



# Clean Ports, Clean Oceans: Improving Port Waste Management in the Philippines

Solid Waste Management Baseline Study  
Manila North Port





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# Acronyms

<b>AMH</b>	AMH Philippines, Inc.
<b>COBSEA</b>	Coordinating Body on the Seas of East Asia
<b>DENR</b>	Department of Environment and Natural Resources
<b>DOST</b>	Department of Science and Technology
<b>DOTC</b>	Department of Transportation and Communication
<b>DOTr</b>	Department of Transportation
<b>DPS</b>	Department of Public Services
<b>DWT</b>	Dead Weight Tonnage
<b>EMB</b>	Environmental Management Bureau
<b>EO</b>	Executive Order
<b>FGD</b>	Focused Group Discussion
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit
<b>GRaSPS</b>	Green, Resilient and Smart Port Strategy
<b>Grieg</b>	Grieg Star Group AS
<b>GT</b>	Gross Tonnage
<b>ha</b>	Hectares
<b>HDPE</b>	High Density Polyethylene

<b>HME</b>	Harmful to Marine Environment
<b>IMO</b>	International Maritime Organization
<b>IPB</b>	Isla Puting Bato
<b>ITDI</b>	Industrial Technology Development Institute
<b>km</b>	Kilometer
<b>km2</b>	Square Kilometer
<b>LDPE</b>	Low Density Polyethylene
<b>LGU</b>	Local Government Unit
<b>m</b>	Meter
<b>m2</b>	Square Meter
<b>m3</b>	Cubic Meter
<b>MARINA</b>	Maritime Industry Authority
<b>MARPOL</b>	International Convention for the Prevention of Pollution from Ships
<b>MC</b>	Memorandum Circular
<b>MEPC</b>	Marine Environment Protection Committee
<b>MNHPI</b>	Manila North Harbour Port Incorporated
<b>MRF</b>	Materials Recovery Facility
<b>MSW</b>	Municipal Solid Waste
<b>NPCC</b>	National Pollution Control Commission
<b>NPOA</b>	National Plan of Action on Marine Litter
<b>NSWMC</b>	National Solid Waste Management Commission
<b>OC1</b>	Operations Center 1
<b>OC2</b>	Operations Center 2
<b>PCG</b>	Philippine Coast Guard
<b>PD</b>	Presidential Decree
<b>PET</b>	Polyethylene Terephthalate
<b>PMO</b>	Port Management Office
<b>PP</b>	Polypropylene
<b>PPA</b>	Philippine Ports Authority
<b>PS</b>	Polystyrene
<b>PSA</b>	Philippines Statistics Authority
<b>PT</b>	Passenger Terminal
<b>PTC</b>	Passenger Terminal Complex
<b>PVC</b>	Polyvinyl Chloride
<b>RA</b>	Republic Act
<b>RAP MALI</b>	Regional Action Plan on Marine Litter
<b>RoRo</b>	Roll-on/Roll-off
<b>SDG</b>	Sustainable Development Goals
<b>SLF</b>	Sanitary Landfill
<b>SRF</b>	Shore Reception Facilities
<b>SUP</b>	Single-Use Plastics
<b>SWM</b>	Solid Waste Management
<b>SWMP</b>	Solid Waste Management Plans
<b>TEU</b>	Twenty-footer Equivalent Units
<b>VMLS</b>	Vitas Marine Loading Station
<b>UN</b>	United Nations
<b>UNDP</b>	UN Development Programme
<b>UNEP</b>	UN Environment Programme
<b>WACS</b>	Waste Analysis and Characterization Study
<b>WaCT</b>	Waste Wise Cities Tool
<b>WOBVIF</b>	Waste On-Board Vessel Information Form
<b>WWF</b>	World Wide Fund for Nature



# INTRODUCTION

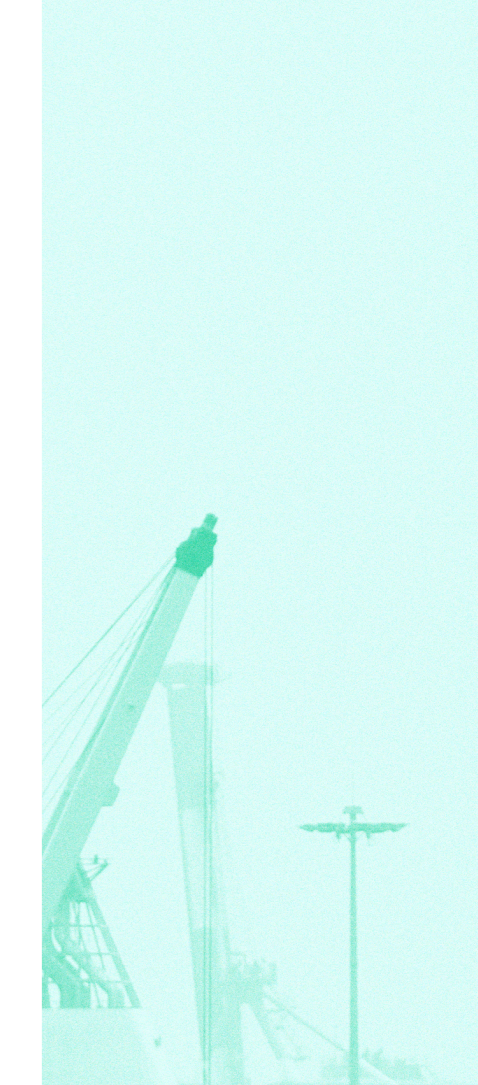
This report presents the results of the conducted baseline study for the Manila North Harbor (Figure 1), which includes a waste analysis and characterization study (WACS), and a port- and community-generated waste flow analysis.

In October 2020, the World Wide Fund for Nature Philippines (WWF-Philippines) and the World Wide Fund for Nature Norway (WWF-Norway) started the project “Clean Ports, Clean Oceans: Improving Port Waste Management in the Philippines”, funded by the Grieg Foundation to help address the issue of plastic pollution in Philippine ports. The project is implemented in partnership with a private sector entity, the Grieg Group (Grieg). WWF-Philippines then contracted AMH Philippines, Inc. (AMH) to conduct baseline studies at select Philippine ports – Manila North Port, Port of Batangas, and Cagayan de Oro Port (Figure 1). AMH is also tasked to conduct a national baseline study.

Port-generated wastes pertain to solid waste generated from port facilities and offices operating in the port area. Community-generated wastes refer to solid waste generated by households in adjacent communities.



Figure 1. Manila North Harbor and the Select Ports of Study (Google Earth, 2021)





## Background of the Study

The Sustainable Development Goals (SDGs) is a campaign of the United Nations (UN) to address the challenges the humanity is currently facing on a global scale. Many SDGs directly relate to waste management and sustainable development such as SDGs 11, 12, 14 and 17.

**SDG 11 – Sustainable Cities and Communities** seeks to make cities inclusive, safe, resilient, and sustainable. One of its global targets is that by 2030, the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management, has reduced (United Nations, 2021).

**SDG 12 – Responsible Consumption and Production** has a goal to ensure sustainable consumption and production patterns. This also aims that by 2030, waste generation are substantially reduced through prevention, reduction, recycling, and reuse (United Nations, 2021).

**SDG 14 – Life Below Water** aims to conserve and sustainably use the world's ocean, seas, and marine

resources. One of its targets is to prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution. An estimate of 5 to 12 million metric tons of plastic enters the ocean every year, which costs roughly US\$ 13 billion per year for clean-up costs and financial losses in fisheries and other industries. About 89% of plastic litter found on the ocean floor are single-use items like plastic bags (United Nations, 2021).

**SDG 17 – Partnership for the Goals** strives to strengthen the means of implementation and revitalize the global partnership for sustainable development. One of its specific targets is to promote the development, transfer, dissemination, and diffusion of environmentally

sound technologies to developing countries on favorable terms, including technologies with regards to waste management (United Nations, 2021).

Plastic pollution is the most widespread problem affecting the marine environment. It threatens ocean health, food safety, human health, and tourism.

The geographical distribution of marine plastic debris is strongly influenced by the entry points and the different transport pathways, which are in turn determined by the density of plastic debris coupled with prevailing currents, wind, and waves (Rech, et al., 2014). Wastes coming from ports, vessels and the communities near the coast have a greater chance of polluting the marine environment than other waste sources.

Despite the provisions of the MARPOL and the Republic Act (RA) 9003: The Ecological Solid Waste Management Act of 2000, there are still large amounts of solid wastes present within the Philippine marine water bodies. Around 2.7 million tons of plastic waste are generated in the country each year with about 20 percent of it ending up in the ocean (McKinsey & Company, 2015) making the Philippines the third largest contributor of plastic wastes into oceans (Jambeck, et al., 2015).



## Objectives of the Study

The main objectives of this selected ports study are to determine proper and scientifically based recommendations to achieve the 50% target reduction of plastic waste leakages and to provide baseline data against which to monitor progress towards the reduction of plastic leakages.

The project specifically aims to provide the garbage generated per passenger, per facilities, per vessel and per deadweight tonnage<sup>1</sup> (DWT) or gross tonnage<sup>2</sup> (GT) data; to develop the waste flow diagrams for port/vessel/community-generated wastes; to provide the data on volume of wastes coming from ports, vessels, and communities and on the recovered and disposed volumes at end points and possible leakage points; and to document the current management of waste, especially plastic waste, in ports in the Philippines. The present study is for the Manila North Harbor.

<sup>1</sup> Deadweight is the unit of measure of how much weight a ship can carry (Philippine Ports Authority, 2021)  
<sup>2</sup> Gross tonnage is the volume of all enclosed spaces of a ship (Philippine Ports Authority, 2021)







## PORT DESCRIPTION

The Manila North Harbor in Manila City is one of three major facilities that compose the Port of Manila, the other two being Manila International Container Terminal (MICT) and Manila South Harbor. It is the biggest and primary port in the Philippines for domestic cargoes (World Port Source, 2021). It is located in Tondo, Manila along the periphery of Manila Bay, a Class SB marine water that has an area of around 2,000 km<sup>2</sup> and bordered by Metro Manila, Cavite, Bulacan, Pampanga, and Bataan (DENR, 2017). Manila North Harbor can be accessed by land from gates along the southbound side of Radial Road 10. It may soon be accessed directly from the North Luzon Expressway (NLEX) upon the completion of the NLEX-Harbor Link (NLEX Corporation, 2020). Other proposed projects such as the the NLEX-Cavite Port Expressway Link

will connect the port to the southern area of Metro Manila (DPWH, 2021). The Pier 4 Station under the LRT-2 West Extension Project will allow a rapid transit option into the port area (Reyes, 2020).

Adjacent to the south of Manila North Harbor are Barangay 20 and Barangay 275 (Section II.F). A community registered under Barangay 29 (Section II.F) is in the main Manila North Harbor port facility.

In Barangay 275, households found above water are to the south side facing the mouth of Pasig River. The other end of Pasig River is connected to Laguna de Bay, the largest lake in the Philippines. Pasig River and its tributaries traverse multiple cities across Metro Manila. The 25-kilometer-long river is a Class C water body.

## History

The Port of Manila predates the Spanish occupation of the Philippine islands and goes back to as early as the 9th Century with the Port of Manila facilitating trade with China, Japan, India, and modern Malaysia and Indonesia. (World Port Source, 2021).

Manila North Harbor (MNH), a component port of the Port of Manila, began its development in 1937. Operations of the port were briefly halted during the escalation of World War II in which the whole Port of Manila was subjected to extensive damage. (De Leon, 1940)



# Physical Description and Facilities

The port has eight piers – numbered as even numbers from 2 to 16 – and four Roll-on/Roll-off<sup>3</sup> (RoRo) ramps located at Pier 2, Pier 4, Pier 10, and at the Marine Spillway. It has a developed terminal area of about 81.4 ha with an annual capacity of 2.2 million twenty-foot equivalent units (TEUs)<sup>4</sup>. There are 41 berth positions within the port and has a total berth length of 3,919.52 m (Figure 2) (Manila North Harbor Port, Inc., 2021).



Figure 2. Berth Position in Manila North Harbor (Manila North Harbor Port, Inc., 2021)

The port also offers ancillary services needed by port users such as bunkering, watering, weighbridge operations, parking, and other services complementary to port operations (Figure 3). The port's passenger terminal management includes the operations and management of passenger terminal facility to ensure passenger comfort, safety, and security to and from vessels (MNHPI, 2018).



a. Cargo Handling Services



b. Berth Management



c. Ancillary



d. Passenger Terminal Management

Figure 3. Services of MNHPI (Manila North Harbor Port, Inc., 2021)

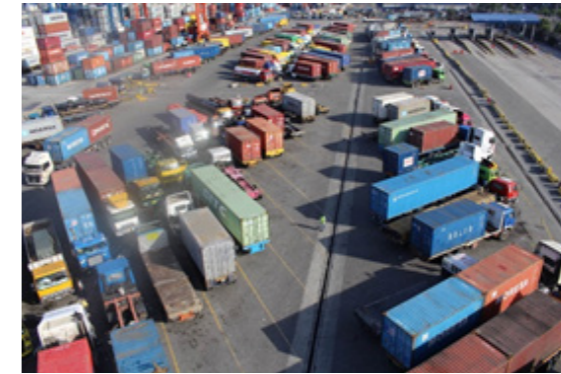
<sup>3</sup> Roll-on/Roll-off (RoRo) are specially designed vessels for carrying trailers, cars and other rolling equipment which is discharged through the bow or stern ramps or both (Philippine Ports Authority, 2017).  
<sup>4</sup> TEU is the unit of measurement equivalent to a container's length of 20 ft. It is often used to express the capacity of container ships or container terminals (Philippine Ports Authority, 2017).



a. Operations Center 1 (Terminal 1)



b. Operations Center 2 (Terminal 2)



c. Truck Holding Area



d. Container Yard



e. MNHPI Hiring Hall



f. Passenger Terminal



g. Berth Space



g. Weigh Bridge Area

Figure 4. Manila North Harbor Facilities (MNHPI, 2018)

The facilities within the port consist of Operations Center 1 (OC1), Operations Center 2 (OC2), weigh bridge areas, truck holding areas, container yards, hiring hall, passenger terminal complex (PTC) and berth space for ships (Figure 4).

There are two terminals in the port: Terminal 1 and Terminal 2. Terminal 1 is located at the north end of the port, in Pier 4, where its key facilities are the OC1, container yard, and berth space for ship-to-shore crane operation. Terminal 2 is situated at the south end of the port and its key facilities are the OC2 and modern passenger terminal complex which caters to RoRo and

vessel passengers. Both terminals have truck holding and weigh bridge areas.

OC1 includes the corporate office of Manila North Harbour Port, Inc. (MNHPI), shipping lines office, and the Philippine Ports Authority (PPA) satellite office; while, OC2 is houses the shipping lines operating within the area.

## Waste Value Chain in the Manila North Harbor

The whole system of plastic waste management in the Manila North Harbor is governed by laws, policies, regulations, and ordinances implemented by various institutions (Section II.F, Figure 5) including those set by the International Maritime Organization (IMO) and by the local government unit where the port is located. For the case of the Manila North Harbor and its adjacent communities, they are under the jurisdiction of the local government unit (LGU) of Manila City.

Port administration for all ports in the

country including the Port of Manila was initially covered by the Bureau of Customs for the revenue collection part, and the, then, Bureau of Public Works for the port maintenance. In 1975, the Philippine Ports Authority (PPA) was created under Presidential Decree No. 505 and Executive Order No. 159 to manage the administration, financing, operations, and maintenance of the ports (Philippine Ports Authority, 2021). This was expanded by Presidential Decree No. 857 (Kritz, 2020) under the Build-Operate-Transfer Law of 1994. The PPA has signified its intent

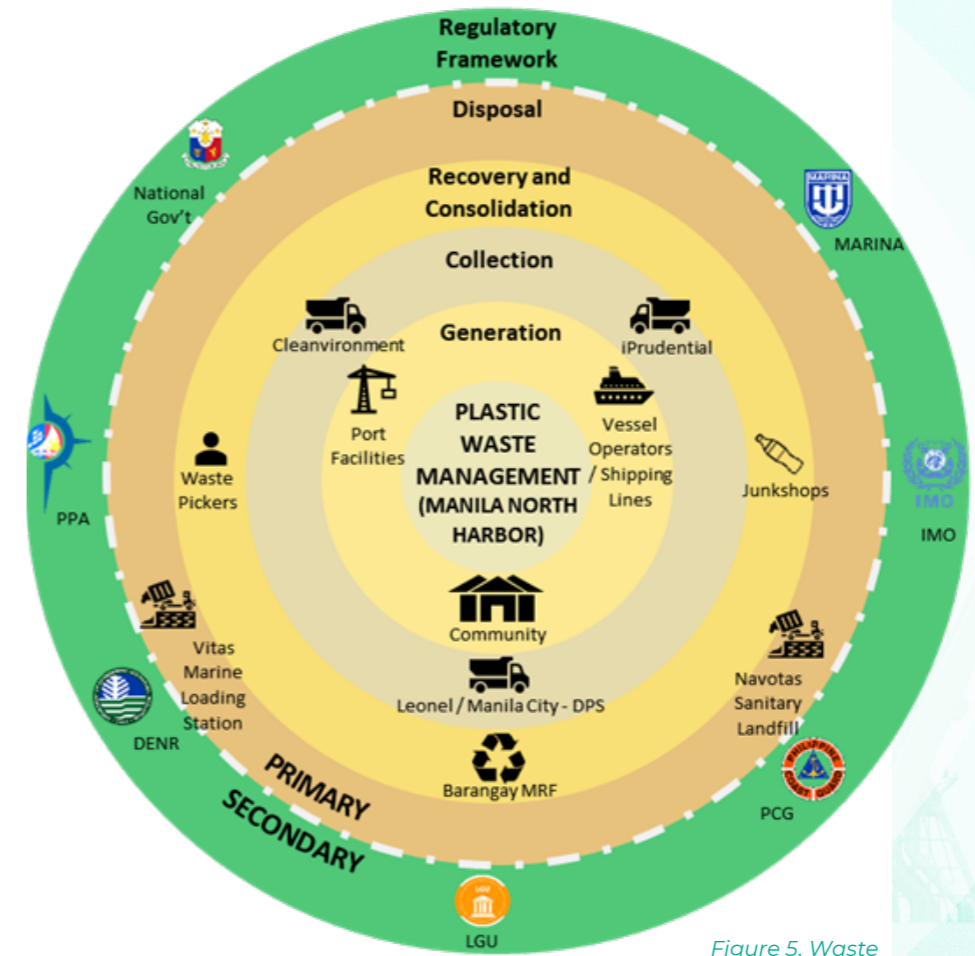


Figure 5. Waste Management System and the Involved Stakeholders

to avail the Coordinating Council for Private Sector Participation technical assistance in the undertaking of the North Harbor Privatization Project (CCPSP, 1999). The Manila North Harbour Port Inc (MNHPI) then entered a 25-year contract with by the PPA in November 2009 to develop, manage, operate, and maintain the Manila North Harbor. (PPA, 2013).

The management of wastes in Philippines ports such that port-related and vessel-related activities do not heavily impact the surrounding marine ecosystem is being handled by the Department of Environment and Natural Resources (DENR). The Maritime Industry Authority (MARINA) also assists the national government in terms of the plastic waste management system at the Manila North Harbor and other Philippine ports by enforcing compliance of the ports with safety standard and other regulations – including the policies in handling vessel-generated wastes; while, the Philippine Coast Guard (PCG) ensures marine environmental protection. The National Pollution Control Commission (NPCC), which is now part of the Environmental Management Bureau (EMB), is



also responsible for managing marine pollution (Presidential Decree No. 979, 1974).

The port is currently operated by the Manila North Harbour Port, Inc. (MNHPI), which is co-owned by International Container Terminals Services Inc. (ICTSI) and San Miguel Corporation (SMC). MNHPI handles all types of inter-island vessels and domestic cargo trade and offers the following services: cargo handling services, berth management, ancillary services, and passenger terminal management (Figure 3). Cargo handling services include stevedoring, arrastre, and other related services. Berth management includes berth allocation and vessel movement, which ensures maximized utilization of terminal facilities and efficient vessel turn-around time.

Communities of mostly informal settlers are also found within the port (Section II.F) and contribute to the wastes that are generated within the port area. These communities have volunteers trained to improve the waste segregation and collection in their respective areas that was initiated by ICTSI (Section III.B.6).

The main sources of plastic wastes in this port are the port facilities composed of offices, container yards and passenger terminals, vessel operators and shipping lines that dock at the port, and communities in and adjacent to the port area. 2Go Group Inc., Asian Marine Transport Corporation, Buena Ocean Ferry Services Inc., CSL Shipping, Oceanic Container Lines Inc., and Moreta Shipping Lines, Inc. are among the

vessel operators and cargo handlers within the Manila North Harbor.

Wastes generated at the Manila North Harbor are collected separately by three service providers (Section III.C.3): iPrudential Stevedoring and Port Services Inc. (iPrudential), Cleanenvironment Waste Management Services Inc. (Cleanenvironment), and Leonel Waste Management (Leonel). iPrudential collects all vessel-generated wastes; Cleanenvironment handles all port-generated wastes coming from port facilities and Barangay 29 collected at various collection points; and, Leonel is under contract with the Manila City LGU to collect municipal solid waste across the whole city, which includes Barangay 20 and 275.

Janitorial personnel of MNHPI also collect wastes – specifically, PET Bottles – and are allowed to sell them (Section III.C.4). Informal waste pickers are in Barangay 20 since there is no MRF present in the area. As part of ICTSI Foundation’s Parola Solid Waste Management Project, Barangay 29 and 275 have residents that are trained to ensure proper waste management and cleanliness in their respective barangays. The program was started in 2013 (ICTSI Foundation Inc., 2020).

Philippine Ecology Corporation (PHILECO) is involved with the solid waste management at the Port of Manila and Manila City. PHILECO manages both the 3-ha transport station – the Vitas Marine Loading Station (VMLS) – in Vitas, Tondo, Manila and the Navotas Sanitary Landfill (SLF, Section III.C.5).



## Cargo Tonnage

**MNHPI caters to majority of the domestic vessels and cargo in Manila (ICTSI, 2021)**

The port received more than 4,300 domestic ship calls<sup>5</sup>. It handles more than 27.5M metric tons of cargo throughput<sup>6</sup> and more than 1.4M TEUs of container traffic (Philippine Ports Authority, 2021). All these numbers have then decreased in 2020 (Table 1) possibly due to stricter travel restrictions imposed across the country during the Covid-19 pandemic.

**Table 1. Manila North Harbor Statistics (Philippine Ports Authority, 2021)**

Statistic	2018	2019	2020	2021 (Q1)
Shipping Calls	4,468	4,380	3,892	882
Cargo Throughput (MT)	27,505,038	27,861,039	8,709,216	4,353,787
Container Traffic (TEU)	1,447,098	1,470,216	1,227,033	323,668
RoRo Traffic	1,256	379	63	8

<sup>5</sup> Ship calls refer to the number of vessels which call or arrive at a particular port at any given time (Philippine Ports Authority, 2021).  
<sup>6</sup> TEU is the unit of measurement equivalent to a container’s length of 20 ft. It is often used to express the capacity of container ships or container terminals (Philippine Ports Authority, 2017).

# Passenger Traffic

Manila North Harbor receives an annual passenger traffic of more than one million domestic passengers (Philippine Ports Authority, 2021). This has, however, declined to around 275,000 passengers in 2020 as the Covid-19 forced both the national and local authorities to impose travel restrictions across the country (Table 2).

**Table 2. Passenger Traffic of Manila North Harbor from 2018 to First Quarter of 2021 (Philippine Ports Authority, 2021)**

Passenger	2018	2019	2020	2021 (Q1)
Disembarked	535,087	582,717	132,371	15,771
Embarked	518,006	550,158	143,651	17,850
Cruise Ships	0	0	0	0
<b>Total</b>	<b>1,053,093</b>	<b>1,132,875</b>	<b>276,022</b>	<b>33,621</b>

# Communities

Manila North Harbor is adjacent to two barangays: Barangay 20 and 275 with a portion of Barangay 29 located inside the MNHPI Port Facility.

Population from Barangay 20 and 275 represent 3.5% of the total population of Manila City (PSA, 2020) (Table 3).

**Table 3. Total Population of Barangays in the Vicinity of MNH (PSA, 2020)**

Passenger	2018	2019	2020	2021 (Q1)
Disembarked	535,087	582,717	132,371	15,771
Embarked	518,006	550,158	143,651	17,850
Cruise Ships	0	0	0	0
<b>Total</b>	<b>1,053,093</b>	<b>1,132,875</b>	<b>276,022</b>	<b>33,621</b>

The wastes from Isla Puting Bato (IPB) in Barangay 20 and Barangay 29 in the port area shall be included in the produced Waste Flow Diagram for the port since these communities significantly contribute to waste generation and leakage of the MNH area and vicinity. Both areas are made up of majority low-income group households.

## Barangay 29

The portion of Barangay 29 that is in the port area is in the vicinity of Pier 6 near the MNHPI Hiring Hall and Philippine Coastguard Compound (Figure 1). The community is made up of approximately 80 families with an average of five members per family. The estimated population of this portion of Barangay 29 is 400, which is approximately 10% of the 2020 population of the whole Barangay 29 (PSA, 2020). According to a resident, a lot of the families here are currently raising children. Some of the residents in Barangay 29 also work in the port container yard and facilities. The rest of the Barangay 29 is located outside of Manila North Harbor.

The Barangay 29 compound in the port is around 3,000 m2 in area and is located between two roads utilized for port operations (Figure 6). Access to the community is restricted by MNHPI and PPA security since the community is in the vicinity of port facilities for container operations. This restriction of access proves to be a challenge for Barangay 29 to receive any support from its barangay LGU for concerns.



Figure 6. Barangay 29 compound in Manila North Harbor last October 21, 2021

Households here do not have septic tanks nor sewerage lines. Run-off and sewage generally end up in the storm drains connected to the drains of the port. The compound does not experience flooding and is around 100 m from the coastline of the port.

## Barangay 20

Across the piers of Manila North Harbor is the Isla Puting Bato (IPB) Area – a community residing on the breakwater and adjacent to MICT to its southwest. This community is part of Barangay 20 with around 2,100 families and four to five members on average. The IPB community makes up roughly 20% of the total population of Barangay 20 (PSA, 2020).

Isla Puting Bato can be accessed from

the MICT North Access Road (Figure 7). There are two parallel main roads in Isla Puting Bato that is around 1.5 m wide in the narrowest sections, and 3 meters in the widest sections. The narrow sections of the roads in IPB only allows up to motorcycles to enter the community. One of the main roads in the area is adjacent to the northeast facing perimeter wall of MICT. The area is about 2.2 km-long with 900 m of which is breakwater (Figure 8).



Figure 7. Entrance to IPB Community last October 20, 2021

A significant number of households here are built on stilts above the water of Manila Bay. Households in the community range from two to three stories high and are built side-by-side leaving no open space in the area. The community is supplied by a water concessionaire, but there are a few hours when water is unavailable.

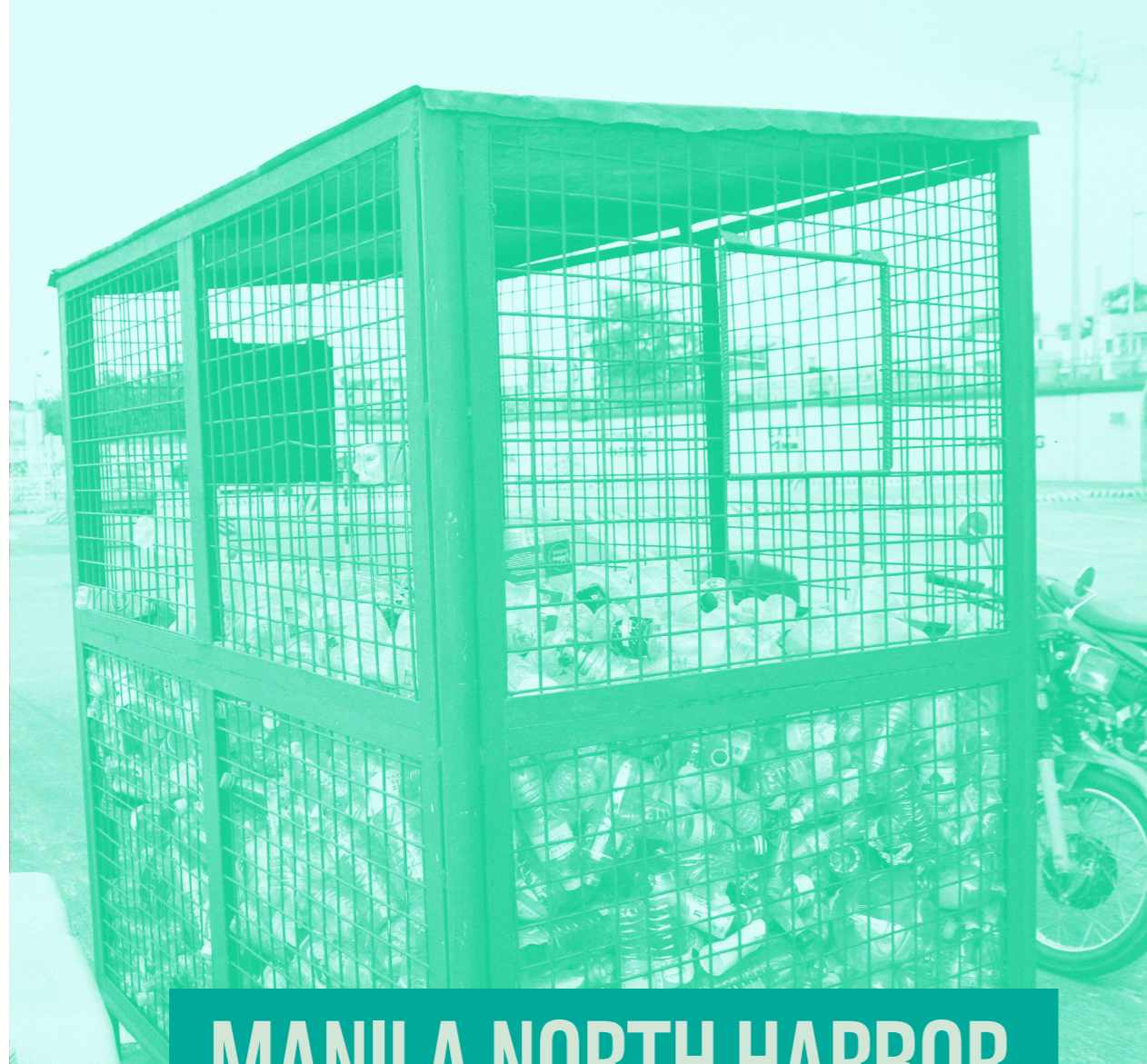
There are barangay laws and ordinances including “Tapat Mo, Linis Mo” and mandatory waste segregation in place, however compliance with solid waste management ordinances continues to be a challenge. According to an interview with a resident from IPB,

there is a mentality among residents that, because they are informal settlers, they are not required to maintain the cleanliness of their area. Seminars are conducted and attended by residents, but most are only motivated by incentives, such as free snacks, and do not actually practice lesson learned from the seminars.

The main environmental hazard of concern for the barangay are typhoons, which also carry rising tides. Flooding and high tides in the barangay cause evacuation of the residents and leave behind driftwoods and plastic wastes. The driftwoods left behind by rising tides are collected and used for making charcoal by residents near the breakwater portion of the area.



Figure 8. IPB Breakwater Area last October 20, 2021



# MANILA NORTH HARBOR SOLID WASTE MANAGEMENT

## International Policies and Laws

The International Convention for the Prevention of Pollution from Ships (MARPOL) and the London Convention and Protocol are among the legal efforts done internationally to address marine pollution.

MARPOL aims to prevent pollution from ships caused by operational or accidental causes and was adopted by the International Maritime Authority in 1973. Annexes I to V of MARPOL 73/78 was ratified in

the Philippines on 2001; while, the Instruments of Accession of the MARPOL Annex VI has been deposited to the International Maritime Organization (IMO) Secretary General on April 24, 2018 (Maritime Industry Authority, 2020). Amendments to the MARPOL were made through the Marine Environment Protection Committee (MEPC) with the latest amendment finalized in March 2020.

MARPOL Annex V, entitled “Regulations on Prevention of Pollution by Garbage from Ships,” completely bans the disposal of all forms of plastic into the sea (International Maritime Organization, 1988). Wastes discharged are also to be recorded following a set of categories (Table 4).

**Table 4. Garbage Categories Recorded in Ships (Marine Environment Protection Committee, 2016)**

Assigned Letter	Waste Category
A	<b>Plastics</b>
B	Food Waste
C	Domestic Waste
D	Cooking Oil
E	Incinerator Ashes
F	Operational Waste
G	Animal Carcasses
H	Fishing Gear
I	E-waste
J	Cargo Residues (Non-HME)
K	Cargo Residues (HME)

Plastics including synthetic ropes, fishing nets, and plastic bags are prohibited from being disposed outside and inside special areas<sup>7</sup>. This prohibition is to be applied to all vessels including fixed or floating platforms<sup>8</sup> and associated vessels based on MARPOL 73/78 Annex V.

The Garbage Record Book should be utilized to record the date, time, position of the ship, description of the wastes, and the estimated amount incinerated or discharged according to Annex V of MARPOL with the data to be kept for up to two years after the date of the last entry. The annex also states that only those cargo residues that cannot be recovered using commonly available methods for unloading could be considered for discharge. Cargo residue that contains substances that are harmful to the marine environment<sup>9</sup> (HME) must be taken to port reception facilities.

<sup>7</sup> Special areas under Annex V are the Mediterranean, Baltic, Black, Red, and North Seas areas and the Gulfs area (Maritime Industry Authority, 2020).  
<sup>8</sup> Fixed or floating platforms and associated vessels includes all fixed or floating platforms engaged in exploration, exploitation or associated offshore processing of seabed mineral resources, and all ships within 500m of such platforms (United States Coast Guard, 2014).  
<sup>9</sup> Harmful to Marine Environment (HME) is a designation for cargo residues containing hazardous chemicals, restricting release and discharge of these residues to the sea (Marine Environment Protection Committee, 2016).



The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known as the “London Convention and Protocol,” regulates what materials can be dumped at sea and what materials are not permitted.

Persistent plastics and other persistent synthetic materials are among the materials prohibited from being dumped into the sea as stated in Annex I of the London Convention and Protocol (Table 5).

**Table 5. Kinds of Waste Prohibited from being Dumped into Sea (London Convention and Protocol, 1972)**

<b>Annex I of the London Convention and Protocol</b>
Organohalogen compounds
Mercury and Mercury Compounds
Cadmium and Cadmium Compounds
<b>Persistent Plastics and Other Persistent Synthetic Materials</b>
Crude Oil and accompanying wastes
Radioactive Wastes or Other Radioactive Matter (Unless Contains Exempt Levels of Radioactivity as Defined by the International Atomic Energy Agency)
Materials Produced for Biological and Chemical Warfare
Substances that make Edible Marine Organisms Unpalatable, or Endanger Human Health or that of Domestic Animals
Industrial Waste

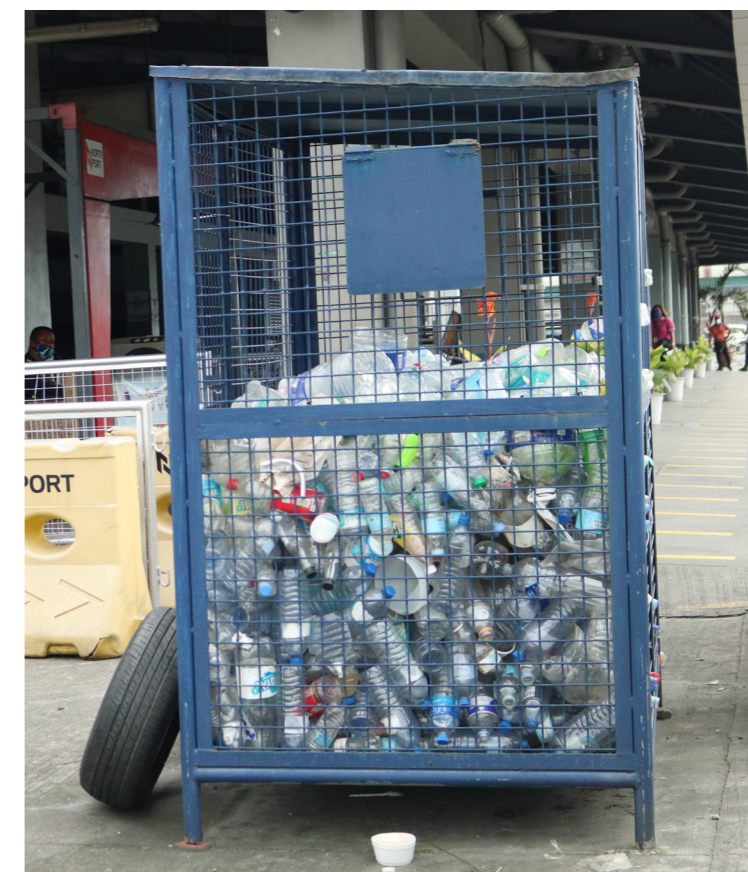
A wide range of land-based and sea-based activities is recognized by the IMO Action Plan to Address Marine Plastic Litter from Ships as the main entry modes of plastics to the marine environment; and, this was adopted by the MEPC in 2018. The plan highlights the negative effects of large plastic items, small plastic particles, and microplastics on biodiversity, marine life, and human health impacting fishing, shipping, and tourism. This plan then aims to build on the policies that have been established by MARPOL and the London Convention and Protocol with the agreed actions that affect ships and fishing vessels to be completed by 2025 (International Maritime

Organization, 2018).

The Coordinating Body on the Seas of East Asia (COBSEA) Regional Action Plan on Marine Litter (RAP MALI) was originally adopted at the 19th Intergovernmental Meeting of COBSEA in Cambodia in 2008. It focuses on enabling the participating countries<sup>10</sup> to deliver the targets of SDG-14 and to prevent and significantly reduce all kinds of marine pollution particularly from land-based activities including marine debris and nutrient pollution. The plan specifically aims to prevent and reduce marine litter, foster sustainable consumption and production considering a whole

lifecycle approach, remove existing marine litter through environmentally acceptable methods, improve monitoring and assessment of marine litter, enhance collaboration and awareness on the impacts of marine litter, and support existing efforts at the national level in coordination with regional and international cooperation (COBSEA, 2019). RAP MALI includes four critical actions: prevent and reduce marine litter from land-based sources, prevent and reduce marine litter from sea-based sources, monitor and assess marine litter, and support the implementation of COBSEA RAP MALI (Annex B).

The ASEAN Regional Action Plan for Combatting Marine Debris in the ASEAN Member States (ASEAN Regional Action Plan) was developed to provide a bold set of actions to tackle the plastic waste littering and marine debris issues in the ASEAN and aims to make the vision of a more sustainable approach to plastics a reality (ASEAN, 2021). It has four components namely policy support and planning, research innovation and capacity building, awareness, education and outreach, and private sector engagement. It also includes an implementation plan for the effective implementation of the regional action plan.



<sup>10</sup> The East Asian countries participating in the action plan are Cambodia, Indonesia, Malaysia, the People's Republic of China, the Philippines, the Republic of Korea, Singapore, Thailand, and Vietnam (COBSEA, 2008).





## Local

There are certain national, local, and port waste management policies, protocols, and laws the Manila North Harbor should abide with.

### Philippine Plans, Programs, Protocols, and Policies

For land-based sources of solid waste, RA 9003: Ecological Solid Waste Management Act of 2000 is the national law governing the implementation of a systematic, comprehensive, and ecological solid waste management plan down to the barangay level (Republic Act No. 9003, 2001) with the National Solid Waste Management Commission (NSWMC) as the government entity in-charge of properly implementing the rules and regulations (IRR) of the act. RA 9003 implements solid waste management from the national level to the local barangay level by outlining the responsibility at each level<sup>11</sup>. At the provincial level, municipal SWM plans are reviewed with coordination between LGUs encouraged where possible. At the city/municipal levels, a municipal

solid waste management (SWM) plan must be prepared, implemented, and monitored. At the local level, barangays are required to handle waste collection, to establish materials recovery facilities (MRFs), and to conduct educational campaigns and seminars (WWF Philippines, 2020). The currently being formulated Philippine Action Plan for Sustainable Consumption and Production (PAP4SCP) being led by the National Economic Development Authority (NEDA) and the currently being processed House Bill (HB) No. 6279: Extended Producers Responsibility for Plastic Waste Act introduced by Representative Rufus B. Rodriguez are expected to augment the provisions of RA 9003 through sustainable consumption and production (SCP) and recycling and

waste and chemicals management (Department of Environment and Natural Resources, 2021) and through addressing the collection of plastic wastes (Extended Producers Responsibility for Plastic Wastes Act, 2020), respectively.

For sea-based sources of solid waste, policy support is provided by Presidential Decree (PD) No. 979: Maritime Pollution Decree of 1976. PD No. 979 is a national policy to prevent and control the pollution of the seas that considers waste dumping and waste discharging into the marine environment unlawful. The National Pollution Control Commission (NPCC) – now the Environmental Management Bureau (EMB) – was empowered by this decree, along with the Philippine Coast Guard (PCG) to promulgate national rules and policies governing marine pollution.

For the management of all designated protected areas (PAs), RA 11038: Expanded National Integrated Protected Areas System Act of 2018 provides for the maintenance of essential ecological processes and life support systems and maintenance of their natural conditions to the greater extent possible. It prohibits the dumping of any waste products and leaving refuse or debris in ground or in bodies of water and provides for deputation of support for enforcement and inclusion of waste, sewerage, and septage management in PA management plans (Department of Environment and Natural Resources, 2021).

EO 533, Series of 2006: Integrated Coastal Management (ICM) Policy adapts user-fee schemes for waste management and inter-LGU cooperation as it promotes integrated waste management along with basin-wide management approaches, environmental protection measures at ports, and involvement of the private sector in ICM. EO 57, Series of 2011: National Coast Watch System established the coordination between agencies for maritime concerns and the National Coast Watch Council (NCWC) for the provision of strategies and policy directions to be carried out by the National Coast Watch Center (Department of Environment and Natural Resources, 2021).

<sup>11</sup> Levels include solid waste management boards at both the provincial and city/municipal levels, and barangay officials (Republic Act No. 9003, 2001).



The NSWMC Resolution No. 1441, Series of 2021: Resolution Adopting the National Plan of Action for the Prevention, Reduction, and Management of Marine Litter (NPOA-ML) resolved the issuance of appropriate documents for the

implementation and dissemination of the resolution on May 12, 2021. NPOA-ML has six strategies under its programmatic cluster of actions and four strategies under its enabling/cross-cutting cluster of actions (Table 6).

**Table 6. NPOA-ML Cluster of Actions (NSWMC Resolution No. 1441, Series of 2021)**

Strategy	Details
Programmatic Cluster of Actions	
Strategy 1	Establish science- and evidence-based baseline information on marine litter
Strategy 2	Mainstream circular economy (CE) and sustainable consumption and production (SCP) initiatives
Strategy 3	Enhance recovery and recycling coverage and markets
Strategy 4	Prevent leakage from collected or disposed waste
Strategy 5	Reduce maritime sources of marine litter
Strategy 6	Manage litter that is already existing in the riverine and marine environments
Enabling/Cross-Cutting Cluster of Actions	
Strategy 7	Enhance policy support and enforcement for marine litter prevention and management
Strategy 8	Develop and implement strategic and targeted social marketing and communications campaigns using various media
Strategy 9	Enable sufficient and cost-effective financing and other institutional resource requirements for the implementation of the NPOA-ML
Strategy 10	Strengthen local government unit (LGU) capacities and local level implementation of NPOA-ML

The NSWMC Resolution No. 1363: Resolution Directing the Department of Environment and Natural Resources (DENR) to Prepare and Implement the Banning of the Use of Unnecessary Single-Use Plastics by National Government Agencies (NGAs), Local Government Units (LGUs) Offices and Other Government Controlled Offices is a state policy on the adaptation of a systematic, comprehensive, and ecological solid waste management system which shall set the guidelines and targets for solid waste avoidance and volume reduction. Plastic cups of thickness

lower than 0.2 mm, plastic drinking straws, plastic coffee stirrers, plastic spoons, plastic forks, plastic knives, plastic labo, and thin-filmed sando bags are considered unnecessary single-use plastics (SUPs) under this resolution. As of 2019, there are 59 cities and municipalities, including Manila City, with ordinances on bans and/or regulations on plastic use (Figure 9).

These national plans, programs, protocols, and/or policies are then supplemented by memoranda and orders from PPA and PCG.

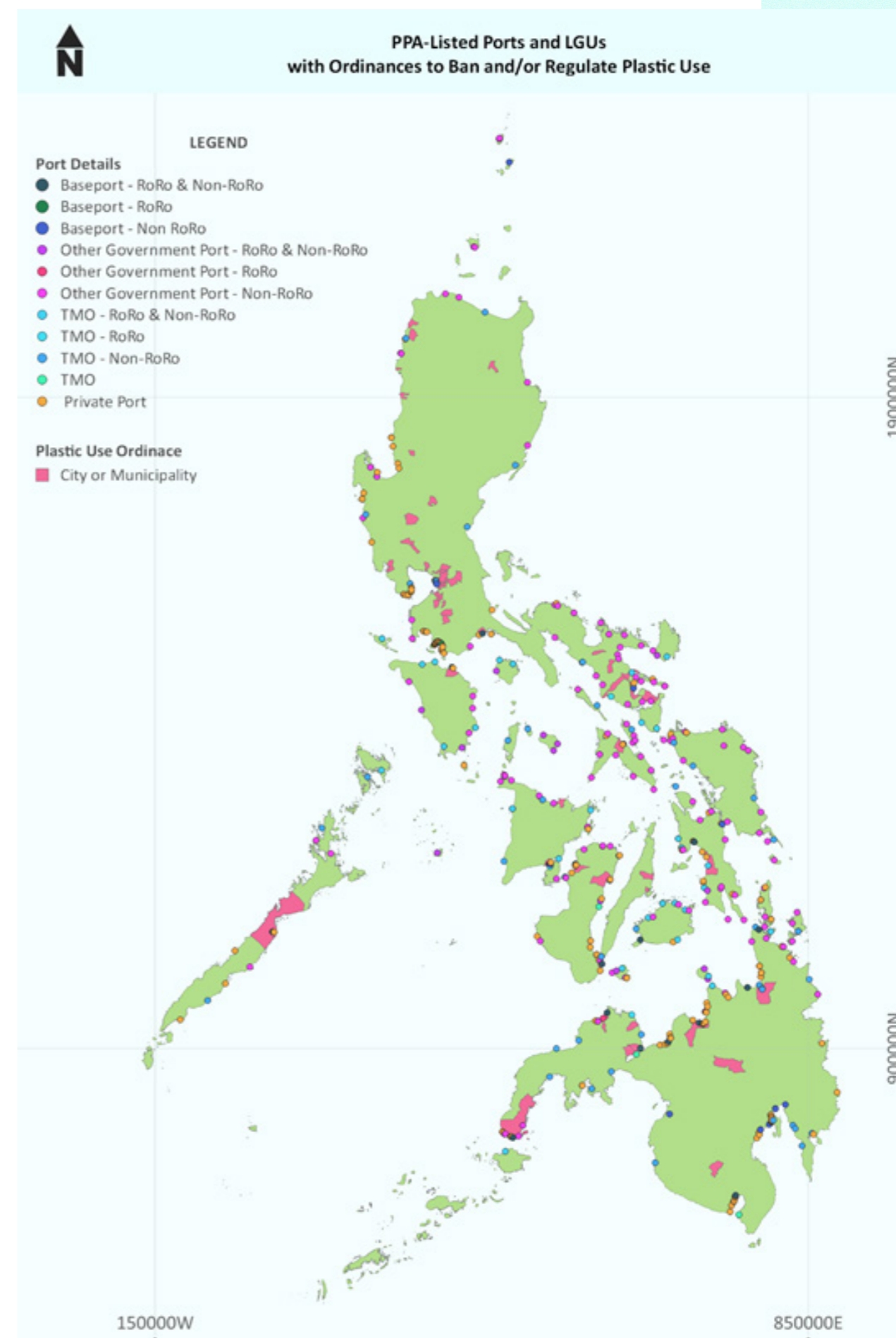


Figure 9. PPA-Listed Ports and the Cities and Municipalities with Plastic Bans and/or Regulations on Plastic Use (The Nerve, 2019; NAMRIA, 2020)

## PPA Memoranda and Orders

The PPA has around 10 memoranda and/or orders pertaining to solid waste management.

PPA Memorandum Circular (MC) No. 07-1995: Anti-Pollution Measures with the Port Zone aims to ensure clean, safe, and environmentally friendly port, to ensure effective enforcement of relevant regulations against pollution in the port, to extend all possible assistance to the Philippine Coast Guard (PCG) for the effective enforcement of PCG and PPA issuances against pollution in ports and harbors, and to undertake measures in ports designed to control pollution and promote protection of the port and environment. It has guidelines related to the IMO Regulations against the discharge of wastes and under pollutants, particularly MARPOL 73/78 and to the following PCG Anti-Pollution Regulations.

- PCG MC No. 01-91: Prevention, Containment, Abatement and Control of Marine Pollution
- PCG MC No. 02-91: Dumping and Discharges of Wastes and Other Harmful Matter at Sea

PPA Administrative Order (AO) No. 16-1995: Rules and Regulations on the Prevention/Control of Oil, Garbage, and Sewage Waste through the Use of Reception Facilities/Collection of Vessels Refuse applies to all foreign and domestic vessels calling at any government or private port within the jurisdiction of PPA. This AO aims to keep harbor clean and prevent/minimize the pollution of marine life through proper disposal of

vessel waste and to implement the provisions of MARPOL 73/78. It also includes guidelines on the mandatory disposal of waste at reception facilities and monitoring and inspection of certificates including the International Garbage Pollution Prevention Certificate (IGPPC).

PPA MC No. 29-2004: Guidelines to Implement the Solid Waste Management System in the PPA and Directing its Strict Monitoring and Compliance aims to maintain an environment-friendly and healthy working atmosphere in all areas within PPA jurisdiction, to instill environmental consciousness in the PPA, particularly through the proper solid waste management in all ports, to utilize environmentally sound methods and maximize the utilization of valuable resources and encourage resources conservation and recovery, to encourage all levels of PPA to contribute to national efforts on conservation and environmental protection through education, information dissemination and implementation of a workable waste management system, to ensure the proper segregation, collection, transport, storage, and disposal of solid waste, to reduce by 10% the volume of solid waste generated in all the PPA Responsibility Centers, to minimize operating costs by about 5% annually from the present level through conservation and austerity measures, to attain for PPA officials and employees, in particular, and for the port community, in general, a cleaner and healthier environment, and to encourage greater private sector participation in solid waste

management. It includes the classification of solid wastes: biodegradables, non-biodegradables, bulky wastes, and hazardous wastes, a 3-Step Solid Waste Management: sorting at source, packaging of wastes, and 3Rs – reduce, reuse, and recycle, the sanitary requirements for the segregation and storage of refuse/solid wastes, a matrix for solid waste management in PPA (Table 7), and reporting – semestral – and monitoring provisions.

**Table 7. Solid Waste Management Matrix Under PPA MC No. 29-2004 (Philippine Ports Authority, 2004)**

Waste Generation	Waste Discharge and Storage	Primary Collection	Communal Storage	Waste Discharge and Destination
<b>Paper</b> <i>all kinds of office paper, computer paper, newspaper, carton, corrugate or packing boxes</i>	Carton Boxes placed in each office	At Source: PPA official/employee  For Storage: Utility Worker	Garbage Receptacle with Tight Lid	Paper Mill
<b>Dry</b> <i>Recyclables aluminum soft drink cans and tabs, plastic bottle containers, plastic utensils, plastic or glass containers/bottles</i>	Blue Covered Bin in each office	At Source: PPA official/employee  For Storage: Utility Worker	Garbage Receptacle with Tight Lid	Factory
<b>Wet Garbage</b> <i>food scraps</i>	Red Covered Bin in each office	At Source: PPA official/employee  For Storage: Utility Worker	Compost Pit	Compost Pit or Garbage Dump



PPA MC No. 16-2005: Strict Implementation of PPA Administrative Order No. 02-2003 Entitled “Implementing Guidelines on MARPOL 73/78 Requirements for Shore Reception Facilities (SRF)” is in response to Civil Case No. 1851-99, an anti-sea pollution complaint against PPA and other co-defendant government agencies and to ensure full compliance to PPA AO. No. 02-2003. Under PPA AO No. 02-2003, Waste on Board Vessel Information Form (WOBVIF)<sup>12</sup> should be accomplished and submitted by the shipping agent/line/company when applying for berth and that sanctions for vessels that fail to dispose of the garbage into the reception facility, to discharge the oily waste or noxious liquid substance into the reception facility after PCG’s verification, and to pay the required fees be applied.

PPA MC No. 13-2009: Supplementary Guidelines on Waste Management and other Environment - Friendly Practices in PPA includes the following supplementary guidelines

in line with PPA MC No. 29-2004.

- Immediate practice of proper solid waste management, the most basic form of environmental responsibility
- Reduction of solid waste generation by fifty percent (50%) within the next six (6) months thru the full implementation of law on solid waste management
- Reduction by fifty percent (50%) the consumption of fossils fuels within two (2) years from the issuance of RA 774

PPA AO No. 07-2015: Guidelines on the Implementation of PPA Orange Book on Safety, Health, Environmental Management and Handling of Dangerous Goods is for the proper implementation of port safety, health and environmental management in PPA ports nationwide for the compliance and guidance of all port users/stakeholders. The PPA Manual on Port Safety, Health and Environmental Management (SHEM) or the PPA Orange Book is divided

into three parts: Book I – Safety and Health in Ports, Book II – Environmental Management in Ports, and Book III – Transport, Handling and Storage of Dangerous Goods in Ports. Book II includes provisions for collection of vessel wastes and for the installation of MRFs in PPA Head Office, PMOs, TMOs, CHOs/Terminal Operators.

PPA AO No. 08-2018: Interim Guidelines on the Issuance of Permit to Operate (PTO) for “Shore Reception Facilities (SRF)/Waste Disposal Service Provider ensures the continuity of providing SRF/waste disposal service in ports under the jurisdiction of the PPA.

PPA AO 05-2018: The Port Environmental Policy (PEP) complies with the following and aims to define the corporate directions of PPA in support of its policy and strategy on environmental protection and preservation in the pursuit of its mandate, to encourage and provide guidance to and where necessary compliance by port stakeholders in adopting environmental protection and preservation while doing business inside the ports, to provide a framework for the formulation and design of capacity-building courses consistent with environmental protection, preservation and management, and to provide the legal basis and effective enforcement of PPA’s programs, projects and activities to implement and sustain the Green, Resilient, and Smart Port Strategy (GRaSPS).

- PD No. 857: Providing for the Reorganization of Port Administration and Operation Functions in the Philippines, Revising Presidential Decree No. 5050 dated July 11, 1974, Creating the Philippine Ports Authority, by Substitution, and for other Purposes
- PD No. 1586: Philippine Environmental Impact Statement System
- RA No. 8749: The Philippine Clean Air Act of 1999
- RA 9275: The Philippine Clean Water Act of 2004
- RA 9003: The Ecological Solid Waste Management Act of 2000
- RA 9279: The Climate Change Act of 2009

<sup>12</sup> WOBVIF is a form filled up by the shipping agent of any vessel upon docking at a port and disembarkment of its wastes and is submitted to the SRF (Philippine Ports Authority, 2020).

- RA 6969: Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal
- United Nations Framework Convention on Climate Change (UNFCCC)
- Kyoto Protocol on Emission Reduction Targets
- 2015 Paris Agreement in the Evolution of UN Climate Change Regime
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
- 1996 London Protocol
- International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990
- Protocol on Preparedness, Response, and Co-operation to Pollution Incidents by Hazardous and Noxious Substances of 2000
- International Convention on the Control of Anti-Fouling Systems on Ships of 2001
- International Convention for the Control and Management of Ship's Ballast Water and Sediments of 2004

GRaSPS Framework hard infrastructure includes waste collection facilities such as sewer lines, drainage lines, waste collection/treatment facilities, and material recovery facilities; while, its soft infrastructure includes governance such as port rules and regulations, business processes and contract management that integrates environmental protection and preservation (Philippine Ports Authority, 2018).

PPA MC No. 19-2020: Collection of Ship Generated Wastes from Cruise and Passenger Ships aims to supplement the guidelines of the PPA in the collection and disposal

of wastes on board ships during Community Quarantine due to the COVID-19 pandemic and to report status of ships, information, type, and quantity of wastes received by SRF Provider.

PPA MC No. 11-2021: Ban on the Use of Unnecessary Single-Use Plastic Products is based on the NSWMC Resolution No. 1363 and is to be applied to all ports and port facilities under PPA, including all offices and establishments inside the ports. Reports on its implementation are to be submitted 30 days after issuance of the resolution and every month after.

## PCG Memoranda

The Philippine Coast Guard implements at least four memoranda in safeguarding the Philippines waters from solid waste.

PCG MC No. 02-2005: Prevention of Pollution by Garbage from Ship specifically mandates Philippine registered vessels and small crafts engaged in either domestic or international trade to abide by the rules in preventing pollution of Philippines waters. It explicitly states that any material made of plastic and any domestic, cargo-associated, maintenance and/or operational waster is considered unlawful to be disposed to any body of water in the Philippines. Vessels are mandated to dispose plastic garbage at respective port reception facilities.

PCG MC No. 01-2006: Rule Prohibiting the Dumping and Discharging of Wastes and Other Harmful Matters mandates the procedures and policies for proper dumping of wastes and other harmful materials into Philippines waters to prevent pollution. It covers offshore plants, ships, and any entity that is a source of marine pollution. The list of materials that is prohibited from being dumped found in Annex I of the memorandum is the same as those listed in the London Convention and Protocol.

PCG MC No. 02-2006: Marine Pollution Inspection/Apprehension Report is to prescribe the policies and procedure implementing the provisions of MARPOL and PCG rules and regulations. Commanders, marine environmental protection command, and coast guard district/station are made in charge of the inspection and apprehension of persons and entities causing marine pollution.

PCG MC No. 07-2014: Prevention of Pollution from Garbage aims to provide rules and regulations to prevent pollution from garbage within the Philippine maritime jurisdiction and to prescribe fines and penalties. Under this memorandum, it is unlawful for any person to dispose into any Philippine waterbody any material made of plastic and any domestic, cargo-associated, maintenance, and/or operational wastes. Any person found violating the policies and requirements of the circular are liable to pay the administrative fine of Php 50,000.00 without prejudice to civil and/or criminal action/s which the PCG may file against the violated whenever warranted.



## City Policies and Laws

The Manila North Harbor is in Manila City, which has an approved Solid Waste Management Plan for 2015 to 2024. City ordinances with regards to plastic waste management and segregation include bans on plastic bags for dry goods and requiring households and establishments to have waste bins to segregate biodegradable and non-biodegradable waste. Penalties are also imposed on improper waste

disposal in rivers, creeks, canals, and waterways. City Ordinance No. 7876 specifically prohibits the dumping and discharging of waste into Manila Bay, which also covers vessels. The following table outlines the city ordinances of Manila City involving solid waste management (Department of Public Services - Manila City, 2015).

**Table 8. Manila City Ordinances on Solid Waste Management (Department of Public Services - Manila City, 2015)**

Ordinance No.	Date Approved	Description
No. 8371	November 18, 2014	An ordinance providing an Environmental Code for the City of Manila
No. 8282	September 3, 2012	An ordinance banning the use of any form of plastic bags on dry goods and regulating its utilization on wet goods, as the use of polystyrene and similar materials as containers for “food, goods and other products” and providing penalties for violation thereof and for other purposes.
No. 8194	August 18, 2009	An ordinance amending section 3 of ordinance no. 7404, entitled “an ordinance covering solid waste disposal practices, including prohibition of open dumping in vacant lots or properties, in esteros and other water courses.”
No. 8174	November 21, 2008	An ordinance creating the Manila Emission Control System for motorize vehicles and providing penalties for smoke belching vehicles plying and traversing the territorial jurisdiction of the city of Manila.

Ordinance No.	Date Approved	Description
No. 7924	June 11, 1997	An ordinance prohibiting the dumping and discharging of garbage, refuse, sewer waste, debris, toxic waste and other pollutants from vessels, factories, commercial and industrial establishments, residential houses, and other structures into Manila Bay.
No. 7876	December 19, 1994	An ordinance requiring all resident of, and business within, the city of Manila to provide their homes and establishment with containers with which to segregate biodegradable and non-biodegradable garbage for composting and recycling, for the purpose of achieving and complying with the objectives and methods of the “zero-waste technology”, and providing penalties for violation thereof.
No. 7866	September 22, 1994	An ordinance penalizing the disposal of garbage, debris and other waste materials in rivers, creeks, canals, and waterways; providing penalties for violation thereof; allocating to the barangays 20% of the fine collected there from and other purposes.
No. 7853	June 10, 1994	An ordinance requiring the provision of garbage receptacles in all public utility vehicles in the City of Manila, providing for penalties for violation thereof, and Amending/repealing for the purpose ordinance no. 6747 and ordinance no. 7436
No. 7849	March 21, 1994	An ordinance amending section 4 of ordinance no. 7695 of the city of Manila referring to disposal of garbage, by providing a higher penalty for violation thereof and providing sub-sections thereto.
No. 7695	March 1, 1989	An ordinance prohibiting the disposal of garbage, trash, rubbish, and refuse in open, uncovered or unsealed containers; providing penalty for violation thereof; and for other purposes.

Ordinance No.	Date Approved	Description
No. 7510	June 5, 1974	An ordinance prohibiting scavenging and providing penalty for violation thereof.
No. 7484	October 10, 1973	An ordinance covering waste disposal practices, including prohibition of open dumping in vacant lots or properties, in estero and other water courses.
No. 7397	September 26, 1973	An ordinance prohibiting the dumping of waste, refuse, garbage materials, papers, cigarette butts and the like, in any place in the streets and other places not otherwise designated as dumping place; and providing penalty for violation thereof.
No. 7392	August 29, 1973	An ordinance requiring property owners and residents along esteros in Manila to keep that portion of esteros abutting their property and their immediate surrounding clean, wholesome and free from collecting waste matters, dirt, floating debris, and others that may obstruct and control flow of water in their surrounding and esteros; and providing penalties for violation thereof.

The solid waste management of the city is the responsibility of the Department of Public Services (DPS) Office of the LGU. City programs involved in solid waste management of the Manila Bay area include a daily clean-up by a DPS team of the Manila Yacht Club, baywalk, Roxas Boulevard area, and Baseco Beach in port area (City of Manila, Department of Public Services, 2021).

### Port Waste Management Policies

The wastes from the terminal operation of Manila North Harbor are covered by the Waste Management Plan for Northport/Manila North Harbour Port, Inc. The plan applies to all organizations and service providers involved in waste handling system of Manila North Port. The four waste types recognized by the waste management system of the

port considers recyclable wastes, reusable wastes, stripping wastes<sup>13</sup>, refuse<sup>14</sup>, and hazardous wastes (Table 9).

**Table 9. Northport Waste Management Plan Waste Types (MNHPI, 2021).**

Waste Type	Inclusions
Recyclable Waste	<ul style="list-style-type: none"> <li>■ Metal scrap</li> <li>■ Wood scrap</li> <li>■ Cans</li> <li>■ Papers/cardboards</li> <li>■ Plastics</li> </ul>
Reusable	<ul style="list-style-type: none"> <li>■ Tote bins</li> <li>■ Metals and plastic drums</li> <li>■ Pails</li> </ul>
Stripping Waste	<ul style="list-style-type: none"> <li>■ Banana waste</li> <li>■ Wood crates</li> </ul>
Refuse	<ul style="list-style-type: none"> <li>■ Food waste from canteen</li> <li>■ Leftovers</li> </ul>
Hazardous Waste	<ul style="list-style-type: none"> <li>■ Used oil</li> <li>■ Oil-contaminated water</li> <li>■ Oil-contaminated materials</li> <li>■ Used Lead Acid Batteries Mercury Compounds/Busted Fluorescent Lamps</li> <li>■ Containers previously containing toxic chemicals</li> <li>■ Pathological or infectious waste</li> <li>■ Waste electrical and electronic equipment</li> </ul>

The plan also describes the waste disposal flow for hazardous and non-hazardous waste. Hazardous wastes are collected and brought by a contracted hazardous waste hauler to a contracted treatment facility. Recyclable non-hazardous wastes can either be stored at a warehouse or brought to a recycling plant. Non-recyclable non-hazardous solid wastes are disposed at the landfill, which liquid wastes are treated at a sewage treatment plant (MNHPI, 2021).

<sup>13</sup> Stripping waste are specific to waste generated from the banana stripping area in the port. Waste generated here are mainly composed of banana leaves and wooden crates  
<sup>14</sup> Refuse in the waste management plan of MNHPI is food waste, and is biodegradable waste identified separately from stripping waste





## Parola Solid Waste Management Project

In 2013, the ICTSI Foundation started the Parola Solid Waste Management Project which aimed to promote solid waste segregation and recycling in the communities of Barangay 20 and 275. Workshops, orientations, team buildings, study tours, and seminars have been conducted in partnership with DENR-EMB, DSWD, Manila City LGU, barangay LGUs and various organizations concerned with solid waste management. Back in 2014, a three-day waste analysis and characterization study (WACS) was conducted in Barangay 20 and 275 to provide baseline data in determining appropriate technologies to process solid waste. In 2015, the project expanded to the IPB community. The MRF in Barangay 275 was established in 2016. Over the years, the project has deployed 78 community volunteers, who continue to conduct solid waste management initiatives independently. Up to 70,000 residents from Barangay 20 and 275 are beneficiaries of the project (ICTSI

Foundation Inc., 2020).

Currently, there are three main waste management roles that the 78 community volunteers take on, namely Eco-Patrols, Eco-Aides, and Eco-Warriors. There are a total of 78 residents in the area that are in these roles (ICTSI Foundation Inc., 2020). Eco-Patrols are mainly responsible for making sure that household wastes are brought to the collection points for Barangay 20, and to the MRF for Barangay 275. Eco-Aides are assigned to ensure that waste at the collection points is collected by the waste collection vehicle. Lastly, Eco-Warriors, alongside volunteers, mainly conduct coastal clean-ups at the IPB in Barangay 20, and bank of Pasig River for Barangay 275. These community volunteers are also involved in conducting clearing of storm drains; however these are not enough to ensure storm drains do not contain plastic wastes.

## Waste Management System at the Manila North Harbor

Waste generation, segregation, collection, recovery, and disposal efforts at Manila North Harbor are generally in place.

### Waste Generation

Port staff, passengers using the passenger terminals, container yard operations, and other waste generating<sup>15</sup> activities contribute to the wastes generated at the Manila North Harbor (Table 10). Waste generation for the port is grouped into two, Terminal 1 and Terminal 2, with Terminal 1 generating more waste since the container yard and Operations Center 1 are found here. Terminal 2 waste generation mostly comes from passenger related activities from the Passenger Terminal Complex. Wastes coming from Manila North Harbor for 2019 were tallied with the wastes mainly coming from the six collection points undergo a regular waste collection schedule (Philippine Ports Authority, 2019). Since the waste hauled from the Pier 10 collection point are from mixed sources, complete documentation of waste coming from this collection point pre-pandemic is unavailable.

**Table 10. Waste Generation from Manila North Harbor for 2019 (Philippine Ports Authority, 2019)**

Port	Recyclable Materials (kg)	Non-Recyclable Materials (kg)	Total Waste Generated per Terminal
Terminal 1	1,237.49	646.41	1,883.90
Terminal 2	773.81	404.20	1,178.01
<b>Total</b>	<b>2,011.30</b>	<b>1,050.61</b>	<b>3,061.91</b>

<sup>15</sup> Generation refers to the total municipal solid waste (MSW) generated by the population and their economic activities within the defined system boundary (UN Habitat, 2021).



Vessel-generated wastes at the Manila North Harbor come from ships docking and disembarking on the wharfs or piers of the port. iPrudential services all vessel-generated waste at MNH. Passengers and ship crews are the main source of vessel wastes with all the wastes coming from domestic vessels (Table 11). Currently, MNH does not allow vessels to disembark wastes at the port.

**Table 11. Vessel Waste Generation in Manila North Harbor for February 2020**

Vessel Type	No. of Vessels Served	Solid Waste (m3)
Container (Domestic)	9	20.78

Manila North Harbor also has community-generated waste from Barangay 20, 29, and 275, which are in the vicinity of the port area. Barangay 20 and 275 are located adjacent to the MNH area, while approximately 10% of Barangay 29's total population is located inside the MNH area (Section III.F.1). According to interviews with residents, waste from the barangays is mostly composed of food waste, plastics, and paper. The following table shows the waste generated from the barangays in 2019 (Table 12).

**Table 12. Community Waste Generation in the Vicinity of Manila North Harbor for 2019**

Barangay	Total Waste Generated per Barangay (kg)
Barangay 20	10,147,961
Barangay 275	4,391,789
Barangay 29	97,684

## Waste Segregation

The Department for Safety, Environment, and Security of MNHPI implements a waste segregation<sup>16</sup> scheme for the offices and operations in the port. Four of the six regular collection points in the MNH port area have waste segregation bins. Three of these four locations have four bins for segregating biodegradable (green), non-biodegradable (black), clinical (yellow), and recyclable (blue) waste. One of the four locations utilizes three waste bins to segregate biodegradable, non-biodegradable, and recyclable waste. Infographics on each type of waste is placed on the front of each respective waste bin (Figure 10).



Figure 10. Color-Coded Waste Segregation Bins at Operations Center 1 last October 20, 2021

Near some of these waste bins are plastic cages for collecting PET bottles. These plastic cages have an approximate volume of 2.5 m<sup>3</sup>.



Figure 11. Plastic Cage at Passenger Terminal 1 last October 20, 2021

<sup>16</sup> Segregation is separating waste into specific categories, usually biodegradable and non-biodegradable, to utilize waste categories that can still be recycled or used for compost (NSWMC, 2016).

Facilities outside of the four waste bins do not practice a strict segregation scheme. Other areas in the port, including Barangay 29, generally mix their waste and have it brought via payloader to the Pier 10 collection point (Figure 12).



Figure 12. Pier 10 Collection Point last October 20, 2021

Vessel generated waste follow segregation protocols mandated by MARPOL for documentation of waste on board vessels (Section III.A). Wastes from vessels are also expected to be segregated similarly upon unloading unto the berthing area.

Barangay 20 does not have an MRF, but has households that practice segregation of wastes from their households, and some waste pickers segregating waste at collection

points. There used to be an initiative in Barangay 20 where segregation containers labeled as MRFs near the collection points were provided (Figure 13). Due to difficulty in utilizing the containers for waste segregation and collection, most of these containers are no longer used. Some informal waste pickers use the idle containers to store their segregated waste before selling their recyclables to junkshops (Figure 14).



Figure 13. Segregation Containers outside Barangay 20 Gates last October 20, 2021



Figure 14. Segregated Recyclable of an Informal Waste Picker in Barangay 20 last October 20, 2021

Barangay 275 has an MRF that mainly facilitates waste segregation for the whole barangay (Section II.C).



Figure 15. Materials Recovery Facility of Barangay 275 last October 21, 2021

## Waste Collection

The task of collecting<sup>17</sup> all wastes generated at the Manila North Harbor is divided between Cleanenvironment and iPrudential. iPrudential handles all vessel-generated wastes entering the port. Cleanenvironment collects all waste coming from activities and operations in the Northport area.

Before the pandemic, vessels, with the assistance of shore reception facility (SRF) checkers, bring their wastes out from the vessels. SRF checkers also document the volume of vessel waste disposed using the Waste On-Board Vessel Information Forms (WOBIVFs), and coordinates

<sup>17</sup> Waste collection refers to the amount of solid waste that is moved from the point of generation, such as collection points, to facilities where the waste is disposed (UN Habitat, 2021).

with the iPrudential dump truck for the collection of these wastes.

Collection points that have a regular collection schedule, every Tuesday, include OC1, OC2, operator's base, PTC, truck holding area, and banana stripping area in the container yard. Terminal 1 regular collection points are made up of OC1, operator's base, truck holding area, and banana stripping area. Terminal 2 regular collection points are in OC2 and PTC. The other collection point in the port area is found at Pier 10, where waste here generally comes from government offices and Barangay 29. The residents in Barangay 29 bring their wastes in plastic bags or sacks outside of their compound and bring these to their collection point along the road right outside of the compound (Figure 6). Their waste is collected daily by a payloader operated by MNHPI. A

payloader collects the waste from the government offices, Barangay 29, and some bulky wastes in other areas of the port and bring it to the Pier 10 collection point. Collection from Pier 10 is done upon request of MNHPI. The request is usually done when the waste pile is observed to fill one truck to maximize the truck trip (Figure 16).

Barangay 20 has ten collection points along the gates facing the MICT South Access Road, and two along MICT North Access Road. The waste collection truck, which is a compactor truck, is operated by Leonel (Figure 17). Household wastes are brought to the collection point via carts that do door-to-door collection by assigned residents (Section III.B.6). Receptacles are not utilized for wastes gathered at these collection points. There is no segregation during the manual loading of the wastes since



Figure 16. Waste Collection Truck for Pier 10 last October 21, 2021



Figure 17. Loading of Waste Collection Truck for Barangay 20 last October 20, 2021

compactor trucks tend to mix wastes during compaction and dump trucks only have a single compartment.

The waste collection truck for Barangay 275 goes to the barangay MRF to collect the residual wastes and is also a compactor truck operated by Leonel. Wastes are brought to the MRF by Ecopatrols, who are personnel given training in solid waste management and a monthly allowance by ICTSI. Residual wastes are manually loaded into the compactor truck.

Wood from the wastes of Barangay 20 and 275 are collected by dump truck of the Manila City Department of Public Service (DPS) (Figure 18).



Figure 18. Manila City DPS Waste Collection Dump Truck last October 22, 2021



Figure 19. Plastic Bank Cart for transporting waste to Barangay 275 MRF last October 21, 2021

## Waste Recovery

There is no observed waste recovery<sup>18</sup> facility within MNH for port generated wastes. All the port generated wastes are disposed to the Navotas SLF. Janitorial services are allowed to sell the PET bottles collected from the plastic cages as extra income. This practice of recovery persisted even before the pandemic.

For vessel generated waste, there is no recovery system established. All the wastes collected from the vessels are disposed at the Navotas SLF pre-pandemic.

Barangay 20 does not have an MRF. Waste recovery is done by informal waste pickers either going door-to-door or staying near collection points to recover recyclables. Some of these waste pickers buy the recyclables from the households by going door-to-door, while others stay at the collection point to receive any waste from the barangay and separate what they can sell. There are a few junkshops in Barangay 20, one of the registered ones located near the entrance of Isla Putting Bato (IPB).

These junkshops also buy recyclables from households that segregate their own waste.

Barangay 275 has an MRF that facilitates the recovery for all the waste generated from the households of the barangay. The centralized recovery allows the MRF to have a fund to work with from the recyclables it can sell. Sorters in the MRF are also given an allowance from the funds generated by the MRF. Incentives from the Plastic Bank, as a partner, are also received by the sorters and barangay members. Plastic bank has also donated sacks for storing segregated PET bottles, and carts for transporting waste from households to the MRF (Figure 19).

Janitorial personnel of MNHPI are allowed to sell the PET bottles stored in plastic cages around the port area. These plastic cages are located near waste bins of MNHPI to divert PET bottles from waste collect and disposal. All other plastics from port activities and vessels are collected and disposed at the disposal site.

<sup>18</sup> Recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfill a particular function, or waste being prepared to fulfill that function, in the facility or in the wider economy (UN Habitat, 2021).

## Waste Disposal

Waste from the port, vessels, and adjacent barangays are all disposed<sup>19</sup> to the Navotas SLF from the VMLS. The Cleanenvironment trucks from the port are weighed before exiting and proceeding straight to VMLS. iPrudential and Leonel trucks proceed straight to VMLS right after collection.

The Vitas Marine Loading Station is the garbage transfer station for all waste disposed at the Navotas SLF. VMLS is located to the north of Manila North Harbor and is operated by PHILECO. At VMLS, waste collection trucks dump their waste at one of two landing craft transport (LCT) barges that sail towards the Navotas SLF located offshore (Phil Ecology Systems Corp., 2021). In 2017, the transfer station was suspended by DENR because it was found to be in violation of its environment compliance certificate (ECC). The specific violation pertained to untreated wastewater from the transfer station flowing into Manila Bay as waste piles accumulated along the shoreline (ABS-CBN News, 2017). The transfer station has not been subject to any other suspensions since then.

PHILECO also operates the Navotas Sanitary Landfill. The 40 ha. bay area type engineered sanitary landfill. is the first of its kind in the Philippines and has been in operation since 2006. The area of the SLF was developed from abandoned fishponds in Navotas City, which PHILECO developed (Phil Ecology Systems Corp., 2021). The Navotas SLF accommodates 3,000 tons of municipal solid waste per day from various cities of Metro Manila (EMB-NCR, 2021).



<sup>19</sup> Disposal defines any operation whose main purpose is not the recovery of materials or energy even if the operation has as a secondary consequence the reclamation of substances or energy (UN Habitat, 2021).



# METHODOLOGY

The conduct of the baseline study for Manila North Harbor involves four major activities (Figure 20) which are adapted from the ITDI-DOST, UN Habitat, and GIZ, University of Leeds, Eawag-Sandec and Wasteaware methodologies (Table 13).

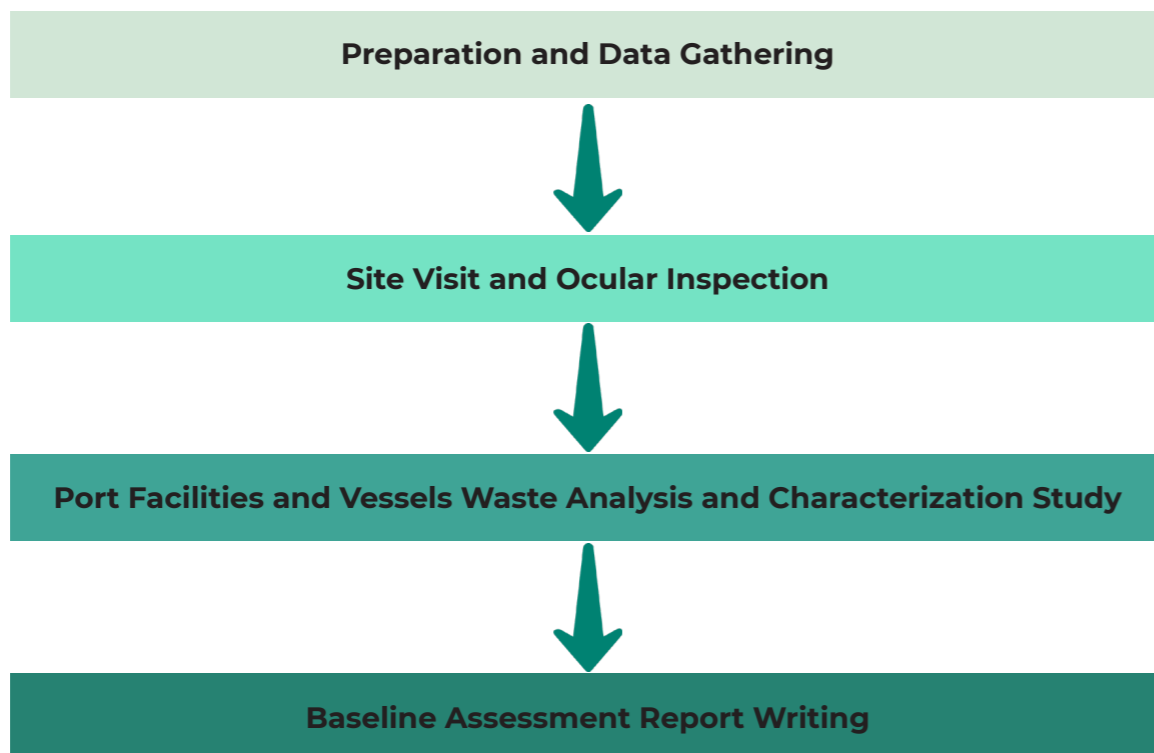


Figure 20. Baseline Study Methodology

Table 13. Waste Guidelines and Tools Adapted

Guidelines and Tool	Developer	Year
Waste Analysis and Characterization Study (WACS)	ITDI-DOST	2021
Waste Wise Cities Tool	UN Habitat	2021
Waste Flow Diagram	GIZ, University of Leeds, Eawag-Sandec and Wasteaware	2020

The field activities conducted at the Manila North Harbor from October 19 to October 24, 2021 include courtesy visits, interviews, orientation, observation of waste management systems, and waste analysis and characterization study (WACS) of solid waste generated by port facilities and adjacent communities as well as the solid waste received by the disposal site (Annex C).

## Preparation and Data Gathering

### Secondary Data Collection and Research

Data needed for the baseline studies were collected from PPA, PCG, Manila City LGU, MNHPI, and Cleanenvironment.

The general information on the Manila North Harbor, the solid waste management plans (SWMP) and solid waste management policies and ordinances of the City where the port is located were reviewed for this study (Section II to Section III.B). Available data on waste analysis and characterization study (WACS) were collected.

### Interviews with Relevant Stakeholders

A series of interviews with relevant stakeholders such as representatives from port management, SRF service provider, landfill operator, training institute, shipping association, port facilities, port janitorial service and shipping operators was conducted using phone communication, video conferencing apps, and in person (Annex D).

# Site Visit and Ocular Inspection

Recovery facilities involving the solid waste management system of port and community generated waste were visited. The recovery facilities were identified as “Intermediate Traders”, “Apex traders” and “End of Chain Recyclers and Recoverers”. Using the set

of criteria provided by the Waste Wise Cities Tool (WaCT) and waste flow diagram (WFD), the amount of waste received, plastic leakage and level of control of recovery and disposal facilities (Annex E and Annex F) were identified.



# Conduct of Waste Analysis and Characterization Study

Wastes from the Manila North Harbor – both from the port facilities and the adjacent communities – were collected between October 22 to October 24. These were then sorted the day after each collection.

The analysis and characterization of the solid waste generated from port facilities and communities were conducted in a tented area in the

port area and Barangay 275 covered courts, respectively. WACS for community-generated waste was conducted from 8:00 AM to 12:00 PM including morning breaks; while WACS for port-generated waste was conducted from 1:00 PM to 5:00 PM with lunch, and afternoon breaks. Weather conditions for all sampling days were sunny with air temperatures ranging from 25°C to 33°C.

Prior to WACS, an orientation was conducted regarding the materials needed and the solid waste categories to which the wastes will be sorted into (Figure 21 and Figure 22).

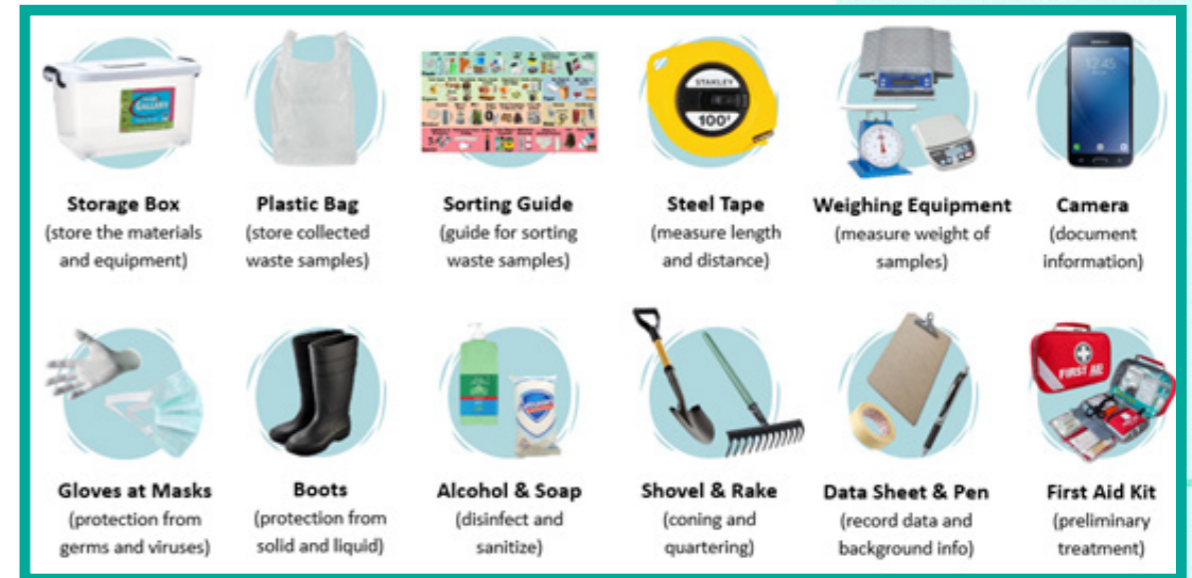


Figure 21. Materials for WACS



Figure 22. Solid Waste Categories Guide for WACS

## Port Facilities Sampling, Bulk Density, and Segregation

A payloader containing the municipal solid waste collected from different areas in Terminal 1 and 2 of Manila North Harbor were brought to a tented area near the Passenger Terminal Complex and Barangay 29 community in the port (Figure 23). The areas in Terminal 1 that were sampled include the port container

yard, crane base, and Operations Center 1. For Terminal 2, the hiring hall, government offices, and Pier 12 wastes were sampled. The payloader would carry the waste from these areas and bring them straight to the designated sorting area in the port (Figure 24).



Figure 23. Tented Sorting Area in the Port Waste in Manila North Harbor last October 22, 2021



Figure 24. Payloader used for Port Facilities Waste Sampling last October 21, 2021

Up to 120 kg were taken from every waste sample carried by the payloader. A container of known volume and weight was filled with the waste up to the brim and weighed (Figure 25). This process was repeated until all the waste sample was weighed. Bulk density is computed by dividing the weight of the waste by the volume of the container. As this process was repeated multiple times, the average of the all the quotients were taken.



Figure 25. Preparation of Waste for Bulk Density Measurement last October 22, 2021

The waste sample is then sorted (Figure 26) according to specified waste categories (Figure 22). Once sorted, each waste category was weighed and recorded for data processing and analysis (Figure 27). This process was done for three days.



Figure 26. Sorting of Port Waste Sample last October 23, 2021



Figure 27. Weighing of Sorted Port Waste Sample last October 23, 2021

## Vessel Facilities Sampling, Bulk Density, and Segregation

No vessel wastes were sampled for the since Manila North Harbor did not allow the unloading of vessel waste ever since the start of the Covid-19 pandemic.

## Community Waste Sampling, Pre-weighing, and Segregation

Households from Barangay 20 and 275 were selected to provide their daily generated waste as waste samples for the conduct of WACS. Wastes were taken from ten cooperators from Barangay 20 and nine from Barangay 275. Cooperators are provided with three plastic bags, where each plastic bag is to be filled with the household's generated waste for one day. The three-day sampling period for household waste sampling is based on the guidelines of NSWMC (NSWMC, 2021). Sorters assigned for the WACS for community generated waste would receive the waste from cooperators that were assigned to them and bring them to the Barangay 275 covered courts (Figure 28).



Figure 28. Barangay 275 Covered Courts last October 19, 2021



Figure 29. Pre-weighing of Community Waste by Cooperator last October 22, 2021



Upon arrival at the sorting area in the covered courts of the cooperator's daily waste generated, each cooperator's plastic bag is pre-weighed and recorded (Figure 29). Then cooperator bags are fitted into a container of known volume and weighed for bulk density measurements of the household waste without mixing waste between households (Figure 30). This process was repeated until all the waste samples were weighed. Bulk density is computed by dividing the weight of the waste by the volume of the container. As this process was repeated multiple times, the average of all the quotients were taken.



Figure 30. Bulk Density Measurement of Community Waste last October 23, 2021



After bulk density measurements, a sorter is assigned to sort one household's waste at a time. Once sorted, each waste category was weighed and recorded for data processing and analysis. This process was done for three days.



Figure 31. Sorting of Community Waste Sample last October 22, 2021



Figure 32. Weighing of Sorted Community Waste Sample last October 22, 2021



## Waste Flow Analysis

Waste Flow Diagram (WFD) tool was used to measure and visualize how the wastes flow from generation to disposal, depicting the complete picture of the current solid management of Manila North Harbor in terms of the quantity and quality of waste as well as the leakage of waste of plastics into the open environment (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2020).

Data obtained from the WACS, interview with the stakeholders and observations during site visit and truck tailgating were incorporated in the diagram. Visual assessment was also conducted to determine the leakage factor at each point of waste management system of Manila North Harbor port facility, IPB, and Barangay 29, specifically, during collection, transportation, and disposal.

Mass flow analysis and data entry software such as STAN and Excel were used to generate the WFD.





# WASTE ANALYSIS AND CHARACTERIZATION RESULTS

Wastes from the Manila North Harbor – both from the port facilities and the adjacent communities – were collected between October 22 to October 24. These were then sorted the day after each collection. Weather conditions for all sampling days were sunny with air temperatures ranging from 25°C to 33°C.

## Port Generated Waste

The port-generated wastes were collected from three areas in Terminal 1 and in Terminal 2. Based on the total amount of daily wastes collected and the bulk waste densities data from the sorting activities, the total waste generation rate for the port facilities was calculated to be at a total of 155.25 kg/day (Table 14). This waste generation rate during the pandemic is more than 1800% higher than the waste generation rate of about 8.38 kg/day on a pre-Covid-19 scenario (Table 14). This may be due to unrecorded wastes in the monthly solid waste monitoring sheets for 2019 since wastes are collected at Pier 10 collection point, which was not being monitored. Some facilities and offices were also not included in the six pandemic-period collection points.

**Table 14. Waste Generation Rate of Port Facilities**

Terminal	Generation Rate (kg/day)	
	COVID-19 (Current)	Pre-COVID-19
Terminal 1	99.00	5.16
Terminal 2	56.25	3.22
<b>Total</b>	<b>155.25</b>	<b>8.38</b>

Biodegradable wastes were at 51.73% of the total port-generated wastes during the recently conducted WACS (Figure 33). Food waste was at 13.37% of the total waste sample; while sweepings, wood, and garden waste were at 11.98%, 10.50%, and 10.18%, respectively. Wet paper was at 4.97%. Agricultural/farm waste and livestock waste were at low quantities in the waste sample.

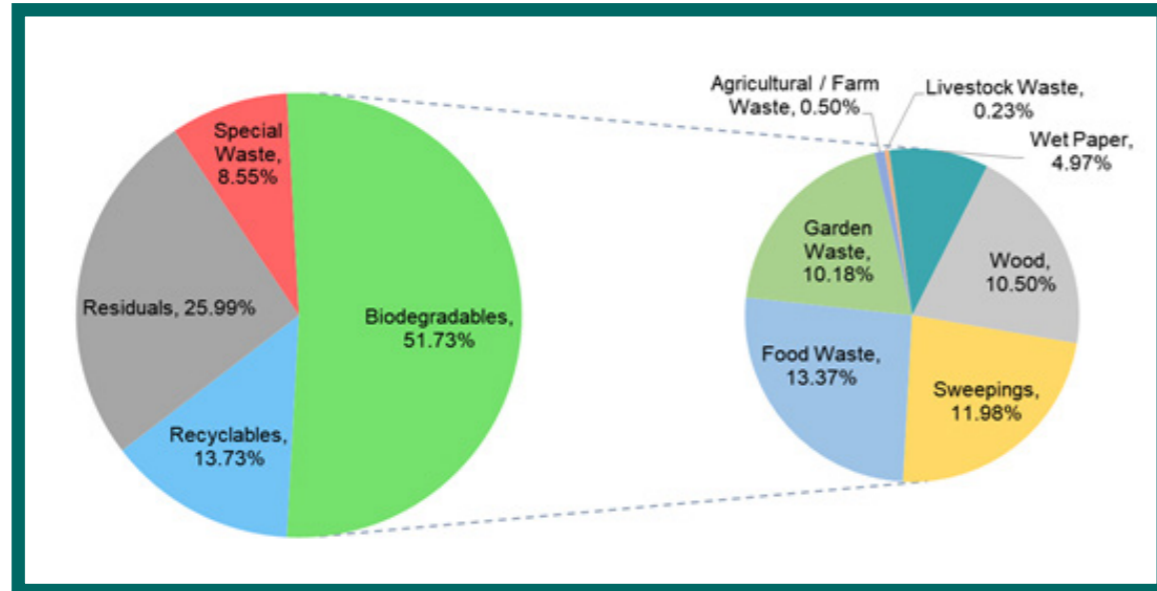


Figure 33. Port-Generated Waste Composition of Biodegradables

Recyclables were found to be at 13.73% of the overall port-generated waste sampled (Figure 34). Plastic wastes comprised most of the recyclables at 6.07%. Paper was at 4.27%. Glass and metals were at 1.44% and 1.32%, respectively.

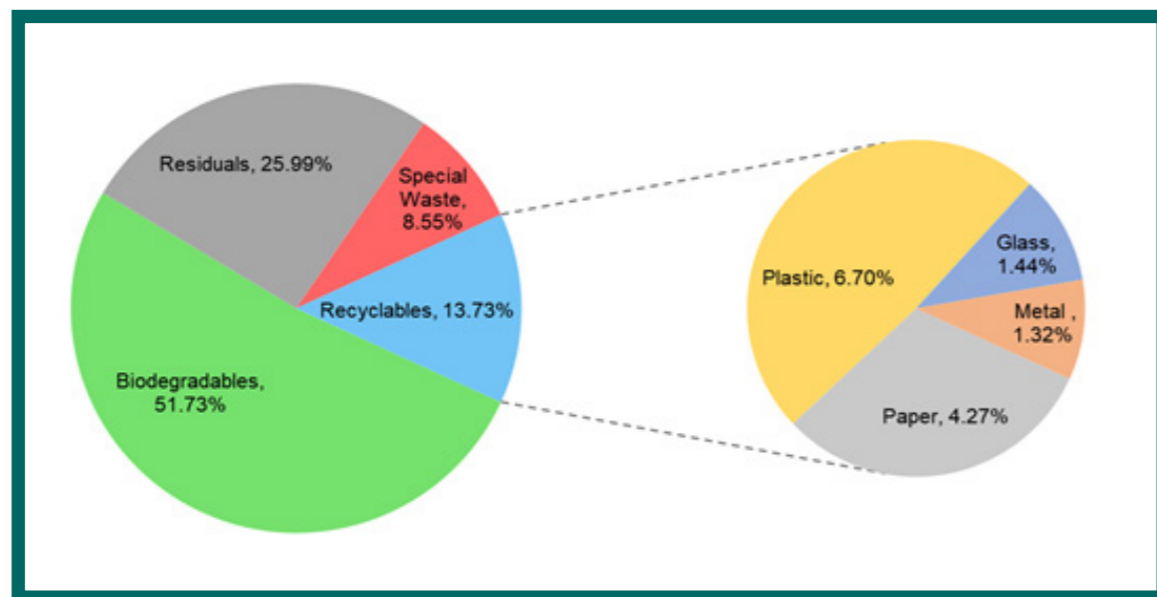


Figure 34. Port-Generated Waste Composition of Recyclables

Residuals comprised 25.99% of the total port-generated wastes (Figure 35). Wastes with potential for recycling<sup>20</sup> – sachets, plastic bags, textiles, leather, and rubber – comprised 13.92% of the entire waste sampled. Residual waste for disposal makes up 12.07% of the total waste sampled. This is mostly composed of coated food containers, soiled plastics, and soiled tissue paper at 5.18%, 3.71%, and 2.38%, respectively. Diapers, napkins, and cigarette butts make up the rest of the residual waste for disposal.

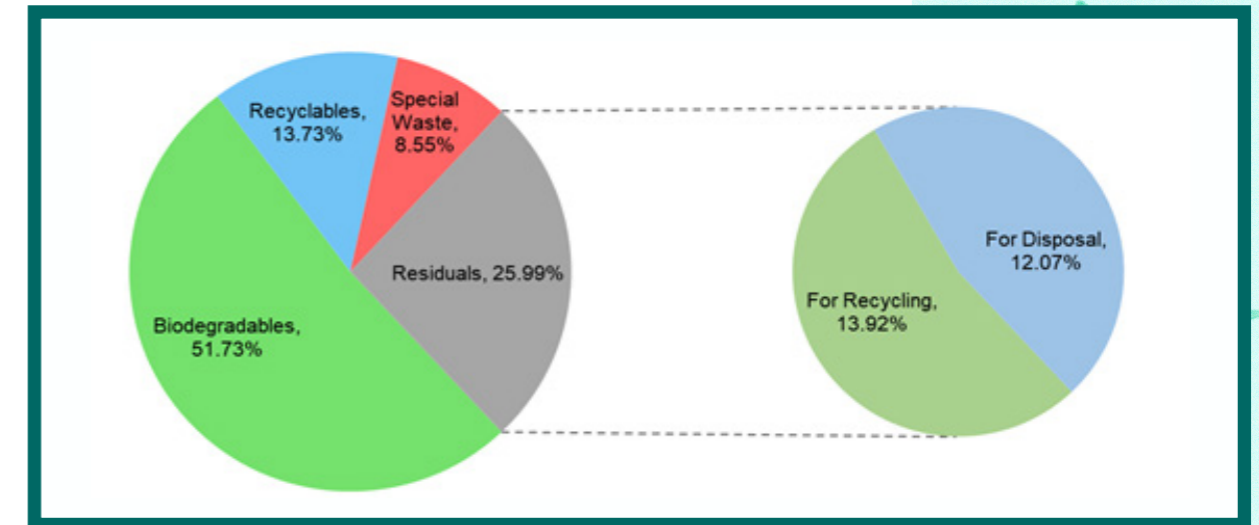


Figure 35. Port-Generated Waste Composition of Residuals

Of the collected wastes from the port facilities, 3.13% by total weight accounts for recyclable plastic wastes in which polyethylene terephthalate (PET) and polypropylene (PP) type of plastics constitute the largest. Polystyrene (PS), polyvinyl chloride (PVC), and high-density polyethylene (HDPE) plastic types were also present in the collected samples (Figure 32).

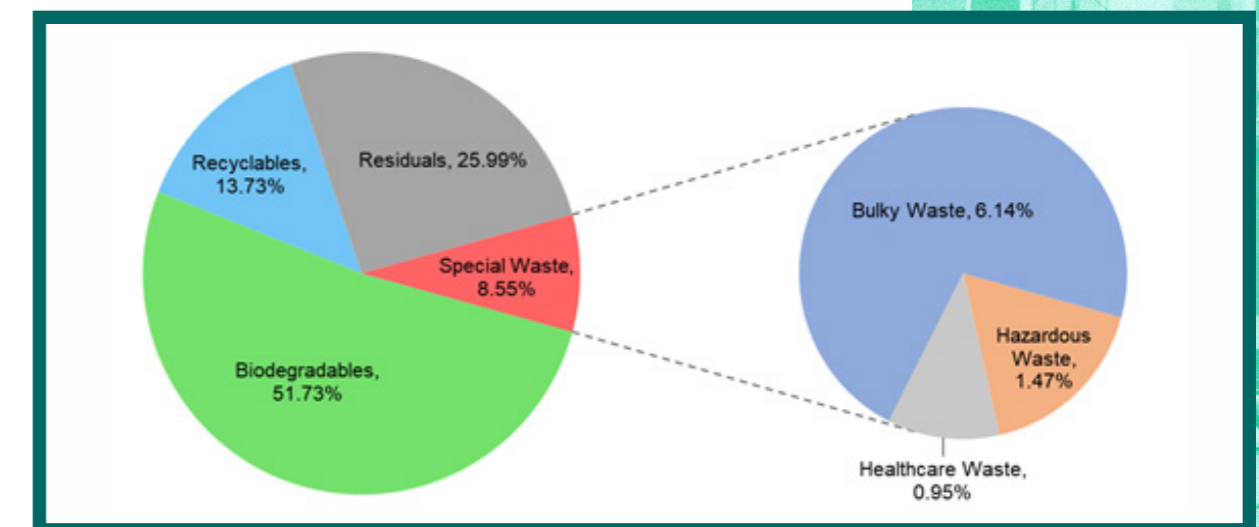


Figure 36. Port-Generated Waste Composition of Special

<sup>20</sup> Wastes with potential for recycling are residuals wastes that would normally be considered for disposal in a sanitary landfill due to economic viability but may eventually be recycled if feasible techniques or technologies would be available to an LGU provided these are dry and not contaminated by hazardous or food wastes (National Solid Waste Management Commission, 2020)

Of the collected wastes from the port facilities, 6.70% by total weight accounts for recyclable plastic wastes in which polyethylene terephthalate (PET) and polypropylene (PP) type of plastics constitute the largest. Polystyrene (PS), polyvinyl chloride (PVC), and high-density polyethylene (HDPE) plastic types were also present in the collected samples (Figure 37).

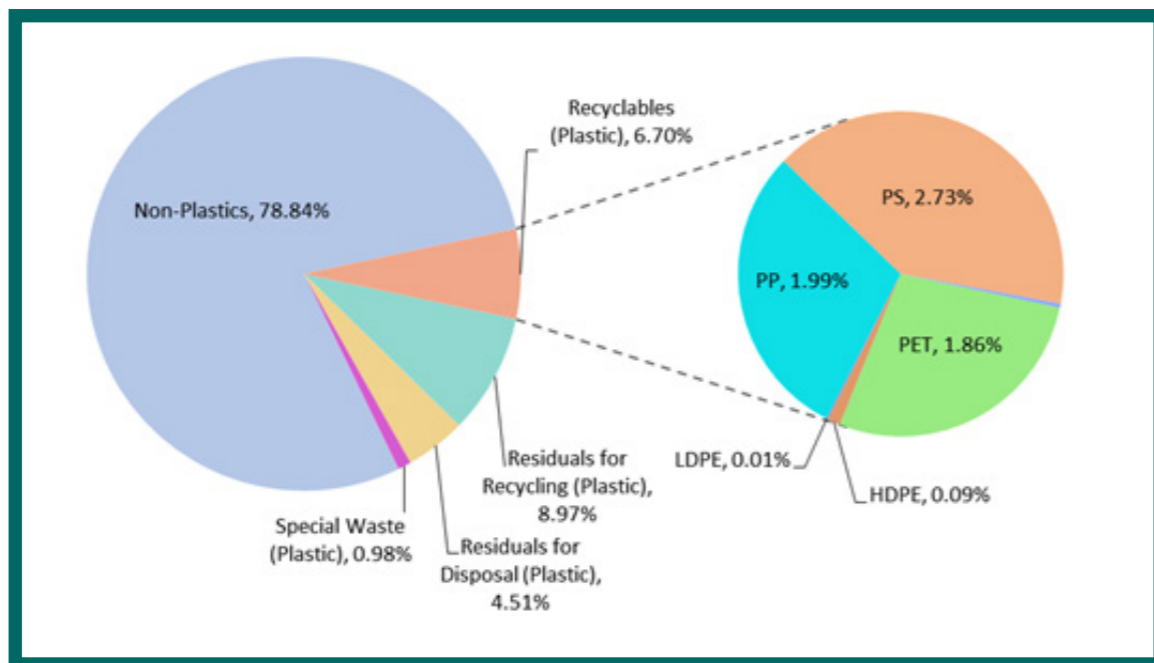


Figure 37. Port-Generated Recyclable Plastic Wastes

Residual plastic wastes with potential for recycling were at 8.97% by total weight of the sorted sample. These plastic items include clear sachets, plastic bags, laminated sachets, sacks, tarpaulins, and some straws (Figure 38).

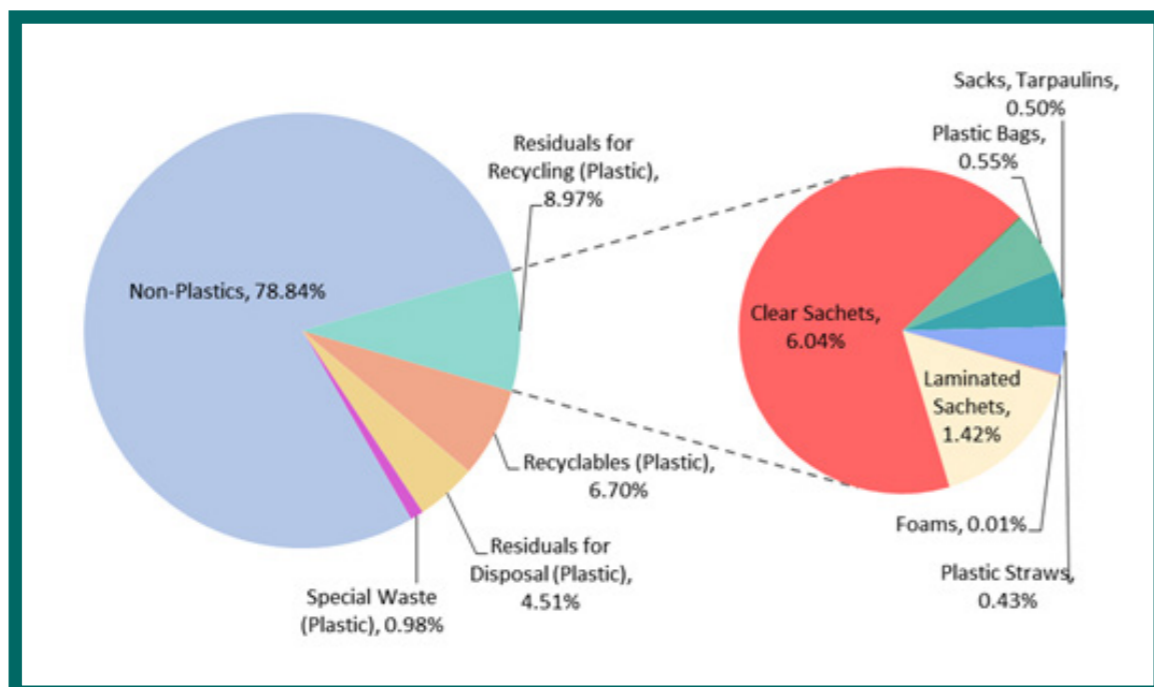


Figure 38. Port-Generated Residual Plastic Wastes with Potential for Recycling

Residual plastic wastes for disposal such as soiled plastics, diapers, and napkins were also collected and were found to be at 4.51% by total weight of the sorted samples (Figure 39).

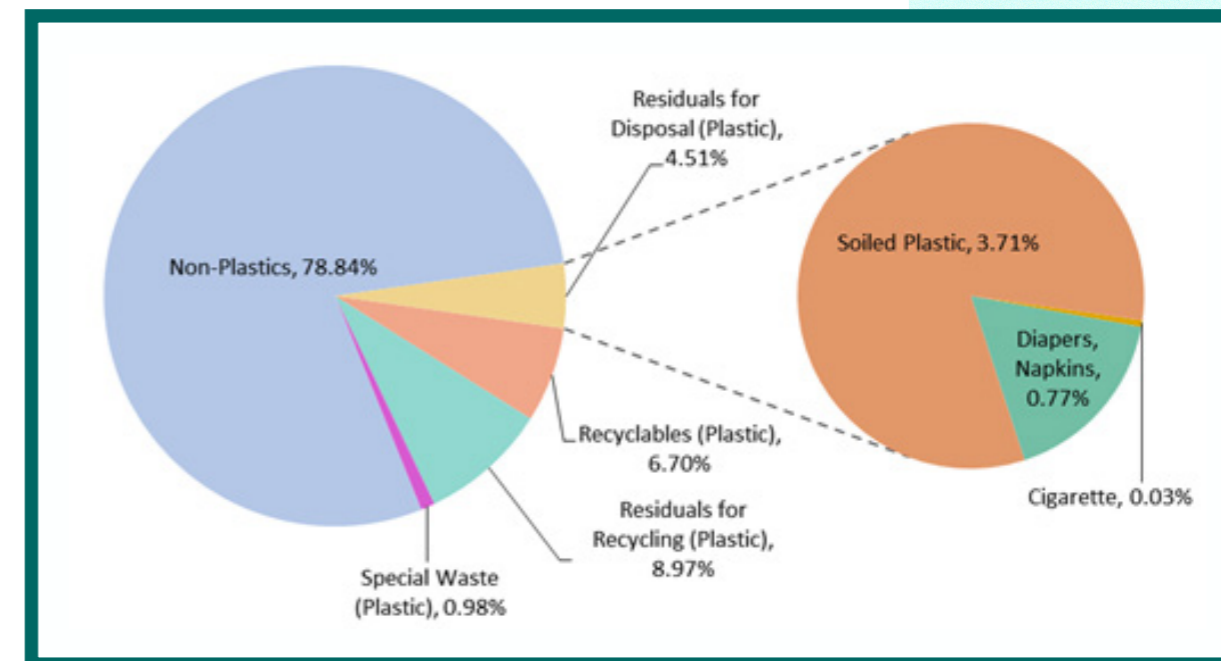


Figure 39. Port-Generated Residual Plastic Wastes for Disposal

Special plastic wastes were also collected from the port facilities and found to be at 0.98% by total weight. These range from healthcare wastes such as face masks to hazardous wastes such as pesticides and consumer electronic products (Figure 40).

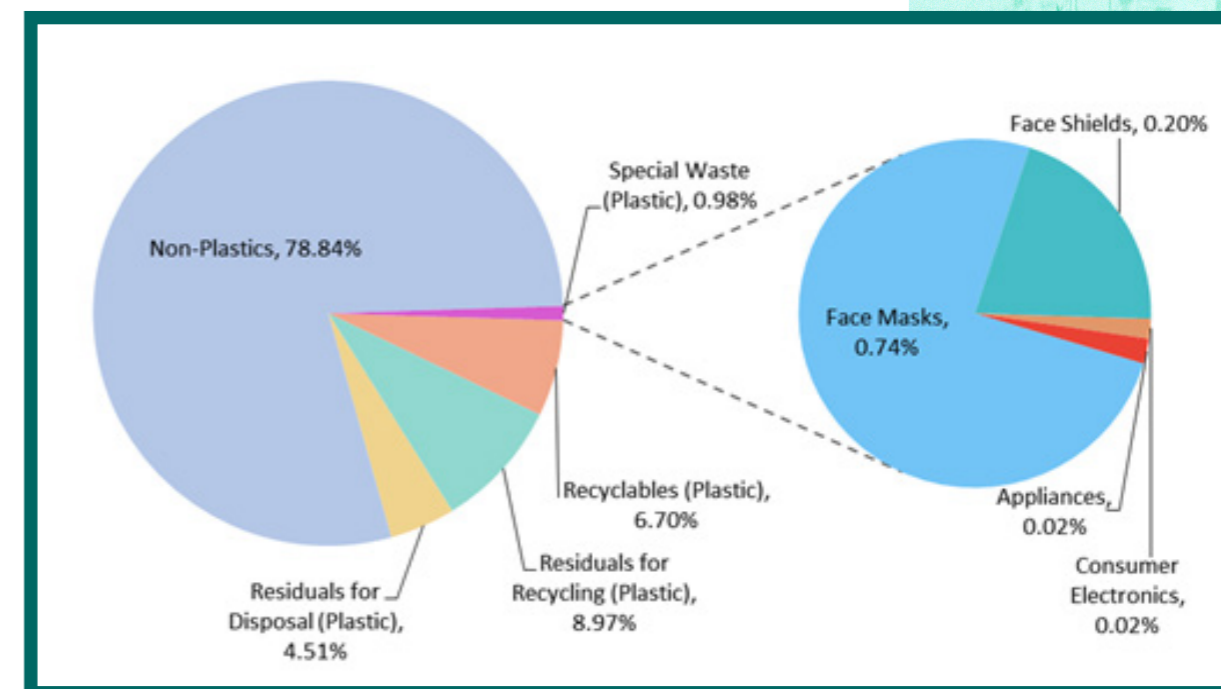


Figure 40. Port-Generated Special Plastic Wastes

# Community Generated Waste

Three barangays in the vicinity of Manila North Harbor that are identified to contribute to the waste generation of the port area are: Barangay 20, Barangay 275, and Barangay 29.

Sampling of community-generated wastes were conducted daily from Barangay 20 and 275 (Section IV.C.3). Based on the recorded weight of household wastes before sorting, an average daily waste generation per capita for the Covid scenario is calculated. This average daily waste generation per capita is multiplied to the 2020 population data of the barangays. The generation rate for communities for the Covid scenario was calculated to be at 19,997.51 kg/day in total (Table 15).

Community waste generation rates on a pre-COVID-19 scenario were calculated from the 2015 daily waste generation per capita data for Manila City and population of barangays for 2020 (PSA, 2020). The 2015 daily waste generation per capita data for Manila City is the latest available waste

generation data. The 2020 population of the barangays is utilized since this is also the closest population count available for the last pre-Covid year of 2019, since this census was conducted in 2020.

For both calculations, only 10% of the total population of Barangay 29 was considered since this is the estimated percentage of Barangay 29 residing in Manila North Harbor.

Comparison of community generation rates between the COVID-19 and pre-COVID-19 scenario shows the effect of the pandemic on the amount of waste generated by households. The community-generated waste in a day has decreased by 51% during the pandemic considering the reduced economic activity for household members.

**Table 15. Vessel Waste Generation Rate for the Manila North Harbor**

Barangay	Generation Rate (kg/day)	
	COVID-19 (Current)	Pre-COVID-19
Barangay 20	13,864.04	27,783.60
Barangay 275	6,000.02	12,024.06
Barangay 29	133.45	267.44
<b>Total</b>	<b>19,997.51</b>	<b>40,075.11</b>

With regards to waste composition, 44.33% of community-generated waste during the recently conducted WACS were biodegradables (Figure 41). The most abundant biodegradable waste was food waste at 40.40%. It was followed by wood and wet paper. Sweepings and garden waste were also found in low quantities.

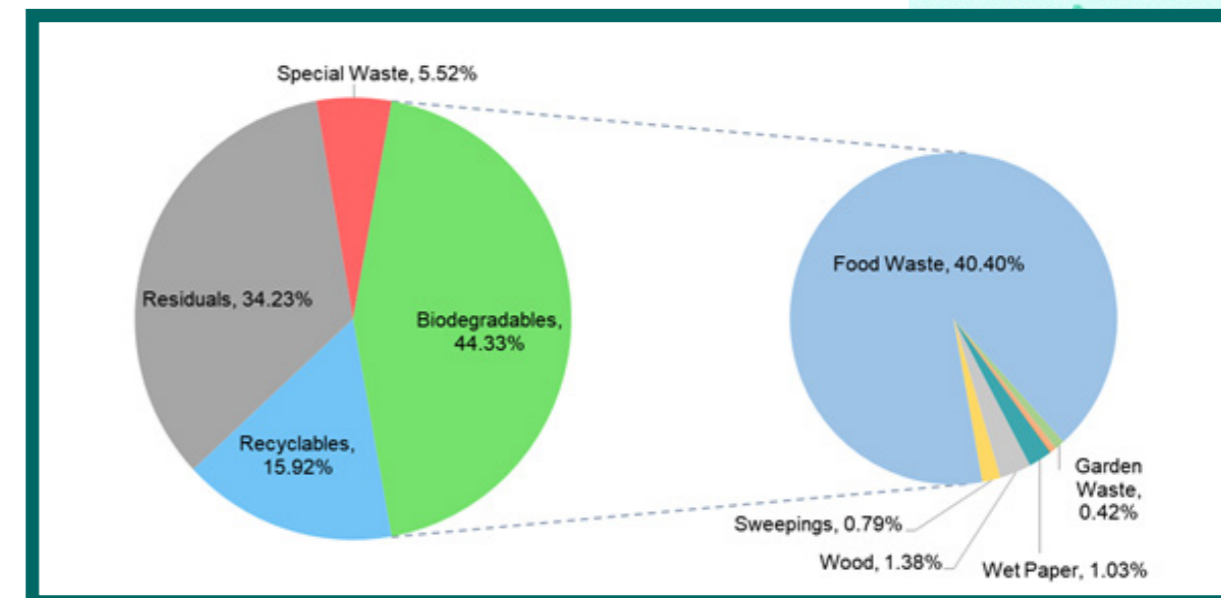


Figure 41. Community-Generated Waste Composition of Biodegradables

Recyclables comprised 15.92% of community-generated waste with plastics being the highest (Figure 42). Papers, metals, and glass were also collected.

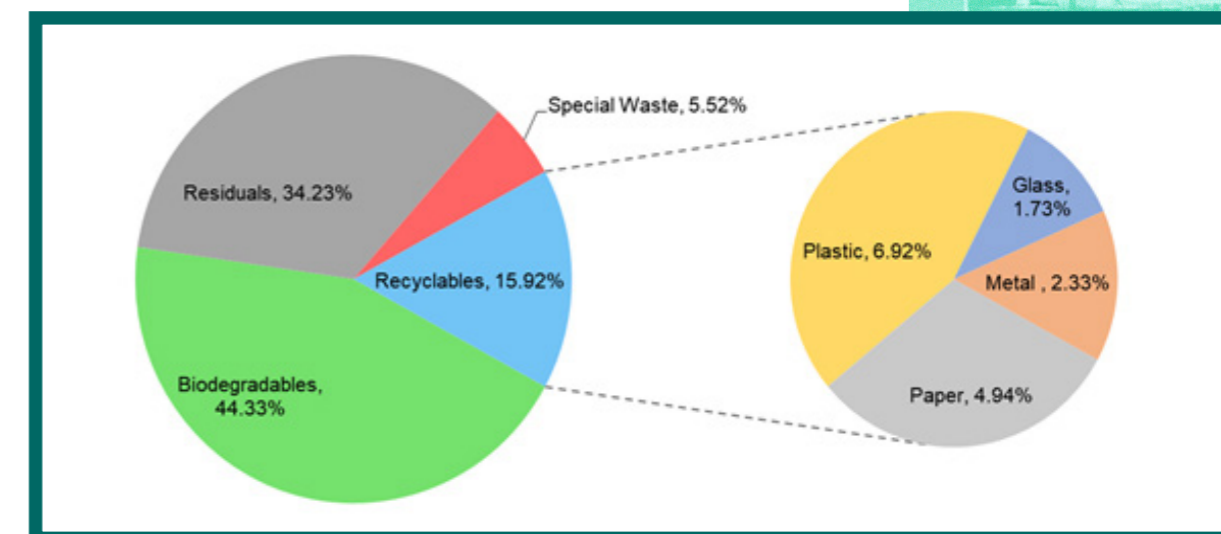


Figure 42. Community-Generated Waste Composition of Recyclables

Residual waste was at 34.23% of the total community-generated waste (Figure 43). 19.16% of these residuals were those with potential for recycling – textiles, clear and laminated sachets, plastic bags, and rubber. The remaining residual wastes – coated food containers, soiled plastics, diapers, napkins, and tissue paper – were for disposal at 15.06% of the total waste.

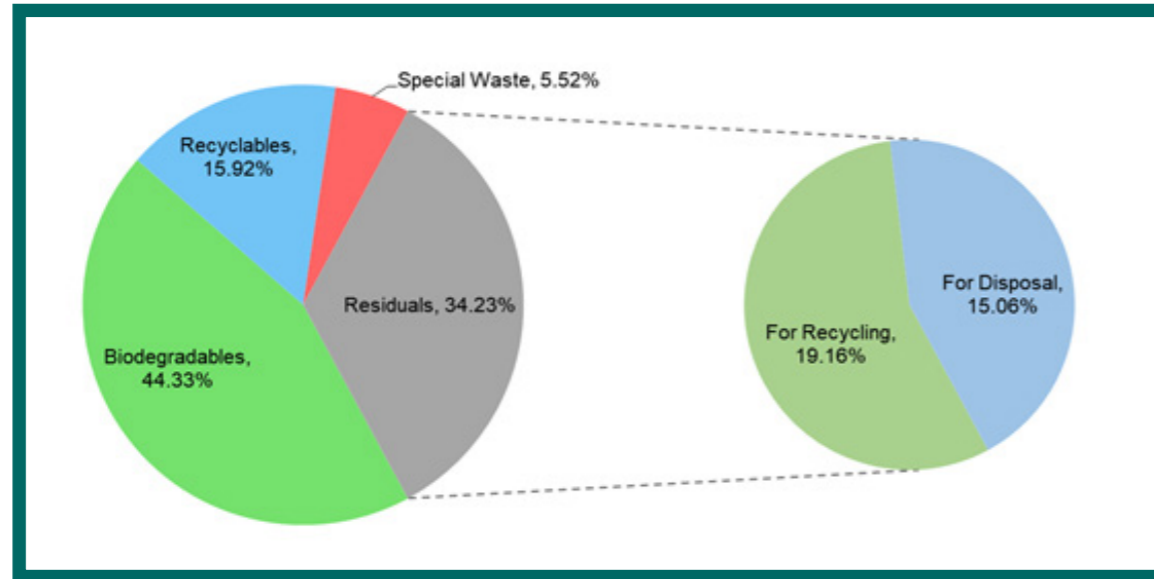


Figure 43. Community-Generated Waste Composition of Residuals

Special wastes were at 5.52% of the total waste sampled (Figure 44). Majority of these wastes were hazardous wastes – industrial and vehicle batteries, contaminated liquids, and consumer electronics – at 3.64%. Bulky waste was at 0.29%; while, healthcare waste was at 1.59%.

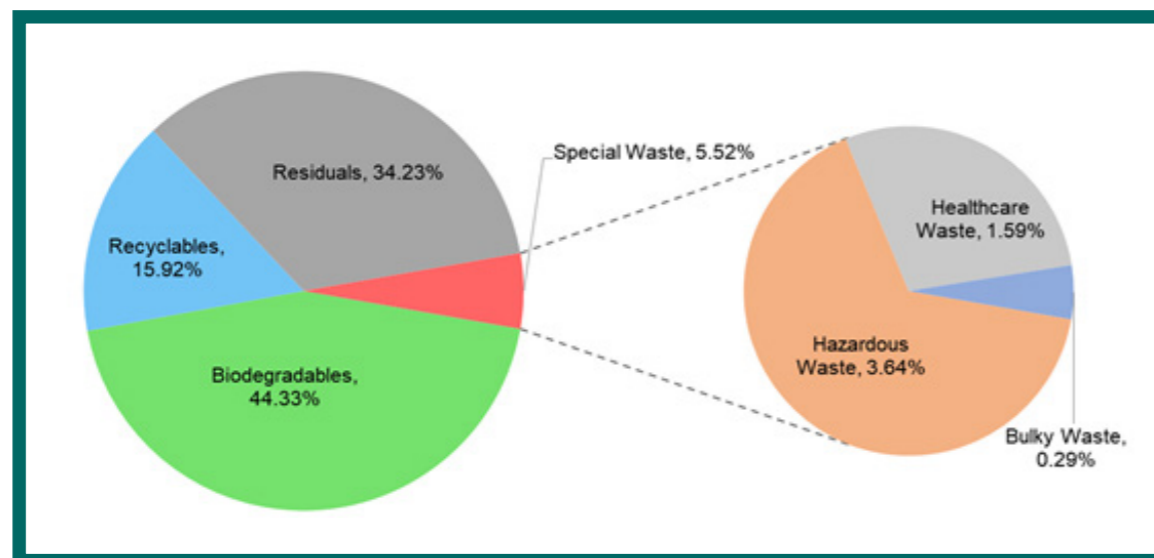


Figure 44. Community-Generated Waste Composition of Special

Of the collected wastes from the community, 6.92% by total weight were recyclable plastic wastes in which PET and PP plastics constitute the largest. PS, HDPE, and LDPE plastic types were also present in the collected samples (Figure 45).

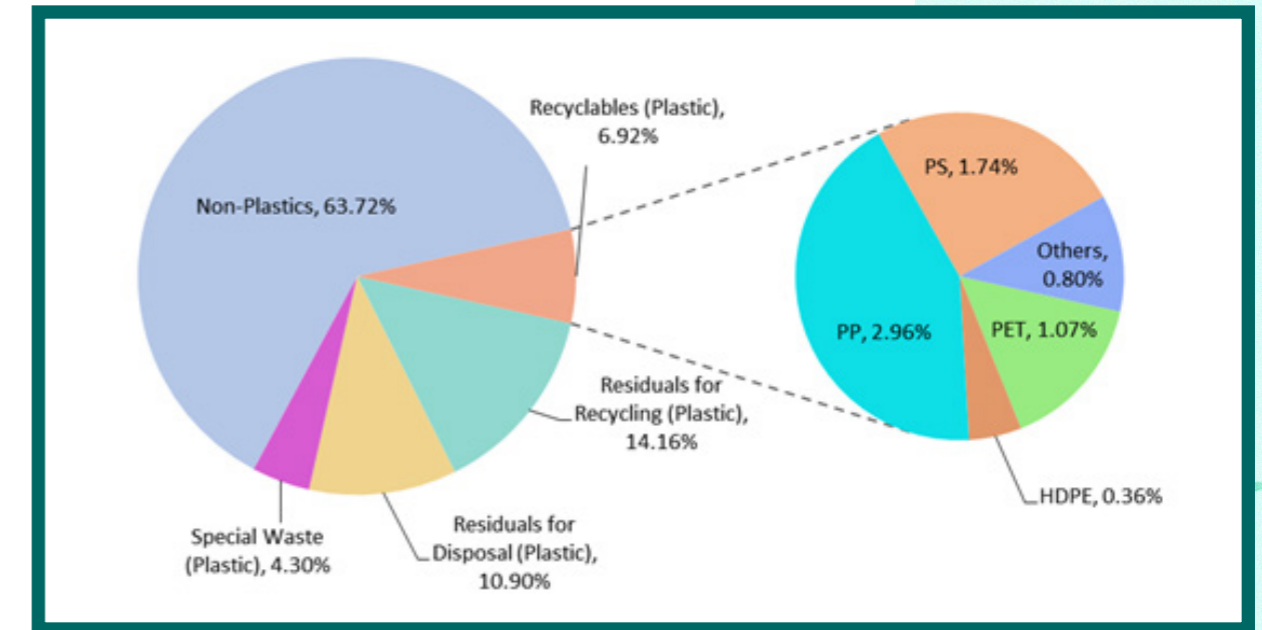


Figure 45. Community-Generated Recyclable Plastic Wastes

Residual plastic wastes with potential for recycling were observed to be at 14.16% by total weight of the sorted sample. These items plastic items include clear sachets, plastic bags, and laminated sachets. Plastic straws, sacks, tarpaulins, and foam were also observed (Figure 46).

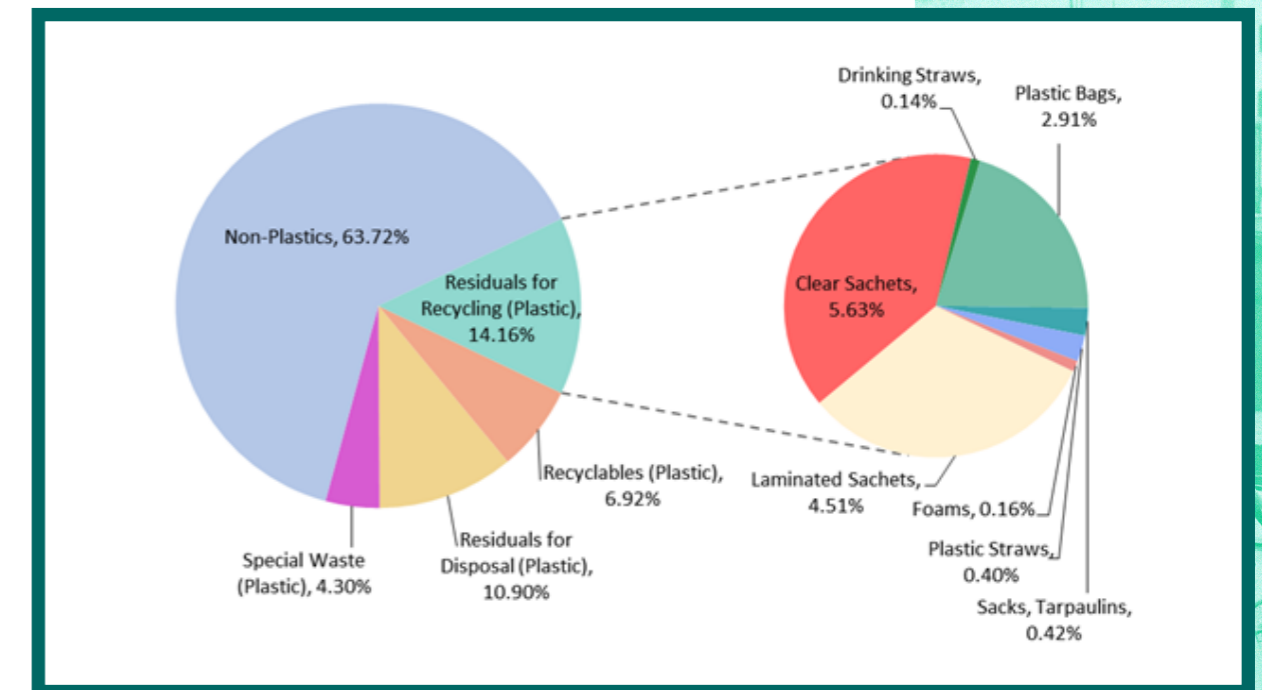


Figure 46. Community-Generated Residual Plastic Wastes with Potential for Recycling

Residual plastic wastes for disposal such as heavily soiled plastics, diapers, and napkins were also collected and were at 10.90% by total weight of the sorted samples (Figure 47).

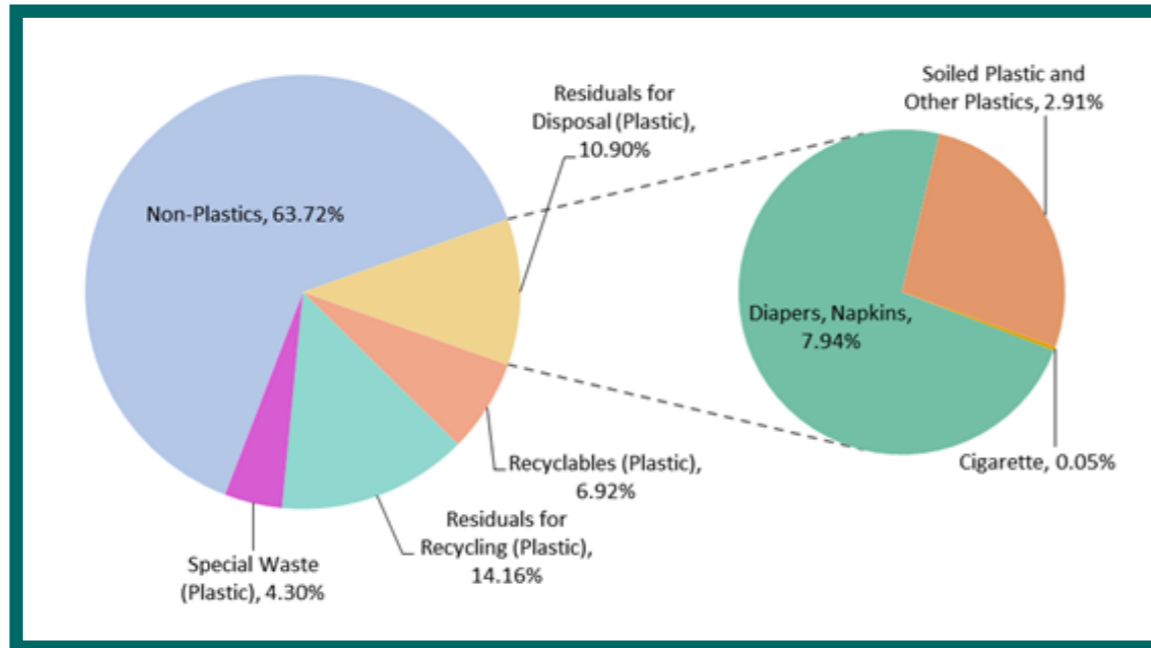


Figure 47. Community-Generated Residual Plastic Wastes for Disposal

Special plastic wastes were also collected from the community and were at 4.30% by total weight. Majority of the weight comes from industrial and vehicle batteries at 2.44% that are composite with a plastic outer shell and plastic components. Face masks, face shields, and consumer electronics were at 1.03%, 0.22%, and 0.53%, respectively. Some hazardous wastes such as gloves, syringes, and gadget batteries were also observed (Figure 48).

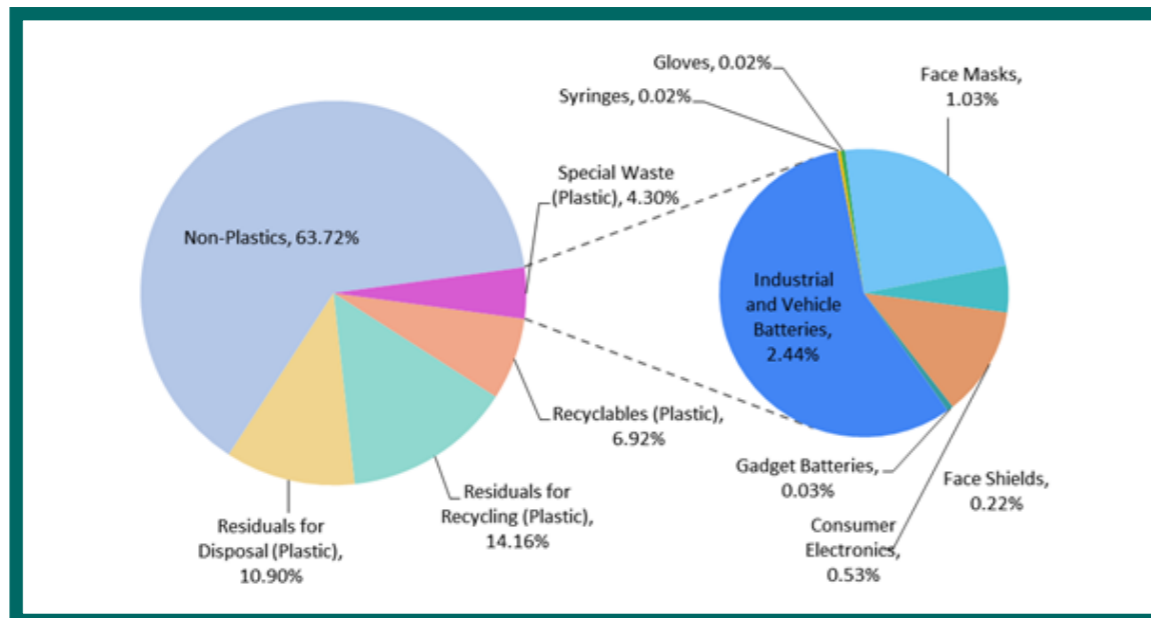


Figure 48. Community-Generated Special Plastic Wastes

## Plastic Waste Leakage

The port-generated wastes do not pass through any recovery point. The community-generated wastes from Barangay 20 are sorted either at the household or by informal waste pickers. For the case of Barangay 275, all waste pass through the barangay MRF for sorting. Wastes then end up in the disposal facility of the city wherein the wastes are expected to comprise of mostly residual wastes. There are still unmanaged wastes, however, that leak out from the solid waste management system – both intentionally and unintentionally – especially during the collection, formal sorting, informal sorting, transportation, and disposal of waste with some of the wastes entering the storm drains.

The calculated plastic leakage factors (Annex I) for both port-generated and Barangay 29-generated are assumed to be the same, while for IPB-generated are different since it is not within Manila North Harbor.



## Leakage from Collection Services

Plastic leakage from collection services describes the plastic which escapes the waste management system while it is being stored waiting for collection service, being loaded on to the collection vehicle; and, on primary transportation.

For port-generated waste, the leakage potential for collection containers<sup>21</sup> was determined to be on a medium level which has a factor of 1.0. The segregated waste bins were only available in four locations, and there are rare occurrences of waste being stored outside of these waste bins. The capacity of the bins is generally sufficient for generated waste of the offices but certain port operations, such as container yard and pier cleaning, can generate waste over the capacity of these bins due to bulky waste.

The leakage potential for loading method was determined to be medium with a factor of 0.5. Wastes are loaded to the garbage trucks using a payloader. Wastes are also transferred to the collection vehicle from the segregated waste bins and in a fixed area.

All primary transportation vehicles are not covered which exposes the collected waste to the open environment (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2020); hence, the leakage potential is medium at a factor of 0.5. Collected wastes from the port facilities generally do not exceed the capacity of the dump trucks.

The leakage potential for the multiple handling of wastes is assessed to be medium at a factor of 1.0. Collected

waste is transferred between multiple vehicles/locations using a payloader that requires manual loading into the open bucket.

A total of 3.0% of the plastic wastes are leaked during collection of port-generated waste when all influencing factors for leakage are combined.

For community-generated waste, the leakage potential for collection containers was determined to be on a very high level which has a factor of 5.0. For Barangay 20, there is no waste container at the collection points. Wastes for collection are placed directly on the ground without any cover. For Barangay 275, residuals that are collected from the barangay MRF are stored in a small shed; but most of the residuals are not contained in bags. Wastes have already undergone sorting.

The leakage potential for loading method was determined to be high with a factor of 0.5. Wastes are loaded to the garbage trucks manually by truck personnel.

All primary transportation vehicles used are compactor trucks, which are covered and prevents exposure of waste to the open environment; hence, the leakage potential is low at a factor of 0. Collected wastes from communities do not exceed the capacity of the compactor trucks.

The leakage potential for the multiple handling of wastes is assessed to be medium at a factor of 1.0. Collected waste is transferred between multiple vehicles/persons from the households to the collection points.

**A total of 7.0% of the plastic wastes are leaked during collection of community-generated waste when all influencing factors for leakage are combined.**

<sup>21</sup> Collection containers are storages or receptacles where solid wastes in garbage bags are being stored before being collected by the collection trucks.



## Leakage from Informal Value-Chain Collections

Plastic leakage during informal value-chain collection pertain to plastic waste that is leaked from the collection by the value chain and transportation by the informal sector (GIZ, 2020).

The activity of selling recyclables directly to junkshops by some households a leakage factor for recyclables extraction method is assessed at medium. The equivalent leakage factor for this is 0.8.

Since there is door-to-door collection using push carts is conducted for the community of IPB, plastic leakage for this transportation method is assessed to be medium. The plastic waste transported is occasionally poorly contained since these push carts are not covered, and over capacity of vehicles leading to leakages during transportation is intermittent. The leakage factor for this is 0.1

**A total of 0.9% of the plastic wastes from IPB are leaked during the informal value-chain collection when all influencing factor for leakage are combined.**





## Leakage during Transportation

Plastic leakage during transportation refers to the plastic items lost when the material is being transported by the collection vehicles to its destination. This indicator only considers the amounts of plastic leaked during the action of transportation (GIZ, 2020).

For the port-generated waste, the leakage potential of capacity versus load is determined to be low at a factor of 0.1. The load in most of the collection vehicles for port wastes does not exceed the capacity. Most of the port-generated waste are contained in garbage bags which are not opened during transport. This has a low leakage potential with a factor of 0.1. Collection vehicles in the port are not covered. This has a very high leakage potential at a factor of 1.0. Multiplying all three leakage

factors, the plastic leakage during transportation of port-generated waste is calculated to be at 0.01%.

For the community-generated waste, the leakage potential of capacity versus load is determined to be low at a factor of 0.1. The load in most of the collection vehicles for port wastes does not exceed the capacity. Not all community-generated wastes are contained in garbage bags since some waste in Barangay 20 are sorted by informal waste pickers, and the MRF of Barangay 275 does not put all its residuals wastes in closed bags. This has a medium leakage potential with a factor of 0.5. Collection vehicles for the communities are covered since these are compactor trucks. This has a low leakage potential at a factor of 0.

**Multiplying all three leakage factors, the plastic leakage during transportation of port-generated waste is calculated to be at 0%.**



## Leakage from Disposal Facilities

Leakage of plastic from disposal facilities describes plastic that leaks from disposal sites carried either by either the wind or by water or by landslides (GIZ, 2020).

The landfill, Navotas SLF, experiences regular flooding; and this condition is very likely to affect the site. The leakage potential is assumed to be very high at a factor of 0.8.

The site is also exposed to heavy and persistent winds or run-off. This gives a medium leakage potential with a factor of 0.5.

All wastes are initially discharged to a tugboat at VMLS, which sails to the SLF and discharges the transported waste in active cells or designated zones only. Waste pickers are restricted at the site. Compaction or management of waste occurs, and waste is observed in pits below ground level with minimal exposure to wind, rain, and surface runoff. The leakage potential for waste handling, therefore, is medium at a factor of 0.75.

Waste is covered at least once a week with soil which gives a medium leakage potential at a factor of 0.4. Burning of waste is illegal and prohibited on site, which gives a very high leakage potential of 1. Water surrounds the perimeter of the facility, and no communities are adjacent by land to the facility.

**The calculated percentage of plastic waste that leaked to the open environment is about 2% considering all these leakage factors from the disposal site.**

## Leakage from Storm Drains

Plastic in storm drains to water systems refers to the amount of plastic which is transferred through storm drain systems and enters water systems. Leakage is computed from two influencers – frequency of rainfall and storm events and drain cleaning.

Rainfall is highly seasonal in the area where the site is located and is often impacted by monsoon rains. Specifically, the climate classification type of the SLF's location can be

described as dry from November to April and wet during the rest of the year (PAGASA, 2007). This has a medium level leakage potential with a factor of 60.

Storm drains are cleaned a few times a year, however high amounts of waste can be observed in the storm drains in the port facility and adjacent communities (Figure 50 and Figure 51). This gives a high leakage potential with a factor of 0.1.

**It is calculated that 94% of leaked plastic wastes in drains are being transferred to water bodies.**



Figure 49. Drainage Outfall in Manila North Harbor last October 20, 2021



Figure 50. Storm Drain in Barangay 20 last October 20, 2021



Figure 51. Storm Drain in Barangay 275 last October 21, 2021



# Waste Flow Diagram

A waste flow diagram (WFD) was generated using the calculated quantities in different stages of the solid waste management in Manila North Harbor, which includes both waste generated from port facilities, IPB, and Barangay 29 considering that the community is serviced by the waste management system of MNHPI (Table 16 and Figure 52).

**Table 16. Amount of Waste per Stage**

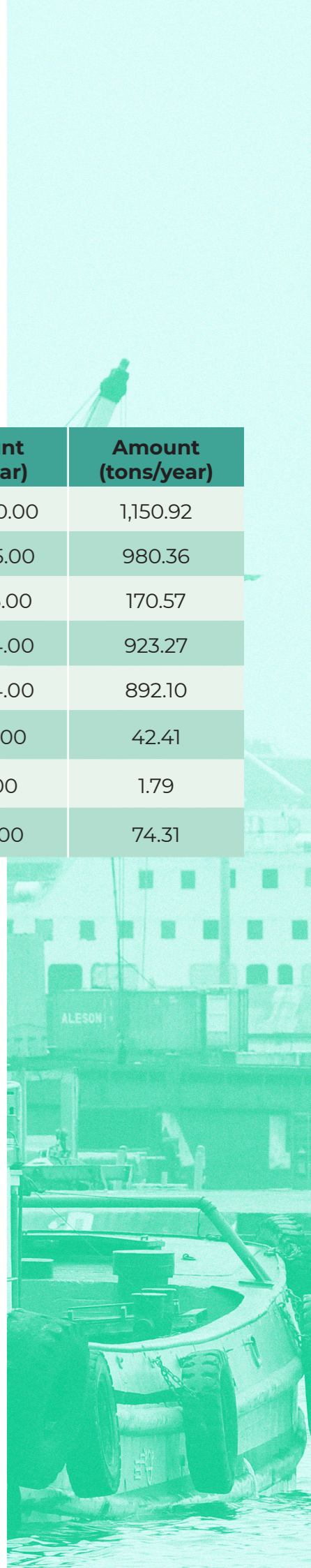
Stage		Amount (kg/year)	Amount (tons/year)
Generated Waste		1,150,920.00	1,150.92
Collected Waste		980,355.00	980.36
Uncollected Waste		170,565.00	170.57
Transported Waste		923,274.00	923.27
Disposed Waste		892,104.00	892.10
Unmanaged Plastic Waste	Retained on Land	42,413.00	42.41
	Leaked to Drains	1,791.00	1.79
	Leaked to Waterways	74,311.00	74.31

About 360,293 kg of wastes is projected to be generated every year (Figure 44). 81% of these wastes are generated from port facilities while the remaining 19% are from vessels.

All generated wastes are collected by the service providers based on interviews, site visit, and tailgating activity. Leakages were observed during the collection of both port and vessel-generated waste resulting to the slight decrease of waste of about 359,919 kg being transported to the MRFs (Section V.C).

About 48,092 kg or 13% of the waste are recovered in the MRFs. Once the recyclables are collected, the waste are then to be disposed to the sanitary landfill.

About 311,138 kg of waste are disposed in the EcoWaste Landfill every year. There is no waste recovery before disposal, hence, most of the biodegradable and residual waste that are



collected are transported to the landfill.

For plastic waste flow analysis, about 33,927 kg or 10% of the annual generated wastes are attributed to plastics (Figure 45). All the plastic waste generated are collected by service providers, but 1% or 374 kg is leaked during the collection. About 4% of the plastic waste are being recovered in the MRFs. These plastic wastes are PET and hard plastics such as PP and HDPE only as these are the only recyclables that can be sold to junkshops. There is also an estimated 12 kg of plastic waste that are being leaked from the MRFs. About 31,544 kg or 93% of the plastic waste are disposed to landfill (Section V.C).

The remaining 3% are the unmanaged plastic waste or the combined leakages from the collection and disposal. 1% or 361 kg of the plastic waste are leaked to water while 1.9% or 642 kg retained to land and 0.1% or 60 kg are leaked to drains every year (Section V.C and Figure 45).

A waste flow diagram without the effect of COVID-19 pandemic is generated to provide comparison on the amount of waste flow per stage of the waste management system (Figure 46). Pre-pandemic secondary data were used to calculate the waste generation of ports and vessels assuming higher vessel and passenger traffic. Generated waste per year in a pre-covid scenario is around 901,820 kg wherein 72% of the wastes comes from the port facilities and the remaining 28% from the vessels. The amount of recyclables collected by the MRFs of the service providers that were being sold to junkshops, with an average of 127,616 kg per year, were also accounted for in the waste flow diagram. Like the current solid waste management system, majority of the generated waste were collected, transported, and directly disposed to the landfill. 771,320 kg of wastes were landfilled (Figure 46).

With regards to plastic waste, same

values from the WACS results were used to estimate the plastic waste generated of about 92,316 kg per year (Figure 47). This is relatively higher than the present amount of plastic waste generated considering the COVID-19 situation. All the plastic wastes were collected with 1% leaked during collection. These were then brought to the MRFs of the service providers while recyclable plastics amounting to 3,855 kg per year were recovered from the MRFs. These plastic recyclables such as PET bottles and hard plastics were then brought and sold to junkshops.

About 85,576 kg or 93% of the total plastic waste generated of plastic wastes are landfilled. The remaining 3% are identified as unmanaged plastic wastes. The unmanaged plastics are suspected to be retained on land at 1.9%, leaked to drains at 0.1%, and entered water systems at 1.0% based on the assessment done using the WFD criteria of the GIZ (2020).

Port and vessel-generated waste flow diagrams for both COVID-19 and pre-COVID-19 scenario are also generated and presented in the annex of this report (Annex H). The plus symbol at certain values in the waste flow diagrams indicate the amount of waste that is at its endpoint of its corresponding site or location (Figure 44, Figure 46, and Annex I).



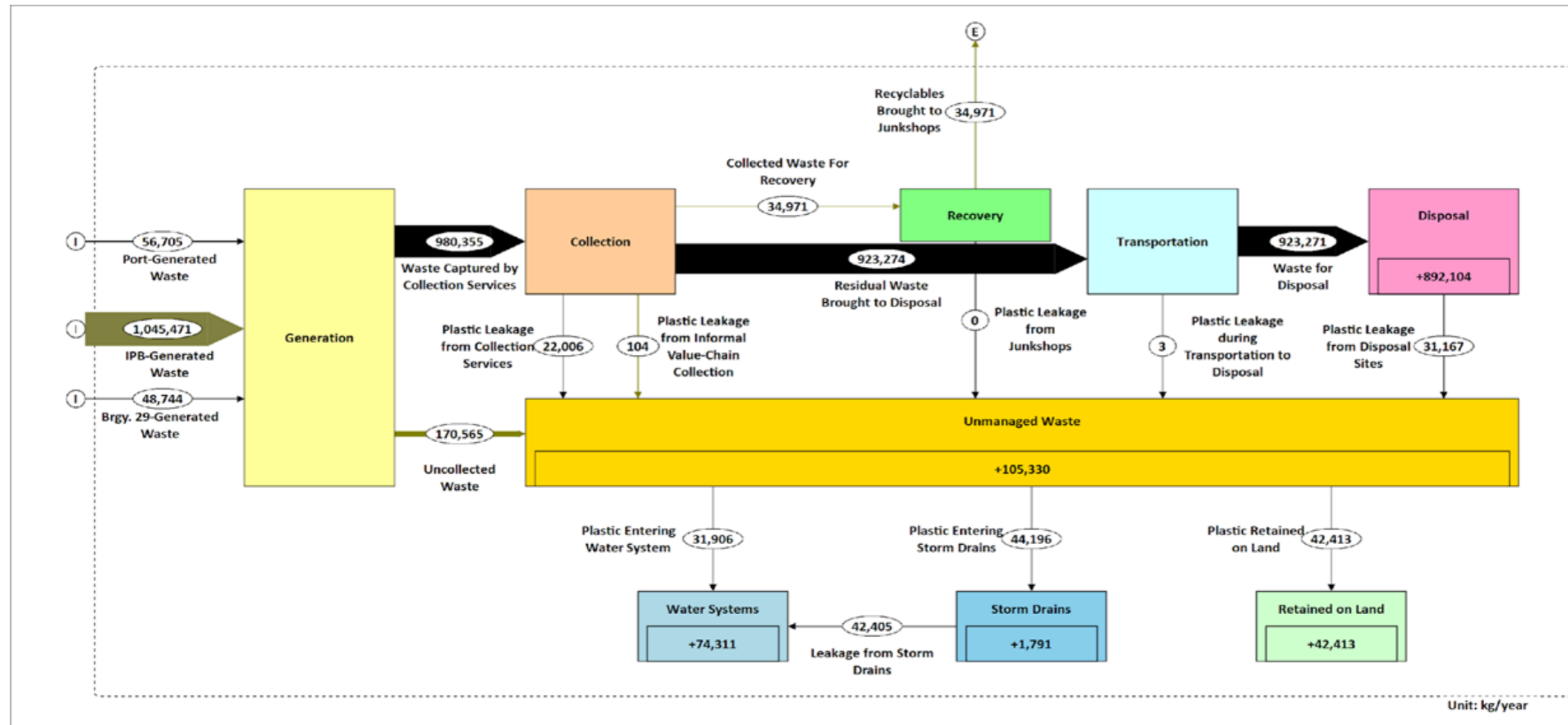


Figure 52. Solid Waste Flow Diagram in COVID-19 Scenario for Manila North Harbor



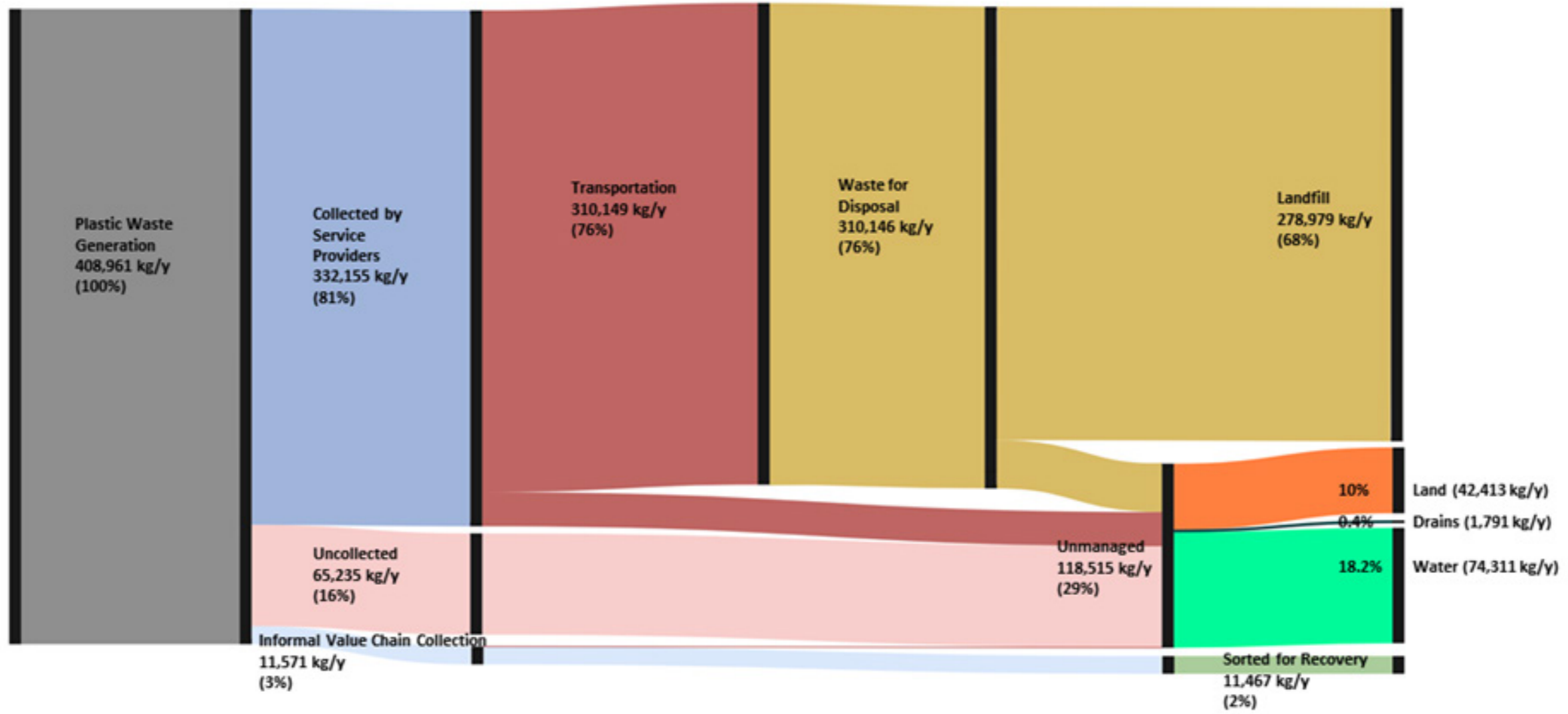


Figure 53. Waste Flow of Plastics in COVID-19 Scenario for Manila North Harbor



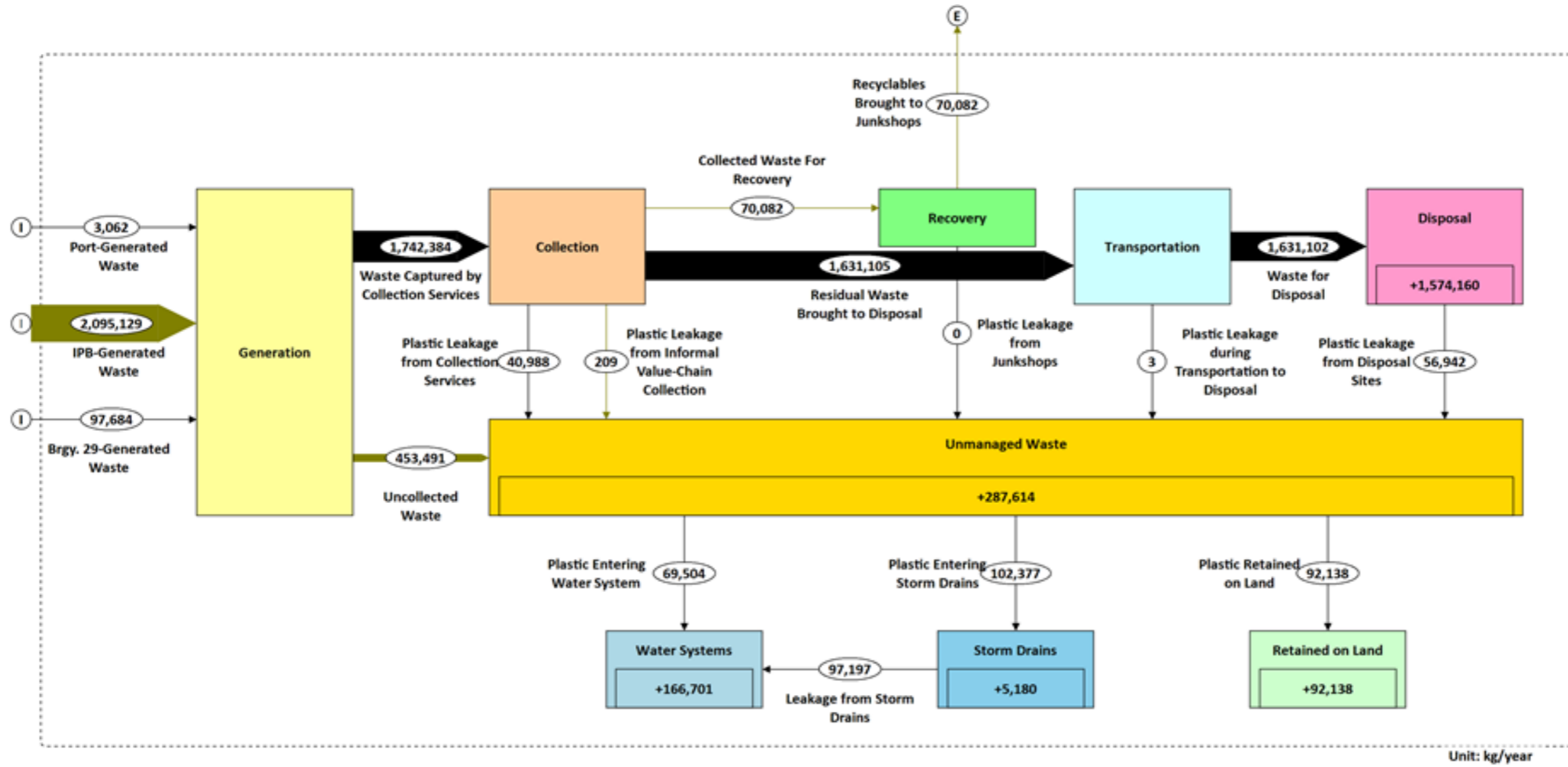


Figure 54. Solid Waste Flow Diagram in a Pre-COVID Scenario for Manila North Harbor



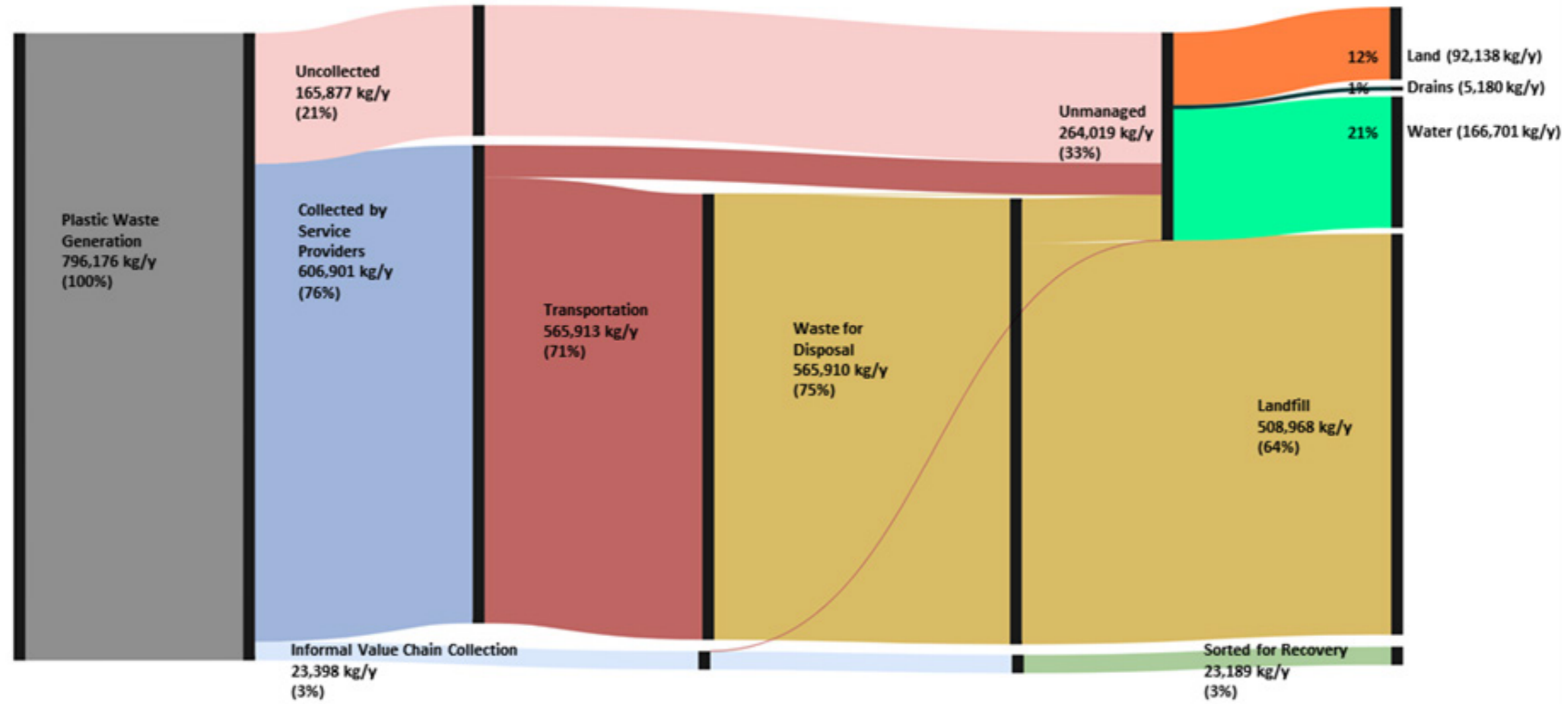


Figure 55. Waste Flow of Plastics in a Pre-COVID Scenario in Manila North Harbor







# OBSERVATIONS

There are several good practices and items for improvement observed at the Manila North Harbor.

## Good Practices

Good practices were observed at the different stages of the waste management system of Manila North Harbor (Table 17). Most of which were observed during waste segregation as this is the current focus of the port waste management system and a practice a significant number of households from the community are familiar with.

**Table 17. Summary of Good Practices in terms of Waste Management at the Manila North Harbor**

Stage	Port	Vessel
<b>Generation</b>	IEC Campaigns on waste segregation for employees of the port facilities.	Some, including families of Eco-Patrols, Eco-Aides, and Eco-Warriors, practice waste segregation at the household level.
	PMO regularly reports the estimated waste generation of their port facilities to PPA.	
<b>Segregation</b>	Manila City LGU bans usage of plastic bags and promotes alternatives.	Presence of plastic cages in some gates of Barangay 20.  Barangay 275 has an MRF where wastes from Barangay 275 are segregated.
	Color-coded waste segregation bins for segregating biodegradable (green), non-biodegradable (black), clinical (yellow), and recyclable (blue) waste.	
	Presence of plastic cages in the port terminals for collecting PET bottles.	
	MNHPI has a waste management plan covering generated waste from terminal operations.	
<b>Collection</b>	Separating hazardous wastes such as contaminated oil.	The use of a compactor truck for collecting waste from both Barangay 20 and 275.  Including the waste collection from Barangay 29 in the port waste collection of MNHPI.  The existence of waste management roles in the barangays through Eco-Patrols, Eco-Aides, and Eco-Warriors.
	Designated collection points are available in the whole port area.	
	Weigh bridge available at port.	
	There is a separate collection for hazardous wastes that is special toxic wastes.	
	The waste collection bins are properly covered.	
<b>Recovery</b>	A payloader is used to load waste from Pier 10 into waste collection truck.	Barangay 275 has an MRF where recyclables from the barangay is sold to a partner junkshop.
	Janitorial service in the port facility is allowed to sell PET bottles from the plastic cages as additional income.	

# Items for Improvement

There are also items for improvement observed at the different stages of the waste management system of Manila North Harbor that, when resolved, shall strengthen, and improve the currently implemented solid waste management system in the port. Suggested interventions to solve them are presented in the following table (Table 18).

**Table 18. Summary of Items for Improvement and Suggested Solutions for the Waste Management System of the Manila North Harbor**

Stage	Issues	Suggested Solution
<b>Generation</b>	Waste generated from the port recorded in the solid waste monitoring report does not include waste collected from Pier 10.	<p>Include weigh bridge record of truck hauls from Pier 10.</p> <p>Specify which terminal the documented waste is coming from, if possible.</p> <p>Provide waste containers for disposal of residuals in the communities</p>
	Prevalence of laminates present in storm drains and shorelines of barangays.	Educating household members, especially children, on proper waste disposal. Provide waste containers for disposing residuals around the barangays.
<b>Segregation</b>	No segregation of waste that is brought to the Pier 10 collection area.	<p>Provide segregation receptacles in the Pier 10 collection point and monitor compliance with proper disposal.</p> <p>Conduct IEC Campaign about proper waste handling and segregation.</p>
	Storage of residuals for disposal at the Barangay 275 MRF can be improved.	<p>Segregate fines, sand, and soil prior to collection from port yards.</p> <p>Place intended recovery bins for specific recoverable wastes, especially those of heavier density.</p>

Stage	Issues	Suggested Solution
<b>Segregation</b>	Only four locations have segregation waste bins.	Provide a covered container at the MRF for the residual wastes to be collected by the compactor truck.
		Increase number of locations with segregation waste bins in the port area.
<b>Collection</b>	<p>Mixing of wastes in compactor and dump trucks.</p> <p>Dump trucks that collect port generated waste are not covered.</p>	When using compactor trucks, make sure that the wastes are homogenous.
		<p>Use of color-coded trash bags.</p> <p>Provide cover for dump trucks.</p>
<b>Recovery</b>	Lack of Materials Recovery Facility that is fully functional, has sorting area and works on waste recovery for port facilities, and Barangay 20.	There should be a centralized MRF within the port, and for Barangay 20, which will process all the recyclable and biodegradable wastes.

## Control Level of Recovery Facilities

There is only one formal recovery facility identified for the Manila North Harbor waste management system. The community-generated wastes from Barangay 275 pass through the barangay MRF. This MRF has a sorting area, which is the primary waste recovery point for Barangay 275 wastes. This facility is found to have basic control over the wastes entering the area. Fencing and locks for access points to the MRF are present, however waste handling and storage, especially for the residuals for collection, can be improved. The location of the MRF is on the side of the MICT South Access Road, and residual wastes for collection are exposed to leakage, especially with passing automobiles. Sorted recyclables are stored in large sacks for PET Bottles and separate carts for other recyclables.





## RECOMMENDATIONS

Utilization of other plastics, installation of a centralized MRF within the port and for Barangay 20, conduct of IEC campaigns, and improvement of collection system and disposal facility are recommended for the Manila North Port.

### Utilization of Plastic Waste

About 23% of the generated wastes from the port and adjacent communities are plastics based on the WACS results. The most abundant type of plastics are the clear and single-layer sachets (Figure 37 and Figure 46), PS, PET and PP recyclables (Figure 38 and Figure 45). Utilizing these wastes may include bayong-making using clear or laminated sachets, upholstery and decorative items from low value plastics. Use of shredders, plastic densifiers, molders, and other innovative

technologies may also be applied to increase waste diversion rate and reduce plastic leakage to environment. When used by communities, these can also add value to the plastics, and can be bought at a higher price.

Manufacturers/recyclers of laminates and sachets is limited because there is no market for the products. To ensure a closed loop, the market for the finished products should also be considered.

### Installation of Centralized MRF inside the Port and Barangay 20

A centralized MRF within the port may optimize the waste diversion process for the biodegradables and recyclables in which the properly roofed facility should not only serve as a storage area but allot space for sorting and composting (Section III.C.4). The current space where Pier 10 collection point is can be utilized for this purpose by providing color-coded waste containers for segregation. The centralized MRF can also incentivize port employees, vessel personnel, and passengers for segregating their waste by having recyclable exchange stations. Incentives can range from discounts with certain port fees to cash. Waste technologies such as shredders, plastics, molders should also be present in the facility.

A MRF can also benefit Barangay 20 to provide a formal job opportunity to

the informal waste pickers in the area and to centralize the waste collection of residuals from the barangay. The existing containers (Figure 13) can still be utilized as an MRF or collection point by making them more accessible, and become under the jurisdiction of the waste management enforcers (Section III.B.6) of the barangay. Improvements can also still be made to the existing barangay MRF of Barangay 275. The use of the same waste technologies mentioned above can also benefit the waste from both Barangay 20 and 275.

The establishment of the MRF can be better achieved through partnerships with both private and public entities such as the Manila City LGU, DOST, DENR, PPA, MARINA, Cleanenvironment, iPrudential, PHILECO, Plastic Bank, NGOs, and other environmental groups (Figure 5)



## Conduct of Information, Education and Communication Campaigns

IEC campaigns can help strengthen the establishment of waste management plans and related mandates in the port facilities and surroundings of the adjacent barangays. Port facility employees and regular passengers are the target audience for IEC campaigns within the port area, which can mainly focus on segregation since segregated trash bins are already available in the passenger terminals. If the current segregation strategy is difficult for the target audience to understand, then an easier segregation scheme is recommended such as segregating according to wet, recoverable, and non-recoverable. The target audience can also be more knowledgeable of mandates of the PPA to food vendors operating in the port area, such as single-use plastic bans. This helps vendors and establishments abide by the mandates with ease in the long run. Both vendors inside the port area and onboard the vessels can be encouraged to participate

in educational seminars. Existing alternatives to plastics that are relevant to their businesses can also be shared with them. PPA or port management may use policy incentives such as command-and-control regulations, social-psychological incentives, and economic incentives to prompt the establishments and businesses to use alternative products for plastics.

Barangay residents are the target audience for IEC campaigns for Barangay 20 and 275, which can focus on proper waste disposal. This can help improve the amount of plastic waste leaked to the storm drains of the barangays. Existing alternatives to plastics that they use in their daily activities can also be shared with them. Manila City LGU and barangay can use incentives such as social-psychological incentives, and economic incentives to prompt the residents to use alternative products for plastics.

## Improvement of Segregation, Collection and Transportation System

Higher participation in segregating wastes at the generation stage benefits both the port and adjacent communities in managing the plastic waste leakage in their waste management system. Segregation can redirect plastics that would be susceptible to leakage in succeeding waste management stages. This can also help in the implementation of an MRF in the port and Barangay 20 (Section VII.B).

Three percent of the plastic wastes were calculated to leak during collection (Figure 53). This can be improved by ensuring that garbage bags are properly sealed and kept indoors to minimize the effects of external factors such as animal access, winds, and heavy rains. For future innovations, using automated systems for waste loading can be considered.

There is also a 0.01% percent leakage during transportation (Figure 53).

This can be minimized by ensuring that all collection vehicles for both port and vessel-generated wastes are compactor trucks that are fully covered.

The capacity of the waste bins distributed around the port can also be increased to lessen the occurrence of waste bins overflowing. An alternative to the payloader can be utilized, such as a vehicle with a divided container, for hauling waste around the port since the open bucket contributes to waste leakage and can negate the segregation done at source if all waste are mixed in the payloader bucket. The payloader can also do collection by waste categories to maintain the waste segregation at source. It is also recommended that waste from Pier 10 collection point be recorded as part of the monthly solid waste monitoring report to have data that more accurately reflects the waste generation of Manila North Harbor.



## Stricter Implementation of Plastic Bans

The Manila City LGU has already implemented the ban on using plastic bags for dry goods, and polystyrene for food containers. Stricter imposition and expansion of these current plastic ban and regulations in the area can help reduce the plastic waste generation and can also assist in promoting the use of environmentally friendly alternative in the Manila North Harbor. There shall be less to nil use of single use plastics such as clear and laminated sachets and disposable products such as PET bottles, PP containers, plastic utensils evident in the WACS results, as the consumers are more inclined to buying the alternatives with proper enforcement of plastic-related regulations.

The alternatives should be made available and that an analysis of the target population – including purchasing power – be made before banning a plastic product. Incentives or subsidy from the government may be looked in detail to address the purchasing power issue.

## Monitoring of Plastic Leakage

PPA, in coordination with DENR, shall be the overall head for the monitoring of the unmanaged waste and to ensure the continuity of solutions that will be put in place. The port management shall be in-charge on the waste retained on drains and in land, while the PCG shall monitor waste leakage on the waterbodies. The service providers shall be responsible in monitoring the leakages during collection and transportation while the landfill operators during disposal.

Further investigation from the city and barangay LGUs is recommended to find possible infrastructures, such as the use of drainage nets or trash traps, that can help improve storm drainage in the adjacent communities.

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## ANNEX A. SUMMARY OF MARPOL ANNEX V PROVISIONS

Garbage Type	All ships except platforms		Regulation 5 Offshore platforms located more than 12 nm from nearest land and ships when alongside or within 500 meters of such platforms
	Regulation 4 Outside special areas and Arctic waters (Distances are from the nearest land)	Regulation 6 Within special areas and Arctic waters (Distances are from nearest land, nearest iceshelf or nearest fast ice)	
Food waste comminuted or ground	≥3nm, en route and as far as practicable	≥12 nm, en route and as far as practicable	Discharge Permitted
Food waste not comminuted or ground	≥12 nm, en route and as far as practicable	Discharge Prohibited	Discharge Prohibited
Cargo residues not contained in washwater	≥12 nm, en route and as far as practicable	Discharge Prohibited	Discharge Prohibited
Cargo residues contained in washwater		≥12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2 and paragraph 5.2.1.5 of part II-A of the Polar Code)	Discharge Prohibited
Cleaning agents and additives contained in cargo hold washwater	Discharge permitted	≥12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2 and paragraph 5.2.1.5 of part II-A of the Polar Code)	Discharge Prohibited
Cleaning agents and additives in deck and external surface washwater		Discharge permitted	Discharge Prohibited
Animal Carcasses (should be split or otherwise treated to ensure the carcasses will sink immediately)	Must be en route and as far from the nearest land as possible.  Should be >100nm and maximum water depth	Discharge Prohibited	Discharge Prohibited

Garbage Type	All ships except platforms		Regulation 5 Offshore platforms located more than 12 nm from nearest land and ships when alongside or within 500 meters of such platforms
	Regulation 4 Outside special areas and Arctic waters (Distances are from the nearest land)	Regulation 6 Within special areas and Arctic waters (Distances are from nearest land, nearest iceshelf or nearest fast ice)	
All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining, and packing materials, paper, rags, glass, metal, bottles, crockery and similar refuse	Discharge Prohibited	Discharge Prohibited	Discharge Prohibited

\*nm - Nautical Miles

## ANNEX B. COBSEA REGIONAL ACTION PLAN ON MARINE LITTER ANNEX 2

Key Actions		Lead Authority
<b>Action 1. Preventing and Reducing Marine Litter from Land-Based Sources</b>		
1.1 Legal and Economic Instruments		
1.1.1.	Encourage and assist countries to enhance leadership, implementation, and quality of government efforts.	Secretariat
1.1.2.	In countries where many government agencies and departments are involved in waste management efforts, COBSEA members may wish to consider, as necessary, establishing a policy making mechanism and supporting agency, or strengthening it if already existing, for the implementation of solid waste management policies.	Countries
1.1.3.	Encourage and assist countries to develop and adopt legal and economic instruments to assist the management and prevention of marine litter from land-based sources and moving towards circular economy models, including harmonization of standards and regulations in the region. This could include: - addressing single-use product consumption (through, for example, fiscal and economic instruments such as a tax on plastic bags and packaging and phase out of single-use plastic items in stores); - establishment and/or further development of deposit refund systems for bottles, containers and cans (e.g., glass, plastics and aluminium).	Secretariat/ Countries
1.2 Integrated Waste Management		
1.2.1.	Enter into dialogue with the industry on waste management practices that impact on the marine environment and identify incentives/measures to promote sustainable practices.	Secretariat/ Countries
1.2.2.	Implement adequate waste reduction, reuse, and recycling measures, as well as other relevant approaches such as product replacement, in order to reduce the amount of litter, particularly the fraction of plastic waste that goes to landfill or incineration without energy recovery. Where incineration with energy recovery is used, this should use modern technology with controls on combustion condition capable of meeting stringent emission standards.	Countries
1.2.3.	Organize the front and middle end of the waste system by building a modern waste collection and separation system, including recognizing and integrating waste pickers in formal systems of waste management and accelerating recycling, while ensuring non-processed waste is disposed of safely in sanitary landfills at the back of the chain.	Countries
1.2.4.	Take the necessary measures to address illegal dumping, including closing existing illegal dump sites on land and strengthening enforcement measures to combat illegal dumping, such as littering on the beach and illegal solid waste or sewage disposal in the coastal zone and rivers, in accordance with national legislation.	Countries
1.2.5.	Seek cooperation with River Authorities, if necessary, municipalities and other relevant authorities in order to address impacts of litter on the marine environment from riverine inputs, including through introduction and improvement of trash traps at river and drainage areas, floating booms and barriers.	Secretariat/ Countries
1.3 Removal of Existing Litter and Its Disposal		
1.3.1.	Develop and implement, in collaboration with relevant stakeholders, programmes and initiatives for identification, removal and sound disposal of accumulations of landbased marine litter, e.g., in combination with existing efforts such as coastal clean-up activities, where economically feasible and ecologically advantageous.	Secretariat/ Countries

Key Actions		Lead Authority
<b>Action 2. Preventing and Reducing Marine Litter from Sea-Based Sources</b>		
2.1 Legal and Economic Instruments		
2.1.1.	Encourage and assist countries to develop and adopt legal and economic instruments, which are consistent with the relevant international instruments such as the United Nations Convention on the Law of the Sea (UNCLOS) and the International Convention for the Prevention of Pollution from Ships (MARPOL) and its Annexes, to assist the management and prevention of marine litter from sea-based sources.	Secretariat/ Countries
2.1.2.	Reinforce the implementation and enforcement of existing national legal instruments in compliance with marine litter related international conventions and agreements such as the MARPOL convention and its Annex V, the London convention and its Protocol, the Basel Convention, and the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries.	Countries
2.1.3.	Provide assistance in the implementation of the requirements of Annex V to the MARPOL Convention to provide and improve reception facilities for all types of ship-generated waste in ports, harbours, terminals and marinas	Secretariat
2.1.4.	Develop sectoral guidelines on the prevention and reduction of marine litter from sea-based sources, particularly for fisheries and marine/coastal tourism.	Secretariat
2.1.5.	Develop and/or strengthen existing legislation requiring all fishing gear to be identified/marked to contribute to reducing fisheries-related marine litter.	Secretariat/ Countries
2.2 Removal of Existing Marine Litter and Its Disposal		
2.2.1.	Develop and implement, in collaboration with relevant stakeholders, programmes and initiatives to locate, remove and dispose of accumulations of sea-based marine litter, where economically feasible and ecologically advantageous.	Secretariat/ Countries
<b>Action 3. Monitoring and Assessment of Marine Litter</b>		
3.1 Expert Group		
3.1.1.	Establish a Marine Litter Monitoring Expert Group under the COBSEA Working Group on Marine Litter.	Secretariat
3.2 Regional and National Marine Litter Monitoring Programmes		
3.2.1.	Prepare regional guidance on the development of harmonized National Marine Litter and Microplastic Monitoring Programmes, in line with globally established guidelines, e.g., Group of Experts on the Scientific Aspects of Marine Environmental Protection Working Group on plastics and microplastics in the ocean (GESAMP WG 40) Guidelines for the Monitoring and Assessment of Plastic Litter in the Ocean, and in consultation with relevant ongoing regional monitoring programmes.	Secretariat
3.2.2.	Conduct regional training on the development and implementation of harmonized National Marine Litter and Microplastic Monitoring Programmes, also addressing associated data management needs and reporting	Secretariat
3.2.3.	Work towards developing and implementing National Marine Litter and Microplastic Monitoring Programmes, based on respective national policies, approaches and circumstances.	Countries
3.2.4.	Prepare regional reports on marine litter and microplastic and delivery against Sustainable Development Goal target 14.1, and other relevant Goals and targets, based on National Marine Litter and Microplastic Monitoring Programmes.	Secretariat

Key Actions		Lead Authority
3.2.5.	Explore development of a regional marine litter and microplastic monitoring metadata base/portal, as appropriate building on available global infrastructure, to facilitate the preparation of periodic regional reports.	Secretariat
<b>Action 4. Activities Supporting the Implementation of COBSEA RAP MALI</b>		
4.1 Regional and International Cooperation and Reporting		
4.1.1.	Establish a COBSEA Working Group on Marine Litter, to include national focal points and experts. This group will promote implementation of the COBSEA Regional Action Plan on Marine Litter, advising and assisting the COBSEA Intergovernmental Meeting and the COBSEA Secretariat. Terms of Reference for the group is provided in Appendix 3 of RAP MALI.	Secretariat
4.1.2.	Establish institutional cooperation with relevant global and regional entities in relation to implementation of the COBSEA Regional Action Plan on Marine Litter and relevant global multilateral environmental agreements, e.g. the MARPOL Convention and its Annex V, the London Convention and its Protocol, the Basel Convention, the Convention on Biological Diversity, Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) as well as the FAO Code of Conduct for Responsible Fisheries and Voluntary Guidelines on Gear Marking.	Secretariat
4.1.3.	Establish partnerships with cities, to provide effective transfer of knowledge and innovation, and promote collaboration between cities/countries.	Secretariat/ Countries
4.1.4.	Convene regional conferences for stakeholder engagement and partnerships and coordinate ongoing efforts with relevant regional and international partners and frameworks, such as the Association of Southeast Asian Nations (ASEAN).	Secretariat
4.2 National Planning and Policy Frameworks		
4.2.1.	Develop and implement National Action Plans on Marine Litter or equivalent planning or policy documents (where relevant building on existing efforts such as development of or updating GPA national programmes of action to strengthen the management and mitigation of land-based pollution), or similar initiatives that contribute to addressing land-based and sea-based sources of pollution.	Countries
4.2.2.	Develop regional sectoral guidelines on the prevention and reduction of marine litter from land-based sources, particularly for sectors of waste management, tourism and plastic manufacturing.	Secretariat
4.2.3.	Develop, at the regional level, a reporting format on national planning and policy frameworks.	Secretariat
4.3 Research Activities		
4.3.1.	Support research and development including of technology and approaches, as well as the consideration of social and behavioral sciences, to prevent marine litter input from land-based sources and promote environmentally sound production and waste management technologies.	Secretariat/ Countries
4.3.2.	Develop and carry out research on the impact of marine litter on the marine and coastal environment and economy (including economic costs and impacts on human health and safety).	Secretariat/ Countries
4.3.3.	Develop and support research on the effectiveness of market-based instruments related to marine litter	Secretariat/ Countries

Key Actions		Lead Authority
4.3.4.	Undertake marine litter trajectory modelling in the COBSEA region, to identify sources and accumulation zones for marine litter. Such models will assist participating countries in tracking progress towards Sustainable Development Goal target 14.1.	Secretariat/ Countries
4.3.5.	COBSEA participating countries to consider undertaking analysis of plastic flows into the region and their relative contribution to marine litter generation.	Countries
4.4 Information, Education, Outreach, and Involvement of Stakeholders		
4.4.1.	Encourage and assist the appropriate involvement of various stakeholders including local authorities, civil society and private sector in implementation of the COBSEA Regional Action Plan on Marine Litter.	Secretariat/ Countries
4.4.2.	Support the implementation of marine litter clean-up campaigns on a regular basis, including: <ul style="list-style-type: none"> <li>- organization of clean-ups as a tool in educating and involving local stakeholders, communities, and media, in combination with public awareness campaigns;</li> <li>- encouraging and assisting entities with a particular interest in or responsibility for certain coastal areas, such as tourist resorts and port authorities, to undertake regular clean-ups;</li> <li>- encouraging stakeholder engagement in relevant international initiatives, such as the International Coastal Cleanup (ICC) campaigns, Clean Up the World (CUW) campaigns, Green Fins, Project Aware and similar campaigns, or programmes.</li> </ul>	Secretariat/ Countries
4.4.3.	Formulate and implement awareness raising campaigns and activities, in line with the Clean Seas campaign and other relevant campaigns, for the general public, various sectors, municipal authorities, local communities and particularly vulnerable groups, school children and youth and other groups.	Secretariat/ Countries
4.4.4.	Develop suitable information material on the COBSEA Regional Action Plan on Marine Litter and translate it into national languages.	Secretariat
4.5 Training and Capacity Building		
4.5.1.	Develop and implement regional education and training for different target groups (across sectors and stakeholder groups) to enhance understanding of marine litter generation pathways, impacts, and preventive action, and to facilitate the application of technical sectoral guidelines.	Secretariat
4.5.2.	Provide technical training and capacity building to staff from national and municipal governments, port authorities and the shipping industry on the prevention and reduction of marine litter from land-based and sea-based sources through regional workshops and training courses.	Secretariat

**ANNEX C. SCHEDULE OF ACTIVITIES CONDUCTED  
IN MANILA NORTH HARBOR**

Activity	October							
	19	20	21	22	23	24	25	26
Check-In, Sorting Area Visit, and Sorters Orientation								
Meeting with PPA, MNHPI, and Cleanenvironment, MNH Visit, and Barangay Visit								
Barangay Visit, Stakeholder Interviews, and Observation of Pier 10 Waste Hauling								
WACS Day 1 for Port- and Community-Generated Waste								
WACS Day 2 for Port- and Community -Generated Waste								
WACS Day 3 for Port- and Community -Generated Waste								

## ANNEX D. STAKEHOLDER INTERVIEW DATES

Stakeholders	Date of Interview
Norwegian Training Institute	June 16, 2021
Philippine Liner Shipping Association	June 22, 2021
iPrudential Manila	June 23, 2021
2GO	June 30, 2021
International Container Terminal Services Inc.	July 7, 2021
Royal Caribbean	July 8, 2021
Barangay 20	July 26, 2021
Cleanvironment	August 27 and October 20, 2021
Philippine Port Authority	October 20, 2021
Manila North Harbour Port Incorporated	October 20, 2021
Barangay 20, 29, and 275 Residents	October 20 and 21, 2021
Barangay 275 Materials Recovery Facility	October 21, 2021
Junkshop	October 20, 2021

## ANNEX E. CONTROL LEVEL OF RECOVERY FACILITIES

Control Level	Other Recovery Facilities (Without Incineration)
<b>Full Control</b>	<input type="checkbox"/> Built to and operating in compliance with current national laws and standards <input type="checkbox"/> Pollution control compliant to environmental standards <input type="checkbox"/> Protection of workers' health and safety <input type="checkbox"/> The nutrient value of biologically treated materials utilized for separate organic waste (e.g., in agriculture/horticulture) <input type="checkbox"/> Materials are extracted, processed according to market specifications, and sold to recycling markets <input type="checkbox"/> Weighing and recording of incoming loads conducted <input type="checkbox"/> All outgoing loads registered by weight and type of destination
<b>Improved Control</b>	<input type="checkbox"/> Engineered facilities with effective process control <input type="checkbox"/> Pollution control compliant to environmental standards <input type="checkbox"/> Protection of workers' health and safety <input type="checkbox"/> Evidence of materials extracted being delivered into recycling or recovery markets. <input type="checkbox"/> Weighing and recording of incoming and outgoing loads conducted
<b>Basic Control</b>	<input type="checkbox"/> Registered facilities with marked boundaries <input type="checkbox"/> Some environmental pollution controls <input type="checkbox"/> Provisions made for workers' health and safety <input type="checkbox"/> Weighing and recording of incoming and outgoing loads conducted
<b>Limited Control</b>	<input type="checkbox"/> Unregistered facilities with distinguishable boundaries <input type="checkbox"/> No environmental pollution controls <input type="checkbox"/> No provisions made for workers' health and safety <input type="checkbox"/> Weighing and recording conducted
<b>No Control</b>	<input type="checkbox"/> Unregistered locations with no distinguishable boundaries <input type="checkbox"/> No provisions made for workers' health and safety <input type="checkbox"/> No environmental pollution control



**ANNEX F. CONTROL LEVEL OF DISPOSAL FACILITIES**

Control Level	Other Recovery Facilities (Without Incineration)
<b>Full Control</b>	<input type="checkbox"/> Waste daily covered <input type="checkbox"/> Waste compacted <input type="checkbox"/> Site fenced and full 24-hour control of access <input type="checkbox"/> Properly sited, designed, and functional sanitary landfill <input type="checkbox"/> Leachate containment and treatment (naturally consolidated clay on the site or constructed liner) <input type="checkbox"/> Landfill gas collection and flaring and/or utilization <input type="checkbox"/> Site staffed <input type="checkbox"/> Post closure plan <input type="checkbox"/> Weighing and recording conducted <input type="checkbox"/> Protection of workers' health and safety
<b>Improved Control</b>	<input type="checkbox"/> Waste periodically covered <input type="checkbox"/> Waste compacted <input type="checkbox"/> Site fenced and control of access <input type="checkbox"/> Leachate containment and treatment <input type="checkbox"/> Landfill gas collection (depending on landfill technology) <input type="checkbox"/> Site staffed <input type="checkbox"/> Weighing and recording conducted <input type="checkbox"/> Protection of workers' health and safety
<b>Basic Control</b>	<input type="checkbox"/> Some use of cover <input type="checkbox"/> Waste compacted <input type="checkbox"/> Sufficient equipment for compaction <input type="checkbox"/> Site fenced and control of access <input type="checkbox"/> No fire/smoke existence <input type="checkbox"/> Site staffed <input type="checkbox"/> Weighing and recording conducted <input type="checkbox"/> The slope of the landfill is stable, landslides not possible <input type="checkbox"/> Protection of workers' health and safety
<b>Limited Control</b>	<input type="checkbox"/> No cover <input type="checkbox"/> Some compactions <input type="checkbox"/> Some equipment for compaction <input type="checkbox"/> Some level of access control/fencing <input type="checkbox"/> No leachate controls <input type="checkbox"/> Some fire/smoke existence <input type="checkbox"/> Site staffed <input type="checkbox"/> Weighing and recording conducted <input type="checkbox"/> The slope of the landfill is unstable with high possibility of a landslide
<b>No Control</b>	<input type="checkbox"/> No cover <input type="checkbox"/> No compaction <input type="checkbox"/> No/ limited equipment <input type="checkbox"/> No fencing <input type="checkbox"/> No leachate controls <input type="checkbox"/> Fire/smoke existence <input type="checkbox"/> No staff <input type="checkbox"/> The slope of the landfill is unstable with high possibility of a landslide

**ANNEX G. GROSS TONNAGE OF VESSELS  
AT MANILA NORTH HARBOR**

<b>Vessel Name</b>	<b>Gross Tonnage (m<sup>3</sup>)</b>
MV Span Asia 30	8829.60
Moreta Cargo I	3707.30
MV Meridiam Cinco	11022.85
MV Don Daxton	7966.45
MV Meridian King	3076.21
MV Solid Sun	13349.11
MV Span Asia 33	8809.79
Moreta Venture	10708.72
Moreda Cargo I	3707.30
MV Meridian Queen	10306.86

## ANNEX H. WASTE FLOW DIAGRAMS LEAKAGE CALCULATIONS FROM LEAKAGE INFLUENCERS AND FATES OF PLASTIC

Leakage Influencer	Grade	Value	Percentage	Port-Generated Waste (kg/year)	Barangay 29-Generated Waste (kg/year)
<b>Leakage from Collection Services</b>					
Collection Containers	Medium	1.00	3.000%	360	532
Loading Method	Medium	0.50			
Primary Transportation	Medium	0.50			
Multiple Handling / Waste Transfer	Medium	1.00			
<b>Leakage during Transportation to Disposal</b>					
Capacity vs Load	Low	0.1	0.010%	1	2
Waste Containment	Low	0.1			
Vehicle Cover	Very High	1.0			
<b>Leakage from Disposal Facilities</b>					
Environmental Hazards	Medium	10.0	10.075%	1,172	1,733
Exposure to Weather	Medium	0.50			
Waste Handling	Medium	0.75			
Coverage	Medium	0.40			
Burning	Very High	1.00			
Fencing	Medium	0.50			
<b>Leakage in Storm Drains Entering Waterways</b>					
Frequency of Rainfall / Storms	Medium	60.00	94.000%	283	445
Drain Cleaning	High	0.10			

Item	Grade	Value	Percentage
<b>Fate of Plastic Leaked during Collection</b>			
Level of Plastic to Land	Medium	0.60	52.17%
Level of Plastic to Drains	Medium	0.30	26.09%
Level of Plastic to Water Systems	Very High	0.25	21.74%
<b>Fate of Plastic Leaked during Transportation</b>			
Level of Plastic to Land	Medium	0.60	52.17%
Level of Plastic to Drains	Medium	0.30	26.09%
Level of Plastic to Water Systems	Very High	0.25	21.74%
<b>Fate of Plastic Leaked from Disposal Facilities</b>			
Level of Plastic to Land	Medium	0.60	35.29%
Level of Plastic to Drains	Medium	0.30	17.65%
Level of Plastic to Water Systems	Very High	0.80	47.06%

Fate of Plastic Leakage	Port-Generated Waste (kg/year)	Barangay 29-Generated Waste (kg/year)
Plastic Retained on Land	295	890
Plastic Waste Entering Storm Drains	147	27
Plastic Entering Water Systems	308	1,350

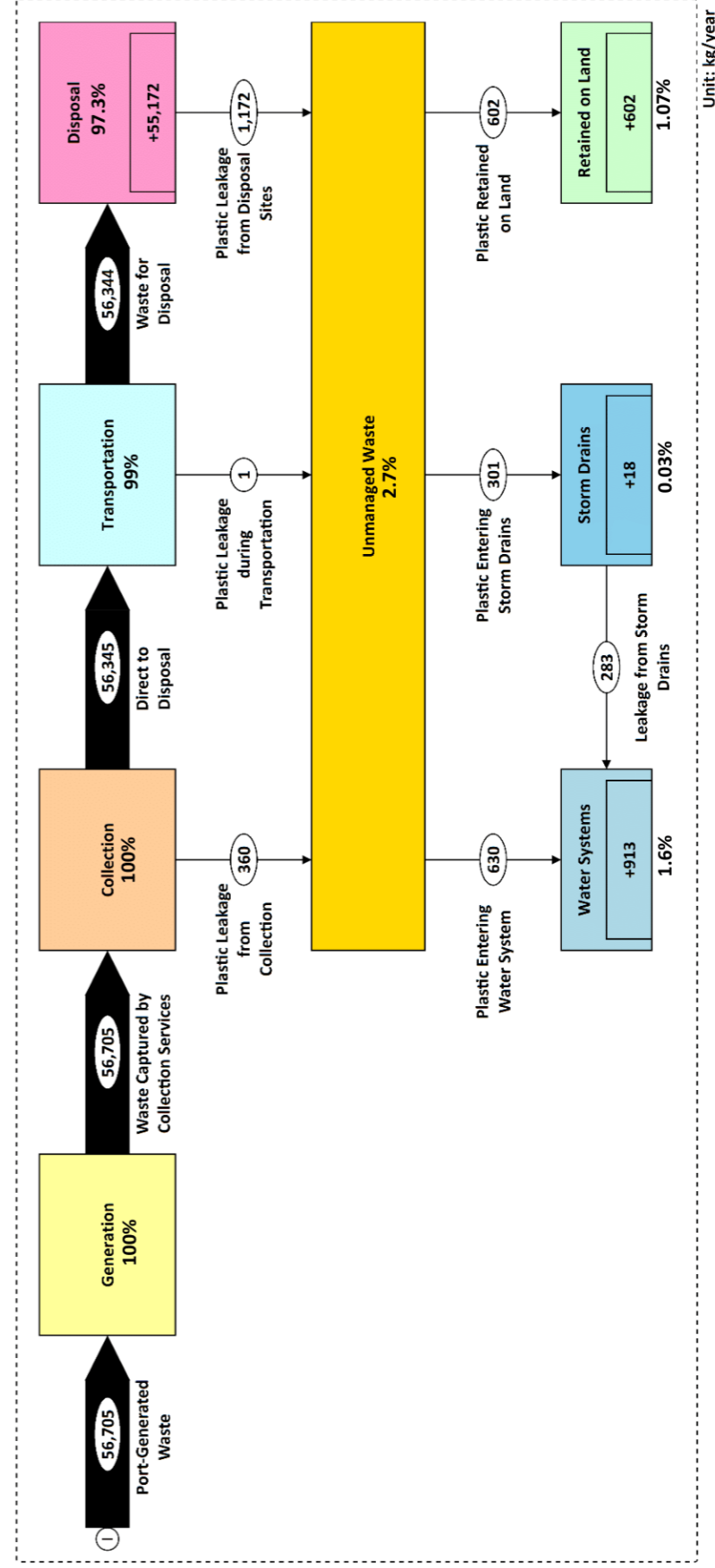
Leakage Influencer	Grade	Value	Percentage	Isla Puting Bato-Generated Waste (kg/year)
<b>Leakage from Collection Services</b>				
Collection Containers	Very High	5.00	7.000%	21,114
Loading Method	High	1.00		
Primary Transportation	Low	0.00		
Multiple Handling / Waste Transfer	Medium	1.00		
<b>Leakage during Informal Value-chain Collection</b>				
Recyclables extraction method	Medium	0.8	0.9000%	104
Transportation Method	Medium	0.1		
<b>Leakage during Transportation to Disposal</b>				
Capacity vs Load	Low	0.10	0.000%	0
Waste Containment	Medium	0.50		
Vehicle Cover	Low	0.00		
<b>Leakage from Disposal Facilities</b>				
Environmental Hazards	Medium	10.0	10.075%	28,262
Exposure to Weather	Medium	0.50		
Waste Handling	Medium	0.75		
Coverage	Medium	0.40		
Burning	Very High	1.00		
Fencing	Medium	0.50		
<b>Leakage in Storm Drains Entering Waterways</b>				
Frequency of Rainfall / Storms	Medium	60.00	94.000%	40,843
Drain Cleaning	High	0.10		

Item	Grade	Value	Percentage
<b>Fate of Plastic Leaked during Collection</b>			
Level of Plastic to Land	Medium	0.60	52.17%
Level of Plastic to Drains	Medium	0.30	26.09%
Level of Plastic to Water Systems	Very High	0.25	21.74%
<b>Fate of Plastic Leaked during Transportation</b>			
Level of Plastic to Land	Medium	0.60	52.17%
Level of Plastic to Drains	Medium	0.30	26.09%
Level of Plastic to Water Systems	Very High	0.25	21.74%
<b>Fate of Plastic Leaked from Disposal Facilities</b>			
Level of Plastic to Land	Medium	0.60	35.29%
Level of Plastic to Drains	Medium	0.30	17.65%
Level of Plastic to Water Systems	Very High	0.80	47.06%

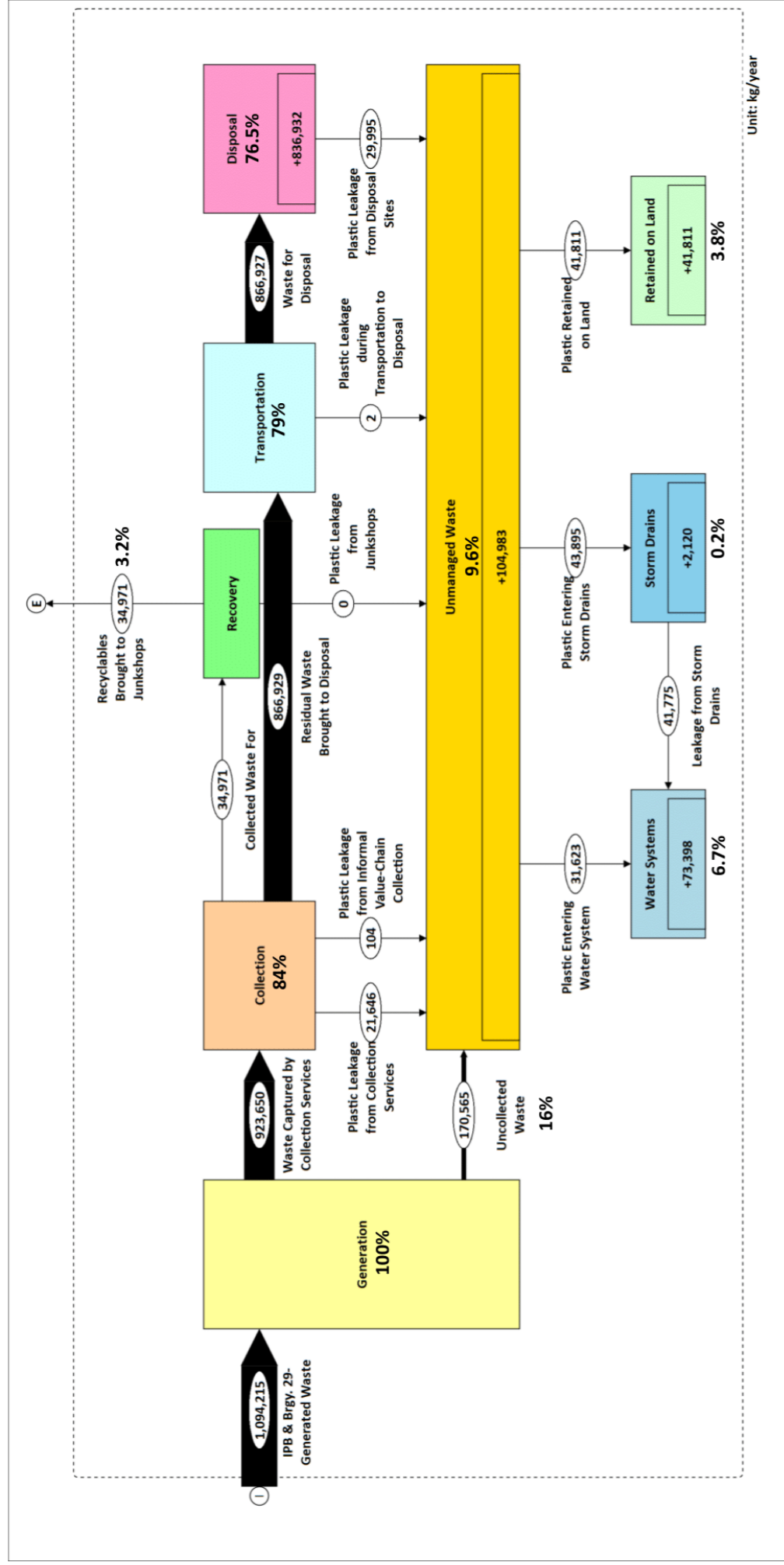
Fate of Plastic Leakage	Isla-Puting Bato-Generated Waste (kg/year)
Plastic Retained on Land	40,921
Plastic Waste Entering Storm Drains	43,450
Plastic Entering Water Systems	31,205

**ANNEX I.**

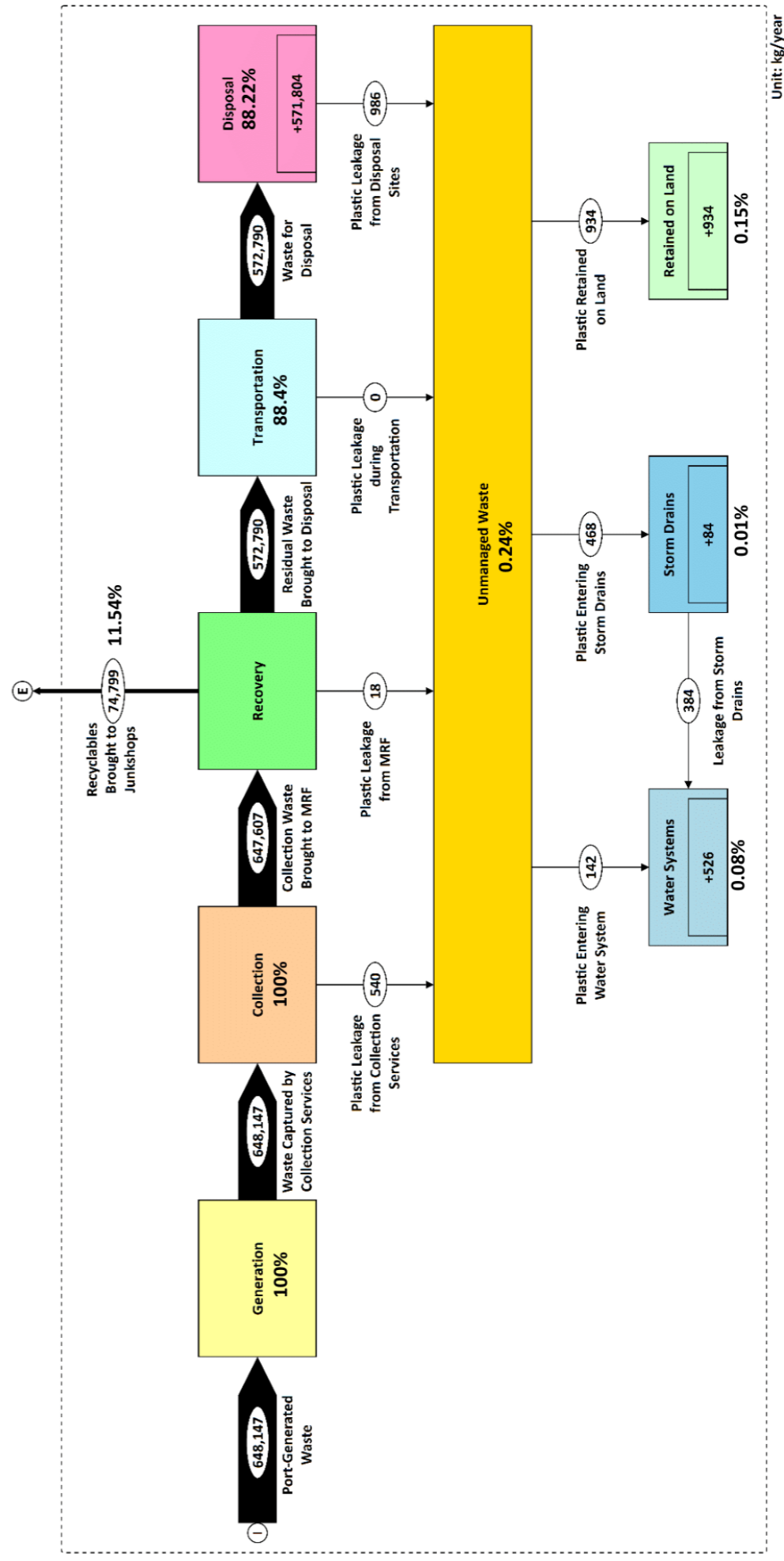
**PORT AND COMMUNITY-GENERATED  
WASTE FLOW DIAGRAMS  
FOR COVID-19  
AND PRE-COVID SCENARIO**



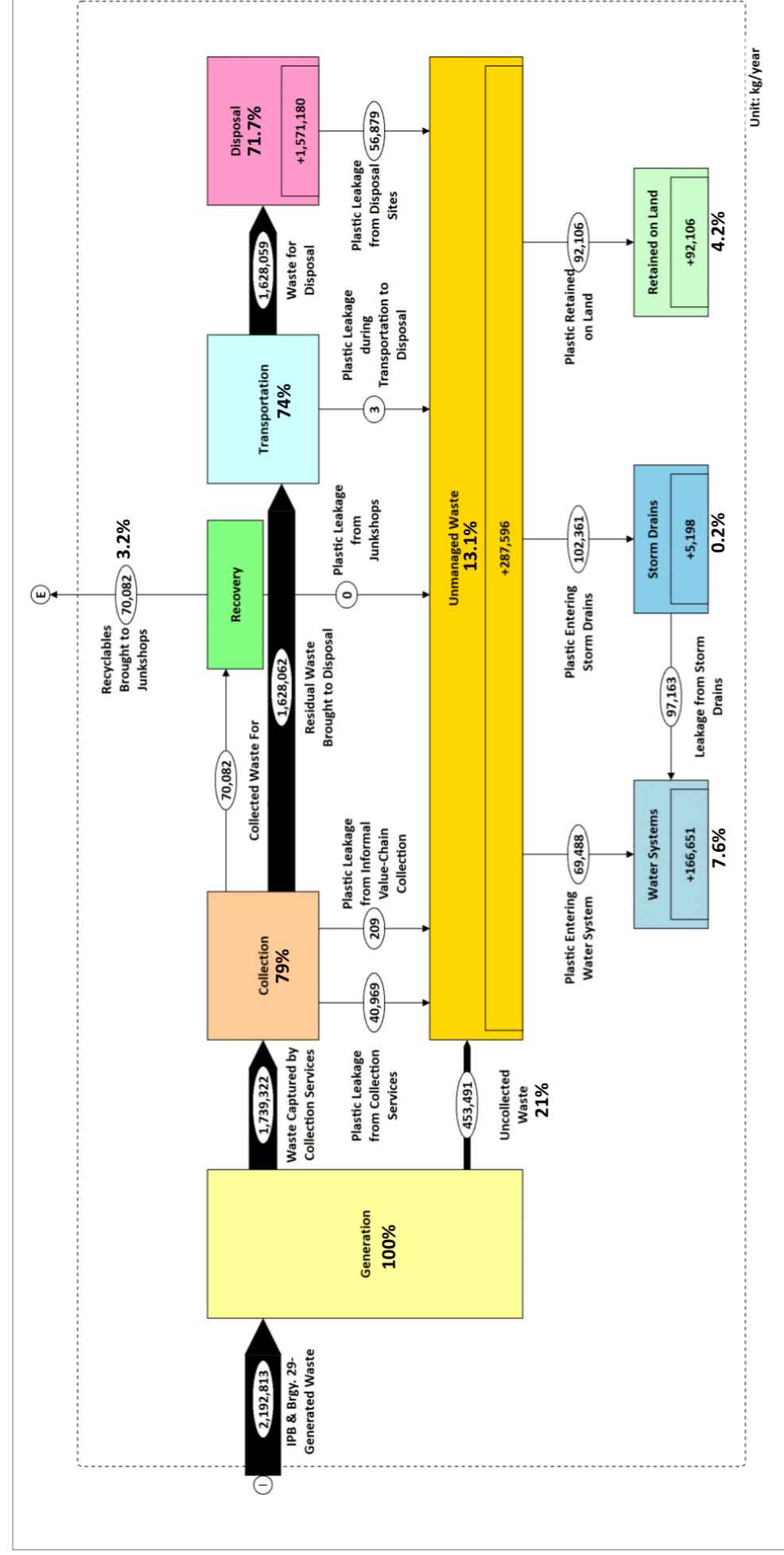
Port-Generated Waste Flow Diagram in Manila North Port for COVID-19 Scenario



IPB and Barangay 29-Generated Waste Flow Diagram in Manila North Harbor for COVID-19 Scenario



Port-Generated Waste Flow Diagram in Port of Cagayan de Oro for Pre-COVID-19 Scenario



IPB and Barangay 29-Generated Waste Flow Diagram in Manila North Harbor for Pre-COVID-19 Scenario

**WWF-Philippines**

*January 2022*

