



CLOSING  
THE LOOP

# CLOSING THE LOOP ON PLASTIC POLLUTION IN KUALA LUMPUR, MALAYSIA

## Baseline Report

# Acknowledgements

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- UN-ESCAP
- Institute for Global Environmental Strategies (IGES)
- University of Leeds (UOL)
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## Abbreviation

<b>3Rs</b>	Reduce, Reuse, Recycle
<b>APEC</b>	Asia-Pacific Economic Cooperation
<b>ASEAN</b>	The Association of Southeast Asian Nations
<b>CSR</b>	Corporate Social Responsibility
<b>CTL</b>	Closing the Loop
<b>KLCH</b>	Kuala Lumpur City Hall
<b>DID</b>	Department of Drainage and Irrigation
<b>DOE</b>	Department of Environment
<b>ESCAP</b>	United Nations Economic and Social Commission for Asia and the Pacific
<b>GTP</b>	Gross Pollutant Trap
<b>ICT</b>	Information and Communications Technology
<b>IGES</b>	Institute for Global Environmental Strategies
<b>ITIS</b>	Traffic Control System
<b>JPSPN</b>	National Solid Waste Management Department
<b>KPKT</b>	Ministry of Housing and Local Government
<b>MFA</b>	Material Flow Analysis
<b>MSW</b>	Municipal Solid Waste
<b>NGO</b>	Non-Government Organization
<b>POP</b>	Public Outreach Program
<b>PPC</b>	Plastic Pollution Calculator
<b>RM</b>	Malaysian Ringgit
<b>SDG</b>	Sustainable Development Goals
<b>SME</b>	Small/Medium Enterprise
<b>SWCorp</b>	Malaysia's Solid Waste and Public Cleansing Management Corporation
<b>SWIMS</b>	Solid Waste Information Management System
<b>UOL</b>	University of Leeds



# SUMMARY

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

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# Statement from Kuala Lumpur

Marine plastic pollution has emerged as a major threat to society and cities. With over half of the land-based sources of marine plastic coming from the Asia-Pacific region, immediate action is now needed to curb its impact. As the capital and largest city in Malaysia, it is pivotal that Kuala Lumpur takes the lead in addressing this problem which threatens the integrity of our planet and the fate of present and future generations.

Neglecting this issue will undoubtedly lead to adverse impact not only on the environment, but towards communities, industries and the economy. Hence, it is only through long-term environmental sustainability that we will be able to realise the country's social and economic aspirations.

With the Klang and Gombak rivers meeting at the heart of the city, there is an especially imminent need to address marine plastic pollution to ensure the health and well-being of our citizens, in line with our vision of developing into a World Class, Sustainable, Liveable City for all.

Complementing ongoing projects such as the River of Life initiative, Kuala Lumpur has embarked on the Closing the Loop project, in line with the country's Solid Waste and Public Cleansing Management Act 2007 (Act 672), National Solid Waste Management Policy 2006 (NSWMP 2006) and Malaysia's Roadmap Towards Zero Single-Use Plastics (2018–2030).

The aim of this study is to understand and effectively address marine plastic pollution originating from Kuala Lumpur with a view towards strengthening the city's capacity for planning and managing plastic waste in line with circular economy principles.

Together with partner cities, Da Nang, Vietnam, Surabaya, Indonesia and Nakhon Si Thammarat, Thailand, I look forward to exploring innovating steps in creating a cleaner and greener world.



The journey towards a city free from pollution and environmental degradation is a collaborative one. With that in mind, I would like to commend the strong commitment and continued efforts of key local players, including KLCH officials, the Solid Waste and Public Cleansing Management Corporation (SWCorp), National Solid Waste Management Department (JPSPN) and Urbanice Malaysia under Ministry of Housing and Local Government (KPKT), Alam Flora Sdn, Bhd, Department of Irrigation (DID) and Department of Environment (DOE) under Ministry of Environment and Water (KASA). I would also like to extend my appreciation to all affiliated government bodies, private entities, NGOs and external development partners, such as United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Institute for Global Environmental Strategies (IGES), University of Leeds and others that have contributed data, shared their expert views and spent their time towards producing this report.

As the driving force of the nation, we are determined to address the challenge of marine litter and we are unwavering in our resolve to overcome plastic waste from entering the Klang River and nearby waterways. Together, we must uphold our duty to society and the global environment.

## Thank you

**YBhg. Datuk Seri Hj. Mahadi bin Che Ngah**  
Mayor of Kuala Lumpur City Hall

# Executive Summary

Malaysia represents one of the key players involved in the global plastic industry with about 1,300 plastic manufacturers currently operating within the country<sup>1</sup>. Plastic production has recorded the highest growth rates of all industries for over two decades<sup>2</sup>. As of 2016, exports amounted to Malaysian Ringgit (MR) 30 billion (about USD 7 billion) and 26 million metric tonnes of resin were utilized in the manufacture of plastics. At the same time, environmental challenges associated with plastic waste present major issues for Malaysia. The country was ranked eighth out of the world's top ten countries responsible for mismanaged plastic waste. One notable study estimates that Malaysia has generated a total of 0.94 million tonnes of mismanaged plastic waste, of which between 0.14 and 0.37 million tonnes may have potentially leaked into the marine environment<sup>3</sup>. Malaysia has also been working to ensure that it does not inadvertently become a global dumpsite for plastic following China's nationwide ban on plastic waste imports in 2018.

Against this background, the Government of Malaysia formulated a national Roadmap towards Zero Single Use Plastics (2018–2030) aimed at addressing plastic waste in an integrated and sustainable manner. In 2016, Malaysia's Ministry of Federal Territories has introduced the used of biodegradable plastic to overcome the high-cost issue from plastic waste management and encouraging its citizen to bring recycling bags when shopping for Kuala Lumpur, Putrajaya and Labuan. In line with the roadmap, starting 15 March 2019, the ministry imposing a pollution charge of RM 0.20 (about US \$ 4.8) in Federal Territories per unit for the distribution of biodegradable plastic bags, while enforcement actions are continued against traders and hawkers who were still using conventional plastic bags.

With a view towards localizing these strategies at the city level, Kuala Lumpur has been working together with ESCAP to develop a baseline study that analyzes the city's current plastic waste management system and identifies key recommendations to address plastic waste management through a wider city action plan.





<sup>1</sup> MESTECC (2018) Malaysia's Roadmap towards Zero Single-Use Plastics 2018–2030. Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), viewed 25 January 2021,

<sup>2</sup> GESB (2011) A Study on Plastic Management in Peninsular Malaysia. Golden Ecosystem SDN. BHD; Malaysia, National Solid Waste Management Department Ministry Of Housing And Local Government, Selangor, viewed 25 January 2021,

[https://jpspn.kpkt.gov.my/resources/index/user\\_1/Sumber\\_Rujukan/kajian/JSPN%20Plastic%20Study%20-%20Final%20Report%20GESB%20-%20Softcopy%20English%20Ed2.pdf](https://jpspn.kpkt.gov.my/resources/index/user_1/Sumber_Rujukan/kajian/JSPN%20Plastic%20Study%20-%20Final%20Report%20GESB%20-%20Softcopy%20English%20Ed2.pdf)

<sup>3</sup> Estimation of mismanaged plastic waste in Malaysia in 2010 (Jenna R. Jambeck et al. 2015)

## Key Findings on Plastic Waste in Kuala Lumpur

Key results of the Plastic Pollution Calculator for the case study of Kuala Lumpur, Malaysia	
 <p>WASTE GENERATION</p>	<ul style="list-style-type: none"> <li>1,000,000 tonnes/year</li> <li>1.52 kg/capita/day (<i>national average = 1.21 kg/capita/day</i>)<sup>3</sup></li> <li>555 kg/capita/year (<i>Estimated waste projection in 2020 = 2.21 kg/capita/day</i>)<sup>4</sup></li> </ul>
 <p>PLASTIC COMPOSITION</p>	<ul style="list-style-type: none"> <li>161,000 tonnes of plastic waste is generated each year</li> <li>16% of MSW is plastic (<i>national average = 15%</i>)<sup>3</sup></li> <li>Plastic bags make up the largest proportion of plastic items by mass accounting for 35% of plastic.</li> </ul>
 <p>WASTE TO THE ENVIRONMENT</p>	<ul style="list-style-type: none"> <li>Over 3,000 tonnes/year of plastic is emitted into the environment, equivalent to 1.68 kg/capita/year.</li> <li>Littering is the largest source of plastic pollution accounting for 64% of plastic emissions, followed by fly-tipping (15%) and leakage whilst waiting for collection (15%).</li> </ul>
 <p>PLASTIC TRANSPORTATION TO WATERWAYS</p>	<ul style="list-style-type: none"> <li>653 tonnes/year of plastic enters waterways as marine litter</li> <li>Whilst only 0.4% of MSW, this is equivalent to many millions of plastic items</li> <li>2,416 tonnes/year of plastic waste is retained uncontrolled on land or in drains</li> </ul>



## Municipal Solid Waste (MSW)

### How much waste?

Around 1,000,000 tonnes/year of MSW (1.52 kg per person per day, excluding tourists). This is slightly higher than values for Malaysia as a whole, with the *World Bank What a Waste 2.0* report suggesting a 2016 waste generation rate of 1.21 kg/capita/day<sup>4</sup>.

### Where is it from?

58% of the waste comes from residential areas, 23% from commercial activities, 2% from institutional establishments, and remaining 17% from other activities (recyclables sold to informal sector, litter and uncollected fly-tipped waste).



## Plastic Waste

### How much plastic waste?

161,000 tonnes of plastic waste are generated per year, which is 16% of the total MSW generation in the city. The highest quantities of plastic waste are generated by multi-family dwellings and then followed by single-family dwellings, retail, wholesale, office and other services.

### Which products?

35% of the plastic waste is plastic bags, 19% is plastic bottles, 15% is plastic film, and 12% is single-use food service plastics. With the exception of drink bottles, the largest portions of plastic waste are comprised of low value plastic, making this a high priority.

<sup>4</sup> KAZA, S., L. YAO, P. BHADA-TATA and F.V. WOERDEN. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development Series, Washington, DC: World Bank, 2018.



## Plastic Pollution

### How much marine litter?

0.4% of plastic waste generation or 653 tonnes of plastic waste enters waterways each year, of which 42% is plastic bags by mass.

### Which products specifically become marine litter?

42% plastic bags, 15% plastic film, 17% bottles, 20% food service and packaging, sanitary products are 3%.

### Which products become pollution in the environment?

Plastic bags increase their share of plastic pollution (46%) compared to their share of plastic waste (35%), because they are lightweight, used while out of home and too low value to be of interest to recyclers. Other plastic film accounts for 16%, bottles account for 15%, and takeaway food and packaging accounts for upwards of 17%, when including pots, tubs, and trays (3%) and single-use food items (14%).

### How does it become pollution?

1,958 tonnes/year of pollution comes from littering. Illegal dumping to avoid charges ('fly-tipping') accounts for 454 tonnes/year. Plastic that escapes while waiting for collection accounts for 448 tonnes/year, and plastic waste emissions from the collection, sorting and transportation of recyclables by the informal sector accounts for 92 tonnes/year.



**How does it get to the water?**

71% (463 tonnes) of river and marine plastic enters waterways via storm drains, where plastic waste that has escaped from waste bins is blown or washed into the drains and transported to waterways. A further 22% (147 tonnes) of river and marine plastic enters waterways via land, representing litter blown across land and into waterways. 7% (43 tonnes) of river and marine plastic is dumped directly into rivers.

**When?**

The peak season for marine plastic litter is during the months of April and November, corresponding with periods of higher precipitation.

**Plastic Management****How much is recycled?**

10.1% of plastic waste (16,300 tonnes) is sorted for recycling, largely conducted by individual households and businesses taking their recyclable waste to waste collection sites and selling it to waste traders. 12.7% of all recyclables collected are plastic by mass, which is subsequently aggregated, sorted and sold on to re-processors.

**How much goes to landfill?**

88% of plastic waste goes to the Bukit Tagar Sanitary Landfill, which is a sanitary landfill located 55 km away from Kuala Lumpur.

**Plastic Management Recommendations****Target High Emissions Plastics (Plastic Bags, Other Plastic Film, Drink Bottles and Single-use Food Service Plastics)****Why?**

Largest sources of plastic waste generation; targeted under Action Plan of the Roadmap Towards Zero Single-Use Plastics in Malaysia

**How?**

Reduce the usage of the plastic through bans, tax/levy, support for alternatives, producing voluntary agreements in retail and commercial sectors (e.g. restaurant, hawkers) and promoting Extended Producer Responsibility (EPR).

**Reduce Littering and Fly-tipping****Why?**

First and second largest point sources of pollution.

**How?**

Encourage the public reporting on littering and fly-tipping, display signage on littering fines, enforce penalties, increase the number of public bins, promote regular city clean-ups of hotspot areas raise awareness, increase street sweeping.



### Improve Waste Storage for Residential Dwellings

#### **Why?**

Leakage while waste is waiting for collection estimated as joint second highest emission source of plastic alongside fly-tipping.

#### **How?**

Improve the quantity and quality of existing waste containers (right size, easy loading to truck, lids securely fastened, protection from animals/rain/wind, durable, maintained).



### Ensure All Storm Drains are Covered

#### **Why?**

Many storm drains are open to the environment, allowing plastic items to enter easily and flow into nearby waterways.

#### **How?**

Enclosing or covering storm drains, regular cleanup of drains, surveillance, positioning of litter traps, regular clean ups, monitoring of street sweeping activities.



### Increase Recycling

#### **Why?**

88% of all plastic waste ends up at the disposal site where it is retained (142,000 tonnes), whereas only 10.1% of plastic is recycled.

#### **How?**

Capacity building including by disseminating information on the status of recycling activities in Kuala Lumpur and promote open-source data sharing on recycling in Kuala Lumpur, Community based waste management, implementation of source separation synchronously, neighborhood collection stations and waste sorting units.

## Policy Recommendations



### Strengthen Enforcement of Policy

#### Why?

A number of policy goals and action plans are in place and ready to translate into action on the ground.

#### How?

Develop a plastic waste management action plan for the city of Kuala Lumpur with a time-bound implementation plan, coordination and monitoring mechanisms.



### Promote 3R Solutions

#### Why?

Preventing plastic waste through reduce, reuse and recycling strategies will reduce waste management costs and prevent pollution.

#### How?

Coordinate with existing programs to reduce single use plastics, awareness on responsible consumption and production, increase recycling.



### Strengthen Capacity of Local Bodies

#### Why?

SWCorp and KLCH is responsible for waste management.

#### How?

Short to medium term training programs, ensure clear designation of government roles and responsibilities.



### Public Participation

#### Why?

Littering and fly-tipping are key sources of plastic pollution and source separation by the public is needed to increase recycling.

#### How?

Awareness raising campaigns, support community waste management initiatives.



### Cost Recovery

#### Why?

Current fees and charges do not cover plastic waste management operations.

#### How?

Increase coverage of existing fees, gradual increases as service improves, cost saving in waste management operations, polluter-pay-principles.



### Informal and Private Sector Participation

#### Why?

The informal sector plays a critical role in the collection of plastic for recycling and can be scaled up to introduce operational efficiency.

#### How?

Establish clear scope and specifications in contracts, assess qualifications and monitor performance.



### Use of Digital Tools, Data Management

#### Why?

To increase the regularity of plastic waste data collection, automate plastic waste monitoring and management, and provide cost effective monitoring tools.

#### How?

Integration of the Digital Tool developed under Closing the Loop into plastic waste action plans and monitoring plans



# CHAPTER 1

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

## Introduction

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## CHAPTER 1

# Introduction

## 1.1 Background

Plastic pollution represents a serious environmental challenge - one that requires an urgent global response. It is estimated that about 8,300 million tonnes (Mt) of virgin plastics have been produced to date. As of 2015, approximately 6,300 Mt of plastic waste had been generated, around 9% of which had been recycled, 12% incinerated and 79% accumulated in landfills or discharged into the natural environment. Should current production, consumption and waste management trends continue, roughly 12,000 Mt of plastic waste will end up in landfills or the natural environment by 2050<sup>5</sup>. Fast-growing cities with inefficient waste management systems in Southeast Asia, South Asia and China are responsible for about 60% of plastic waste leakage<sup>6</sup>. Ocean plastics also cost the tourism, fishing and shipping industries in the Asia-Pacific Economic Cooperation (APEC) region alone US\$ 1.3 billion a year<sup>7</sup>, whereas sound management and recycling of plastic can save consumer goods companies an estimated US\$ 4 billion per year<sup>8</sup>.

<sup>5</sup> Geyer et al., 2017

<sup>6</sup> Ocean Conservancy (2017): Stemming the Tide: Land-based strategies for a plastic-free ocean. <https://oceanconservancy.org/wpcontent/uploads/2017/04/full-report-stemming-the.pdf>

<sup>7</sup> Understanding the Economic Benefits and Costs of Controlling Marine Debris in the APEC Region" (APEC Marine Resources Conservation Working Group 2009): [http://publications.apec.org/publication-detail.php?pub\\_id=164](http://publications.apec.org/publication-detail.php?pub_id=164)

<sup>8</sup> UNEP (2014) Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry.

The absence of effective policies, technologies and capacities to manage plastic waste at the local level has regional and global implications. Further actions are required to implement plastic pollution measures and support effective waste management operations in the region, including ensuring policy coherence on plastic ban and use regulations, and organizing consumer campaigns around limiting single-use plastics and building circularity across the waste value chain. Tackling plastic waste has positive benefits for the ocean, opening opportunities for delivering on the 2030 Development Agenda, particularly with regard to Goal 11 (Sustainable Cities) 12, (Responsible Consumption and Production) and 14 (Life Below Water), all of which contain specific targets on plastic waste.

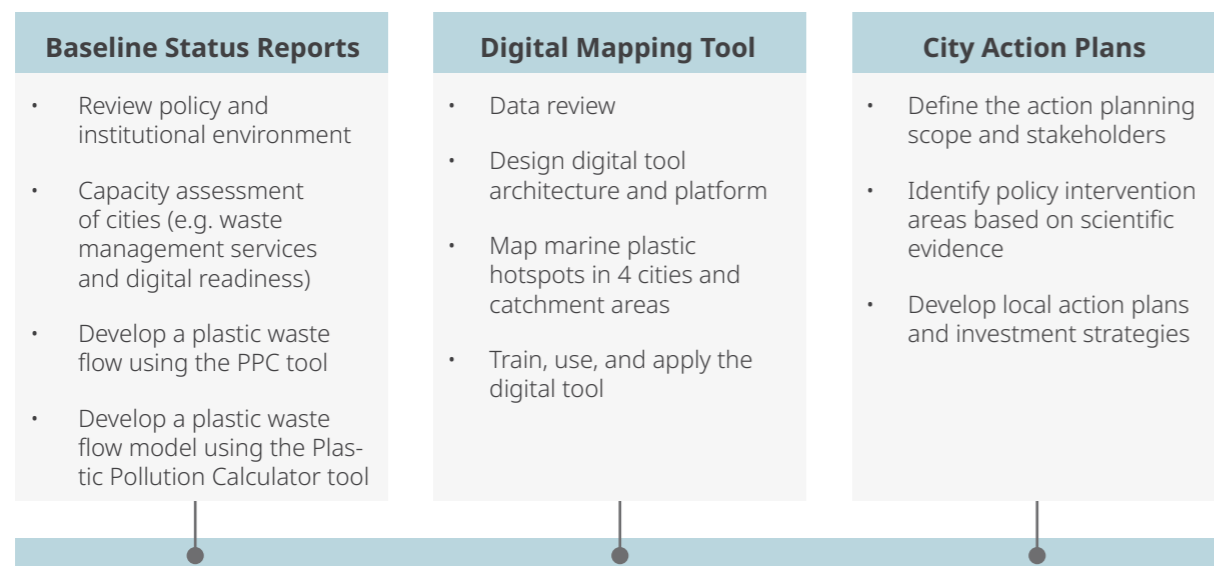


**Figure 1**  
Regional Overview of the Closing the Loop Project

## 1.2 Aims

The Project - *Closing the Loop: Scaling up Innovation to Tackle Marine Plastic Pollution in Cities* - aims to reduce the environmental impact of cities in ASEAN by addressing plastic waste pollution in the marine environment. In line with the ASEAN framework of Action on Marine Debris, G20 Osaka Blue Vision and national policies and action plans, this project assists four cities in the ASEAN region (**Figure 1**): **Kuala Lumpur**, Malaysia, **Da Nang**, Viet Nam, **Surabaya**, Indonesia and **Nakhon Si Thammarat**, Thailand in developing city action plans to address plastic litter, make plastic waste management more circular and reduce the amount of plastic waste entering the marine environment from land-based sources.

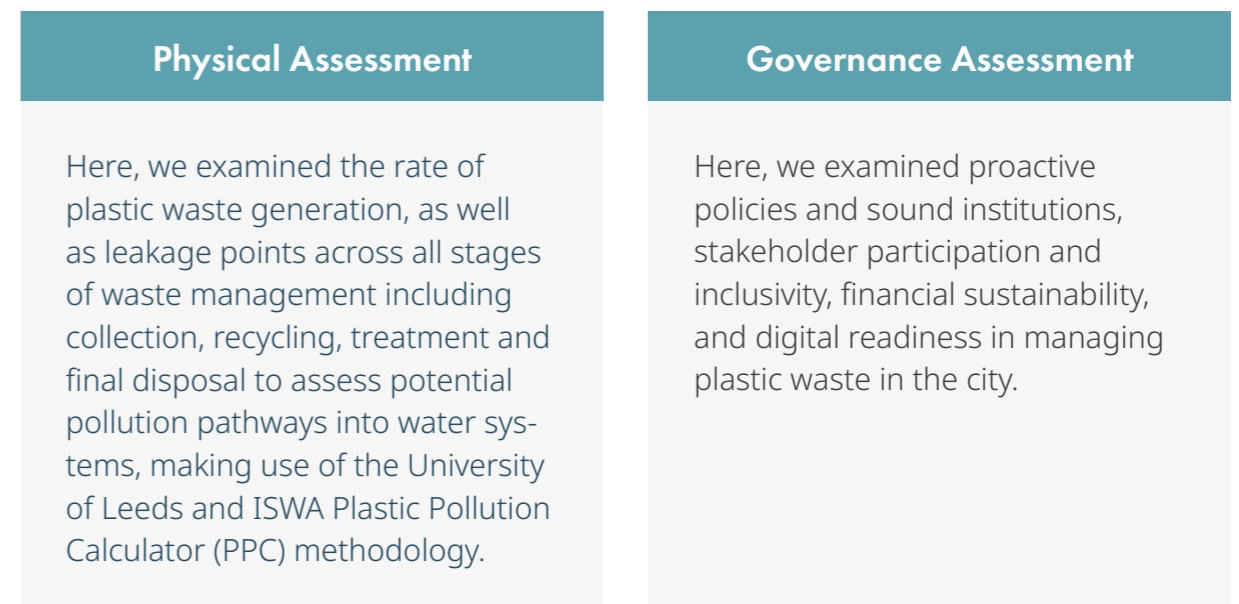
As shown in **Figure 2**, the Project also works to build capacities and technical expertise on innovative data collection methods and digital tools aimed at enabling local governments and their partners to monitor and visualize plastic waste and identify hotspots to improve plastic waste management. The Project also aims to raise awareness of marine litter and city-driven solutions for better plastic value chain management, aimed towards promoting behavioural change among consumers and other concerned industries as well as creating an enabling space for continued policy development.



**Figure 2**  
Project activities and outcomes

## 1.3 Methodology

This baseline report presents and analyzes the current plastic waste management system in Kuala Lumpur. The structure of the report consists of five major sections, including (1) introduction, (2) city profile, (3) plastic waste management, plastic leakages and hotspots, (4) governance review and (5) recommendations and conclusions. Data collection is based on the following activities. Considering the importance of addressing both the physical components and the governance features<sup>9</sup> for sustainable waste management, it covers data related to both aspects as shown in **Figure 3**.



**Figure 3**  
Our baseline assessment approach

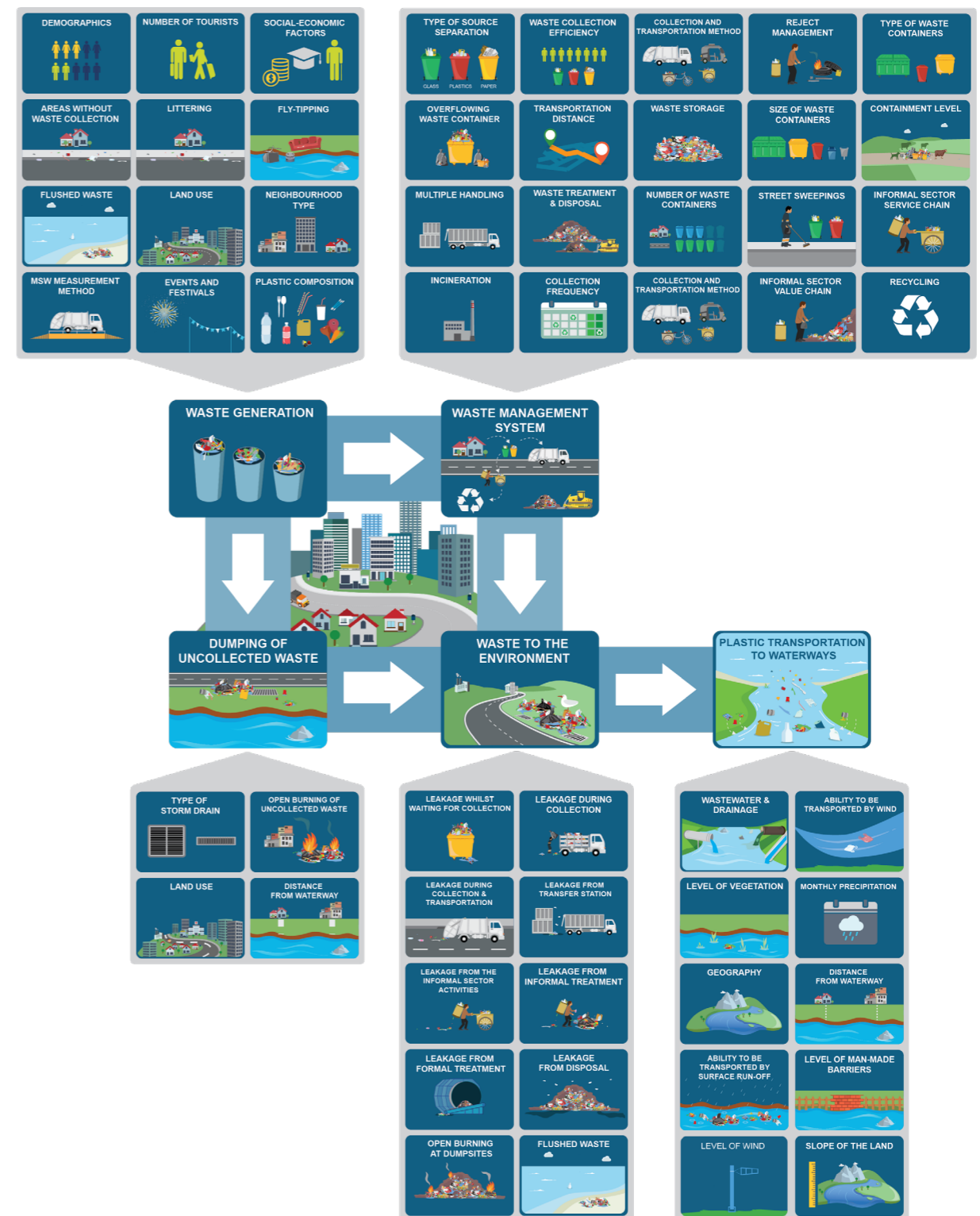
<sup>9</sup>Scheinberg et al., 2010b

## 1.3.1 The Plastic Pollution Calculator (PPC)

### A Material Flow Analysis Approach

The Plastic Pollution Calculator (PPC)<sup>10</sup> model, developed by the International Solid Waste Associate (ISWA) and the University of Leeds, was implemented in Kuala Lumpur. This toolkit models land-based plastic pollution at local and regional levels to measure item-specific plastic waste generation and its subsequent flows throughout the waste management system and the environment at an intra-urban scale. This includes a quantification of macro plastic, which may potentially leak into the environment and become marine plastic pollution.

Such quantification is carried out by factoring in the quality of local infrastructure, as well as by examining relevant socio-economic conditions and waste management practices to determine the likelihood of plastic emissions. This methodology is based on a Material Flow Analysis (MFA) approach, which categorizes plastic into 11 different item types (i.e. bottles, bags), 16 waste generating sources (i.e. land uses and activities that produce waste) with consideration of daily intervals over a defined time-period (e.g. the year 2020).



**Figure 4**

Generalized material flow analysis (MFA) approach used in the Plastic Pollution Calculator (PPC)

<sup>10</sup> <https://plasticpollution.leeds.ac.uk/wp-content/uploads/sites/89/2020/07/Plastic-Pollution-Calculator-Summary.pdf>

## Calculation of Plastic Emissions into the Environment

As shown in **Figure 4**, all major components of the solid waste management system are modelled so that the plastic item flows are balanced across each process. Acknowledging the challenge in calculating plastic waste emissions to the environment due to variations in time and space/location, the PPC uses conceptual models to relate all factors important in estimating plastic emissions based on available data and expert opinion which are converted to mathematical algorithms.

Input data on waste management infrastructure, practices and other influencing factors are then combined to estimate the likely amount of plastic waste emitted into the environment. The transfer coefficients, the ability to be moved by wind or surface runoff, probability of collection for recycling, and likelihood of becoming entangled in vegetation once released in the environment, are also calculated for each plastic item type within the MFA.



## Spatial Distribution of Plastic Emissions and Leakage

The PPC is applied at sub-city-district or neighborhood level assuming that lowest administrative areas have relatively homogeneous features for key plastic waste emission factors (e.g. waste management infrastructure, socio-economic, geographical characteristics). This allows a reasonably accurate picture of plastic flows across a whole city or region (also accounting for any transboundary flows). However, districts or neighborhoods are even not entirely homogenous, thus, the PPC estimates the spatial distribution of plastic emissions within a district by allocating each emission source to one of five grids, including residential activity grid (e.g. population density), Non-residential activity grid (e.g. shops, tourist sites, parks), All activity grid (e.g. combined residential and non-residential activities), Roads grid and Waste infrastructure grid (e.g. dumpsites, transfer stations).

Each of these five grids are ultimately overlaid to provide an overall spatial representation (hotspot map) of plastic emissions at the sub-district level. The PPC also identifies the important factors influencing the likelihood of a plastic item being transported in the environment (e.g. distance to waterways, meteorological conditions, the geographical and built landscape). A conceptual model is created to estimate plastic emissions entering waterways by assigning a relative weighting to each factor depending on its perceived influence and relationship with other variables. The PPC uses a Digital Elevation Model (DEM) and flow routing algorithms to map the routes that plastic waste emitted into the environment would travel due to surface runoff and the locations where plastic released into the environment may eventually reach waterways and the ocean.



## Limitations of PPC

The Plastic Pollution Calculator (PPC) functions by performing Material Flow Analysis (MFA) to map plastic waste flows across each district in the city, with emissions of plastic waste determined via analysing the waste management infrastructure and practices and linking it to the Calculator's conceptual models. However, this approach relies on there being sufficient reliable data available to perform the MFA. For the case of Kuala Lumpur, some input data was not directly available and as such had to either assumed using proxies or estimated using expert opinion from the local teams guided by University of Leeds. Examples of input data that proved particularly difficult to obtain included data on recycling activities within the city, particularly those of the informal recycling sector, and understanding with high reliability the amounts of littering, and fly-tipping occurring. Additionally, as previously mentioned, no evidence of open burning was found. However, this activity is still likely to occur even if on a relatively small basis. These data needs are discussed more in the following section.



Other limitations of the study revolve around the assumption that waste management practices within Kuala Lumpur were largely homogeneous. Typically, the Plastic Pollution Calculator runs at a district (neighborhood) level smaller than the city to accurately describe the local characteristics of the waste management system. Within this study however, Kuala Lumpur was modeled as one homogeneous area, therefore it is likely that some areas may be misrepresented by the homogeneous approach. Although efforts have been made to account for any differences in waste management by allowing this to be specified for each land use, some variance is still likely. For example, the affluent areas of the city are likely to have improved waste management compared to the less affluent areas, whilst activities such as littering and fly-tipping may also show some spatial dependence within the city.

Lastly, whilst the interventions provided are linked to the plastic pollution source, items, pathways and sinks in Kuala Lumpur; here we were unable to assign an estimated impact of these interventions. This is due to sensitivity analysis being required in order to account for the complex relationship that upstream and downstream interventions may show, which was out of scope for this project.

## 1.3.2 Review of Governance Aspects

In examining governance aspects, we focused on four key areas: proactive policies and sound institutions, stakeholder participation and inclusivity, financial sustainability, and digital readiness<sup>11</sup>.

### Proactive Policies and Sound Institutions

Strong policies and sound institutions are key to a sustainable plastic waste management system. Without them, plastic waste management systems will not operate effectively or sustainably over long time periods. Here, we assess the adequacy of the national/ local policies/ legal framework and measures of the institutional strength and coherence of the city's solid waste management.

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<sup>11</sup>Wilson *et al.*, 2015

### Stakeholder Participation and Inclusivity

While municipal authorities are responsible for managing solid waste, including plastic/ marine litter in a city, governments cannot provide effective services in isolation. Sustainable plastic waste management systems need to incorporate all key stakeholders in the planning, implementation and monitoring of actions, particularly involving three main stakeholder groups: service providers, including those from both the formal and informal sectors;; users, who represent the clients; and external agents responsible for support an enabling environment, including national and local government actors, who set boundary conditions and enact legislation and policies. Accordingly, we assess different stakeholders involved in supporting city-wide plastic waste management, the degree of their inclusion and methods/ mechanisms available to carry out planning, policy formation, implementation and evaluation.

### Financial Sustainability

Securing financial sustainability in solid waste management represents a major challenge for cities. In developing cities, solid waste management in general represents a significant proportion of their total recurrent budget, yet in spite of relatively high costs, collection service coverage is often low and disposal standards remain poor. Thus, here we assess the degree to which a city's solid waste management service is financially sustainable.

### Digital Readiness

Ensuring that an appropriate digital architecture is in place opens new ways for cities to prevent, reduce and even eliminate waste from specific sectors and material streams, as well as advance resource recovery, achieve high standards of treatment and disposal, and substantially reduce pollution and related environmental impacts. At the same time, it provides new tools to connect stakeholders and promote their interaction, enhance awareness and mobilize citizens' participation, as well as impose penalties and coordinate Extended Producer Responsibility (EPR) activities as part of wider smart city initiatives.

### 1.3.3 Data Collection

#### Desk Research and Interviews

A literature review was conducted to assess plastic waste management conditions using relevant data and information from academic, ngo, private and public sector sources.

An open-ended questionnaire was also used to gather waste management data from the staff of national ministries, local environmental departments and official service providers. Formal and informal private sector actors involved in plastic waste management activities, as well as local NGOs carrying out awareness raising activities and capacity building to promote 3R approaches were also included.



#### Field Surveys and Observations

Field surveys and associated observations were used for assessing and understanding the present situation and current problems concerning MSW management and plastic waste management. Due to the lack of secondary data on plastic waste generation, characteristics and management used by the PPC, primary data related to different sources such as households (multi- and single-family dwellings), rural areas, public areas, commercial areas, institutional areas, formal waste transfer, recycling activities and at the disposals have been gathered. In addition, images were taken as evidence.

#### Mapping Method

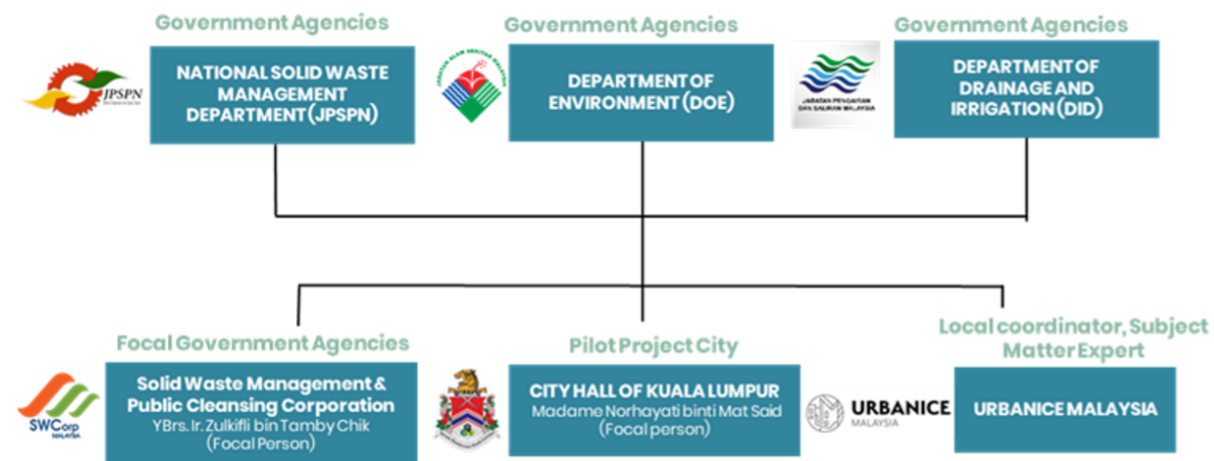
The proximity of city residents to nearby rivers and lakes was calculated using land use data and a cadastral map of Kuala Lumpur.

## 1.4 Project Coordination Team

The purpose of project coordination team is to streamline project activities and assign roles and responsibilities to all stakeholders representing the Technical Committee involved in project implementation.

Urbanice Malaysia has been appointed as a local coordinator of the Closing the Loop project in Kuala Lumpur. The National Solid Waste Management Department (JPSPN), Solid Waste Management and Public Cleansing Corporation (SWCorp), Department of Drainage and Irrigation (DID) and Department of Environment (DOE) are also actively involved in the Closing the Loop Project.

**Figure 5** illustrates the project coordination structure. As Kuala Lumpur falls under the jurisdiction of Act 672, JPSPN, SWCorp, DID and DOE are tasked with reviewing and providing relevant inputs to the project, including by actively participating and engaging with key ministries, agencies and other relevant actors on plastic waste management with respect to overall project objectives.



**Figure 5**  
Project coordination structure in Kuala Lumpur



## 1.5 Data Verification

Due to various sources and inconsistencies of data, a data verification workshop was held to verify and consensually accept the data to be published in the report. The workshop was conducted on the 4th of September 2020 at the Ministry of Housing and Local Government (KPKT) which was attended by various agencies (see Annex A). Amongst the verified data included: update on relevant policies, Stakeholder analysis, Kuala Lumpur waste generation rate, Kuala Lumpur Waste collection, and Kuala Lumpur plastic waste composition.



# CHAPTER 2

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

## City Profile

P43 **Population**

P45 **Economy**

P46 **Land Use Pattern**

P47 **Environmental Conditions**

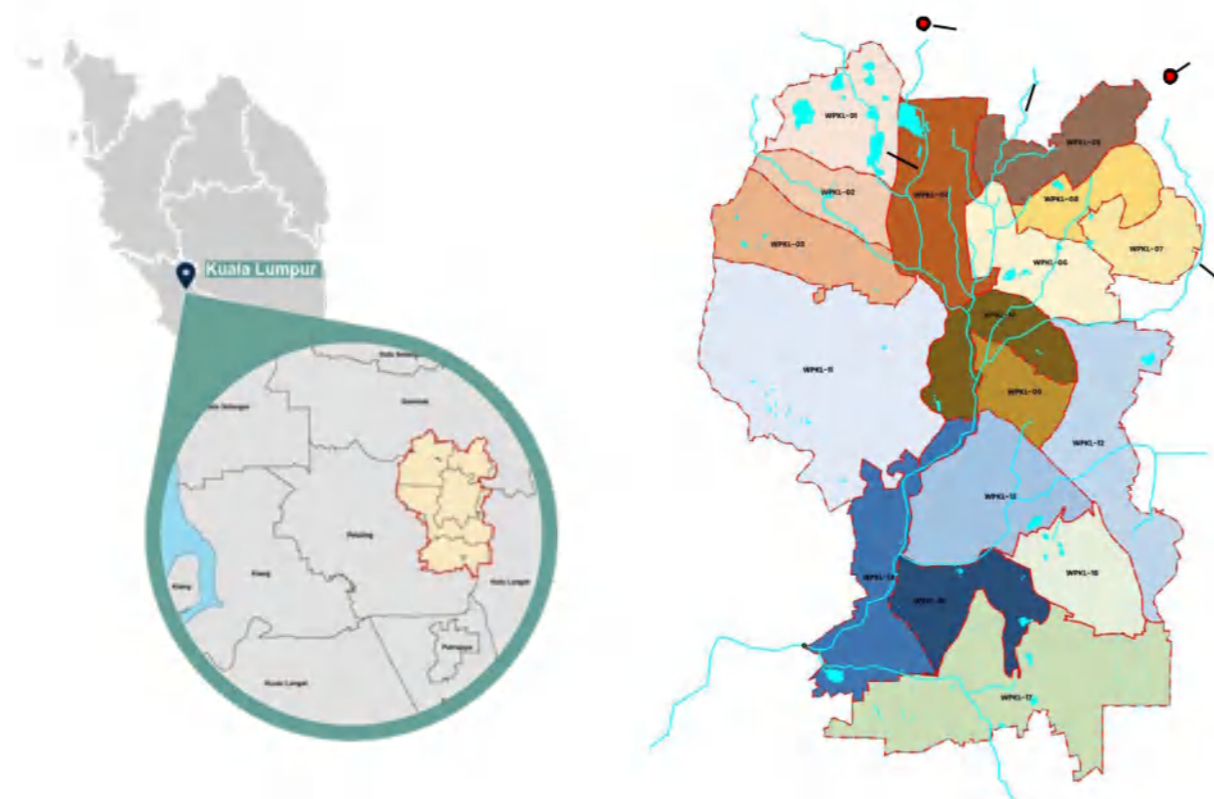
River Tributaries and Drainage System  
Environmental Challenges

## CHAPTER 2

# City Profile

Kuala Lumpur is the capital and the largest city in Malaysia. It is located in the Klang Valley Basin in Peninsular Malaysia as demonstrated in **Figure 6**. The Klang and Gombak Rivers converge in the city centre before flowing through Selangor State and discharging downstream into the Straits of Malacca. The Klang drains 1,342 km<sup>2</sup> and spreads 120 km across Malaysia's most urbanized area.

Originating in the Gombak and Hulu Langat mountainous Selangor state districts, the Klang is fed by 10 major tributaries and influenced by two large upstream supply dams; Batu Dam and Klang Gates Dam. The Klang Gates Dam marks the source of the Klang River until it flows through the city into the Malacca Straits.



**Figure 6**  
Location of Kuala Lumpur and Major Rivers

## 2.1 Population

With a total land area of 243km<sup>2</sup>, the city is also a home for nearly 1.77 million people as of 2020<sup>12</sup> (see **Table 1**). The population is made up of 87.2% local citizens and 12.4% non-local citizens<sup>13</sup>. The average size of Kuala Lumpur households by district was 3.3 per household and the number of living quarters are 543,600 houses in 2019. The percentage of the population living in family dwellings was identified as 76.5%, 22.6% for single-family dwellings and 0.9% for urban village housing, respectively. The majority of citizens are working adults (15 – 64 years old) comprising 72.7% of the total population in 2019.



**Table 1**  
Kuala Lumpur Population by strategic zone

<sup>12</sup> Malaysia Department of Statistic, 2021. Poket Stats Negeri, Wilayah Persekutuan ST1 2021

<sup>13</sup> Malaysia Department of Statistic, 2021. Population Statistics.

[https://www.dosm.gov.my/v1/index.php?r=column/cthree&menu\\_id=UmtzQ1pKZHBjY1hVZE95R3RnR0Y4QT09](https://www.dosm.gov.my/v1/index.php?r=column/cthree&menu_id=UmtzQ1pKZHBjY1hVZE95R3RnR0Y4QT09)

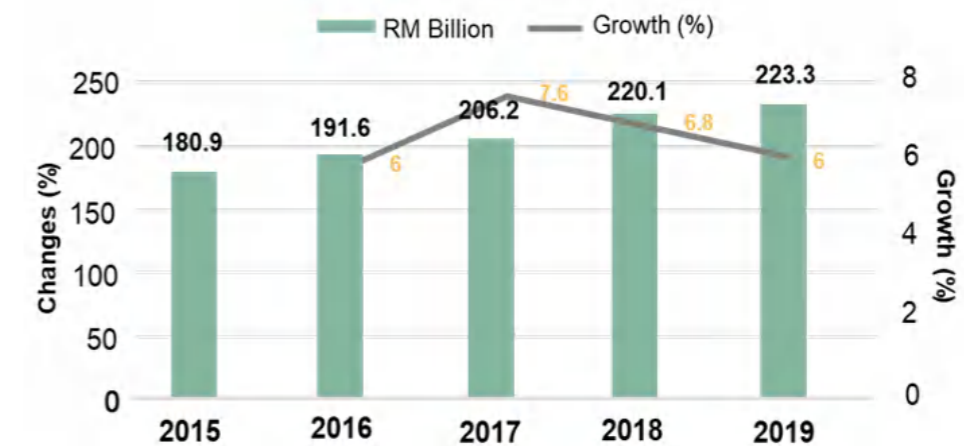


## 2.2 Economy

Kuala Lumpur is the wealthiest state in Malaysia with a GDP of approximately RM 223.3 billion (US\$ 55.7 billion) in 2019 contributing 16% of national production<sup>16</sup> (see **Figure 7**). Kuala Lumpur's main economic activities include tourism, finance, the electronics industry and commerce. Kuala Lumpur's economic performance continues to be propelled by the services sector with a contribution of 87.9%. The city economy grows 6-7% per year, outpacing the national average of 5% (2011-2018)<sup>17</sup>.

The city is a regional financial center and specialises in Islamic finance. Kuala Lumpur is also a major tourist destination and ranked in the top 10 most visited cities in the world<sup>18</sup>. Additionally, the integration of the greater Kuala Lumpur region with China's maritime Belt and Road Initiative suggests sustained investment in infrastructure and connectivity in future.

Currently, there are no neighborhoods classified as rural in Kuala Lumpur and the city has not enacted any rural housing policies since 2016. Following national trends, Kuala Lumpur's population has begun to plateau, with annual population growth rates slowing from +0.5% in 2016 to -0.2% in 2018<sup>14</sup>. Despite slowing population growth, long-term urbanization patterns are expected to continue and reach 90% urban residency by 2050. Additionally, growth is still expected in the wider conurbation, which is seeing faster annual changes (4-6%) than the city proper<sup>15</sup>.



**Figure 7**

Kuala Lumpur GDP (RM Billion) and Percentage of Growth (%)

<sup>14</sup> [https://www.dosm.gov.my/v1/index.php?r=column/cone&menu\\_id=bjRIZXVGdnBueDJKY1BPWEFPRihIdz09](https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=bjRIZXVGdnBueDJKY1BPWEFPRihIdz09)

<sup>15</sup> <https://www.unescap.org/sites/default/d8files/Closing%20the%20Loop%20-%20Kuala%20Lumpur%20City%20Profile.pdf>

<sup>16</sup> Department of Statistics Malaysia, 2020. National Accounts: Economic Performance 2019

<sup>17</sup> Department of Statistics Malaysia, 2018. State Socioeconomic Report 2018

<sup>18</sup> Euromonitor International, 2019 Top 100 City Destinations Report  
<https://go.euromonitor.com/white-paper-travel-2019-100-cities.html>

## 2.3 Land Use Patterns

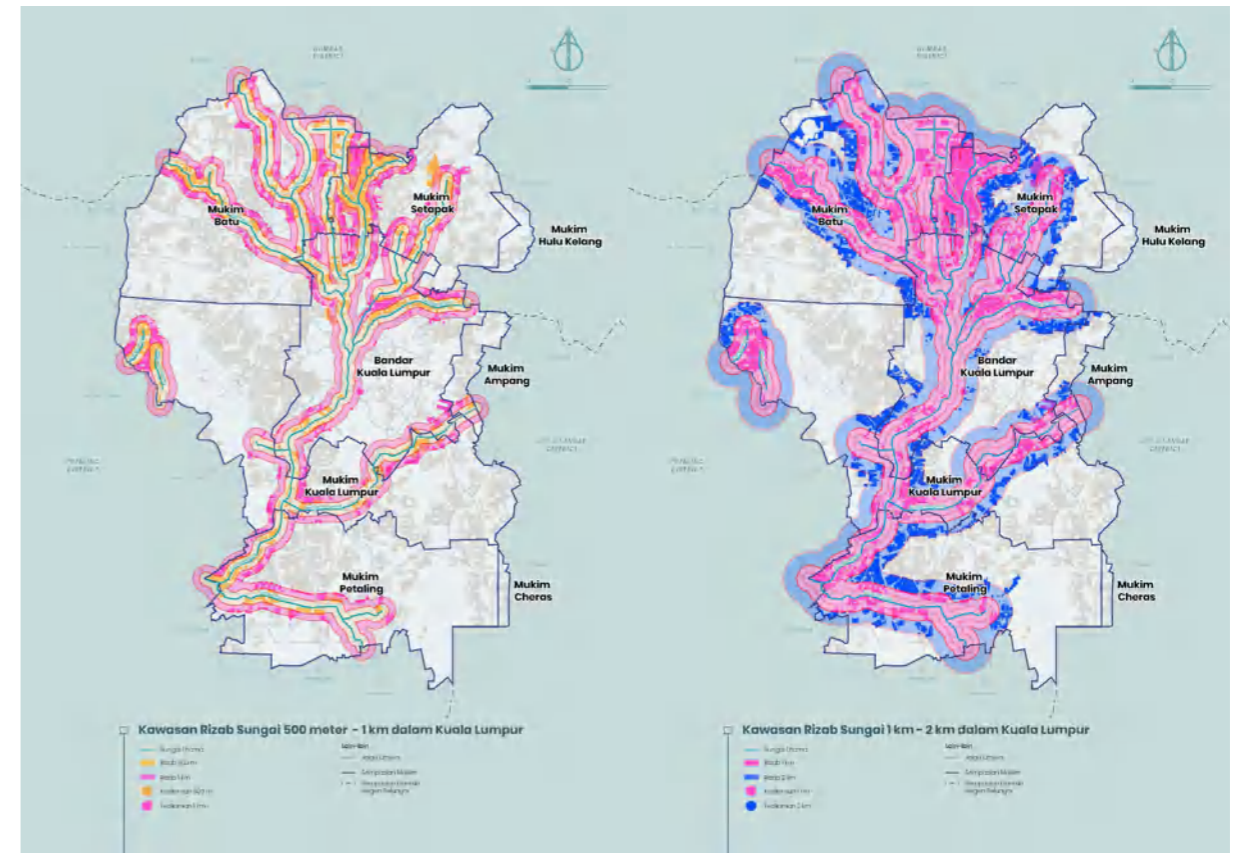
Kuala Lumpur is predominantly built area with a total of 194.3 km<sup>2</sup> (80%), with 7.32 km<sup>2</sup> (3%) of this land use comprising water bodies. There are 461,000 households in Kuala Lumpur. Land use is associated with a wide range of economic activities, which are sub-categorized into residential, commercial, industry, community facilities, infrastructure and utilities, road, open space and recreational areas.



## 2.4 Environmental Condition

### 2.4.1 River Tributaries and Drainage System

Kuala Lumpur is situated in the Klang Valley Basin and 3 major rivers, 7 main rivers and 12 minor rivers intersect the city. **Figure 9** shows proximity of population living near waterways. The general land topography of the city is moderate slope, between 5° - 8.5°.



**Figure 9**  
Population living near waterways within 500 m & 500 m - 1 km (left) and 1 km - 2 km & over 2 km (right)



Proximity of population living near waterways	Percentage of people living near waterways
within 500m	15%
500 m – 1 km	23%
1 km - 2 km	35%
over 2km	27%

**Table 2**

Percentage of proximity of population living near waterways

As shown in **Table 2**, about 38% of the population live within 1 km from waterways. All of Kuala Lumpur's main waterways have complete coverage of vegetation and/or man-made barriers surrounding it. Wastewater is treated for solid waste removal before being released into the environment as stipulated by Malaysia's Clean Water Act 1972. While Kuala Lumpur makes use of enclosed storm drains, storm drain water is untreated and directly discharged to waterways

Several projects have been undertaken both at the national and city levels aimed at addressing the health of the Klang River. The most prominent project is the Klang River revitalization initiative and Heritage and Commercial Centre for Greater Kuala Lumpur / Klang Valley under the River of Life Project (ROL).

ROL is a seven year project headed by the Government of Malaysia to transform 110 km of Klang River basin, covering eight rivers, into a vibrant and livable waterfront with high economic value. This project is divided into three major components:

1. River Cleaning (led by Department of Irrigation & Drainage (DID) Malaysia)
2. River Beautification (led by Kuala Lumpur City Hall (KLCH))
3. Commercialization and Tourism (led by Ministry of Federal Territory (KWP))

Under the River Cleaning Component, a Public Outreach Program (POP) was initiated in 2012 to foster partnerships and improve attitudes and behaviours of target groups to reduce pollution (see **Figure 10**).

Additionally, 368 Gross Pollutant Traps (GTPs) (362 GTPs under DID and 6 under KLCH) and 33 log booms were installed all over Kuala Lumpur drainage basin to prevent solid waste including plastic waste from Kuala Lumpur reaching the ocean.

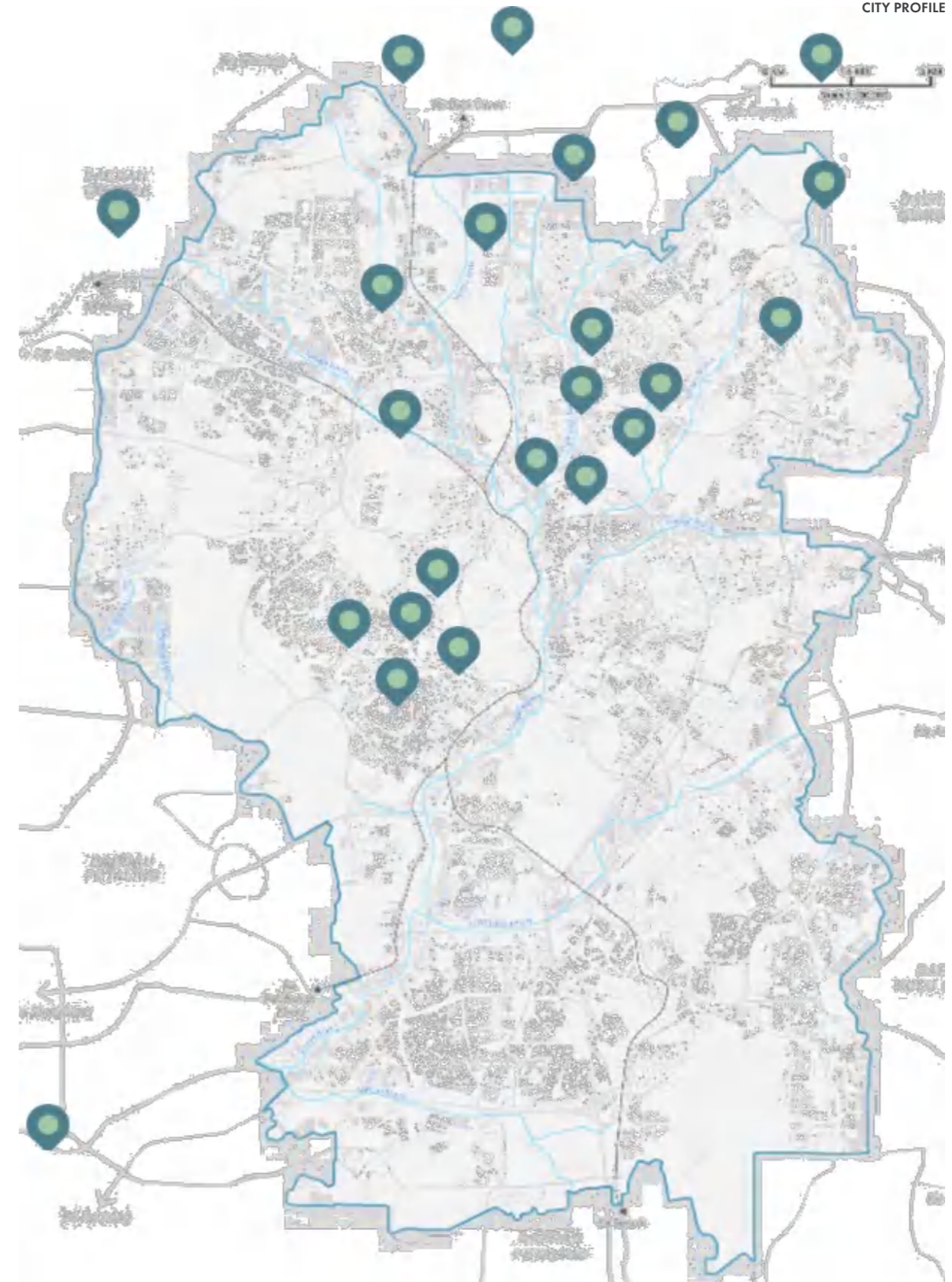
**Figure 10**

The River of Life project area

## 2.4.2 Environmental Challenges

Kuala Lumpur is exposed to climate changes and natural disasters, which consequently affect the physical, social and economic structure of the city. Ongoing management challenges include: soil erosion and sedimentation, flooding (averaging three major floods per year) and solid waste pollution. Recurring regional water shortages are also a major concern. These result from dry upstream conditions coupled with a high local reliance on river reservoirs for po water. Rain intensity above normal levels is causing flash floods.

Most flash flood incidents occur in urban areas due to inadequate drainage and lack of construction site supervision. Flash flood incidents may induce marine plastic litter as the high water level collect solid waste on pavements and exacerbate plastic waste leakage from the city. So far, the Integrated Flood Forecasting and River Monitoring Project in the Klang Valley has greatly increased monitoring capacity and established 88 hydrological stations. The KL Drainage Master Plan proposal has also identified a further 1,000 GPTs to be installed within river tributaries.



**Figure 11**  
Flash flood cases (2016-2018)<sup>19</sup>

<sup>19</sup>Draft Kuala Lumpur Structure Plan, 2040



# CHAPTER 3

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

## Status of Plastic Waste Management, Leakage and Hotspots

- P54 Municipal Solid Waste (MSW) Generation**
  - Overall MSW Generation
  - MSW Generation by Source Activity
- P57 Plastic Waste Generation**
  - Plastic Waste Composition
- P61 Plastic Emissions to the Environment**
  - Key Sources of Plastic Pollution
  - Composition of Plastic Emissions to the Environment
  - Plastic Emissions with Time
  - Spatial Distribution of Plastic Pollution Emissions
- P68 River and Marine Plastic Pathways**
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- P71 Fate of Plastic Waste**
  - Plastic Recycling
  - Retained at Disposal Site
  - Openly Burnt
  - Retained on Land and Drains
  - River and Marine Plastic Pollution

## CHAPTER 3

# Status of Plastic Waste Management, Leakage and Hotspots

## 3.1 Municipal Solid Waste (MSW) Generation

### 3.1.1 Overall MSW Generation

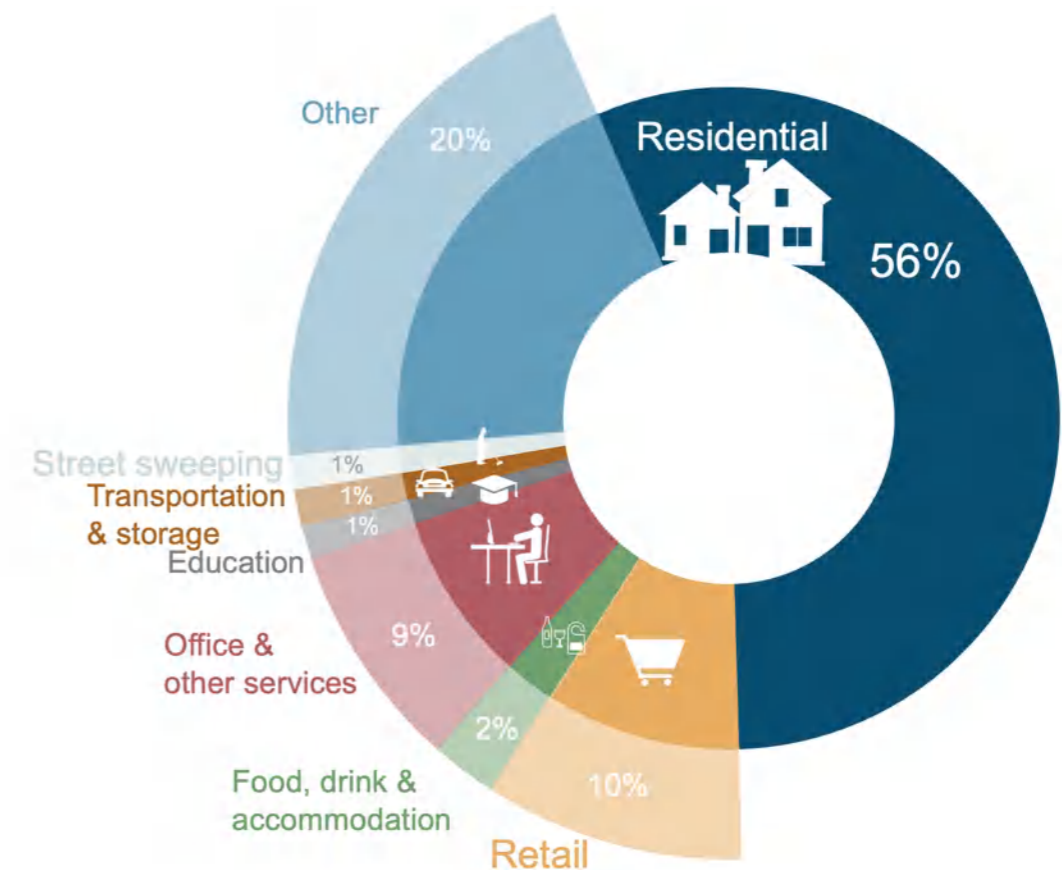
In total around 1 million tonnes of municipal solid waste (MSW) is generated in Kuala Lumpur per year. With a residential population of just over 1.8 million people, this equates to an average waste generation rate of 1.52 kg per resident per day (555 kg/capita/year). This is slightly higher than average values for Malaysia as a whole, with the *World Bank What a Waste 2.0* report suggesting a 2016 waste generation rate of 1.21 kg/capita/day<sup>20</sup>. This may be explained by Kuala Lumpur being particularly affluent and having a significant amount of commercial activity and tourism.

Receiving an estimated 22.4 million tourists per year, with an average visit length of 5.7 days, a portion of this waste generated in Kuala Lumpur every day can be assigned to that generated by tourists. Accounting for these tourists, the waste generation rate per person (i.e. residents + tourists) reduces to 1.27 kg/person/day (465 kg/person/year). However, this does not account for the likelihood that tourists may have different waste generation rates than local residents.

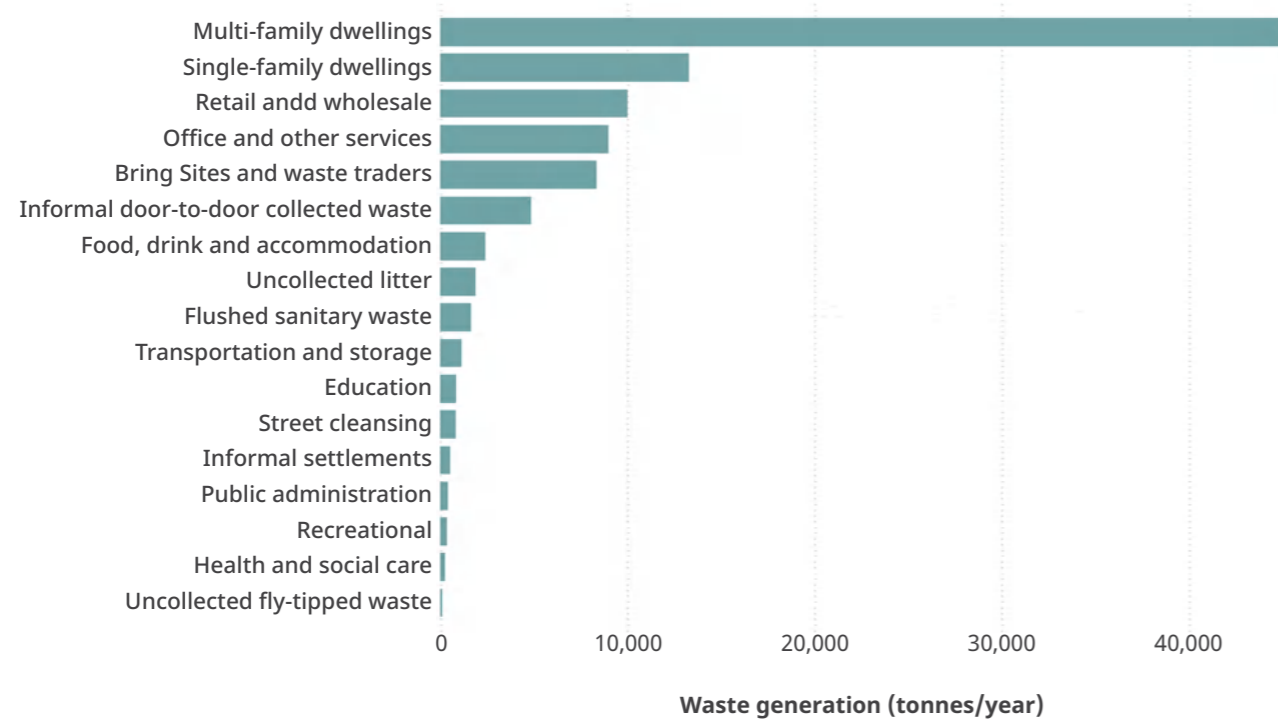
<sup>20</sup> KAZA, S., L. YAO, P. BHADA-TATA and F.V. WOERDEN. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development Series, Washington, DC: World Bank, 2018.

### 3.1.2 MSW Generation by Source Activity

The MSW generating activities that produce this waste can be thought of broadly as residential waste, commercial waste, institutional waste (e.g. schools, healthcare and public administration) and other waste (e.g. street sweepings, litter that remains uncollected). **Figure 11** and **Figure 12** show that residential waste, especially from multi-family dwellings accounts for the majority of the MSW generation at 56% followed by retail and wholesale (10%) and office and other services (9%). The bulk of the 'other' category is related to recycling activities of the informal sector or households that sell their recyclables directly to waste traders – an activity deemed to particularly prevalent within Kuala Lumpur.



**Figure 11**  
MSW generation by detailed activity



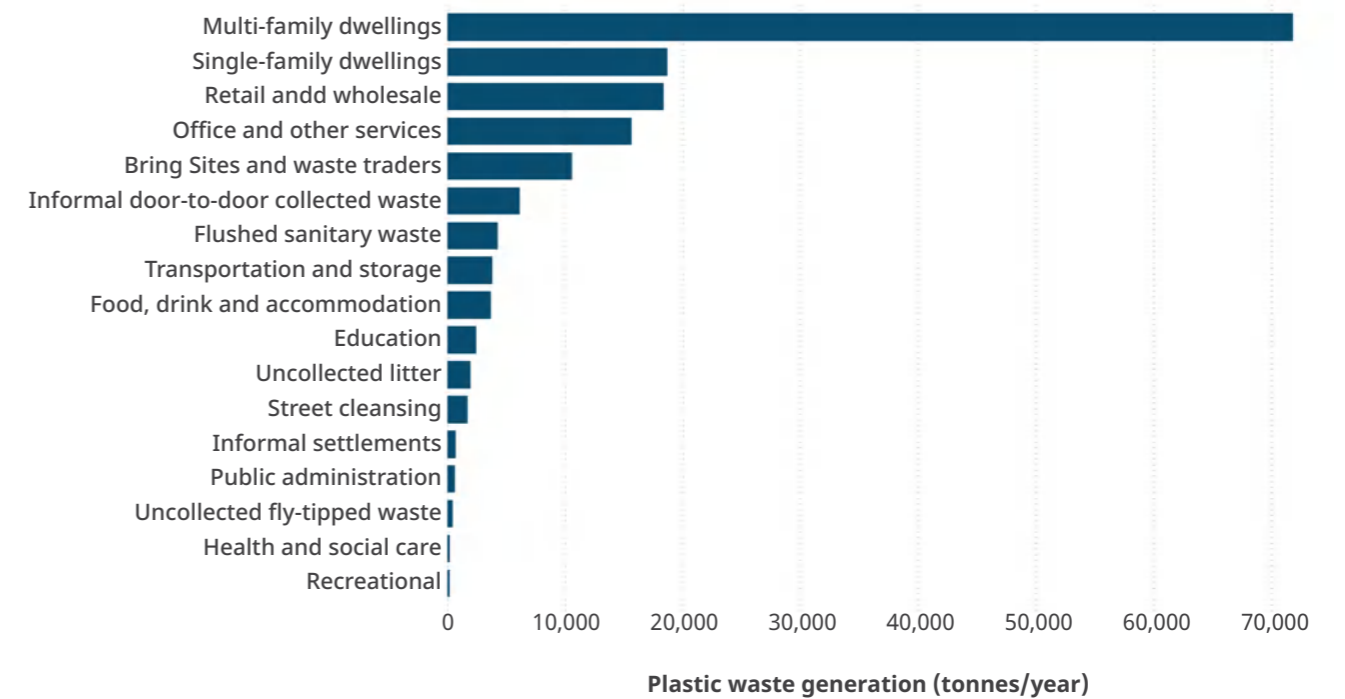
**Figure 12**  
MSW generation in tonnes per year by detailed activity

In addition to these recycling flows, litter and fly-tipped waste that goes uncollected is also included in this category. As the waste generation rate originally provided as input to the PPC were measured at the 'point of collection' (i.e. transfer station), we assume that littering, fly-tipping, flushed sanitary waste, informal sector collection and direct sale of recyclables to waste traders were not included in this rate and therefore were added on top. This equates to approximately 169,000 tonnes of extra MSW generation per year.

### 3.2 Plastic Waste Generation

Each of the detailed MSW generating activities shown in **Figure 12** have its own unique waste quantity and composition. Applying these compositions to the waste generation quantities shown in the previous section calculates 161,000 tonnes of plastic waste is generated per year.

The distribution of this plastic waste is largely consistent with the overall MSW quantities for each detailed activity as shown in **Figure 13**, with the exception of a few waste generating sources being ranked higher due to having higher proportions of plastic waste products. The highest quantities of plastic waste are generated by multi-family dwellings, followed by single-family dwellings, retail and wholesale and office and other services.

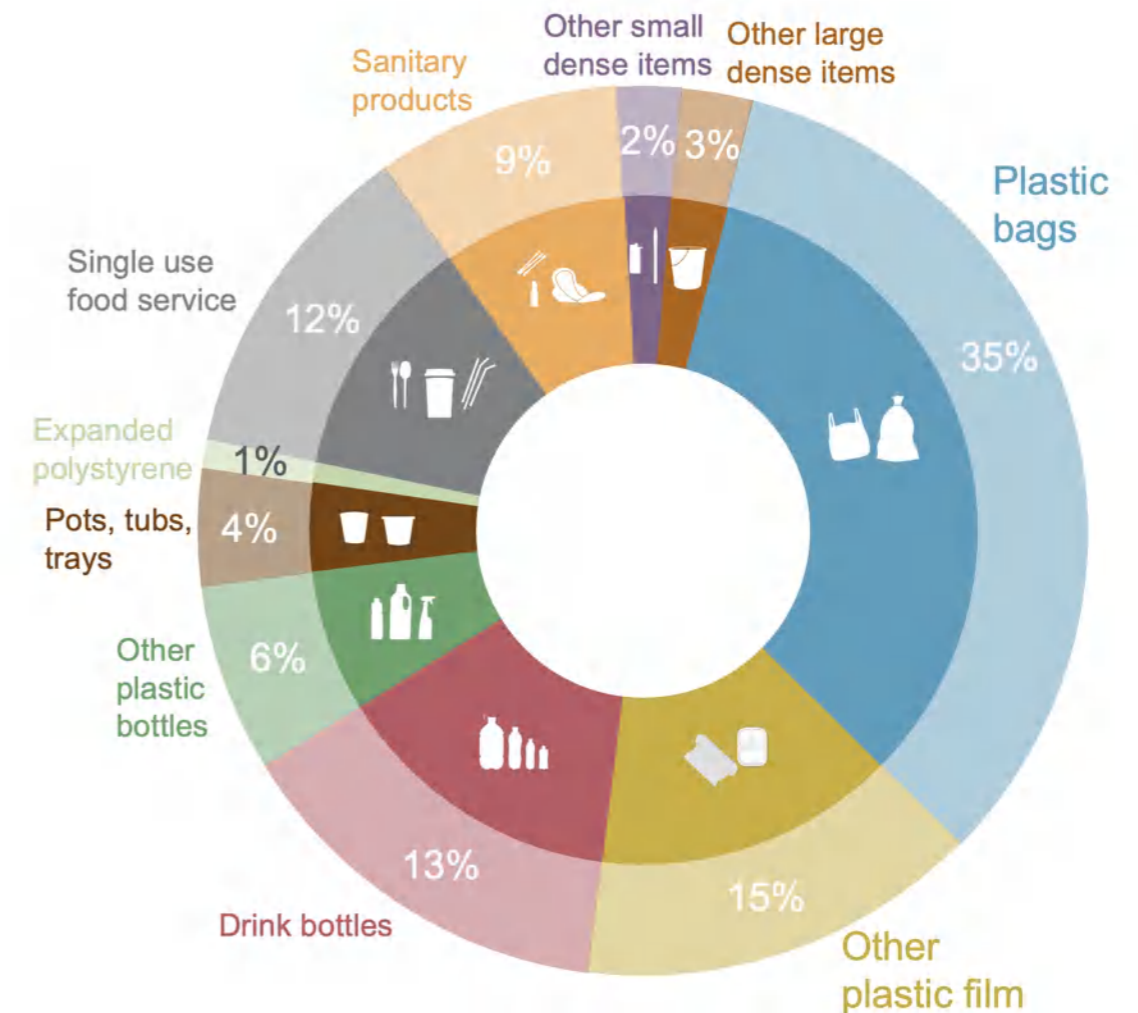


**Figure 13**  
Plastic waste generation by detailed activity

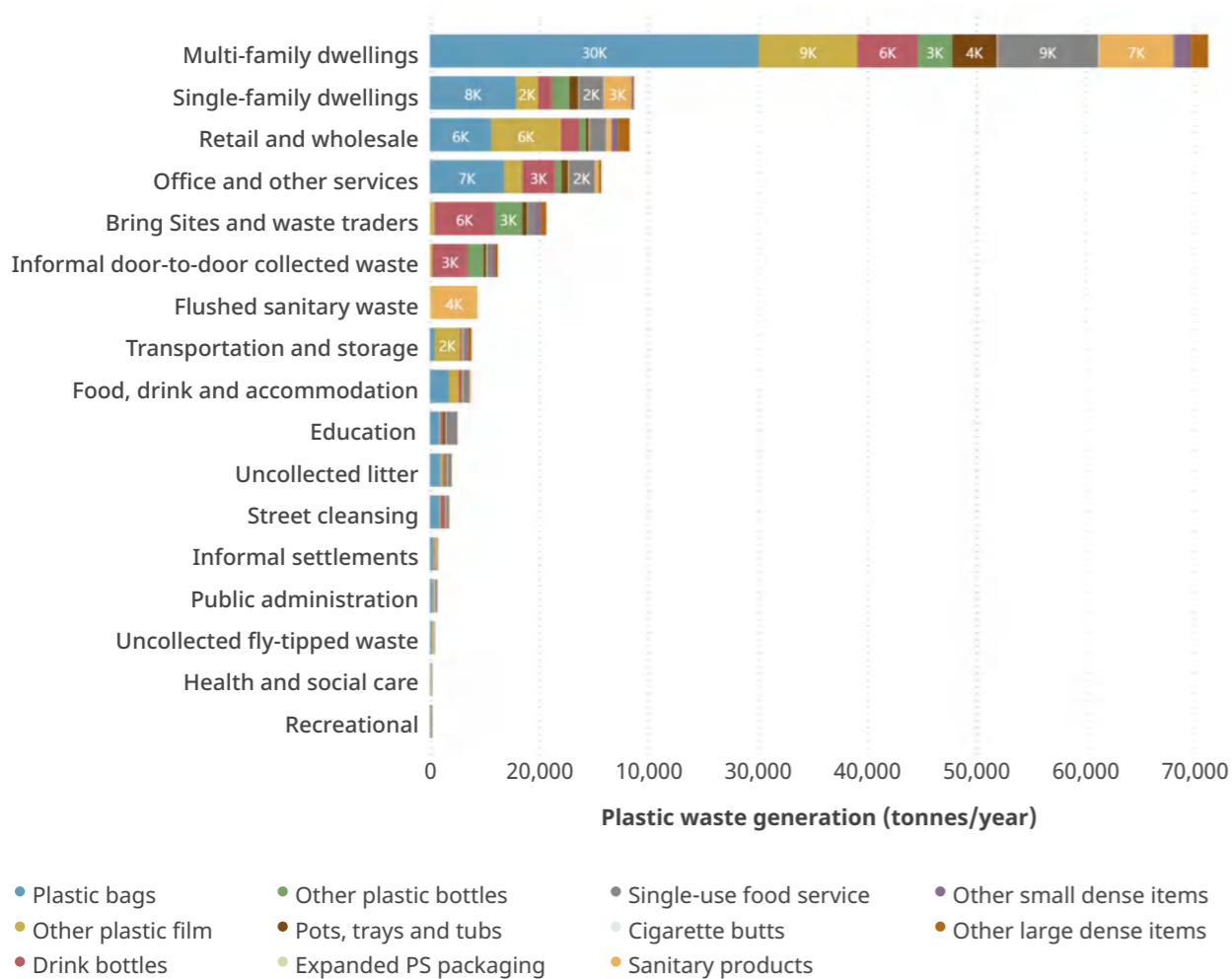
### 3.2.1 Plastic Waste Composition

In order to understand the fate of plastic waste released into the environment it is essential to account for the physical properties of these items. For example, knowledge of whether the item is easily transported by wind, or whether it floats is key in predicting the transportation of uncontrolled waste plastic in the environment. Likewise, the economic value of that item further dictates its likelihood of being collected by informal waste pickers for recycling. The overall composition of the plastic waste generated is shown in **Figure 14**, a more comprehensive breakdown by each detailed activity is shown in **Figure 15**.

As shown in **Figure 14**, plastic bags make up a significant proportion of the plastic waste generation mass, accounting for 35%. This value becomes even more influential considering that these plastic bags weigh considerably less than other typical plastic items such as drink bottles, and therefore by count represent an even higher percentage. In addition to plastic bags, other plastic film and drink bottles are also relatively high at 15% and 13% respectively. Likewise, single-use food service plastics make up a further 12% of plastic items. With the exception of drink bottles, the largest portions of plastic waste is low value plastic, and is therefore susceptible to not being collected and instead escaping into the environment. This is particularly the case for plastic film, which due to its low density and small size, can easily be moved by wind and therefore can be emitted into the environment. Higher value plastic items which are commonly targeted for recycling such as plastic bottles represent 19% of plastic waste generation, thereby allowing the potential for economically viable recycling.



**Figure 14**  
Plastic waste item composition



**Figure 15**

Plastic waste composition by detailed land use activity

It is important to not only consider the overall plastic waste composition but also the composition by land use and economic activities. Plastic waste composition can vary significantly, with some land uses generating larger amounts of 'troublesome' items such as carrier bags or single-use plastics, thereby becoming key areas for intervention. In the case of Kuala Lumpur, it can be seen from **Figure 15** that plastic bags form a major part of the plastic waste generation by households.

Retail waste has a higher proportion of other plastic film, likely due to packaging wrap used within the sector. The recyclable streams related to waste collection sites and from selling directly to waste traders and informal door-to-door collectors can also be seen to be primarily composed of bottles (both drink bottles and other household plastic bottles). However, other items are also collected such as some select forms of pots, tubs and trays, single-use food service plastics, other dense plastic items and other plastic films (presumably uncontaminated film from the commercial sector).

### 3.3 Plastic Emissions to the Environment

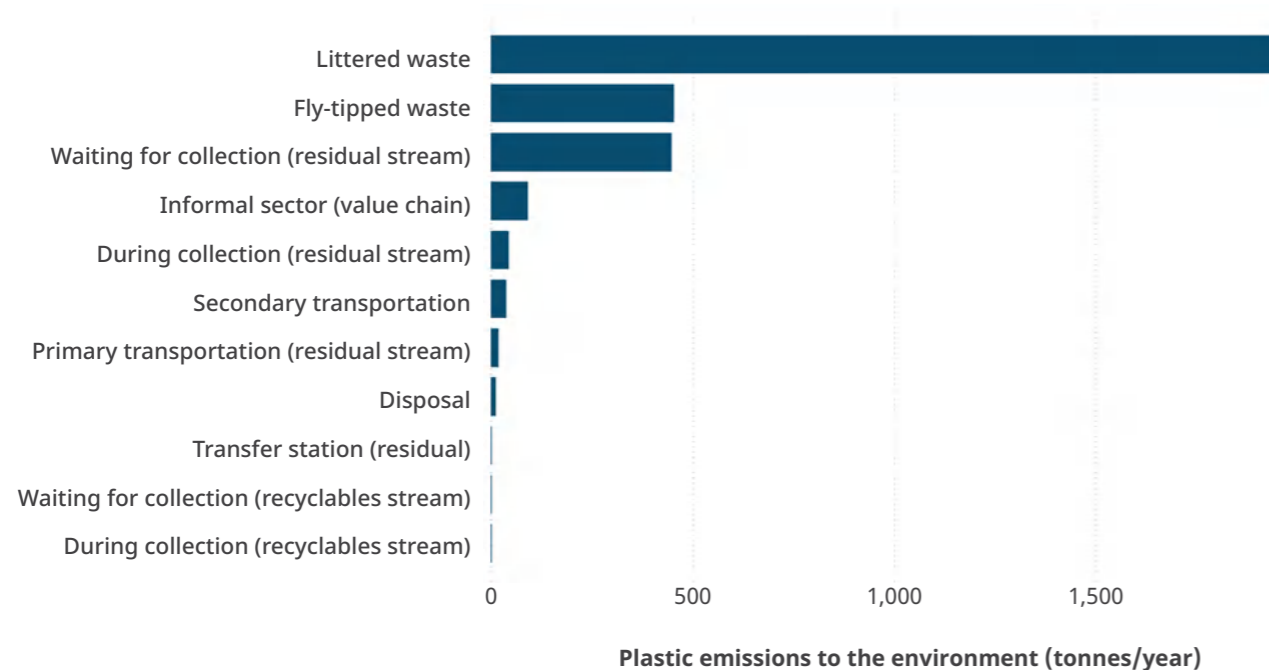
Plastic emissions to the environment (i.e. plastic leakage) are here defined as the plastic waste which escapes the MSW management system to become uncontrolled in the environment. The box below shows the definitions of some of the plastic pollution sources which have been analysed with the PPC.

- **Littered waste:** dumped waste on a small scale (single item)
- **Fly-tipped waste:** illegally dumped waste on a large scale (multiple items) by residents or businesses, often as a means to avoid paying disposal fees. Fly-tipped is illegal when alternate disposal options are available (e.g. pay the municipality to collect). Waste which is dumped by residents which lack any form of waste collection service is not included
- **Waiting for collection:** plastic waste that escapes to the environment while it is stored in residual waste bins and waiting for collection



### 3.3.1 Key Sources of Plastic Pollution

The plastic emission sources to the environment for Kuala Lumpur are shown in **Figure 16**. In total 3,069 tonnes of plastic are emitted into the environment each year. It can be seen that littered waste forms the largest emission source, releasing 1,958 tonnes of plastic waste a year. This is followed by fly-tipped plastic at 454 tonnes/year, plastic waste waiting for collection (448 tonnes/year) and plastic waste emissions from the collection, sorting and transportation of recyclables by the informal sector (92 tonnes/year).



**Figure 16**  
Key source of plastic pollution



**Figure 17**  
Fly tipping site



**Figure 18**  
Overflowing waste containers

Fly-tipping often occurs on the periphery of urban areas, and on wasteland where dumping can occur without being noticed. Riverbanks in particular often form key areas for fly tipping and can lead to marine litter. An example of fly-tipping in Kuala Lumpur can be seen in **Figure 17**. **Figure 16** shows waste overflowing or at the side of the collection containers. In the case of Kuala Lumpur, the waste containers are largely maintained at a high level.

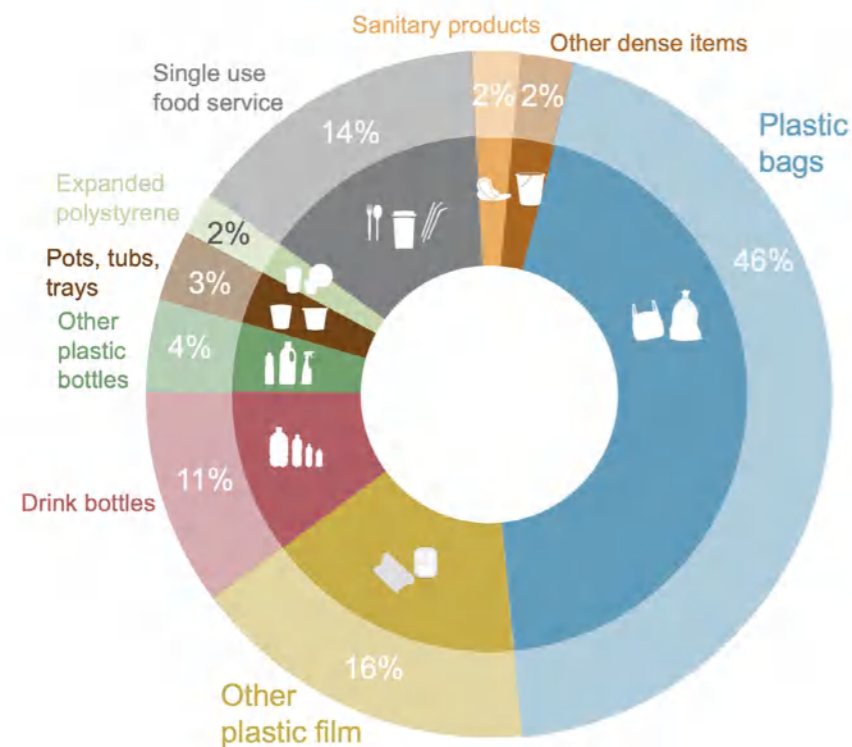
However, in some areas the large 660 litre collection containers used for multi-family dwellings and commercial establishments can be seen to have lids left permanently open. The dispersed but widespread nature of this emission source means even small emission rates can amount to large quantities of plastic waste being uncontrollably released.



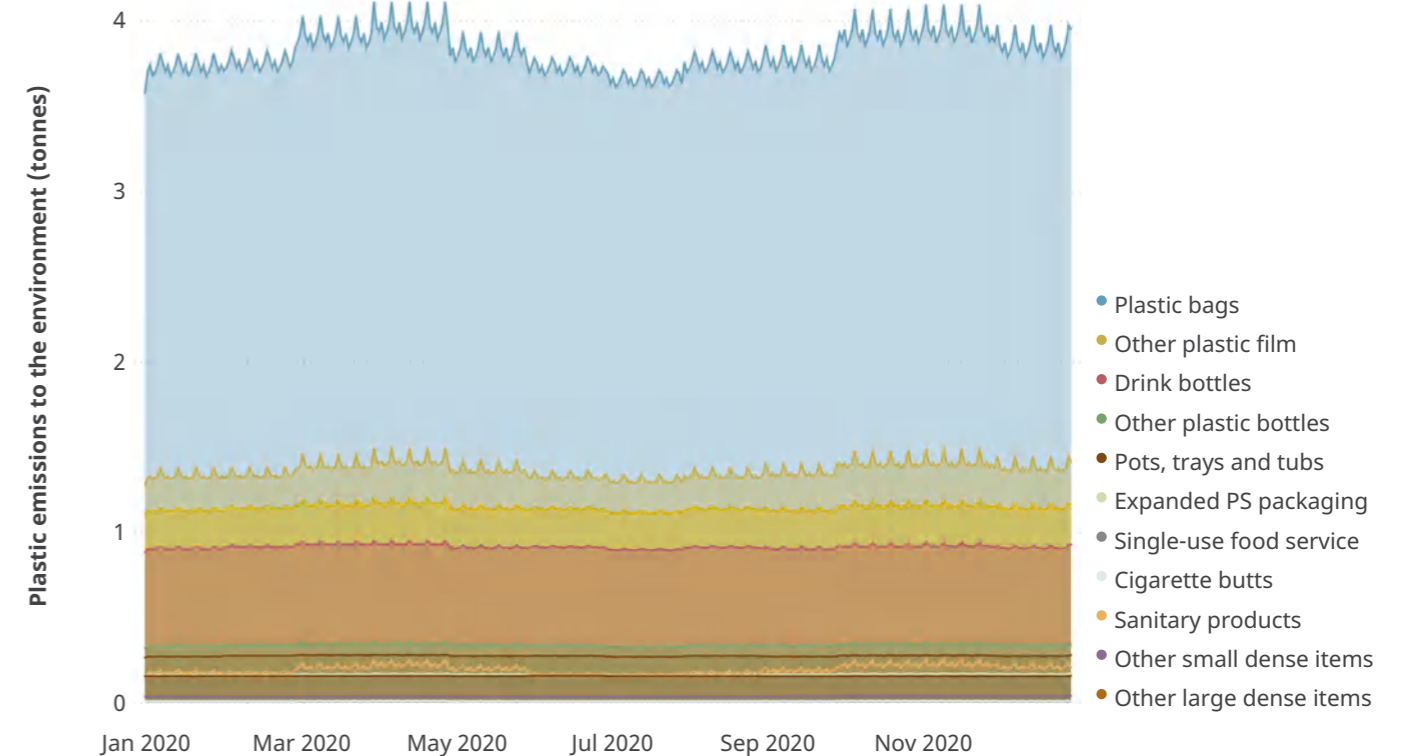
### 3.3.2 Composition of Plastic Emissions to the Environment

The composition of plastic emitted to the environment varies compared to that generated (Figure 19). This is due to the increased likelihood that certain item types leak into the environment based on the waste management practices of their source activity as well as due to their inherent materials making some more susceptible to movement. For example, the emissions to the environment of plastic bags increased from 34% generated to account for 46% of all plastic released.

Similarly, other plastic film, single-use food service and expanded polystyrene all make up a bigger proportion of the emitted plastic than that of plastic waste generation. In contrast, higher value plastics such as bottles or items that are difficult to be emitted accidentally such as 'other dense items' reduce in comparison to that at generated.



**Figure 19**  
Item composition of plastic emissions to the environment



**Figure 20**  
Plastic emissions to the environment by item type with time

### 3.3.3 Seasonality of Plastic Emissions

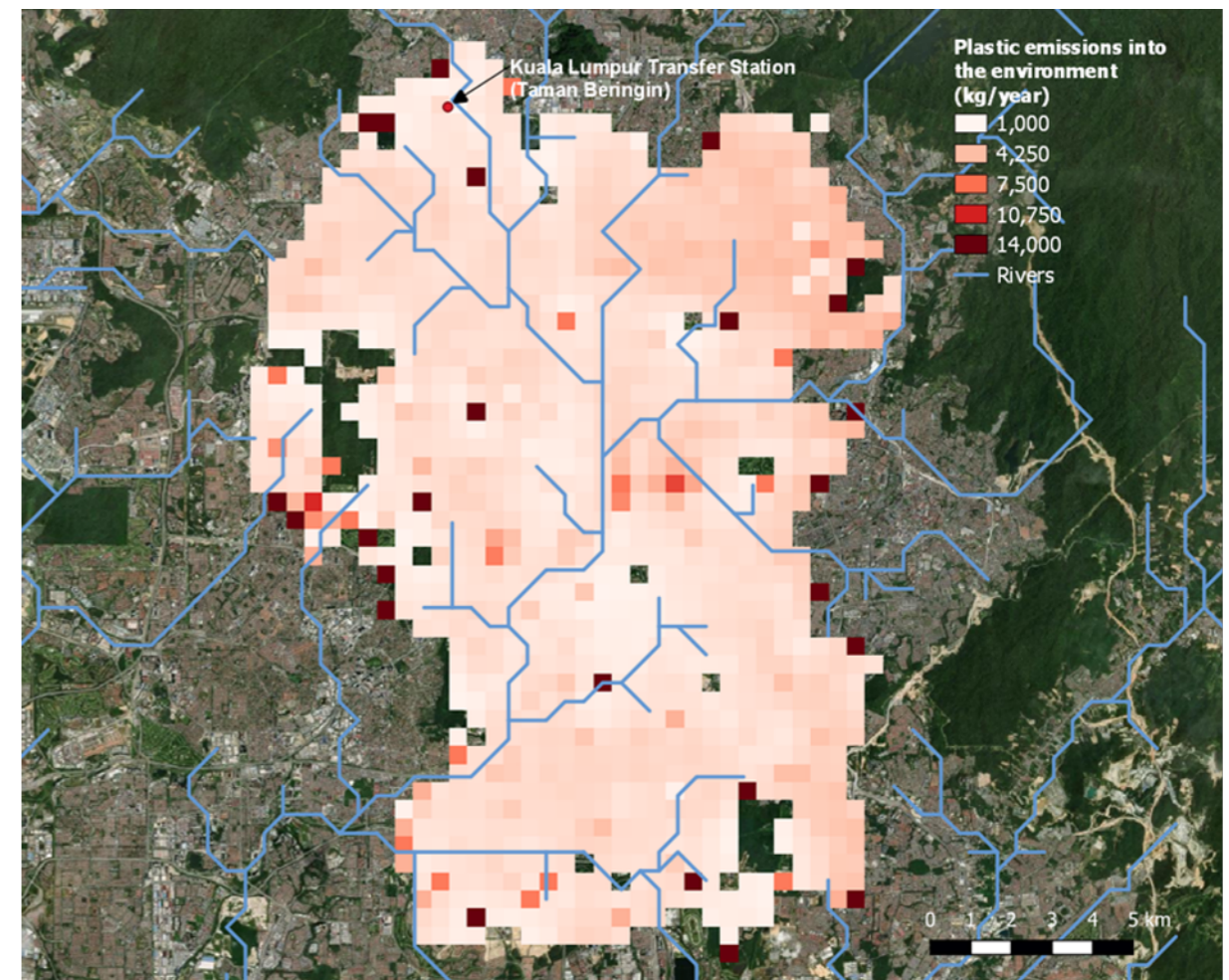
The emissions of plastic waste can often vary across the different months of the year. This is particularly the case when emission sources are a result of surface runoff and flood events which can show seasonal patterns. This time dependence for emissions can be seen in the results for Kuala Lumpur in Figure 20. Although small peaks can be seen during the periods of March to May and October to December, corresponding with periods of higher precipitation, the emissions with time are relatively stable.

This is due to the emissions being predominantly from actions such as littering and fly tipping which are assumed to occur throughout the year and where its release into the environment is not impacted by the weather (as compared with waste blowing off a collection container).

### 3.3.4 Spatial Distribution of Plastic Pollution Emissions

The results so far have shown the plastic emission results for Kuala Lumpur as a whole. We examined the plastic emissions to the environment by spatial location. The plastic emissions by location of emittance are shown in **Figure 21**, mapped for each pixel (~450m x 450m) in kg/year. Only the emissions from within the Federal Territory of Kuala Lumpur are shown, therefore any point source emissions such as those at the sanitary landfill outside of Kuala Lumpur are excluded. These however are relatively small accounting for 0.4% total plastic emissions as the operation of the sanitary landfill is well controlled.

The spatial representation of plastic emissions is achieved by allocating the emissions from each source by the distribution of that source. For example, plastic emissions from residential activities are distributed according to the population. Alternatively, littering is distributed based on both the population and the presence of other activities (e.g. shops, schools). Fly-tipping on the other hand is allocated to areas which have low population which could tend to also have weak law enforcement.



**Figure 21**  
Spatial distributions of plastic emissions in kg per year

## 3.4 River and Marine Plastic Pathways

As plastic entering waterbodies has the potential to cause harm to aquatic life, the Plastic Pollution Calculator assumes a broad definition for its river and marine plastic which encompasses all MSW derived macroplastic waste (over 5mm in size) entering aquatic environments (i.e. permanent rivers and waterbodies).

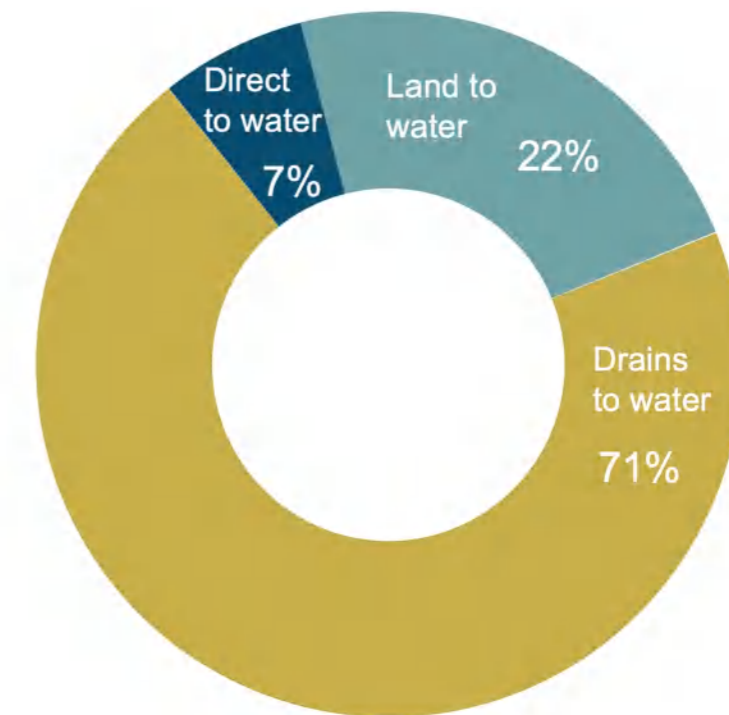
Depending on the location and in-river characteristics not all this plastic waste may enter oceans, however, this broad definition is deemed preferable to account for all potential harm. Plastics pollution encompasses all damaging aspects of plastic emissions into the environment, therefore accounting not only for river and marine plastic, but also plastic retained on land, retained in drains or openly burnt.



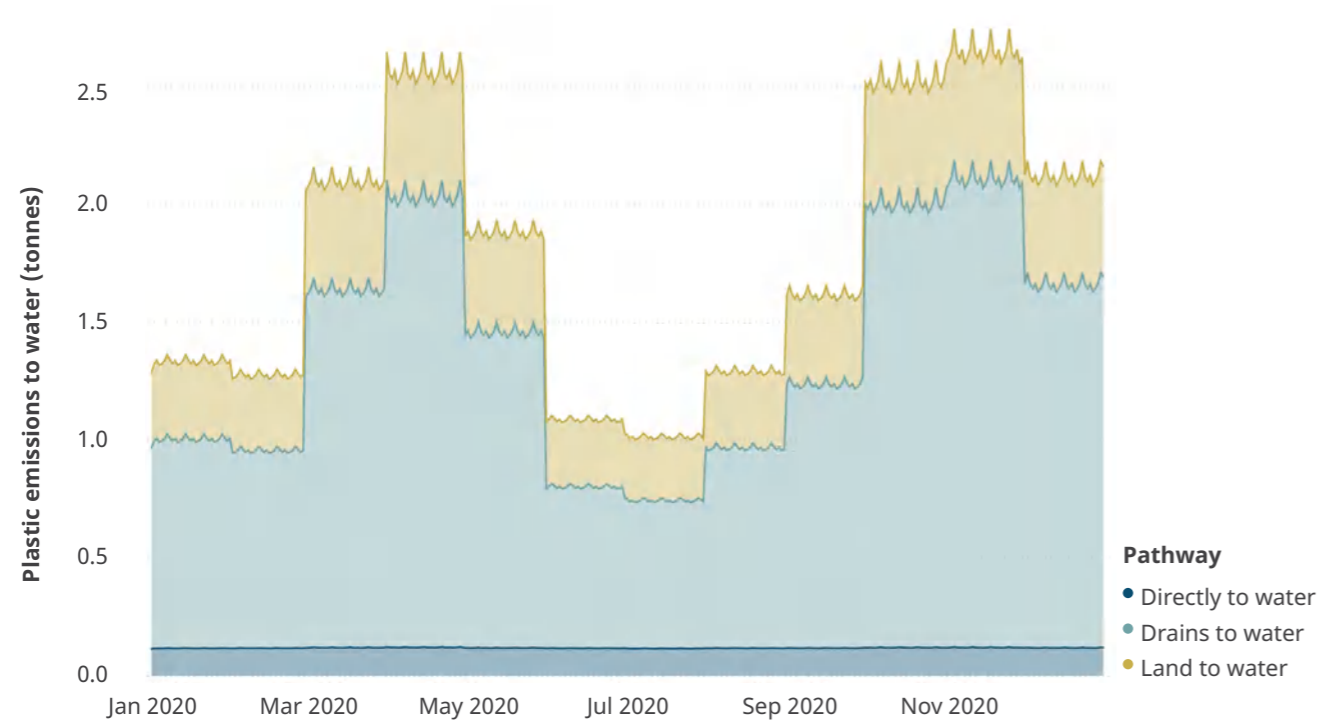
### 3.4.1 Key Pathways of River and Marine Plastic

Specific pathways wherein plastic pollution enters into waterways are illustrated in **Figure 22**. It can be seen that 71% (463 tonnes) of river and marine plastic enters waterways via storm drains. This is primarily due to the storm drains not being enclosed through large areas of Kuala Lumpur, thereby allowing any litter or plastic waste that has escaped from waste bins to be blown or washed into the drains and transported to waterways.

A further 22% (147 tonnes) of river and marine plastic enters waterways via land by wind, while 7% (43 tonnes) of river and marine plastic is dumped directly into rivers. This direct dumping is partly from littering but mainly from fly-tipping on the banks of rivers. Lastly, the presence of a wastewater treatment in Kuala Lumpur ensures that plastic waste flushed down toilets is removed and therefore this is not included as a pathway.



**Figure 22**  
Key plastic pollution pathways



**Figure 23**  
Plastic emissions to water with time

### 3.4.2 Pathways of River and Marine Plastic with Time

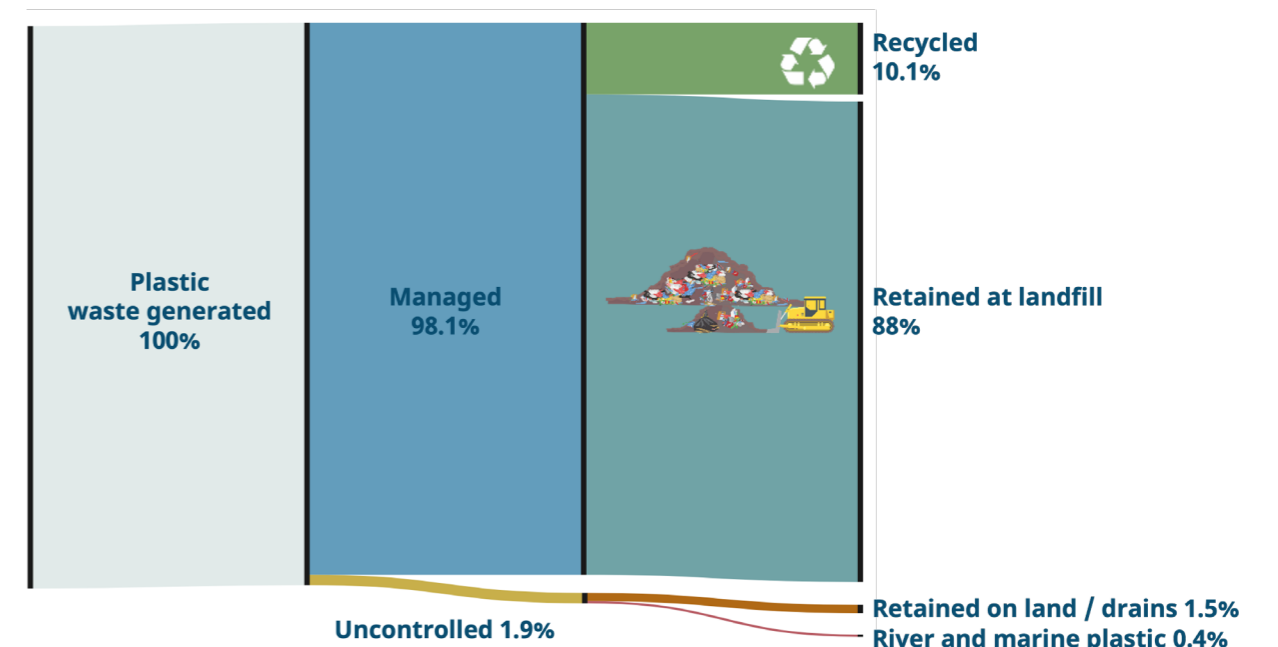
The strong dependence of plastic transportation with meteorological conditions can be seen in **Figure 23**. Here the plastic emissions to water with time show two peaks during the months of April and November, corresponding with periods of higher precipitation.

As storm drains are the dominant pathway that plastic waste in the environment is transported to waterways, higher precipitation therefore improves the likelihood of plastic being transported into rivers and the ocean.

## 3.5 Fate of Plastic Waste

An overview of the fate of plastic waste for within Kuala Lumpur is summarized in the Sankey Diagram of **Figure 24**. It can be seen that of all the plastic waste generated 88% (161,000 tonnes) ends up at the disposal site where it is retained (142,000 tonnes), 10.1% of the plastic is sorted for recycling (16,300 tonnes), and 1.9% of the plastic waste generated is deemed to be uncontrolled in the environment (3,069 tonnes). This plastic waste has high potential to cause damage to the environment and ecosystem health.

Of this, 2,416 tonnes a year of plastic waste, equivalent to 1.5% of that generated, is predicted to be retained on land or in drains whereby it becomes entangled. Over time and with out clean up activities this plastic would degrade and breakdown into innumerable microplastics, many of which will contaminate the nearby environment. The remaining 653 tonnes (0.4%) enters waterways becoming river and marine plastic.



**Figure 24**  
Sankey diagram of plastic waste fate in Kuala Lumpur

### 3.5.1 Plastic Recycling

Kuala Lumpur is known to have an active recycling practice whereby residents sell their waste to waste traders and recycling centres. About 95% of collected waste in Kuala Lumpur is sent to the Taman Beringin Transfer Station (TBTS) in Kepong, Kuala Lumpur, which is situated 500 meters away from waterways and has a strong slope of 8.5°- 16.5°. On average 2,000 tonne/day is managed. Recyclable wastes are sent to this transfer station which conducts manual sorting for recyclables. Although there is formal door-to-door collection of recyclables in Kuala Lumpur, this was calculated as being negligible in terms of contributing to overall plastic recycling, collecting only 56 tonnes of plastic in total in 2020.

Instead, the largest method for recycling was calculated as being due to individual households and businesses taking their recyclable waste to collection sites and selling it to waste traders, accounting for 46.5% of all recyclables generated. Similarly, the informal recycling sector is estimated to collect a further 18.4% of recyclables. Whilst these rates are high, the waste composition analysis conducted for this work found that on average only 12.7% of recyclables collected are plastic by mass. This plastic waste is subsequently aggregated, sorted and sold on to reprocessors.

### 3.5.2 Retained at Disposal Site

The vast majority of plastic waste generated in Kuala Lumpur ends up at the Bukit Tagar Sanitary Landfill. The strict environmental controls at this site mean that plastic waste is largely kept secure and does not escape to the environment, with only 12 tonnes /year of plastic (0.0084%) predicted to escape.

### 3.5.3 Openly Burnt

Due to a lack of evidence of open burning within Kuala Lumpur, this fate of plastic was omitted from the analysis. Open burning of waste is notoriously difficult to monitor, measure and enforce; and is known to occur even in countries with state-of-the-art waste management systems. As such, more research should be undertaken to understand the true extent of open burning both in Kuala Lumpur and in the surrounding areas.



### 3.5.4 Retained on Land and Drains

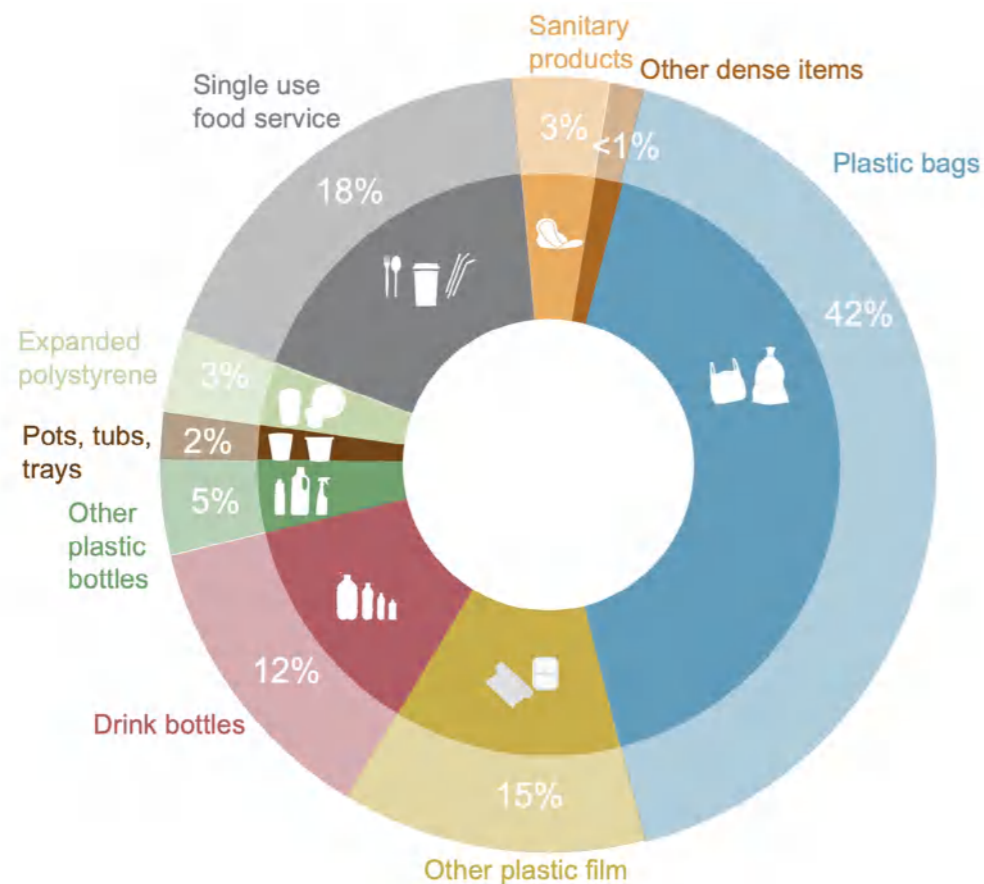
In addition to the plastic waste retained at the landfill, an estimated 1.5% of plastic waste is predicted to be retained and dispersed across land areas and drainage sites. For example, this plastic waste may have become trapped in vegetation as well as the greater urban environment. Whilst it is assumed that this plastic waste does not become marine litter within the modelling timeframe of a year, it is likely that some of this plastic may enter waterways in subsequent years.

This is particularly the case if the plastic begins to degrade and fragment in the environment into microplastics (less than 5mm) making transportation by surface runoff more likely to contaminate soil. Likewise, plastic retained in the storm drain network poses risks of local flooding by obstructing the channels leading to potential flooding.

### 3.5.5 River and Marine Plastic Pollution

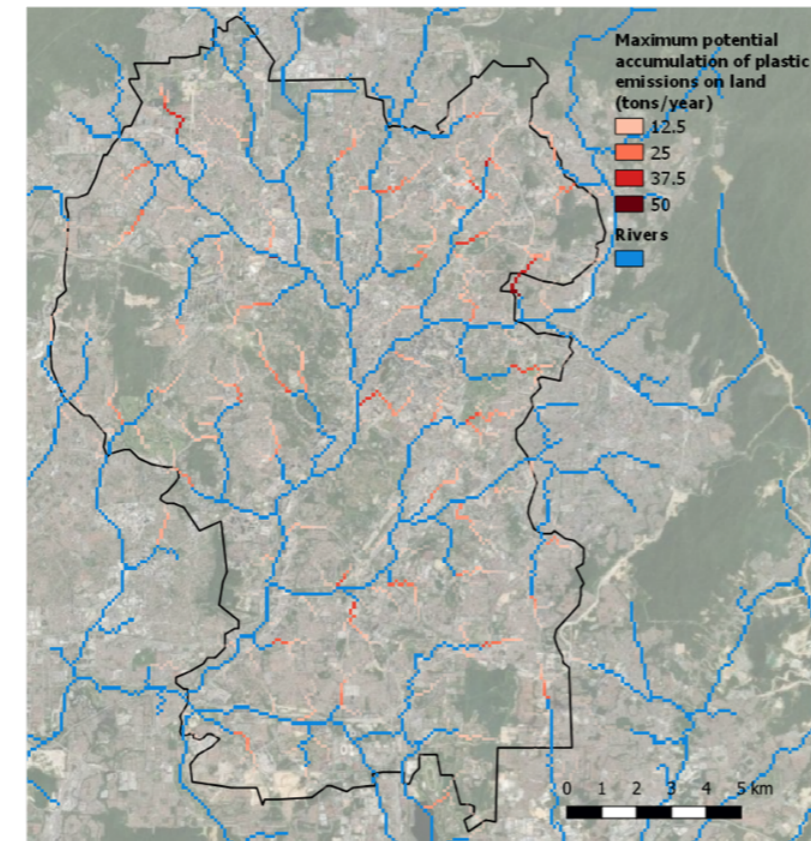
Importantly, whilst 0.4% of plastic waste generation becoming marine litter may sound small in comparison to other flows, in fact this represents 653 tonnes of plastic waste a year. The lightweight nature of plastic means that this actually represents many millions of items. For example, the composition of this marine litter is 40% plastic bags by weight as shown in **Figure 25**.

Assuming a plastic bag weighs approximately 5g, this would represent 55 million plastic bags entering waterways each year. Likewise, although only 12% of the marine litter is plastic bottles, assuming an approximate average mass of 20 grams per bottle, this would represent 4 million bottles becoming marine litter per year.



**Figure 25**

Composition of plastic waste entering waterways



**Figure 26**

Maximum potential annual accumulation of plastic emission on land

The exact locations at which plastic waste may enter waterways within Kuala Lumpur was further estimated by performing flow routing methods assuming plastic waste movement follows the natural drainage patterns of the land, as detailed in the methodology section. The results of this can be seen in **Figure 26** whereby each cell represents the flow of plastic waste that would pass through that location over one year assuming no retention (zero stock).

However, as there will inevitably be some retention and clean-up, we expect the actual flows to be lower than those reported in this worst case annual scenario, instead summing up to the overall marine litter amount of 653 tonnes/year.



# CHAPTER 4

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

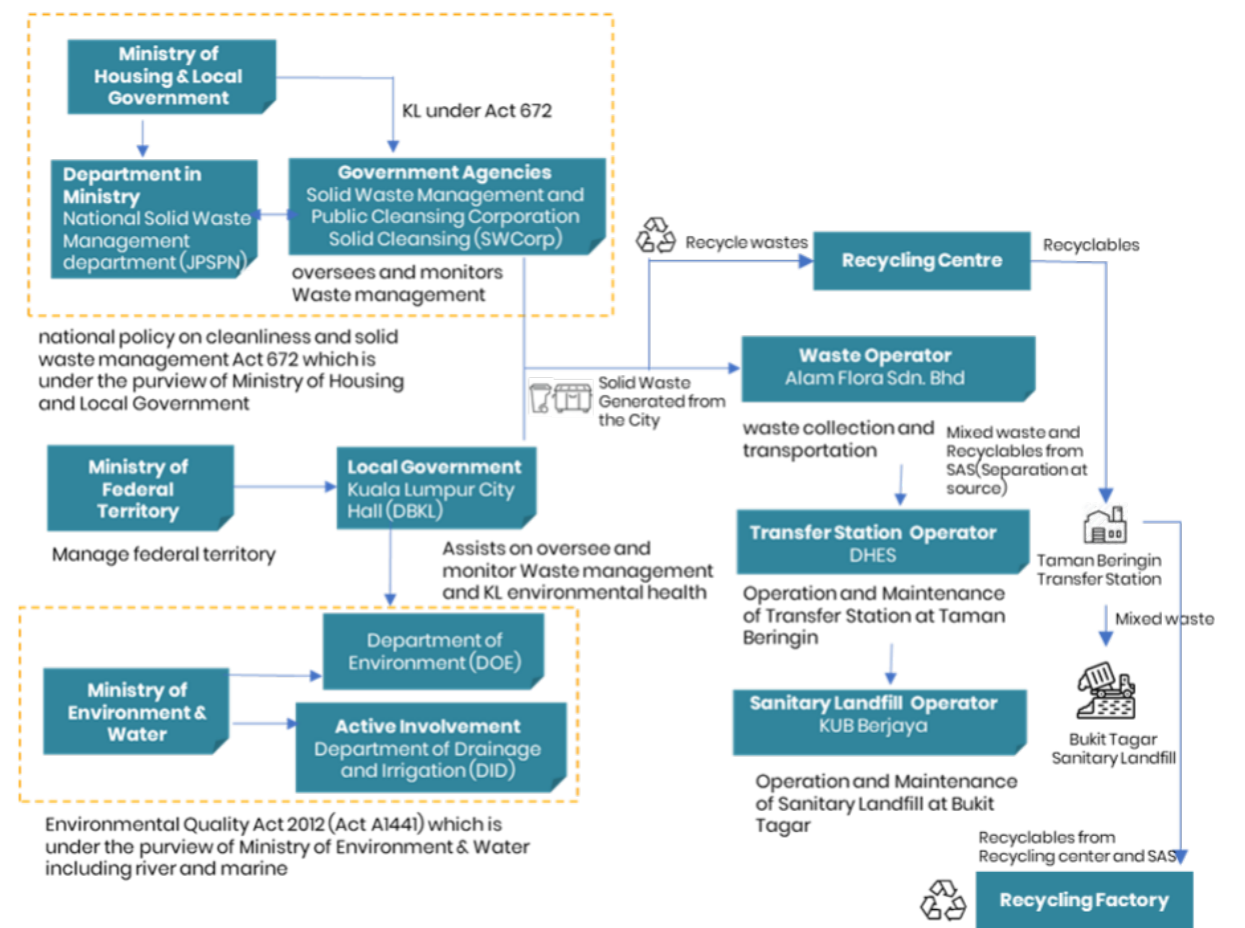
## A Review of Governance Aspects

- P80 Institutional Setup**
  - National/ Provincial Institutions Responsible for Implementing Plastic Waste/ Marine Litter
  - Local (City) Institutions Responsible for Implementing Waste Management and Marine Litter
- P87 Key Policies and Regulations**
  - National Policies and Legislations
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CHAPTER 4

# A Review of Governance Aspects

Kuala Lumpur’s plastic waste management system is governed by three different ministries and several departments and agencies (see **Figure 27**). National policy goals on plastic waste management have been set towards zero single-use plastics for a cleaner and healthier environment in Malaysia by 2030.



**Figure 27**  
Kuala Lumpur plastic waste management governing bodies



## 4.1 Institutional Setup

### 4.1.1 National/ Provincial Institutions Responsible for Implementing Plastic Waste/ Marine Litter

Malaysia is structured into eleven states and two federal territories. The urban center of Kuala Lumpur belongs to a federal territory and is managed under the jurisdiction of the Federal Territories Ministry of Malaysia. Malaysia is governed as a representative democracy with state governments established under their respective state constitutions. Policy is developed and implemented through a three-tier structure of federal, state and local authorities.

In the context of solid waste management and marine litter, the main responsible authority is the Ministry of Housing and Local Government which is guided the National Policy on Cleanliness and Solid Waste and Public Cleansing Management Act 2007 (Act 672). In addition, several other relevant ministries and departments in waste management are summarized in **Table 3**.

Ministry	Key Roles and Responsibilities
Ministry of Federal Territory (KWP)	<ul style="list-style-type: none"> <li><b>Kuala Lumpur City Hall (KLCH)</b> Responsible for overall governance of Kuala Lumpur</li> </ul>
Ministry of Housing and Local Government (KPKT)	<ul style="list-style-type: none"> <li><b>National Solid Waste Management Department (JPSPN)</b> Responsible for consistently upgrading the quality of solid waste and public cleansing management through policy formulation, strategy, action planning and legislation.</li> <li><b>Solid Waste Management and Public Cleansing Corporation (SWCorp)</b> Responsible for administering and enforcing the laws on solid waste management, public to cleansing and its related matters. The corporation's role is to ensure the solid waste management and public cleansing services are implemented efficiently and holistically to fulfill a great expectation and satisfaction of the consumers and community</li> </ul>
Ministry of Environment and Water (KASA)	<ul style="list-style-type: none"> <li><b>Department of Environment</b> Responsible for managing water resources including irrigation and for monitoring water services with a view towards ensuring sufficient and sustainable water resources and supply</li> <li><b>Department of Irrigation and Drainage</b> Responsible for providing engineering expertise services and water resources management including river, coastal, flood and drought management to improve citizens lives in the context of water security and environment sustainability</li> </ul>
National Water Resources Council	Tasked with promoting effective water management, including the implementation of interstate water transfers.
Ministry of Science, Technology and Innovation (MOSTI)	<ul style="list-style-type: none"> <li><b>Malaysia Green Technology and Climate Change Centre</b> Responsible to lead the nation in the areas of green growth, climate change mitigation and climate resilience and adaptation</li> </ul>

**Table 3**

Key national ministries involved in waste management and marine litter

### 4.1.2 Local (City) Institutions Responsible for Implementing Solid Waste Management and Marine Litter

The Federal Territory of Kuala Lumpur is the capital city of Malaysia and is the largest city in Malaysia. Kuala Lumpur consists of a large and fast-growing metropolitan area. The wider urban area also including parts of the surrounding Selangor state. Kuala Lumpur was declared a Province Federation on 1 February 1974. Administered by Kuala Lumpur City Hall (KLCH) created in 1972. Executive power lies with the City Mayor who is appointed for three years by the Federal Territories Minister.

This system of appointing the mayor has been in place ever since the local government elections were suspended in 1970. Kuala Lumpur is composed of 23 departments and plays a central role in decision-making and development planning. Departments are organized along five main themes, including management, socio-economic development, project management, planning and others as listed in **Table 4**<sup>21</sup>.

<sup>21</sup> [https://en.wikipedia.org/wiki/Kuala\\_Lumpur\\_City\\_Hall](https://en.wikipedia.org/wiki/Kuala_Lumpur_City_Hall)

Sector	Departments
<b>Management</b>	<ul style="list-style-type: none"> <li>• Finance Department</li> <li>• Human Resource Management Department</li> <li>• Administration Department</li> <li>• Information Management Department</li> <li>• Property Management and Valuation Department</li> </ul>
<b>Socio-economic Development</b>	<ul style="list-style-type: none"> <li>• Enforcement Department</li> <li>• Housing Management and Community Development Department</li> <li>• Licensing and Petty Traders Development Department</li> <li>• Health and Environment Department</li> <li>• Culture, Arts and Sports Department</li> </ul>
<b>Project Management</b>	<ul style="list-style-type: none"> <li>• Project Implementation and Building Maintenance Department</li> <li>• Civil Engineering and Urban Transportation Department</li> <li>• Mechanical and Electrical Engineering Department</li> <li>• Landscape and Recreation Development Department</li> <li>• Quantity Surveying Department</li> </ul>
<b>Planning</b>	<ul style="list-style-type: none"> <li>• City Planning Department</li> <li>• Infrastructure Planning Department</li> <li>• Economic Planning and Development Department</li> <li>• Building Control Department</li> </ul>
<b>Other Departments</b>	<ul style="list-style-type: none"> <li>• Legal and Prosecution Department</li> <li>• Corporate Planning Department</li> <li>• Internal Audit Department</li> <li>• Integrity Department</li> </ul>

**Table 4**  
City Departments in Kuala Lumpur

Name of the Department	Responsibility
<b>Department of Health and Environment</b>	Responsible for monitoring the health of citizens, while also trying to enhance the quality of health of its citizens. In addition, this department is also responsible for resolving complaints relating to emergencies
<b>Department of Civil Engineering and Drainage</b>	Responsible for performing the functions of management, maintenance and construction of road infrastructure projects, bridges, rivers, slopes, main ditches, flood mitigation and other related functions
<b>Department of City Planning</b>	Responsible for implementing the Planning Control services in line with the vision, policies and strategies of the Kuala Lumpur Structure Plan
<b>Department of Infrastructure Planning</b>	Responsible for the long term planning, investment and implementation of urban infrastructure in Kuala Lumpur
<b>Department of Landscaping and Recreation Development</b>	Responsible in ensuring the beautification of the city is ongoing towards achieving our vision of making Kuala Lumpur a World Class Sustainable Tropical City by 2020

**Table 5**  
Key Departments and Their Responsibilities

The Department of Health and Environment, which is called Jabatan Kesihatan dan Alam Sekitar (JKAS) is the main department responsible in assisting relevant federal government agencies to oversee cleanliness concerning solid waste management and public cleansing services in Kuala Lumpur.

In addition, there are some other departments are actively involved in the subject as summarized in **Table 5**.

The Federal Government agencies involved in the solid waste management including National Solid Waste Management Department, SWCORP and Alam Flora Sdn Bhd (the appointed Solid Waste Concessionaire). KLCH pays monthly to SWCORP the agreed amount for carrying out the solid waste collection and public cleansing services, operating transfer station and landfill. Three major components of solid waste management in Kuala Lumpur and the appointed operators are:

- Bins provision, waste collection and transportation - Alam Flora Sdn Bhd,
- Operation and Maintenance of Transfer Station at Taman Beringin – Department of Health, Environment and DRB Hicom Environmental Services Sdn Bhd (DHES), and
- Operation and Maintenance of Sanitary Landfill at Bukit Tagar- KUB Berjaya



The appointment of operators or the concessionaires are done at federal level through the National Solid Waste Management Department (JPSPN). Alam Flora Sdn Bhd, as the concessionaire for solid waste collection, carry out the waste collection services based on requirements stipulated in the Concession Agreement, which is standard with other Concessionaires in Northern and Southern region of Malaysia. The service level, which includes collection frequency, is based on the type of dwellings. Alam Flora has divided Kuala Lumpur into 17 schemes for operational purposes such as collection routes, sub-contractors' appointment, supervision zones and administrative matters. In addition, the following stakeholders are active in plastic waste management and marine litter in Kuala Lumpur (see **Table 6**).

Institute	Roles and Responsibilities
<b>Malaysia Plastics Pact</b>	Tasked to lay out concrete actions to reach its targets, MPP is the collaborative initiative that will assist Malaysia Single-Use Plastic, Roadmap to create a circular economy for plastics in Malaysia. MPP also brings together all players in the plastic value chain
<b>IPC recycling centre</b>	IPC Shopping Centre under its annual sustainability initiative have kicked-off a campaign called "Trash to Treasure" to help the community make recycling a part of the "new normal" and extends its waste collection efforts to the public
<b>Waste Management Association of Malaysia</b>	The Waste Management Association of Malaysia (WMAM) is an association for waste management stakeholders. Established in 2005, WMAM represents people from many disciplines, including engineering, law, science as well as management. WMAM aims to promote and encourage the maintenance of high standards of waste management services in Malaysia in respect of solid and liquid waste, hazardous, clinical and all other types of waste
<b>WWF - Extended Producer Responsibility Project (regional)</b>	WWF-Malaysia works with local communities, local and state government agencies and the private sector to improve management of important and threatened ecosystems and species

**Table 6**

Key stakeholders involved in Plastic Waste Management in Kuala Lumpur

## 4.2 Key Policies and Regulations

### 4.2.1 National Policies and Legislation

At the national level, Malaysia's Roadmap towards Zero Single-Use Plastics (2018-2030) provides a national vision towards zero single-use plastics for a cleaner and healthier environment in Malaysia by 2030<sup>22</sup>. It provides policy directions to all stakeholders including State Governments to ensure a unified and collective approach.

The Roadmap also provides opportunities for the local businesses to adopt new, eco-friendly solutions that could encourage penetration into a broader global market as the world shifts towards adopting and producing more circular plastic good and processes. This Roadmap is a living document which will be updated periodically and as necessary in accordance with national policies. The actions it includes can be seen in **Table 7**.

<sup>22</sup> <https://www.pmo.gov.my/ms/2019/07/pelan-hala-tuju-malaysia-ke-arrah-sifar-penggunaan-plastik-sekali-guna-2018-2030/>

Year	Action Plan
<b>Phase 1 (2018 – 2021)</b>	
<b>2018</b>	<ul style="list-style-type: none"> <li>Official launching of Roadmap towards Zero Single-Use Plastics in October 2018.</li> <li>Nationwide stakeholder engagement in drafting the CEPA program led by KPKT.</li> <li>KPKT to publish a guideline for Local Authority/PBT on the licensing requirement to implement the pollution charge collection.</li> <li>Workshop to be conducted for all PBTs regarding single-use plastics and the mechanism and implementation of pollution charge in cooperation with Penang State Government.</li> <li>To establish institutional framework and governance structure for the implementation of the Roadmap.</li> <li>To establish a dedicated secretariat to coordinate, monitoring and to facilitate the implementation of the Roadmap.</li> <li>SIRIM Berhad to lead the revision of ECO001 criteria document to include only biodegradable and compostable products and excluding photo and oxo-degradable. New ECO001 criteria document to be published.</li> <li>Technical guidelines on biodegradable and compostable products for State Governments.</li> <li>R&amp;D funding on alternative eco-friendly products.</li> </ul>
<b>2019</b>	<ul style="list-style-type: none"> <li>No straw by default practice where straw is given by request with no charge. Will be implemented in fixed premises (See page 14 of the Roadmap).</li> <li>Local government authorities nationwide to utilise compostable garbage bag for garden waste collection.</li> <li>Customers encouraged to bring their own food container or the food business operator at fixed premises (as per page 14) will sell food containers that complies ECO001 and ECO009 to replace polystyrene and plastic food packaging.</li> <li>States will impose a pollution charge at a minimum of RM0.20 for plastic bags. Nationwide implementation by end of 2021. Each state will decide the implementation time (from 2019 till 2021); Applicable to fixed premises as per page 14; and Plastic bags will be sold as SKU product with barcode. (Note: The above is the minimum standard notwithstanding the right of States to take action that is more protective for addressing plastic pollution).</li> <li>Expand Bionexus equivalent status and other incentives to ECO001 resin manufacturers and ECO009 product manufacturers.</li> <li>Rapid testing kit for ECO001 compliant material (starch-base) introduced.</li> <li>Review existing laws/develop legal framework on single-use plastics.</li> <li>Develop a regional marine debris project for external funding such as Global Environment Fund (GEF) to be implemented in Phase II.</li> <li>A comprehensive CEPA program developed and deployed by KPKT.</li> </ul>
<b>2020</b>	<ul style="list-style-type: none"> <li>A Circular Economy Roadmap (CER) for plastics including bottles launched by 2020 to be implemented in Phase 2.</li> </ul>
<b>2021</b>	<ul style="list-style-type: none"> <li>Technical workshop in developing capacity of all stakeholders in implementing CER.</li> </ul>

Year	Action Plan
<b>Phase 2 (2022 – 2025)</b>	
<b>2022</b>	<ul style="list-style-type: none"> <li>Widespread uptake of bio bag nationwide replacing plastic bags and sold as SKU item.</li> <li>No straw by default' practice continues and extended to non-fixed premises. SKU ECO001 straw (bio straw) will be introduced including straws for packet drinks.</li> <li>Expansion scope of biodegradable and compostable products: Food packaging; Plastic film; Cutleries; Food container; Cotton buds; Polybags and plant pots; and Slow release fertilizers.</li> <li>Implementation of CER for plastics including bottles and other single-use product.</li> <li>Implementation of minimum pollution charge on plastic bags continues and extended to non-fixed premises by 2025.</li> <li>The Federal Government will impose a pollution levy to manufacturers of plastic bags.</li> <li>The pollution levy collected will be managed in a transparent manner. The fund will be used for redressing plastic pollution, research and development (R&amp;D) on eco-friendly alternatives, incentives to manufacturers and CEPA activities.</li> <li>R&amp;D funding on alternative eco-friendly products.</li> <li>Rapid testing kit for ECO001 compliant material (PHA and other products) developed.</li> <li>Introduction of legal framework on single-use plastics.</li> <li>Implementation of a regional marine debris project.</li> </ul>
<b>2023</b>	<ul style="list-style-type: none"> <li>A mid-term review of this Roadmap will be conducted and a report will be published.</li> <li>Experiential learning integrated into the education system.</li> <li>Review CEPA's implementation by KPKT.</li> </ul>
<b>Phase 3 (2026 – 2030)</b>	
<b>2026 - 2030</b>	<ul style="list-style-type: none"> <li>Substantial increase in the volume of production of local biodegradable and compostable alternative products for local consumption.</li> <li>Expansion scope of biodegradable and compostable products: Single-use medical devices (e.g. catheter); Diapers &amp; feminine hygiene product; and Other single-use plastics that cannot enter the circular economy.</li> <li>R&amp;D funding on alternative eco-friendly products.</li> <li>Rapid testing kit for ECO001 compliant products deployed.</li> <li>CEPA program continues.</li> </ul>
<b>2030</b>	<ul style="list-style-type: none"> <li>An implementation report of the Roadmap will be published.</li> </ul>

**Table 7**

Key commitments of the Roadmap towards Zero Single-Use Plastics in Malaysia

In addition, there are some additional national policies related to waste management in Malaysia. The Cabinet approved the National Solid Waste Management Policy 2006 (NSWMP 2006) aiming to develop a national SWM system that is comprehensive, integrated, cost effective, sustainable and acceptable by the community, which reduces waste generation through 3Rs.

In 2016, the National Solid Waste Management Policy 2016 was announced to upscale the same principle as NSWMP 2006 with enhanced initiatives to increase 3R activities to include waste separation at source, pay-as-you-throw and deposit refund system. It includes 17 strategies and 50 actions with various policy instruments including information and awareness raising, regulation, institutional capacity, economic mechanisms as well as infrastructure and services<sup>23</sup>.

The Solid Waste and Public Cleansing Management Act 2007 (Act 672) was passed by the Parliament and gazetted in August 2007 regulating the management of solid waste to ensure standardized and high quality SWM services based on the waste hierarchy. The Act is effective throughout Peninsular Malaysia, Federal Territory of Putrajaya and Labuan and implemented in phases. Currently, the Act is implemented in the states of Kedah, Perlis, Pahang, Negeri Sembilan, Melaka, Johor, the Federal Territories of Kuala Lumpur and Putrajaya.

Act 672 is administered and enforced by the Director-General of Solid Waste and Public Cleansing Management under the Ministry of Housing and Local Government (JPSPN) and the SWCorp statutory body established on 1 June 2008. The Solid Waste and Public Cleansing Management Corporation Act 2007 (Act 673) was passed in 2007 establishing the Solid Waste Management and Public Cleansing Corporation (SWCorp) to manage the operational and implementation issues. The main result of the Act is the federalization of SWM from local authorities. Further relevant waste management policies and laws are summarised in **Table 8**.

<sup>23</sup> [https://hrmars.com/papers\\_submitted/6567/Linking\\_the\\_Malaysias\\_Solid\\_Waste\\_Management\\_Policy\\_Instruments\\_with\\_Household\\_Recycling\\_Behavior1.pdf](https://hrmars.com/papers_submitted/6567/Linking_the_Malaysias_Solid_Waste_Management_Policy_Instruments_with_Household_Recycling_Behavior1.pdf)

Objective	Actions
<b>Solid Waste Corporation Strategic Plan, 2014-2020</b>	
The plan aims to strengthen and enhance solid waste management services and national public cleansing as well as driving hygienic culture to achieve the mission making Malaysia a country that have a clean environment by 2020.	<b>Strategy 1:</b> Transformation Of Societal Minds Towards Environmental Hygiene Culture
	<b>Strategy 2:</b> Solid Waste Management Towards Sustainable Environment
	<b>Strategy 3:</b> Continuous Service Improvement, Technology And Solid Waste Facilities
	<b>Strategy 4:</b> Empowering Enforcement of Actions And Regulation
	<b>Strategy 5:</b> Strong Financial Resources
	<b>Strategy 6:</b> Increased Research And Development
	<b>Strategy 7:</b> Empowering Corporate Image And Systems Organization Delivery
<b>National Cleanliness Policy, 2020 - 2030</b>	
This strategy aims at making Malaysia a clean country and building a community that adopts the practice of cleanliness to assure people's well-being and environmental sustainability.	<b>Cluster 1:</b> Awareness of Cleanliness (1.1: Enhance the Culture of Cleanliness; 1.1.6: Encourage society to reduce the use of plastic bags; 1.2: Promote the Practice of Cleanliness at Home, Workplace, Educational Institutions and Public Areas; 1.2.3: Promote cleanliness awareness programs and 3R practices in educational institutions)
	<b>Cluster 2:</b> Environmental Sustainability (2.1: Optimize Cleanliness Quality; 2.2: Improve Solid Waste Management Mechanisms)

**Table 8**

Other relevant national policies and laws

When it comes to the specific waste management targets in Malaysia, the National Strategic Plan for Solid Waste Management (NSP) was formulated by the Ministry of Housing and Local Government in 2005 to serve as a guide in planning and allocating resources based on national priorities in line with the vision for Malaysia to achieve a fully developed country status by 2020<sup>24</sup>.

The NSP stresses the importance of waste reduction at source of production influencing the “Zero Waste” as a long-term commitment while setting out a number of key measures for implementation over the immediate term, such as the preparation of a Waste Minimization Master Plan.

Level of service	In 2005	2003 - 2009	2010 - 2014	2015 - 2020
1. Extend waste collection service	75%	80%	85%	90%
2. Reduction and recovery	3-4%	10%	15%	17%
3. Closure of dumpsites	112 sites	50%	70%	100%
4. Source separation	None	20%	80%	100%

**Table 9**

Solid waste management service targets in the National Strategic Plan for Solid Waste Management in 2005

The Malaysian government also has introduced some other policies and laws related to sustainable development that are also relevant in order to address the plastic waste and marine litter in the country.

<sup>24</sup> [https://jpspn.kpkt.gov.my/resources/index/user\\_1/PSP/Ringkasan\\_Eksekutif/ExecSum-Final%20Report.pdf](https://jpspn.kpkt.gov.my/resources/index/user_1/PSP/Ringkasan_Eksekutif/ExecSum-Final%20Report.pdf)

Policies/ Acts	Relevance to Marine Plastic Pollution
<b>National Policy on Environment, 2002</b>	The policy statement sets out the principles and strategies necessary to ensure that the environment remains productive, both ecologically and economically. The National Policy on Environment is based on eight principles that harmonize economic development goals with environmental imperatives
<b>Environmental Quality Act 2012 (Act A1441)</b>	“Pollutant” means any natural or artificial substance, whether in a solid, semi-solid or liquid form, or in the form of gas or vapor, or in a mixture of at least two of these substances, or any objectionable odor or noise or heat emitted, discharged or deposited or is likely to be emitted, discharged or deposited from any source which can directly or indirectly cause pollution and includes any environmentally hazardous substances; [subs. Act A953:s.2].
<b>National Physical Plan-3 (NPP-3)</b>	The goal of the 3rd NPP is to achieve a viable country resilient to ensure growth sustainable and sustainable after 2020. It emphasizes on sustainable development and planning as the main principle in achieving a country that resilient and habitable in 2040.
<b>11th Malaysia Plan 2016-2020</b>	Green growth was a fundamental shift in the Eleventh Malaysia Plan, 2016-2020, in how Malaysia views the importance of environmental resources in its socio-economic development, while maintaining both development gains and biodiversity. The enabling environment must be improved to pursue green growth — especially in terms of the policy and regulatory system, human capital, green technology investment and financial instruments
<b>National Policy on Biological Diversity, 2016-2025</b>	The National Policy on Biological Diversity 2016-2025 provides the direction and framework for the nation to conserve the biodiversity and use it sustainably in the face of the increasingly complex challenges. The policy has five overarching goals encompassing stakeholder empowerment, reducing pressures on biodiversity, safeguarding ecosystems, species and genetic diversity, ensuring fair and equitable sharing of benefits from the utilization of biodiversity and building the capacity of all stakeholders

**Table 10**

Other relevant policies and acts

## 4.2.2 City Policies and Legislation

Given that waste management in Malaysia is largely under the remit of national government, there are a limited number of local policies addressing plastic waste management and marine litter at the city level. The Kuala Lumpur Structure Plan (KLSP) 2020 - 2040, however, sets a framework for the spatial planning and development of Kuala Lumpur for the next 20 years. It focuses on transforming Kuala Lumpur as the capital of Malaysia to a climate-smart and low-carbon city by adopting a holistic, inclusive, equitable, livable and sustainable approach. One of the strategies aims to strengthen integrated sustainable solid waste management including implementing sorting of solid waste by putting in place recycling facilities at the local level, enhancing management of solid waste in construction and industrial sectors and conducting activities for value-added by-product recovery from municipal solid waste.

Another strategy concerns improving drainage systems to ensure waste are diverted from nearby waterways. The Kuala Lumpur Drainage Masterplan addresses river engineering, flood risk and pollution management for city waterways. The Kuala Lumpur Local Plan 2030 presents development targets across six themes: economic sustainability, inclusive community, city greening beautification, low carbon city, efficient mobility and integrated land management.



Beyond these measures, Alam Flora Pvt Ltd, has worked together with SWCorp to promote awareness to minimize waste generation and indiscriminate waste disposal. Malaysia's Ministry of Federal Territories has promoted the use of biodegradable plastic in 2016 to reduce the high cost plastic waste management through encouraging its citizens to bring reusable bags when shopping in Kuala Lumpur, Putrajaya and Labuan. In tandem with the roadmap, starting 15 March 2019, the ministry imposing a pollution charge of RM 0.20 (about US \$ 0.48)<sup>25</sup> in Federal Territories per unit for the distribution of biodegradable plastic bags, while enforcement actions are continued against traders and hawkers who were still using conventional plastic bags.

As the last effort to prevent solid waste including plastic waste from flowing outside Kuala Lumpur into the sea, a total of 368 Gross Pollutant Traps (GTP)--362 installed by DID and 6 by KLCH--and a total of 32 log booms, 18 established by DID and 14 by KLCH, have been set up in various drainage sites across Kuala Lumpur.

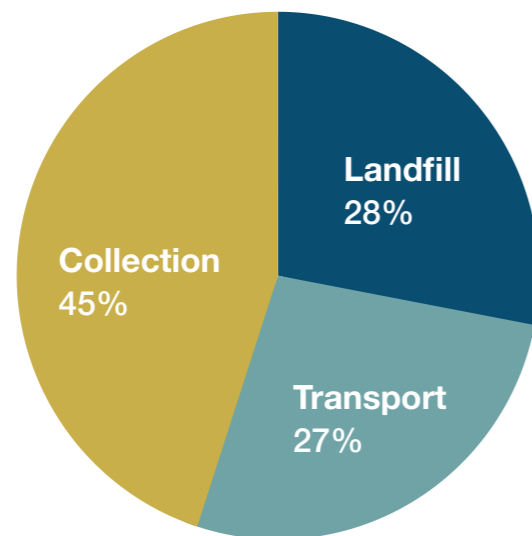
<sup>25</sup> <https://www.thestar.com.my/metro/metro-news/2019/11/01/ensuring-accountability-in-20sen-plastic-bag-charge>



### 4.3 Financial Capacity

Delivering sound solid waste management services and maintaining financial sustainability of the waste system has led to financial challenges for Kuala Lumpur. The cost of Kuala Lumpur solid waste management is divided into two parts, 60% from SWcorp and 40% from KLCH<sup>26</sup>. The estimations shows that total costs for solid waste management in Malaysia is about 148 RM/ tonnes/ day<sup>26</sup>. This is not including the costs for recovery and treatment, which is expected to be at least 250 RM/ tonnes/ day according to the same study. The Federal government and Kuala Lumpur City Hall (KLCH) cover the full cost for solid waste service in Kuala Lumpur.

It is important that all service users pay at least some proportion of the total costs of waste management service, either directly (through charging to the household) or indirectly (via property tax, communal service charges or a utility bill or a component of a utility bill linked to water/wastewater or electricity bills). It was learnt from the city hall that the cost recovery from households is less than 25% when compared to commercial and other institutions (between 50% - 74%). However, the collection cost is different based on type of premises and based on assessment rate of property (payment biannually, bank in or walk in).



**Figure 28**

Budget allocation for waste management activities in Kuala Lumpur<sup>26</sup>

<sup>26</sup> [https://www.kpkt.gov.my/resources/index/user\\_1/Attachments/hebahan\\_slider/slaid\\_dapatan\\_makmal.pdf](https://www.kpkt.gov.my/resources/index/user_1/Attachments/hebahan_slider/slaid_dapatan_makmal.pdf)

### 4.4 Digital Readiness in Kuala Lumpur

Promoting information and communications technology (ICT) uptake and high-tech business is an important policy goal in Malaysia. As the centre for the country's digital economy, Kuala Lumpur has developed strong technology infrastructure and high human resource capacity. Over time the government has provided significant incentives for digital development from the formation of the Multimedia Super Corridor (MSC) in 1996 to the Digital Free Trade Zone established in 2017. Kuala Lumpur City Hall aims to be a fully electronic, paperless governing body in line with the Public Sector ICT Strategic Plan 2016-2022. It has equipped with many digital technologies, such as GIS, AVLS, CCTV, SWIMS (Solid waste information management system) and Traffic control system (ITIS).

Among them, SWMIS aims to establish a Smart Bin System<sup>27</sup> to make it easier to alert contractors to collect garbage when the bin is full, which will save time and resources, increase productivity and reduce operating costs. Proper location tracking of bins helps to improve the efficiency of the waste collection process, as well as to enhance overall public hygiene as the sensor system helps to prevent garbage overflow from the bin. Electricity usage is also reduced from incorporated solar panels that help to activate the sensors and associated LED displays while also minimizing carbon dioxide emissions as contractors only collect garbage when necessary.

<sup>27</sup> [https://www.ur-net.go.jp/overseas/AseanSmartCityNetwork/lrmhph00000162t5-att/KUALA\\_LUMPUR.pdf](https://www.ur-net.go.jp/overseas/AseanSmartCityNetwork/lrmhph00000162t5-att/KUALA_LUMPUR.pdf)



# CHAPTER 5

CLOSING THE LOOP ON PLASTIC POLLUTION  
IN KUALA LUMPUR, MALAYSIA

## Conclusions and Recommendations

P100 **Management-Level Recommendations**

P106 **Policy-Level Recommendations**

## CHAPTER 5

# Conclusions and Recommendations

Selected policy actions and infrastructure interventions are outlined in this section inline with the Plastic Pollution Calculator and suggested guidance discussed in previous sections of this report. The following actions have been identified based on their potential to address key pollution sources, problematic plastic items, different transportation pathways, accumulation hotspots (plastic sinks), seasonality / time dependence and other factors.

In addition, supporting evidence for selected interventions is based on a comprehensive literature review on existing policy and engineering strategies proposed or implemented at the global level comprised under the scope of prevention and plastics pollution abatement. In sum, the following interventions are linked to the scientific evidence based and tailored to address the plastic pollution situation within Kuala Lumpur.

## 5.1 Management-Level Recommendations

### 1. Reduce the Generation of Plastic Waste

The generation of plastic waste in Kuala Lumpur is influenced by community knowledge and varying perceptions on different waste management practices for reducing disposal volumes. Interventions to address this include:

- Providing Smart Bins in lower income areas to support alternative sources of income generation.
- Mapping locations of formal and informal recycling centres in Kuala Lumpur and disseminating this information online.
- Organizing information and awareness campaigns to encourage the reduction of single-use plastic bags/ containers and associated packaging among small businesses, retailers, restaurants, hawkers and other SMEs.
- Encouraging and rewarding small businesses, retailer, restaurants, hawkers and other SMEs for making use of alternatives to plastic packaging.
- Increasing the number of formal and informal recycling centres based on area population.



## 2. Reduce Littering/ Improve Street Sweeping

Littering was highlighted as the largest emission source in Kuala Lumpur, accounting for 64% of all plastic emissions. Interventions to address this include:

- Establish a sufficient network of public litterbins and provide frequent evacuation of bins. Litterbins shall be provided at regular intervals in streets where there are many pedestrians and where there are no community bins into which passers-by can drop unwanted items.
- Place signboards alerting polluters on fines for littering. Introduce fixed penalty notices on littering incidents.
- Establish comprehensive and targeted street sweeping to remove any littered items and promote clean living environment.
- Organise awareness and education campaigns around littering, including community clean up campaigns.

## 3. Reduce Fly-Tipping

After littering, fly-tipping was found to be the second largest source of plastic emissions into the environment at 15%. Interventions to address this include:

- Place signboards alerting polluters on fines for fly-tipping. Introduce fixed penalty notices on fly-tipping incidents.
- Perform regular clean-up of fly-tipping sites and if possible install surveillance to catch perpetrators.
- Establish free or affordable collection of bulky household items for residents.
- Ensure cooperation between the local authority and private land owners for prevention and clean-up of fly-tipping.

## 4. Improve Storage Containers for Multi-Family Dwellings

Leakage whilst waste is waiting for collection was estimated as the joint second highest emission source of plastic in Kuala Lumpur after littering and alongside fly tipping, accounting for 15% of emissions. These emissions were found to be primarily from communal containers used in multi-family dwellings. This was due to it being calculated that multi-family dwellings are likely in some cases to become full or begin to overflow, particularly on the days waste is not collected. Additionally, whilst the containers are largely of reasonable quality some aspects could be improved such as ensuring waste is as isolated as possible, with no access to the waste for flies, animals, wind and rain.

A well-fitting lid can be effective for these purposes, provided that the lid is kept closed most of the time. As seen in the photos of **Figure 18**, many of the 660 litre communal containers are seen to have lids left permanently open in Kuala Lumpur. It is noted that ensuring that a lid remains closed when not in use may be difficult to achieve in practice, especially if the container is used by many people, however, other container types such as below ground storage may offer a potential solution.

## 5. Provide Dedicated Recycling Containers for Single-Family Dwellings

Although the estimated plastic emissions of recyclable waste from single-family dwellings whilst waiting for collection was calculated as small, this is largely due to the practice not being widespread within Kuala Lumpur. If formal collection of recyclables from single-family dwellings is encouraged, the provision of dedicated waste storage containers will help ensure the recyclables remain secure.

At present, plastic bags are used to hold recyclables until their collection, however, plastic bags are easily torn open by dogs and cats, and sharp objects can easily pierce them to cause injury to the person who is carrying them or release waste into the street. Instead, the use of larger and more durable containers can be supplied to keep the waste more secure during storage and allow easier loading on to collection vehicles, thereby reducing plastic emissions.

## 6. Target High Emission Plastics - Such as Plastic Bags, Other Plastic Film, Drink Bottles and Single-Use Food Service Plastics

The plastic emissions to the environment in Kuala Lumpur have been shown to be dominated by plastic bags (46%), other plastic film (16%), single use food service plastics (14%) and plastic bottles (11%). This is due to both being generated in large amounts, and also being susceptible to leakage into the environment either by accidental means (e.g. plastic bags blowing off waste containers), or deliberate means (e.g. littering). Potential interventions to address these troublesome plastic items could therefore significantly reduce plastic pollution and include:

- Introduce bans where possible on the troublesome plastic items such as plastic bag.
- Introduce a tax or levy on the troublesome items. The tax referred to customer charges for the targeted single-use plastic products or taxes paid by the stores that sell them.
- Assess the availability of alternatives to consumers such as paper bags/containers, reusable bags/bottles, biodegradable bags/containers, etc. and ensure that there are preconditions for their uptake in the market.
- Encourage the uptake of reusable plastic items such as refillable plastic bottles and coffee cups and reusable plastic bags.
- Sign a voluntary agreement with the retail sector to encourage them to take measures that reduce their distribution of these troublesome plastic items.
- Introduction of an extended producer responsibility (EPR) scheme or deposit return scheme to fund clean-up activities or discourage littering, even on voluntary basis.

## 7. Ensure All Storm Drains are Covered

Many of the storm drains within Kuala Lumpur are open to the environment, particularly those on small side streets and in some residential areas. These open drains allow plastic items to enter them easily and transport them into nearby waterways becoming marine litter, with 97.1% of leakage believed to be transferred by the Klang River. Possible interventions to reduce this pathway include:

- Storm drains can be enclosed (e.g. under the street) or provided with covers to inhibit plastic waste entering them.
- Regular drain cleaning should be undertaken to remove any waste that has entered the drain, particularly before periods of heavy rainfall. Provision should also be provided to prioritise the drain locations particularly susceptible to waste entering and perform more regular clean up here.
- Litter traps may be placed within the drainage network. If positioned at key points before entry into the river, any plastic that may have entered the drains may be stopped from becoming marine litter. These however are unsuitable by themselves and should be combined with regular manual clean up activities.
- Ensure street sweeping activities do not sweep their waste into the storm drain as a timesaving method but instead clean up any accumulated waste from within the storm drains.

## 5.2 Policy-Level Recommendations

### 1. Moving from Policies to Actions

While there are some national and local efforts to address the plastic pollution and marine litter, such as National Roadmap towards Zero Single-Use Plastics and No Plastic Bag Day Campaign, the challenge is how to effectively translate these into actions and results on the ground.

This requires strong cooperation and coordination between the Federal Government, State Governments and relevant waste management agencies and enforcement that are efficient is necessary to ensure the maintenance of cleanliness at the highest level apart from leading to an increase in social awareness. Kuala Lumpur is encouraged to develop a Plastic Waste Management Action Plan with time-bound implementation plan and a clear monitoring and evaluation mechanisms.

### 2. Authorization of Waste Minimization, Circular Economy and 3Rs

In line with the national and city aspirations to achieve a Material Cycle Society and circular economy, waste minimization activities and 3R (reduce, reuse and recycle) principles are systemized and effectively embedded in the actions of government, private sector and residents of Kuala Lumpur. Efforts to realize transformation from a linear economy to a circular economy should be based on the principles of reduce, reuse and recycle and be extended to all industrial sectors, carried out with a view towards minimizing solid waste generation at source and maximizing the use of resources, with the greater aim of reducing carbon dioxide emissions and air pollution in the ambient environment. The shift to greater circularity in the industrial sector can also encourage the promotion of a green economy both by reducing and reusing waste that is generated. An integrated approach is needed across all stages of the waste management cycle from segregation at source and collection to resource recovery and final disposal. As mandated under national and local policies and plans, waste minimization and 3R actions should be promoted to significantly reduce the amount of waste to be disposed of at final disposal sites, which in turn will reduce public expenditures and associated health and environmental risks. Keys to success include the segregation of waste at source, providing collection points for collecting recyclable items, and encouraging the development of recycling facilities in close proximity to designated residential, industrial, commercial and government areas.

In carrying out the management plastic waste, resource recovery, recycling and treatment facilities need to be established in partnership with private sector. The selection of technologies should be based on the proper guidelines and standards to ensure that they are well aligned with local capacities and conditions. Moreover, government should lead efforts aimed at encouraging industrial actors to adopt circular economy principles, including by manufacturing products using recycled waste as raw materials and from recycled materials (upcycling), providing rewards or incentives and promoting the use of recycled goods in government procurement projects.



### 3. Quality and Skilled Human Capital

Ensuring that skilled labour is available is another critical element associated with supporting government efforts to address plastic pollution and marine litter in Kuala Lumpur. Government efforts aimed at enhancing the image of sanitation workers as well as working to promote positive work ethics in the sector will help in producing quality and skilled workers. Developing in-house capacity is therefore essential. Actions may include establishing a center of excellence for plastic pollution and marine litter, enhancing professionalism and the competency of waste workers, improving the perception and image of workers through the provision of proper attire as well as carrying out regular performance monitoring, among others.

In addition, local authorities can foster strategic partnerships to promote human capital development by engaging with educational institutions as well as other relevant stakeholders, both local and foreign. Similarly, a code of work ethics may be developed in order to set guidelines for enhancing job performance and professionalism and improve productivity and quality of workers through continuous learning.



### 4. Public Participation and Consultation

The wider public plays an important role in maintaining the cleanliness of the environment. Kuala Lumpur alone cannot meet the challenge of addressing plastic pollution and marine litter. It requires the cooperation and commitment of society as a whole. Community participation needs to be ensured through information, education and communication campaigns to enhance citizens' awareness of 3Rs and better SWM. Awareness should start from the practice of cleanliness at home, workplace, education institutions and "no littering" in public places. Once a city plans new actions to address plastic waste, communities should be fully consulted and their views need to be reflected in the plan.

This may include assurance of proper operation and management of the site by the local bodies, and development and implementation of social programs from which local communities can benefit. Introducing appropriate methods for waste segregation and collection also requires close consultation with and collaboration from communities so that their needs are incorporated into the arrangements. Actions may include creating a platform for cooperation between government, NGOs and civil society stakeholders in order to strengthen city-led cleanliness programs and awareness campaigns while also enhancing Corporate Social Responsibility (CSR) to guide private sector-led cleanliness activities in surrounding areas.

## 4. Cost Recovery

Currently, Federal Government and Kuala Lumpur share the cost of solid waste management. The total will continue to increase with the increase of waste generation. Thus, increasing income and reducing costs are important. Kuala Lumpur is collecting an SWM service charge through various measures, including by imposing a surcharge on property and business taxes, and charging direct fees on households and bulk waste generators, though these have proven inadequate for efficient operations. Initially, the focus will be on increasing the coverage of fee collection rather than increasing the level of the fee, and the fee should be commensurate with the level of service provided.

Later, a gradual fee increase could be considered in association with improvements in the level of service so that operation and maintenance costs are fully recovered first. Reduction in expenditures on SWM is equally important, and city should review their existing practices to identify cost-saving measures and implement Extended Producer Responsibility (EPR). Encourage the involvement of industry to implement Extended Producer Responsibility (EPR) through the creation of EPR Roadmap as a guide and reference for stakeholders, introduce the Reverse Vending Machine (RVM) to encourage recycling and create a platform for engagement sessions between the government and industry, NGOs and educational institutions.

## 5. Encourage Private Sector Participation

The limited private sector participation in SWM and recycling in Kuala Lumpur to date has yielded mixed results; therefore, waste management still viewed as a government-led responsibility rather than a green growth market opportunity. While plastic waste recovery and recycling activities hold great business potential, private sector engagement is currently focused on downstream activities, particularly recycling and treatment of plastic waste, which constrains operational efficiency and cost effectiveness of plastic waste management.

However, major capital investment by the private sector in SWM may remain a challenge in the current context due to the limitations and shortcomings at the subnational level, such as uncertainty of the legal framework, inconsistent implementation of regulations, low fees, and lack of reliable data, access to start-up liquidity and accounting for lifecycle cost, *inter alia*. Kuala Lumpur requires additional technical and policy support for conducting competitive bidding; establishing appropriate scope and performance specifications in contracts; assessing qualification requirements of private sector companies, and monitoring performance in accordance with the provisions of specified contracts.





## 6. Use of Digital Tools, Data Management, Updating and Dissemination

There is also a need to establish a centralized solid waste database in order to better inventory feedstock resources, assess the capacity and level of implementation of different waste management facilities, create a mechanism to ensure data tracking and reporting on a real time basis to support stakeholders with making informed decisions on waste management actions and activities. The Plastic Pollution Calculator featured under this project provides useful data and information on the state of plastic waste management in Kuala Lumpur, which can be applied to plastic waste management planning. Kuala Lumpur should establish proper institutional and support mechanisms including the allocation of appropriate budget to regularly update baseline data, track changes and assess implementation.

Some of the key performance indicators (KPIs) for plastic waste management, which may include waste generation rates, separation, collection efficiency, rate of resource recovery and recycling, efficiency of SWM charges, and rate of cost recovery, need to be identified and the accompanying data should be collected using a uniform methodology. Periodic updates of basic data on KPIs are also essential for monitoring progress. Dissemination of data through city newsletters and city's website will help the public and other stakeholders better understand the status of plastic waste management and enable comparisons over time and among municipalities. In order to ensure this database is effective and fit for purpose, SWCorp and JPSPN should be engaged in database development, management and maintenance with JPSPN given regular access to the database for extracting and analyzing relevant information.

# ANNEX

## CLOSING THE LOOP ON PLASTIC POLLUTION IN KUALA LUMPUR, MALAYSIA

Institution	Name	Position
<b>National Solid Waste Management Department (JPSPN)</b>	Puan Nor Ain Fazlina bt Saari	Assistant Director, Policy and Strategic Division, National Solid Waste Management Department
	Puan Sharfeyney binti Sazali	Principal Assistant Director, Policy and Strategic Division, National Solid Waste Management Department
<b>Kuala Lumpur City Hall (KLCH)</b>	Puan Norhayati binti Mat Said, Focal Person for KLCH	Environmental Control Officer, Health and Environment Department, KLCH
	YBrs. En. Nor Azman Suboh	Deputy Director, Civil Engineering & Drainage Department
	En. Shahrul Hafizi bin Abdul Raawi	Environmental Control Officer, Health and Environment Department, KLCH
	Puan Nurazyan	Environmental Control Officer, Health and Environment Department, KLCH
<b>Solid Waste and Public Cleansing Management Corporation (SWCorp)</b>	YBrs. Ir. Zulkifli bin Tamby Chik , Focal Person for SWCorp	Director of Department of Research and technology
	En. Abdul Nazib bin Halid	Engineer, Department of Research and technology
<b>Department of Environment (DOE)</b>	YBrs. Tuan Azlan bin Ahmad	Director of Kuala Lumpur Department. DOE
	Puan Norliza yen	Officer, Kuala Lumpur Department. DOE
<b>Department of irrigation (DID)</b>	Puan Norhidayah binti Abu Hassan	Officer, River Basin Management, DID
<b>Urbanice Malaysia</b>	YBrs. Dr. Azmizam bin Abdul Rashid	Deputy CEO, Urbanice Malaysia
	Puan Sarifah Yaacob	Subject matter expert, Urbanice Malaysia
	Dr. Mohd Hafiyyan bin Mahmud	Senior Executive, Urbanice Malaysia
	Hamsareka Thevadass	Data analyst, Urbanice Malaysia

### Annex A

List of participants from the Data verification workshop

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