/ instruments, etc.

Regarding POPs, there is very limited awareness/ knowledge concerning how to address unintentionally produced POPs in MPP. Information available on POPs between sectors differs; some have enough information, but some have little or no information. There is inadequate information on chemicals, POP-related products, as well as POPs contained in various materials and residues due to improper database management by the relevant organisations. Most of the time, different stakeholders in hazardous solid waste including the private sector, do not want to share data/information. Therefore, there is no transparent information on the different kinds/ amount of hazardous waste produced and how the waste is managed. On other hand, dissemination of information, education and knowledge on proper management of hazardous waste is not widely conducted.

Local enterprises are seen to be contributing to the generation of POPs with the release of PCDD/PCDF

resulting from: (i) open burning of electric cables by waste pickers and junkshop owners; (ii) combustion of waste piles at dumpsites. These actions are beyond the competence of authorities and may lead to serious environmental and human health impacts. This is mostly because the specific legislation/regulation for PCDD/PCDF management has not yet been developed.

7.4. Medical Waste Management

In Cambodia, most health care service providers mix medical waste with the municipal waste which is thereafter collected by the Medical Waste Management Unit (MWMU). In the case of Phnom Penh, MWMU is experiencing major issues concerning the level of willingness to pay among health care service providers. Payments of collection fees are far below existing waste tariffs (ranging from 20% to 35%) and therefore efforts have been made to increase the fee on an annual basis. This is a factor when considering upgrading and expanding medical waste management to other M/D in other provinces, especially with regard to the separation of medical waste from domestic/household waste. In addition, high investment capital is required for managing medical waste treatment facilities, including operation and maintenance costs.

7.5. Construction and Demolition Waste Management

There is insufficient data/information concerning the volume of generated C&D waste and its composition. According to existing regulations, C&D waste management only comprises collection from construction sites, where such waste is required to be

properly stored in a designated areas, as well as final disposal. At present there are no legal instruments or guidelines focused on the management of C&D waste. C&D waste is currently classified as municipal waste; however, waste generators are responsible for transporting the waste to the municipal landfill site and are required to outlay addition fees for the disposal of C&D waste. Because the formal collection, transport and disposal of C&D waste is not practiced in MPP, there is wide confusion about procedures with regard to final disposal. Accordingly, because C&D waste may be substantial in volume, it can create challenges for municipal authorities tasked with management and disposal (UNEP, 2009). At the same time, C&D waste also contains high amounts of recyclable materials, such that if appropriate regulations exist, a large percentage of the waste could be recycled easing pressure on final disposal facilities (UNEP, 2009).

8. Conclusions and Recommendation

This study finds that waste management is a great challenge in Phnom Penh and there are many gaps and shortcomings in the current waste management system. As highlighted in this study, the promotion of holistic waste management in Phnom Penh, continues to be constrained by an increasing volume of waste, lack of data and information on current waste management systems, unsatisfactory waste management services, limited infrastructure, unclear responsibility by concerned authorities, unavailability of waste treatment technology as well as poor management among households and businesses. Aside from the solid waste that is collected and transported to assigned landfills, much of the city's waste is disposed of by open burning and dumping, which poses risks to the environment and the wider public. Mismanagement of waste, including the lack of source separation, the mixing of domestic and hazardous waste, and the lack of effective recycling and treatment facilities thus remains a major obstacle for Phnom Penh's continued development.

As there are no proper regulations on different kind of solid waste, Phnom Penh must tackle a range of policy challenges in this regard. For instance, the development of legal instruments including detailed guidelines and regulations on hazardous waste, industrial solid waste, medical waste and C&D waste are required to encourage due diligence on the part of waste generators. Similarly, there is no specific legislation or regulation in Phnom Penh aimed at minimising and/or halting the release of unintentionally produced POPs, apart from the National Environmental Law and relevant sub-decrees. Likewise, the city has a limited number of regulations to separate, collect, treat and promote

the use of organic waste in commercial production.

The development of a national legislative and institutional framework for waste management has been in progress following the issue of Sub-decree No. 113 on Urban Solid Waste Management; the provision of new regulations, tools, and technical and financial support aimed at empowering local authorities to address MSWM have also been ongoing since 2015. However local authorities are still unaware of their responsibility in waste management due improper communication and guidance between central government and local government based on authority transfer.

As documented above, a number of gaps and challenges were identified both in terms of availability and accuracy of existing data on solid waste in Phnom Penh for all different kinds of solid waste, and some recommendations were proposed to manage the waste using a more holistic approach as listed below. Identifying gaps and recommendations holds implications for this study as well as pointing out the need for developing a city waste management strategy.

Recommendations for Appropriate Municipal Solid Waste Management

- Future assessments of waste management should take into account the number of internal migrants from other provinces/cities as well as tourist arrivals in population estimates in order to avoid misinterpreting waste collection rate figures and other data.

- Basic information on waste activities should be made publicly available; this would be particularly helpful in attracting future investments to the sector. Disseminating lessons learned and good practice examples from other countries would be useful for enhancing information and knowledge sharing.
- Although various studies have been conducted on municipal solid waste management in Cambodia, especially targeting main cities and municipalities, there is a general desire among local authorities to support the development of pilot or demonstration projects with the potential for addressing current MSWM issues, including in the areas of waste reduction, improved collection service, promotion of source separation and waste recycling.
- Local authorities should be supported by clear regulatory instruments and delegated appropriate responsibilities for waste management including through incentives and other means.
- Guidelines and incentives should be developed aimed at improving implementation and operations of the existing MSWM system as needed, supported by sufficient political will and the commitment of all stakeholders, to be carried out by the responsible local authorities.
- Upon implementation of Sub-decree No. 113, town/municipality and district-level administrations should be granted appropriate responsibilities for managing solid waste management. A requisite coordination mechanism should be developed outlining clear institutional roles and responsibilities to increase the overall effectiveness of solid waste management in MPP.
- Future capacity development activities should focus on improving the capabilities of administrative staff, waste collection companies, municipalities and ministries. Such activities should be carried out with recognition of existing institutional hierarchies and structures, emphasising the efficient organisation and administration of waste management particularly at MPP level to enhance coordination between national and municipal actors.
- Local environmental offices should be granted the authority to enforce laws independently, without Ministry authorisation, in order to more effectively engage with local communities and support their needs.
- Community-based environmental education measures should be developed and implemented accordingly, including integration of waste management topics in educational curriculum, capacity building of religious authorities and disciples during festivals, and media campaigns broadcasted and disseminated via newspapers, internet, social media and television, such as awareness raising on appropriate hygiene and sanitation practices in low income and vulnerable communities.
- Penalties for waste violations, such as open dumping of waste on fallow land, streets, rivers, etc. should be initiated and enforced without delay, with transparent mechanisms to encourage the involvement and support of the wider public.
- Continued awareness raising, together with efforts to strengthen the capacity of institutions and law enforcement shall be conducted to encourage behaviour changes of the general public.
- Case studies with clear examples of lessons learned, especially with regard to landfill construction, operation and management should be widely disseminated.
- Community-based solid waste management practices should be directed by responsible actors (i.e., municipal authorities, community leaders and other concerned stakeholders) starting with a focus on addressing public complaints with regard to existing waste management services. This activity should include the creation of a public hotline for citizens to describe specific waste issues and problems (location, time, etc.) which the designated authorities would seek to address with practical measures aimed at changing behavior,

such as educating the public about waste prevention. Such an initiative could subsequently be followed by campaigns aimed at promoting waste separation at source once appropriate recycling facilities have been established.

- Government should support and encourage the development of waste recycling facilities to advance green business initiatives.
- Landfills should more widely take into consideration safety measures concerning the protection of human and environmental health. Further, the life of a landfill would be significantly increased if waste is separated at source, and if composting is carried out for organic waste, as well as using a compactor at the landfill to manage the waste.
- Government and CINTRI should consider sustaining the current scheme for waste service fee collection through EDC in order to maintain the current level of income, while optimizing the differentiated fee system based on the weight and payment capacity. The awareness raising activities by the government targeting waste generators on the waste management and promotion of 3R will also play an important role to this end.

Recommendations for Appropriate Hazardous Waste Management

- There should be development of pilot or demonstration projects aimed at improving the e-waste management systems and practices (e.g. waste separation at source, separate collection, recycling and so on) to get skills and knowledge for proper waste management of hazardous waste by different stakeholders.
 - Institutional capacity and awareness of national and local authorities should be further enhanced on relevant international legislation and guidelines on e-waste management, including for example the Basel Convention, with a view towards strengthening and enforcing national policies (for instance, Sub-decree No. 16 on Management of Electrical and Electronic Waste; Declaration on Permit Standard Setting of Toxic or Hazardous Substances Discharged).
- The development of training workshops and dissemination of information to the public regarding various type of EEE/e-waste substances is also recommended, including but not limited to the following topics:
 - Implementation of the 3Rs related to e-waste (i.e., reduce, reuse and recycle)
 - Sound management of e-waste
 - Impact assessments on waste with regard to environmental, health and economic factors
 - Analysis of various materials associated with e-waste (especially toxic and hazardous substances in EEE)
 - Occupational health and safety of waste operators
 - E-waste recycling should be invested in, with a view to both recovering valuable materials and resources as well as raising awareness on the avoidance of hazardous pollution through improved waste prevention practices.
 - Developing and implementing training workshops and disseminating information to the public on the following:
 - Drivers and effects of various types of POPs
 - Improvement of MRV for accounting for POPs by concerned stakeholders
 - Environmental sound POPs management
 - Importance of developing relevant legislation/regulation for PCDD/PCDF management and enforcing credible accountability mechanisms in the private sector in line with improvements in business performance
 - Development and enhancement of appropriate technology to reduce impacts of POPs
 - Importance of public engagement and support for pollution prevention and treatment
 - Promotion of inter-ministerial and cross-sectoral

cooperation with clearly identified roles and responsibilities

Recommendations for Appropriate Industrial Waste Management

- Efforts to enhance accountability with regard to industrial solid waste management should target both the private sector and responsible authorities to encourage more environmentally sound industrial development in Cambodia.
- Declaration No. 148 should clearly highlight opportunities for marketing reusable and recyclable materials produced by the factories.
- Legal instruments regarding industrial inspection procedures should be improved upon including by enhancing response mechanisms to violations committed by factories.
- MOE should make efforts to coordinate and guide factories in proper waste separation practices; strong enforcement of waste separation would assist waste collection companies in improving the quality of service provision.
- Evaluate opportunities to raise industrial waste collection fees to levels comparable to existing tariffs set by MOE with a view towards enhancing the capacity of waste collection and treatment companies to improve the quality of service provision.
- The government should take a more active role in providing technical guidance and support towards improving conditions of industrial landfill sites.

Recommendations for Appropriate Medical Waste Management

- The separation of medical waste at source should be further promoted and enforced by law.

- MWMU should work towards progressively and incrementally increasing waste collection fees year-by-year, with a view to more effectively investing in the expansion of incineration facilities for the treatment of medical waste.
- Phnom Penh MWMU should be promoted as a centre of excellence aimed at raising the awareness and building the capacity of relevant stakeholders and medical waste treatment operators in other provinces and cities.
- Attention should be paid to efforts aimed at increasing the number of medical waste treatment facilities in line with the expansion of the city, recognising that citizens may complain about pollution generated by the incineration plants in the future.
- Replacement incinerators should be more user-friendly, as well as easier to maintain, and should make use of reliable appropriate technologies.

Recommendations for Appropriate Construction and Demolition Waste

- Private C&D waste collection service providers, including individual workers, should be registered with a view towards formalising employment in the sector. This should include regularly reporting data on estimated collection amounts in order to better support oversight and management by the public sector.
- Guidelines on C&D waste management and treatment should be developed, which focus on mandating the recovery and reuse of C&D waste, and enforcing prohibitions on open burning of C&D waste.
- Existing regulations designed to stop open burning of C&D waste should be implemented and enforced without delay, as combustion of C&D waste may release toxic pollutants to the environment with corresponding impacts on human health. Health

inspectors should work towards monitoring and evaluating pollution levels in cooperation with local communities and encourage public participation in legal proceedings targeting polluters.

- Hazardous substances contained in C&D waste should be disposed of separately, clearly communicating precise guidelines that specify separate treatment of C&D waste from municipal waste. In addition, dissemination of information on proper C&D waste management practices and related outreach activities should be conducted targeting service providers and other relevant stakeholders.

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