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

Solid Waste Management Baseline Study
Port of Cagayan de Oro

December 2021

Acknowledgement

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Acronyms

AMH	AMH Philippines, Inc.
BOD	Biological Oxygen Demand
CLENRO	City Local Environment and Natural Resources Office
COBSEA	Coordinating Body on the Seas of East Asia
COD	Chemical Oxygen Demand
DAP	Development Academy of the Philippines
DENR	Department of Environment and Natural Resources
DO	Dissolved Oxygen
DOST	Department of Science and Technology
DOTC	Department of Transportation and Communication
DOTr	Department of Transportation
DWT	Dead Weight Tonnage
EMB	Environmental Management Bureau
EO	Executive Order
Far East	Far East Fuel Corporation
FGD	Focused Group Discussion
GBPR	Government Best Practice Recognition
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRaSPS	Green, Resilient and Smart Port Strategy
Grieg	Grieg Star Group AS
GT	Gross Tonnage
ha	Hectares
HDPE	High Density Polyethylene
HME	Harmful to Marine Environment
IMO	International Maritime Organization
ITDI	Industrial Technology Development Institute
IRR	Implementing the Rules and Regulations
km	Kilometer
km2	Square Kilometer
LDPE	Low Density Polyethylene
LGU	Local Government Unit
m	Meter
m2	Square Meter
m3	Cubic Meter
MARINA	Maritime Industry Authority
MARPOL	International Convention for the Prevention of Pollution from Ships
MC	Memorandum Circular
MEPC	Marine Environment Protection Committee
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
NPCC	National Pollution Control Commission
NPOA	National Plan of Action on Marine Litter
NSWMC	National Solid Waste Management Commission
Oroport	Oroport Cargo Handling Services Inc.
OTS	Open Transit Shed
PCG	Philippine Coast Guard
PD	Presidential Decree
PET	Polyethylene Terephthalate
PMO	Port Management Office
PP	Polypropylene
PPA	Philippine Ports Authority
PS	Polystyrene
PSA	Philippines Statistics Authority
PT	Passenger Terminal
PTC	Passenger Terminal Complex
PVC	Polyvinyl Chloride
RA	Republic Act
RAP MALI	Regional Action Plan on Marine Litter
RoRo	Roll-on/Roll-off
SDG	Sustainable Development Goals
SLF	Sanitary Landfill
SRF	Shore Reception Facilities
SUP	Single-Use Plastics
SWM	Solid Waste Management
SWMP	Solid Waste Management Plans
TEU	Twenty-footer Equivalent Units
TS	Transit Shed
UN	United Nations
UNDP	UN Development Programme
UNEP	UN Environment Programme
WACS	Waste Analysis and Characterization Study
WaCT	Waste Wise Cities Tool
WOBVIF	Waste On-Board Vessel Information Form
WWF	World Wide Fund for Nature

INTRODUCTION

This report presents the results of the conducted baseline study for the Port of Cagayan de Oro (Figure 1), which includes a waste analysis and characterization study (WACS) and an analysis of the flow of waste being generated in ports.

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 Port of Cagayan de Oro (Figure 1). AMH is also tasked to conduct a national baseline study.

Figure 1. Port of Cagayan de Oro and the Select Ports of the 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 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 leakage and to provide baseline data against which to monitor progress towards the reduction of plastic waste leakage.

The project specifically aims to provide the waste generated per passenger, per collection point, per vessel and per deadweight tonnage[1] (DWT) or gross tonnage[2] (GT) data; to develop the waste flow diagrams for port/vessel-generated wastes; to provide the data on volume of wastes coming from ports, vessels, 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 port of Cagayan de Oro.

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

PORT DESCRIPTION

The Port of Cagayan de Oro in Cagayan de Oro City, Misamis Oriental is one of the busiest government ports in Northern Mindanao in terms of cargo throughput. It is located along the periphery of Macajalar Bay, a Class SB/SC marine water with an area of around 1,250 km2 and bordered by two cities and 12 municipalities. Land access to the port is through a cemented causeway/ access road with quay length of 1,248 m. Navigation to the port by sea is guided by a Pilot Boarding Station and a lighthouse, with safe anchorage area at 60 fathoms or approximately 400 m from the shore (PMO of Cagayan de Oro, 2021).

To its west is the Cagayan de Oro River that has a river basin listed as one of the 36 water quality management area (WQMA) of the country under DAO 2013-018 (Department of Environment and Natural Resources, 2013). To its south is the Bitan-ag Creek (Figure 1), which is among the five major creeks of Cagayan de Oro City (Del Rosario & Palmes, 2010) with headwaters at the area around Barangay Nazareth. This creek was clogged with garbage that led to flooding in some parts of Cagayan de Oro City – at Lim Ket Kai Complex and at the University of Science and Technology of Southern Philippines (USTSP) – in January 2017 (Lagsa, 2017).

Misamis Oriental's strategic and accessible location enables the province to be a center of industry, trade and commerce in the region. (Department of Trade and Industry, 2021) The rapid economic growth in the region, however, has spawned an increased land speculation, illegal logging, sea piracy, destructive fishing and mining practices, shipping, and industrial pollution. The establishment of ports and increase in waste generation that comes with it greatly affected the marine environment in Macajalar Bay (Ravanera, 2002). This project, which aims to study the amount of plastic wastes produced by vessels and port facilities, will greatly help on the monitoring and on the reduction of plastic pollution in Macajalar Bay.

The Port of Cagayan de Oro is adjacent to three barangays: Barangay Macabalan, Barangay Puntod, and Barangay Lapasan (Figure 1). Population from these three barangays, based on the 2020 census represent 10.66% of the total population of Cagayan de Oro (PhilAtlas, 2021).

History

The development of the Port of Cagayan de Oro began in 1976 which rehabilitated the existing port, expanded the total port area, and added various facilities (Tumampas, 1984).

The old wooden port has since then modernized into a wide and advanced port complex (PMO of Cagayan de Oro, 2021).

Executive Order (EO) No. 769 of 2008 declared the delineation and expansion of the Cagayan de Oro Port Zone under the administrative jurisdiction of the Philippine Ports Authority (PPA). Over the years, the port has spurred the economic development of Northern Mindanao. Since 2010, the Philippines has enjoyed a satisfactory performance in terms of GDP, with an average growth rate of 6.3% from 2010 to 2014, while Northern Mindanao registered 5.6%. This economic upswing in the region is expected to continue further as more road networks and bridges now connect the port to major cities in Mindanao such as the coastal road which offers an alternate link to Bukidnon and Opol, Misamis Oriental (PMO of Cagayan de Oro, 2021).

The Port of Cagayan de Oro, along with the Port of Batangas, have been conferred by the Asia-Pacific Economic Cooperation (APEC) Port Services Network last December 2018 with the Green Port Award System (GPAS) (Lu, 2019). This program is a green evaluation system for ports in the APEC region, intended to improve environmental awareness and increase the understanding of green port development strategy. The port is recognized with the award for its initiatives for environmental protection and conservation. The port management office (PMO) of the Port of Cagayan de Oro was also recognized during the Development Academy of the Philippines' (DAP) 2018 Government Best Practice Recognition (GBPR) (PMO CDO, 2019).

Physical Description and Facilities

The 364-ha Cagayan de Oro Port Zone has around 25 has of land area and 340 has of sea area. It is an advanced port complex housing the biggest Passenger Terminal Building (PTB) among PPA-owned seaports. With a floor area of 5,597 m2, it can accommodate approximately 3,000 passengers during peak passenger-season which is triple its original capacity (DOTr, 2019). The two-story terminal was inaugurated in 2019 along with a 6-lane Cargo Gate Complex (PMO of Cagayan de Oro, 2021).

The port has a total area of 267, 831.25 m2 with quay length of 1,398 m. It has one Roll-on/Roll-off[3] (RoRo) ramp and 14 berths with drafts ranging from 8 m for Berth 3-5 to 13 m for Berth 12-14. Its storage facilities include a 40,087.50 m2 open storage area, one transit shed[4], two open transit sheds, a container freight station, and a container marshaling yard[5] . Five units of 80-ton capacity weighbridge are also available on site (PMO of Cagayan de Oro, 2021).

3 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, 2021).
4 Transit sheds are covered buildings on the pier or wharf used for storage of cargo in transit, that is, cargo recently unloaded from or soon to be loaded to a ship (Philippine Ports Authority, 2017).
5 Marshalling yard is a place where containers are stacked and arranged according to the sequence or withdrawal to consignee or transferred to CY-CFS or CY inside Port/Customs Zone (Philippine Ports Authority, 2017).

Waste Value Chain in the Port of Cagayan de Oro

The whole system of plastic waste management in the Port of Cagayan de Oro is governed by laws, policies, regulations, and ordinances implemented by various institutions (Section III, Figure 2) 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 Port of Cagayan de Oro, it is under the jurisdiction of the local government unit (LGU) of Cagayan de Oro City.

In the Philippines, the administration, financing, operations, and maintenance of the ports is handled by the Philippine Ports Authority (PPA) as mandated by the Presidential Decree No. 505 and Executive Order No. 159 (Philippine Reef and Rainforest Conservation Foundation, 2021); while, 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

Figure 2. Waste Management System and the Involved Stakeholders

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 Port of Cagayan de Oro and other Philippine ports by enforcing compliance of the ports with safety standards 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). Offices and passenger terminals within the port area and vessel operators and shipping lines of vessels docking at the port are the main sources of plastic wastes at the Port of Cagayan de Oro. Trans-Asia Shipping Lines, Super Shuttle Ferry, Cokaliong Shipping Lines, and the Oroport Cargo Handling Services Inc. are among the vessel operators and cargo handlers within the Port of Cagayan de Oro; while, Solid Shipping Lines, Oceanic Container Lines, ABC Express, and 2Go Express operate near the port.

Far East Fuel Corporation (Far East) and Oroport Cargo Handling Services Inc. (Oroport) are the two service providers that collect the wastes from the Port of Cagayan de Oro. Far East collects all vessel-generated and port-generated wastes from PPA Facilities – Building 1 (Administration Building), Building 2 (Cargo Facility), and Passenger Terminal Complex (PTC). Oroport handles all port-generated wastes coming from the Oroport Facilities and other wastes collected at various collection bins located at the Port of Cagayan de Oro (Section III.C.3).

The main venues of recovery of materials and consolidation of the port wastes and vessel wastes generated at the Port of Cagayan de Oro are at the sorting / temporary storage area of Oroport and at the Pontillas Junkyard, a partner junkshop of Far East. Recyclables such as PET bottles, hard plastics, cardboard, and glass are among the materials recovered from the port and vessel-generated wastes. The Centralized Materials Recovery Facility (MRF) of Cagayan de Oro City, also known as Zayas MRF Cooperative, and junkshops then recover the recyclable materials from these areas. There are also junkshops near the port where the waste pickers sell their collected recyclables. The wastes which are not diverted by the MRFs and sold to junkshops from the port and vessel-generated waste are disposed to the sanitary landfill.

EcoWaste is the operator of the sanitary landfill where the port and vessel-generated waste are ultimately disposed. EcoWaste ensures that the wastes from the Port of Cagayan de Oro and other sources are being dumped on the designated active cell in the landfill. They also ensure the maintenance of the landfill to avoid leakage of wastes to the surrounding environment.

Cargo Tonnage

The Port of Cagayan de Oro receives around 3,000 ship calls[6] every year (Table 1) with majority of the vessels coming from various ports across the country and only more than 100 shipping calls from foreign vessels (Philippine Ports Authority, 2021).

It also handles more than 6.6M metric tons of cargo throughput and more than 250,000 twenty-footer equivalent units (TEUs)[7] of container traffic, both of which have decreased since 2018; while, the RORO traffic of the port has increased from 23,000 vehicles to 25,000 vehicles between 2018 and 2019. All these numbers have then decreased in 2020 (Table 1) due to the stricter travel restrictions imposed across the country brought about by the COVID-19 pandemic.

Table 1. Cagayan de Oro Port Statistics (Philippine Ports Authority, 2021)

Type of Vessel	2018	2019	2020	2021 (Q1)
Shipping Calls	**3,001**	**2,730**	**2,390**	**563**
Domestic	2,891	2,579	2,232	522
Foreign	110	151	158	41
Cargo Throughput (MT)	**7,244,726**	**6,683,369**	**6,136,973**	**1,578,542**
Domestic	5,798,695	5,119,522	4,634,785	1,226,190
Foreign	1,446,031	1,563,847	1,502,188	352,353
Container Traffic (TEU)	**279,418**	**256,410**	**225,772**	**63,171**
Domestic	279,418	256,410	225,772	63,171
Foreign	0	0	0	0
RoRo Traffic	**23,839**	**25,056**	**11,668**	**1,608**

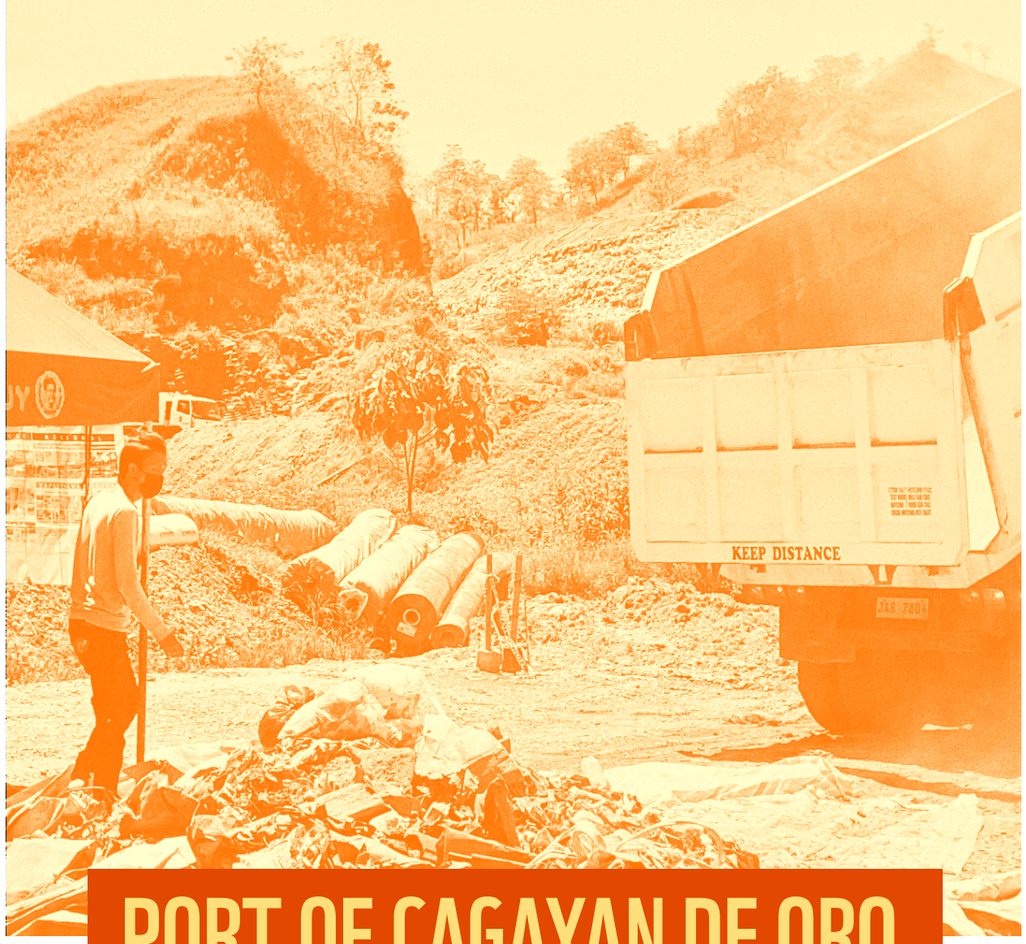
6 Ship calls refer to the number of vessels which call or arrive at a particular port at any given time (Philippine Ports Authority, 2021).
7 TEU is the unit of measurement equivalent to a container's length of 20 ft. It is often used to express the capacity of container ships or container terminals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

Passenger Traffic

The port receives an annual passenger traffic of more than 1.1 million domestic passengers (Philippine Ports Authority , 2021). This, however, has declined to around 260,000 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 Port of Cagayan de Oro from 2018 to First Quarter of 2021 (Philippine Ports Authority, 2021)

Passenger	2018	2019	2020	2021 (Q1)
Disembarked	589,497	585,537	140,445	18,521
Embarked	583,214	571,755	122,224	13,977
Cruise Ships	0	0	0	0
Total	**1,172,711**	**1,157,292**	**262,669**	**32,498**



PORT OF CAGAYAN DE ORO 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 3).

Table 3. Garbage Categories Recorded in Ships (Marine Environment Protection Committee, 2016)

Assigned Letter	Waste Category
A	**Plastics**
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[8]. This prohibition is to be applied to all vessels including fixed or floating platforms[9] 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[10] (HME) must be taken to port reception facilities.

8 Special areas under Annex V are the Mediterranean, Baltic, Black, Red, and North Seas areas and the Gulfs area (Maritime Industry Authority, 2020).
9 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).
10 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 4).

Table 4. Kinds of Waste Prohibited from being Dumped into Sea (London Convention and Protocol, 1972)

Annex I of the London Convention and Protocol
Organohalogen compounds
Mercury and Mercury Compounds
Cadmium and Cadmium Compounds
Persistent Plastics and Other Persistent Synthetic Materials
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

The plan entitled "IMO Action Plan to Address Marine Plastic Litter from Ships" recognizes the wide range of land-based and sea-based activities through which plastic litter enters 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. The plan also states that marine plastic litter can negatively impact activities like fishing, shipping, and tourism. This plan aims to build on the policies that have been established by MARPOL and the London Convention and Protocol. The agreed actions that affect ships and fishing vessels are set out 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[11] to deliver the targets of SDG-14 and to prevent and significantly reduce marine pollution of all kinds 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.

11 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 Port of Cagayan de Oro 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[12]. 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).

12 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 5).

Table 5. 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 Cagayan de Oro City, with ordinances on bans and/or regulations on plastic use (Figure 3).

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

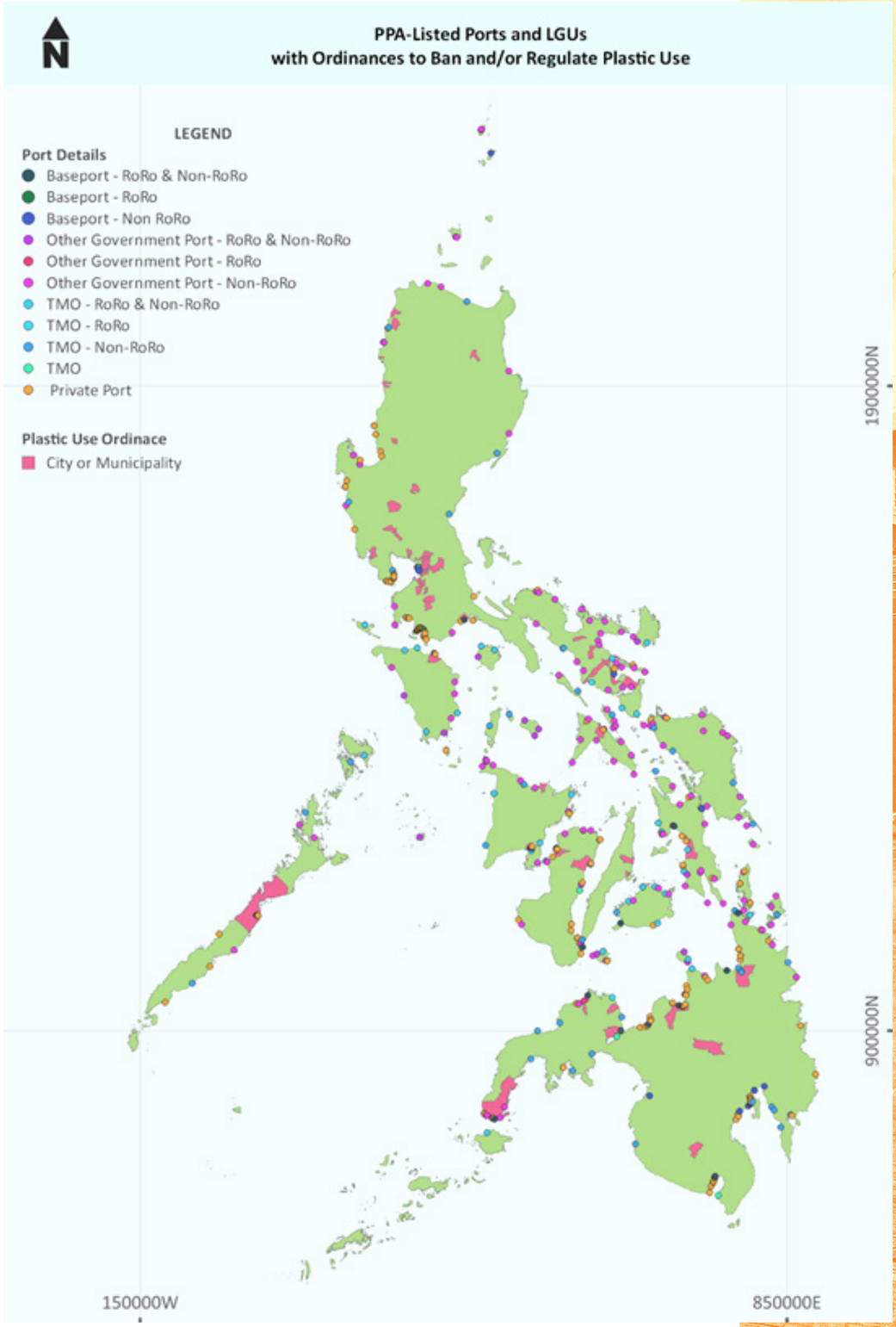


Figure 3. PPA-Listed Ports and the Cities and Municipalities with Plastic Bans and/or Regulations on Plastic Use (The Nerve, 2019; NAMRIA, 2020)

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: Ru les 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 6), and reporting – semestral – and monitoring provisions.

Table 6. Solid Waste Management Matrix Under PPA MC No. 29-2004 (Philippine Ports Authority, 2004)

Waste Generation	Wate Discharge and Storage	Primary Collection	Communal Storage	Waste Discharge and Destination
Paper *all kinds of office paper, computer paper, newspaper, carton, corrugate or packing boxes*	Carton Boxes placed in each office	At Source: PPA official/ employee For Storage: Utility Worker	Garbage Receptacle with Tight Lid	Paper Mill
Dry *Recyclables aluminum soft drink cans and tabs, plastic bottle containers, plastic utensils, plastic or glass containers/ bottles*	Blue Covered Bin in each office	At Source: PPA official/ employee For Storage: Utility Worker	Garbage Receptacle with Tight Lid	Factory
Wet Garbage *food scraps*	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) 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 through 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
- 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. 1 9-2020: 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

Solid waste management within Cagayan de Oro City – including the Port of Cagayan de Oro – is being handled by the City Local Environment and Natural Resources Office (CLENRO) according to its prepared 10-year solid waste management plan (SWMP) (Cities Development Intitative for Asia, 2018).

The city mandates the City Ordinance No. 13378-2018: Integrated Eco-biological Solid Waste Management Ordinance. This ordinance includes regulation on the use of single-use plastics (SUP) and a “No Segregation, No Collection” Policy (Philippines News Agency, 2019).

Port Waste Management Policies

The Port Management Office (PMO) of the Port of Cagayan de Oro released Operations Memorandum Circular No. 018-2018 on the integrated management system in the port in line with the City Ordinance No. 13378-2018. The type of wastes versus the method of disposal, waste storage, and time of disposal are indicted in this memorandum (Table 7).

Table 7. Integrated Management System in Port of Cagayan de Oro (Philippine Ports Authority, 2018)

Type of Waste	Method of Disposal	Waste Storage	Time of Disposal
Pure Waste *(Waste Materials that are non-compostable and non-recyclable)*	Should be placed in Black Plastic Bag labeled as to vessel name and type of waste	Yellow garbage bins located at Berth 3 and Open Transit Shed (OTS) 1	Daily 8:00 – 9:00 am
Recyclable Waste (Plastic Bottles and Aluminum Cans)	Should be placed in Black Plastic Bag tied with blue string/ribbon or Blue Plastic Bag or Sack labeled as to vessel name and type of waste	Yellow Garbage Bins located at Berth 3 and OTS 1	Daily 8:00 – 9:00 am
Used Oil	To be collected by the PMO’s registered service provider	Not Applicable	Not Applicable
Waste Materials Composed of Glass Fragments, Broken Glass or Any Sharp Objects	Not allowed, strictly prohibited	Not Applicable	Not Applicable

Waste Management System at the Port of Cagayan de Oro

Waste generation, segregation, collection, recovery, and disposal efforts are in place at the Port of Cagayan de Oro.

Waste Generation

Port staff, passengers alighting and arriving in passenger terminals, stalls inside the port, and other waste generating[13] activities contribute to the wastes generated at the Port of Cagayan de Oro.

Wastes coming from the Cargo Facility last 2019 were tallied with the wastes coming from the Passenger Terminal Center (PTC) as the PTB was inaugurated only in July 2019 (Philippine Ports Authority, 2019). This resulted to the Administration Building 1 having a larger portion of the wastes collected (Table 8).

Table 8. Waste Generation from Each Facility for 2019 (Philippine Ports Authority, 2019)

Port Facility	Recyclable Materials (kg)	Non-recyclable Materials (kg)	Total Waste Generated per Facility
Building 1 (Administration Building)	734.90	740.05	1,474.95
Building 2 (Cargo Facility)	734.90	416.75	1,151.65
Passenger Terminal Complex	-	-	-
Oroport Facilities			
Total	**1,469.80**	**1,156.80**	**2,626.6.12**

13 Waste 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 Port of Cagayan de Oro come from ships docking and embarking on the wharfs or piers of the port. Passengers and ship crews are the main source of vessel wastes with most of the wastes coming from domestic vessels (Table 9).

Table 9. Vessel Waste Generation in Port of Cagayan de Oro for 2019 (Philippine Ports Authority, 2021)

Port Area	Domestic	Total
Domestic	2,733	2,827.97
Foreign	90	50.70
Total	**2,823**	**2,878.67**

This year – in March 2021, a waste analysis and characterization study (WACS) was conducted by the CDO CLENRO at the adjacent barangay of the port, at Barangay Macabalan; and, found that the barangay of 19,562 residents generates wastes at a rate of 0.3kg-capita/day. The wastes at Barangay Macabalan were mostly biodegradables, followed by recyclable wastes and residual wastes. Special wastes were also found (Table 10).

Table 10. WACS Result for Barangay Macabalan, Cagayan de Oro (CDO CLENRO, 2021)

Waste Category	Composition (kg)	Percentage
Biodegradable Wastes	52.72	43.83%
Recyclable Wastes	32.75	27.23%
Residual Wastes	32.72	27.20%
Special Wastes	2.09	1.74%
Total	**120.28**	**-**

Waste Segregation

The PMO of the Port of Cagayan de Oro is implementing waste segregation[14] scheme on all facilities at the Port of Cagayan de Oro (Section III.B.5) assisted with the infographics on samples of wastes that can be thrown to a particular bin (Figure 4).

Wastes from vessels are expected to be segregated upon placement to the quay (Figure 6). Most vessel-generated wastes are contained in trash bags. These are then recorded into the Waste on Board Vessel Information Form (WOBVIF)[15] by the SRF personnel.

Figure 4. Color-Coded Waste Segregation Bins at the Transit Shed 2 last September 24, 2021

Port-generated wastes are segregated into three major categories: biodegradables, non-biodegradables, and recyclables. Some collection points have separate containers for PET bottles (Figure 5).

Figure 5. Waste Collection Point at Greenbelt Area last October 14, 2021

14 Waste 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).
15 WOBVIF is a form filled up by the shiipping agent of any vessel upon docking at a port and disembarkment of its wastes and is submitted to the SRF (Philippine Ports Authority, 2020)

Waste Collection

Figure 6. Vessel-Generated Wastes Brought to the Quay last October 14, 2021

The task of collecting[16] all wastes generated at the Port of Cagayan de Oro is divided between the Oroport and Far East. Far East handles all vessel-generated wastes entering the port, including all port-generated waste coming from the PPA-PMO Misamis Oriental / Cagayan de Oro (MO/C) buildings: Admin Building 1, Admin Building 2, and the Passenger Terminal Complex (PTC).

Vessel personnel, with the assistance of SRF checkers, bring their respective vessel-generated wastes to the quay area (Figure 6). There are four locations along the berth areas that serve as collection points for vessel waste (Figure 13). SRF checkers also document the volume of vessel waste disposed using the WOBVIFs and coordinates with the Far East dump truck for the collection of these wastes.

Vessel waste unloading to the quay is conducted within a few hours before the daily collection of Far East at 9:00 A.M (Table 7). There is no vessel-waste receptacle utilized. All vessels that dock at the wharf of the Port of Cagayan de Oro and dispose of their solid waste must pay a reception fee depending on the type of vessel and type of waste as per PPA Administrative Order No. 01-2020 (Philippine Ports Authority, 2020).

16 Collection refers to the amount of MSW generated that is moved from the point of generation, such as specific addresses or designated collection points, to facilities where the waste is recovered or disposed, regardless of collection modality (UN Habitat, 2021).

Figure 7. Waste Collection Point for Vessel-Generated Wastes at Berth Area last October 14, 2021

Far East waste collection is conducted by a dump truck with gross weight capacity of 2000 kg (Figure 8). Following the route of waste collection, the collection points are as follows: PTC, Berth 1-7 for passenger vessels, Berth 8-11 for cargo vessels, Berth 12-17 for foreign vessels, Administration Building 1, and Administration Building 2 (Figure 13).

Figure 8. Far East Waste Collection Truck last October 15, 2021

There is a total of 17 collection points strategically placed at various areas within the port area for the port-generated wastes coming from Oroport Facilities and for those that are to be collected by Oroport (Figure 12). Following the route of waste collection, these points are the Open Transit Shed (OTS) 1A, OTS

1B Key Area, Transit Shed (TS) 1A, TS 1B Key Area, Area A, Berth 1, Area F, Greenbelt 1 (Weigh Bridge Area), Greenbelt 2, Port Manager's Quarter, Clinic Area, Access Area, Engineering Office, Admin Office, Area L, OTS 2A, OTS 2B.

Wastes are manually loaded into the Oroport dump truck with gross weight capacity of 13,000 kg. The dump truck used by Oroport does not have compartments to segregate waste. Collection services are scheduled from Monday to Saturday starting at 9:00 A.M. daily (Table 7).

Waste storage bins are also disinfected before and after collection of wastes as an added preventive measure against the spread of COVID-19 virus.

Figure 9. Waste Collection Point TS Door 1 last October 14, 2021

Figure 10. Oroport Waste Collection Truck last October 15, 2021

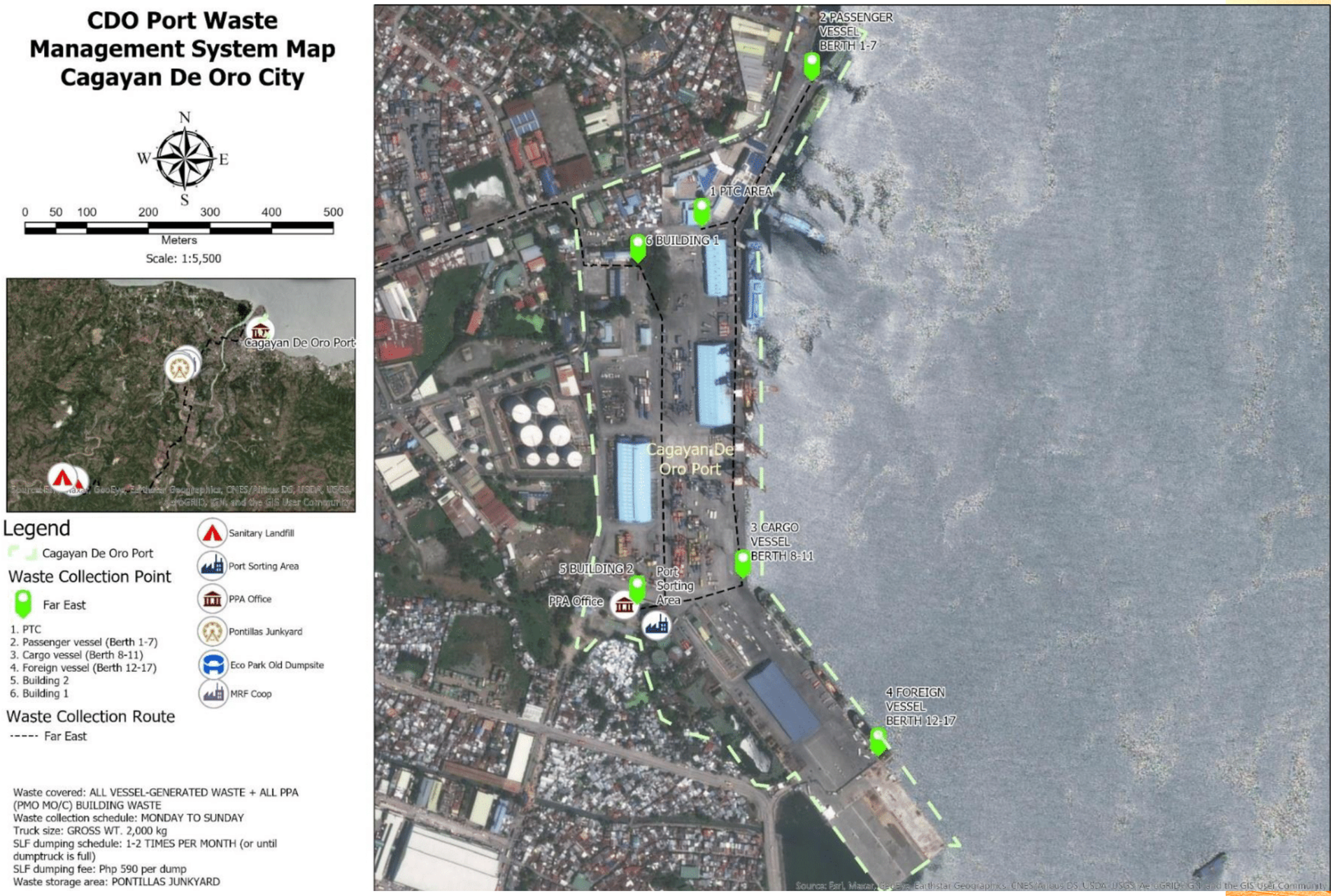


Figure 12. Collection Points for Oroport Waste Hauling (WWF Philippines Inc, 2021)

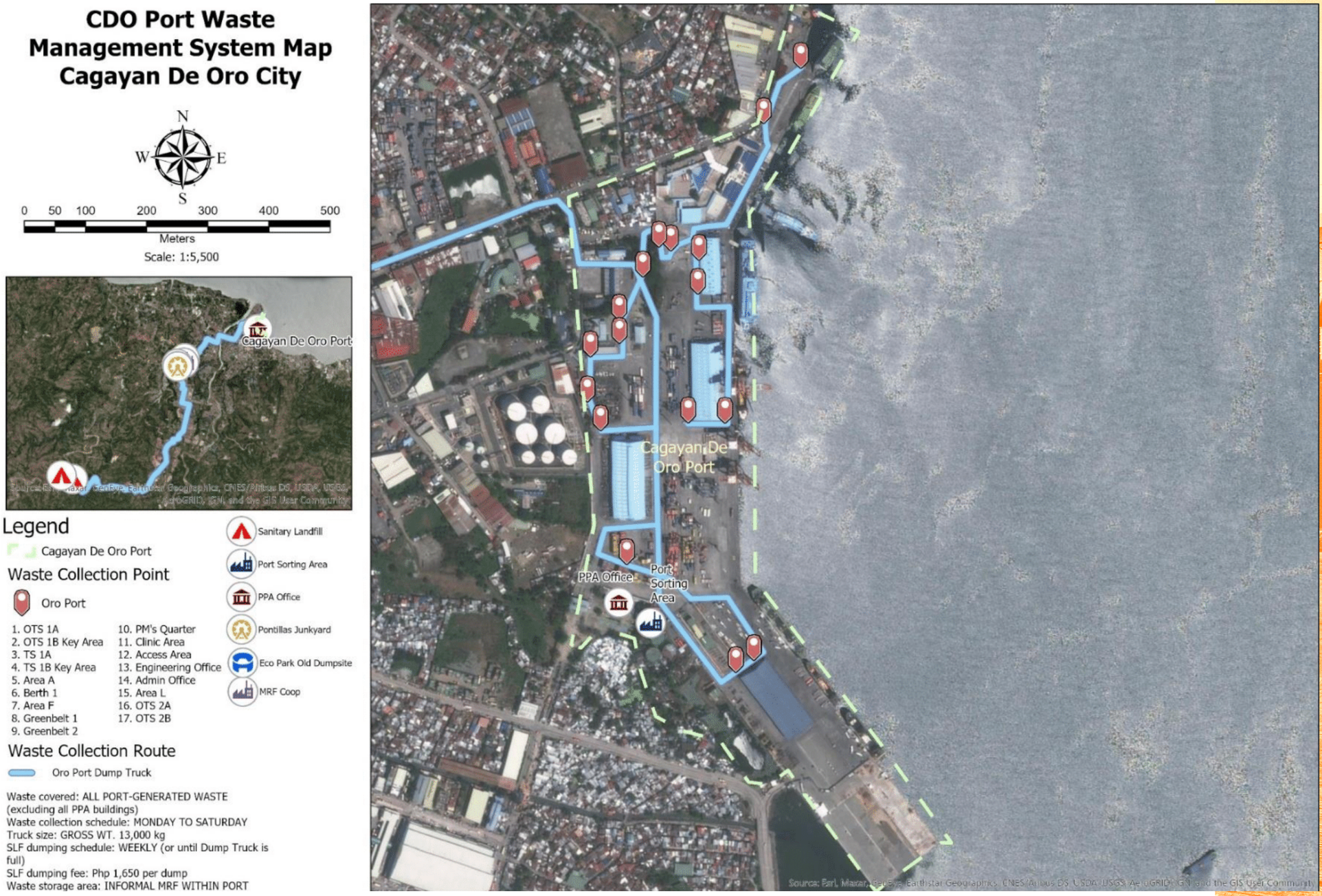


Figure 13. Collection Points for Far East Waste Hauling (WWF Philippines Inc, 2021)

Waste Recovery

Two separate facilities conduct the waste recovery[17] for port and vessel wastes. Port-generated wastes and vessel-generated wastes handled by Far East pass through the Pontillas Junkyard near the old Zayas landfill (Figure 11).

Pontillas Junkyard is situated at Barangay Canitoan, Cagayan de Oro City. Wastes recovered include cartons, recyclable plastics, and metals (Figure 14).

All other port-generated wastes coming from the Oroport Facilities and those collected at various receptacles are transported into the sorting area located within the port (Figure 15).

At the sorting area, wastes are further segregated with residual wastes temporarily stored in big yellow containers (Figure 16). Once the container is full, it is forklifted to transfer the waste back into the dump truck for hauling into the sanitary landfill (SLF).

Sorters from the City Central MRF located at the Old Zayas Landfill, collect the recyclabe wastes such as plastics, metals, and cartons recovered at the sorting area within the port (Figure 15).

Figure 11. Pontillas Junkyard at Barangay Canitoan, Cagayan de Oro last October 14, 2021

17 Waste 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 fulfil a particular function, or waste being prepared to fulfill that function, in the facility or in the wider economy (UN Habitat, 2021).

Figure 14. Pile of Recovered Wastes at Pontillas Junkyard last October 14, 2021

Figure 15. Oroport Sorting Area Located within the Port of Cagayan de Oro last October 14, 2021

Figure 16. A Yellow Container for Residual Wastes Sorted by Oroport last October 14, 2021

Figure 17. EcoWaste Treatment and Disposal Facility last October 14, 2021

Waste Disposal

The EcoWaste Treatment and Disposal[18] Facility or the Pagalungan SLF is a Category 3[19] SLF with 70-100 tons/year net residual waste capacity. It is located at Sitio Buracan, Barangay Pagalungan, Cagayan de Oro City, covers 46.5 ha of land, and is being developed into an Eco Park[20]. It has been in operation since April 2017 as the city's designated SLF and receives both the port-generated and the vessel-generated wastes from the Port of Cagayan de Oro (Figure 17).

The Pagalungan SLF receives residual waste only as most biodegradable wastes and all recyclable wastes are expected to have been recovered at the City Central MRF and/or at the Pontillas Junkshop (Section III.C.4).

Volume recording of waste from incoming trucks are estimated based on the vehicle capacity. Construction of weigh bridge on site is currently on-going and is estimated to be fully operational next year.

A hazardous waste facility that accepts wastes primarily from hospitals and health care facilities in the city is also present in the SLF. Other health care wastes mixed with the municipal solid wastes (MSW)[21] such as face masks and face shields are also disposed to the SLF.

An average of Php 553.00 per tonnage of waste is imposed at the SLF as dumping fee. Far East dumps their collected wastes into the Pagalungan SLF once or twice a month – depending on the volume of wastes they have collected (Section III.C.3) – at an average of Php 590.00 per dumping regardless of the volume of wastes. Wastes collected by Oroport are dumped weekly or until their dump truck is full (Section III.C.3) at an average of Php 1650.00 for each disposal.

The wastes at the SLF are covered with 1 m of soil upon reaching 2 m high with place compaction being done at the landfill.

Waste pickers are restricted from entering the area by guards; and there is no fencing around the SLF with nearby or adjacent communities located around 5 km away. Burning of wastes is also prohibited as with the whole CDO which bans the practice.

Landslides and flood control measures have been installed in the site as the general site location is occasionally exposed to heavy rainfall. Leachate control and management in site is treated through recirculation (Figure 18).

Water quality monitoring is done quarterly and semi-annually for some parameters – pH, temperature, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), oil and grease, lead, and mercury.

Figure 18. Leachate Ponds at the City SLF last October 14, 2021

18 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).
19 Category 3 SLF is a final disposal facility applied to LGUs with net residual waste generated of greater than 75 tons per day (TPD) but less than or equal to 200 TPD. It shall also apply to a cluster of LGUswith a collective disposal residual waste greater than 75 TPD but less than or equal to 200 TPD (Department of Environmental and Natural Resources, 2006).
20 Eco Parks are large parks which use ecological landscape features to reduce watering maintenance while enhancing wildlife and human values (Refaat, 2014).

21 Municipal Solid Wastes (MSW) are wastes generated from residential, institutional, commercial, and industrial sources. Other sources include illegal dumps, street sweepings and litter and rubbish from roads, open spaces, and water bodies (Environmental Management Bureau, 2017)

CDO Port Waste Management System Map Cagayan De Oro City

Legend

Cagayan De Oro Port

Waste Collection Route

Oro Port

Far East

Sanitary Landfill

Port Sorting Area

PPA Office

Pontillas Junkyard

Eco Park Old Dumpsite

MRF Coop

Note: Waste Collection to Waste Disposal

Port Waste Collection: Truck proceeds to informal MRF within port. Segregates waste further and stores residual waste in big yellow containers. Once container is full, container is fork-lifted and waste is transferred back into dumptruck. Dumptruck proceeds to Sanitary Landfill Pagalungan.

Vessel Waste Collection: Truck proceeds to Pontillas Junkyard near old landfill at Zayas. Pontillas and company segregates waste further and stores residual waste in waste bins and/or big black bags. Depending on the amount of waste being dropped by vessels, Pontillas proceeds to Sanitary Landfill Pagalungan 1-2x a month.

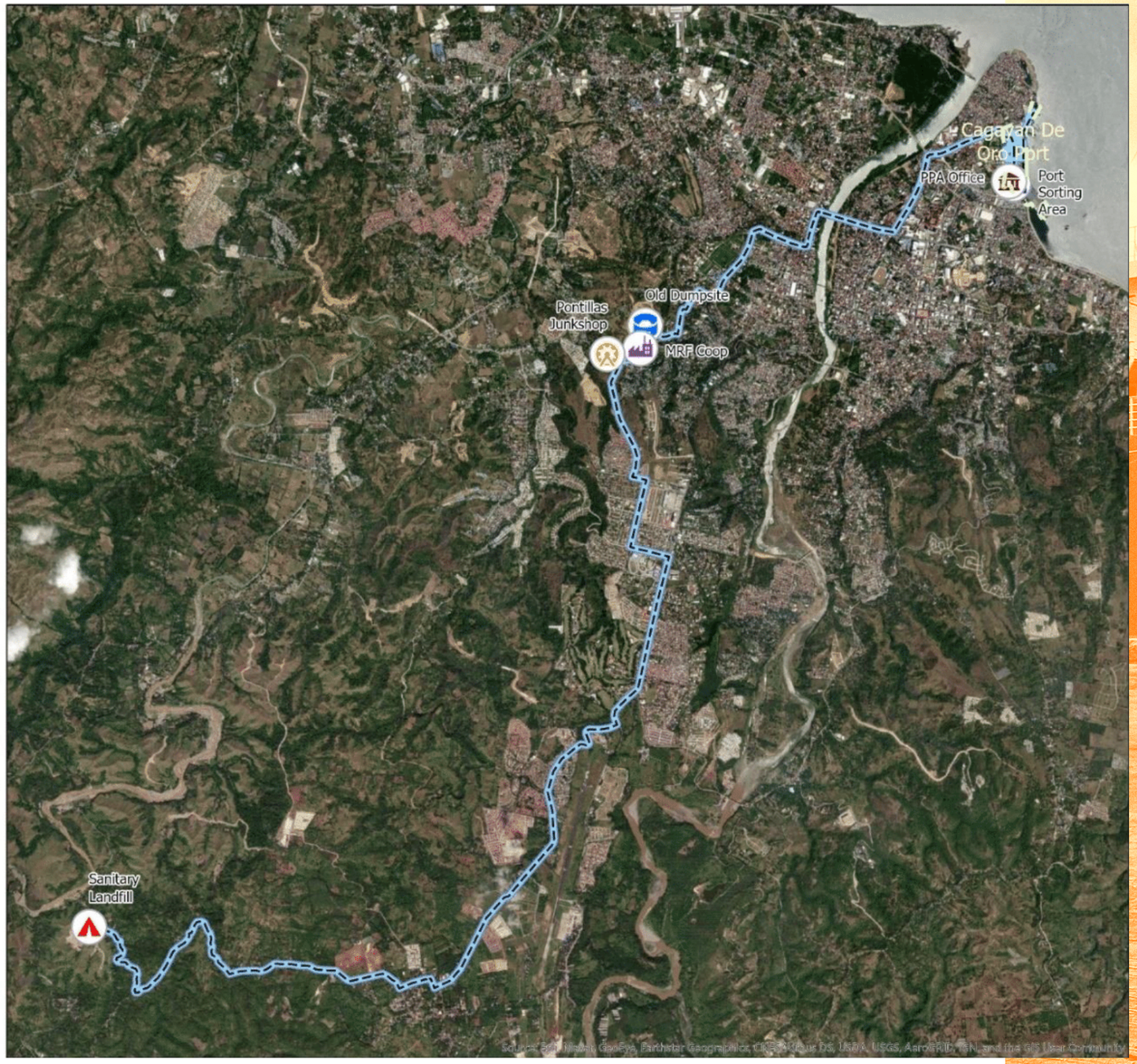
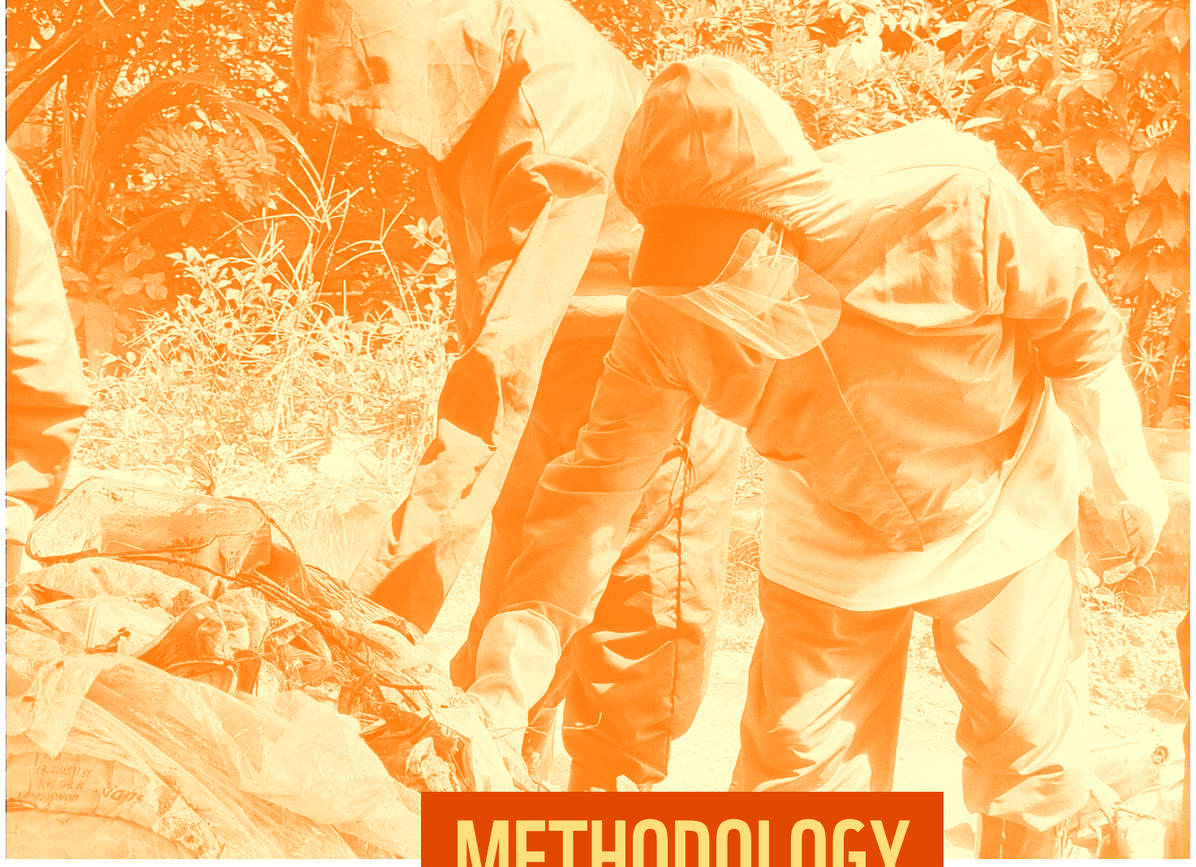


Figure 19. Waste Collection Route and Disposal (WWF Philippines Inc, 2021)



METHODOLOGY

The conduct of the baseline study for Port of Cagayan de Oro 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 11).

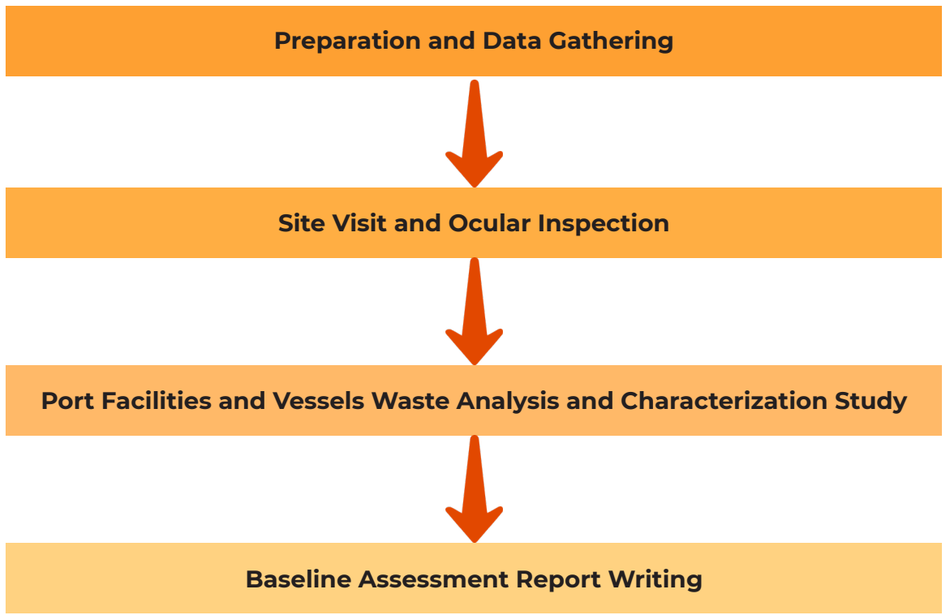


Figure 20. Baseline Study Methodology

Table 11. 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 Port of Cagayan de Oro from October 12 to October 22, 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 vessels 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, CLENRO, Oroport and Far East.

The general information on the Port of Cagayan de Oro, the solid waste management plans (SWMP), and solid waste management policies and ordinances of the Cagayan de Oro City were reviewed for this study (Section II to Section III.B). Available data on waste analysis and characterization study (WACS) were collected.

Pre-COVID-19 port waste generation rates from each collection point were calculated using existing waste collection data collected from the PPA. Pre-COVID-19 vessel waste generation rates for each type of vessel were calculated from vessel traffic data and total solid waste generation in 2019 (Philippine Ports Authority , 2021).

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 and disposal facilities involving the solid waste management system of port and vessel generated waste were visited. The recovery facilities were identified as “Intermediate Traders[22]”, “Apex Traders[23]” and “End of Chain Recyclers and Recoverers[24]”. 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 F and Annex G) were identified.

22 Intermediate traders receive materials from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to apex traders (UN Habitat, 2021).
23 Apex traders receive materials from intermediate traders or directly from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to end-of-chain recyclers/recoverers (UN Habitat, 2021).
24 End of chain recycler/recoverer receives materials from apex traders or direct from both formal and informal MSW collection systems and processes them into materials and products that have value in the economy either through recycling, incineration with energy recovery, or other recovery process (UN Habitat, 2021).

Conduct of Waste Analysis and Characterization Study

The analysis and characterization of the solid waste generated from port facilities and vessels were conducted in a tented area at the sanitary landfill operated by EcoWaste from October 15 to 17, 2021.

WACS was conducted only within the official working hours which were from 8:00 AM to 5:00 PM including morning, lunch, and afternoon breaks.

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).

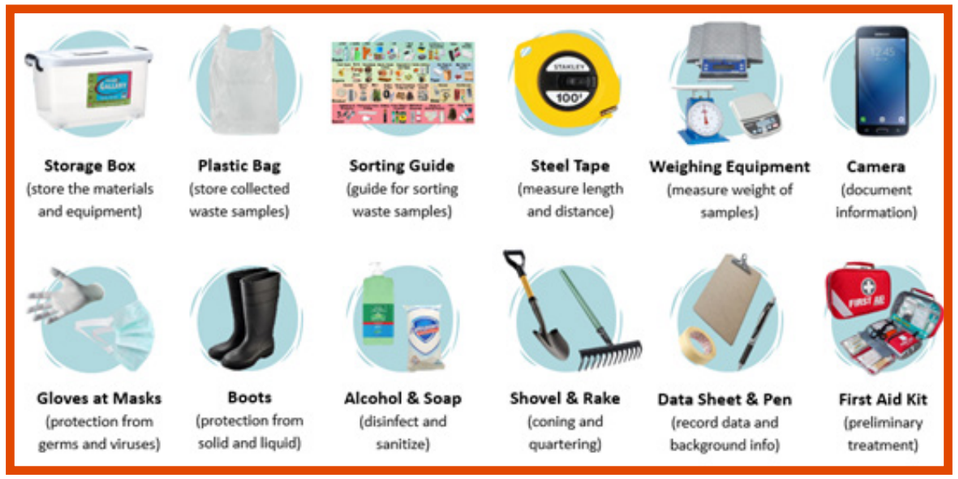


Figure 21. Materials for WACS

Figure 22. Solid Waste Categories Guide for WACS

Port Facilities Sampling

A truck containing the municipal solid waste collected from four collection points within the Port of Cagayan de Oro were weighed using a weigh bridge before and after collection to determine the weights of the wastes to be sampled. The four collection points involved are the Administrative Building, the Cargo Facility, the Passenger Terminal, and the Oroport Facilities. After weighing, the wastes were then brought to the EcoWaste SLF for characterization.

Vessel Waste Sampling

A truck containing the municipal solid waste collected from vessel waste receptacles within the Port of Cagayan de Oro was weighed using a weigh bridge. Preliminary information on the vessels such as type, gross tonnage, number of passengers, cargo weight, and other pertinent information were collected using the provided WOBVIFs by Far East Fuel Corporation. Vessel waste sampled come from vessels that dock the day prior to the sorting day; hence, the recorded dates of samples are one day before the WACS days (Table 12).

Table 12. Number of Vessels Sampled

Day	Container and Passenger Vessels	RoRo and Passenger Vessels	Container	Liquid Bulk
October 15, 2021 (Friday)	1	1	3	0
October 16, 2021 (Saturday)	2	0	1	1
October 17, 2021 (Sunday)	2	1	1	0

Figure 23. Unloaded Vessel Generated Waste last October 14, 2021

Pre-weighing, Quartering, Segregation, and Bulk Density Measuring

The same procedure was done for three port waste samples and three vessel waste samples at the Port of Cagayan de Oro. Up to 500 kg were taken from every truck sample. These were pre-weighed, mixed as thoroughly as possible, and spread out on the flat surface. The sample wastes were then divided into four parts using straight lines perpendicular to each other, then a quarter with a weight of around 125 kg will be selected and sorted (Figure 24). The surplus 'three-quarters' were retained for analysis of bulk density.

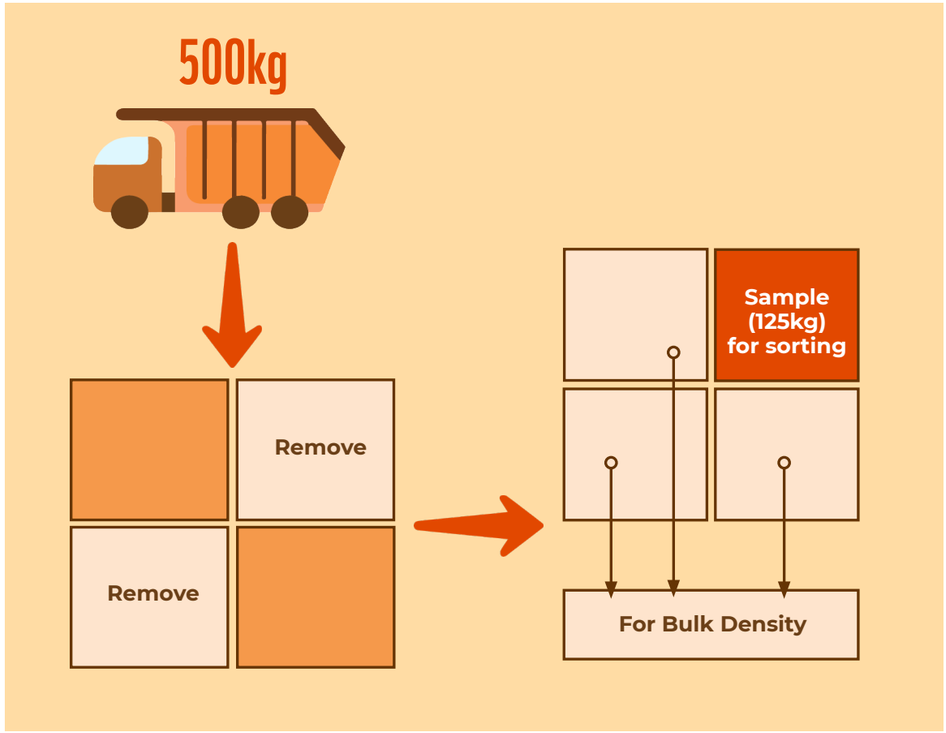


Figure 24. Quartering of Sample Waste

Figure 25. Sorting Area in EcoWaste SLF last October 16, 2021

The part taken for segregation was sorted according to specified waste categories (Figure 22). Once sorted, each waste category was weighed and recorded for data processing and analysis.

Figure 26. Weighing and Recording of Sorted Waste last October 17, 2021

The other three parts – weighing approximately 375 kg – were used to measure the bulk density. A container of known volume and weight was filled with the waste up to the brim and weighed. This process was repeated until all the 375 kg of waste were weighed. Bulk density was 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 27. Bulk Analysis of Waste last October 15, 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 Port of Cagayan de Oro 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 the site visit and truck tailgating were incorporated in the diagram. Visual assessment was also conducted to determine the leakage factor at each point of the waste management system of Port of Cagayan de Oro, specifically, during collection, transportation, and disposal.

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

The wastes from the Barangay Macabalan (Section III.C.1) and other surrounding communities, however, will not be included in the produced WFD since the waste collected from the port does not mix with those of the barangays.

WASTE ANALYSIS AND CHARACTERIZATION RESULTS

WACS was conducted for port-generated and vessel-generated wastes. The port-generated and vessel-generated wastes at the Port of Cagayan de Oro were generally composed of 7.57% and 17.05% plastics, respectively. The following sections describe the detailed results.

Port Generated Waste

The total waste generation rate for the port facilities was calculated to be at a total of 794.29 kg/day (Table 13) based on the total amount of daily wastes collected and weighed using weigh bridge and the bulk waste densities data from the sorting activities.

Port-generated waste has decreased by 33% during the pandemic compared to the waste generation rate of about 1,181.78 kg/day pre-Covid-19. Daily waste generation at the passenger terminal has also reduced from 119.24 kg/day to 20.80 kg/day during the pandemic. This is likely due to the decrease of passengers and vessels, closure of establishments such as food stalls in passenger terminals, and other activities disrupted by the pandemic. The daily waste generation rates however, of Building 1 and Building 2 have significantly increased in the Covid-19 scenario. Possible reasons may be the increased consumption of food, toilet papers, face masks, gloves, and among others of the personnel in these facilities, or the previous amount of waste recorded by PPA were underreported.

Table 13. Waste Generation Rate of Port Facilities

Port Facilities Group	Generation Rate (kg/day)	
	COVID-19 (Current)	Pre-COVID-19
Building 1 (Administrative Building)	31.20	9.39
Building 2 (Cargo Facility)	52.00	7.33
Passenger Terminal Complex	20.80	119.24
Oroport Facilities	690.29	1,045.84
Total	**794.29**	**1,181.80**

Biodegradable wastes was around 47.57% of the total port-generated wastes (Figure 28). Sweepings make up majority of all biodegradables at 29.31% of the entire waste sampled. Composition of garden waste was at 8.73%, while wood and food waste were found at 4.28% and 3.35%, respectively. Agricultural/farm waste such as coconut and corn husks which may have been brought along by vessel passengers were found at low quantity in the waste sample.

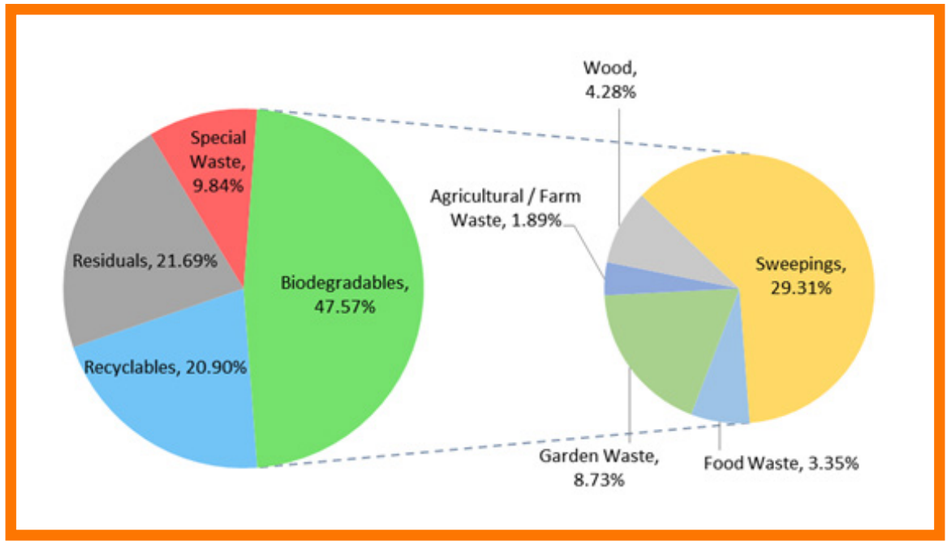


Figure 28. Port-Generated Waste Composition of Biodegradables

Recyclables were found to be at 20.90% of the overall port-generated waste sampled (Figure 29). Paper at 15.09% comprise majority of the recyclables. Plastic was found at 3.13%. Glass and metals were found at 1.92% and 0.76%, respectively.

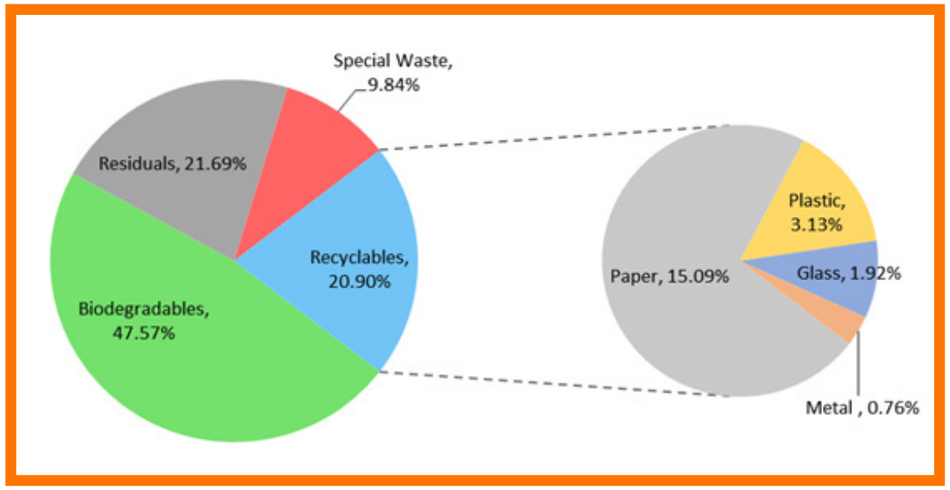


Figure 29. Port-Generated Waste Composition of Recyclables

Residuals comprise 21.69% of port-generated wastes (Figure 30). Wastes with potential for recycling[25] were at 5.89% of the entire waste sampled. Residual waste for disposal were at 15.80% of the waste sampled. This is composed of mostly fines, ash, and soils at 15.36%. Soiled tissue paper, diapers, napkins, and soiled plastics make up the rest of the residual waste for disposal.

25 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)

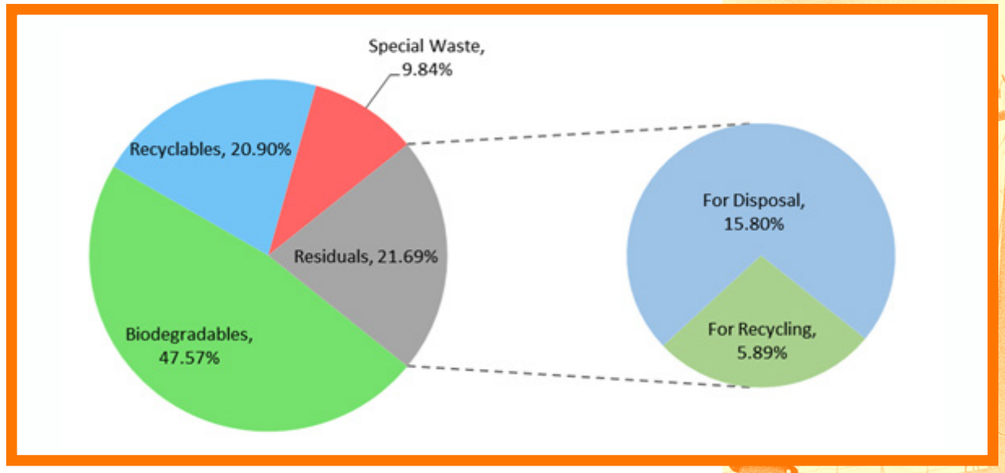


Figure 30. Port-Generated Waste Composition of Residuals

Special wastes comprise about 9.48% of port-generated wastes. Majority of these wastes were comprised of bulky yard waste at 8.84%. Hazardous wastes like busted lights, consumer electronics, paint and other cleaning chemicals were found to be at 0.58%. Healthcare wastes were found to be at 0.42%. Majority of these healthcare wastes were face masks. Increase of these wastes is likely due to the ongoing COVID-19 pandemic.

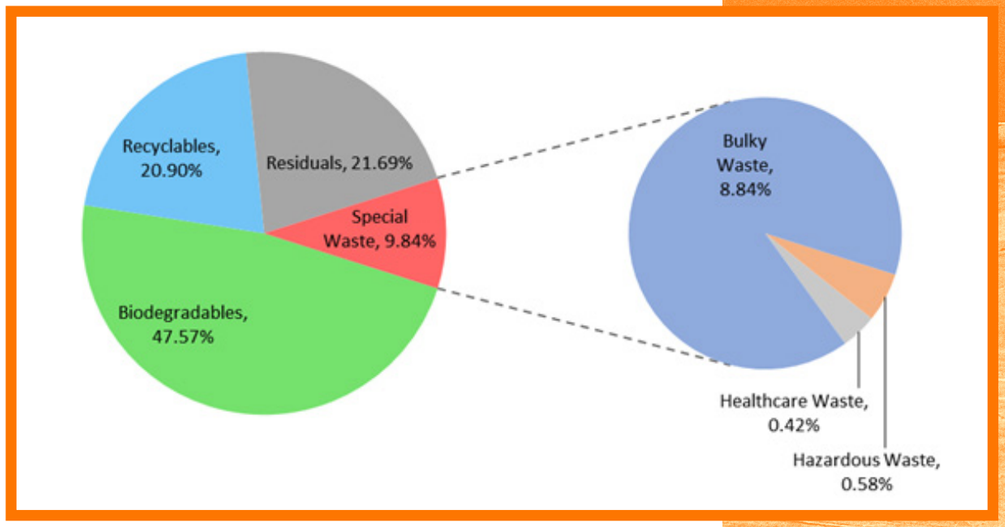


Figure 31. Port-Generated Waste Composition of Special

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).

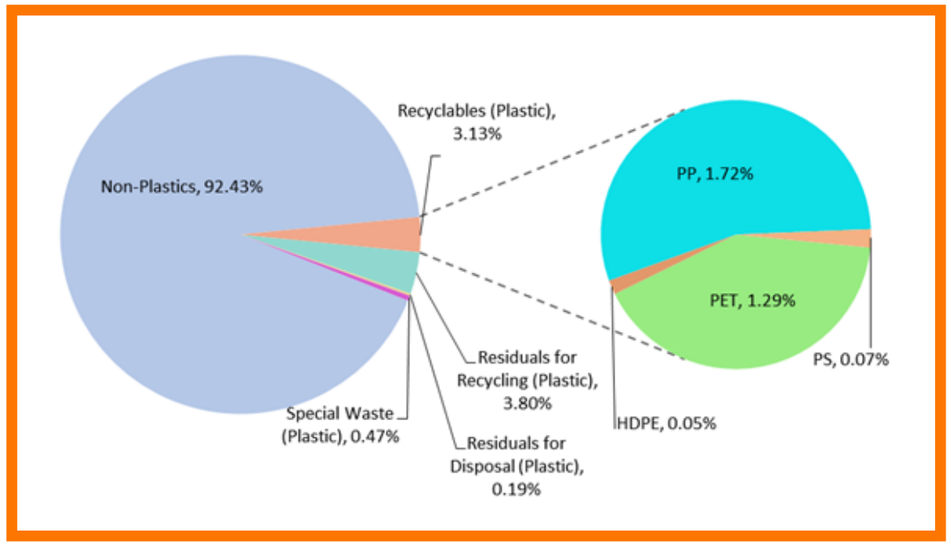


Figure 32. Port-Generated Recyclable Plastic Wastes

Residual plastic wastes with potential for recycling were observed to be at 3.80% by total weight of the sorted sample. These plastic items included clear sachets, plastic bags, laminated sachets, sacks, tarpaulins, and some straws (Figure 33).

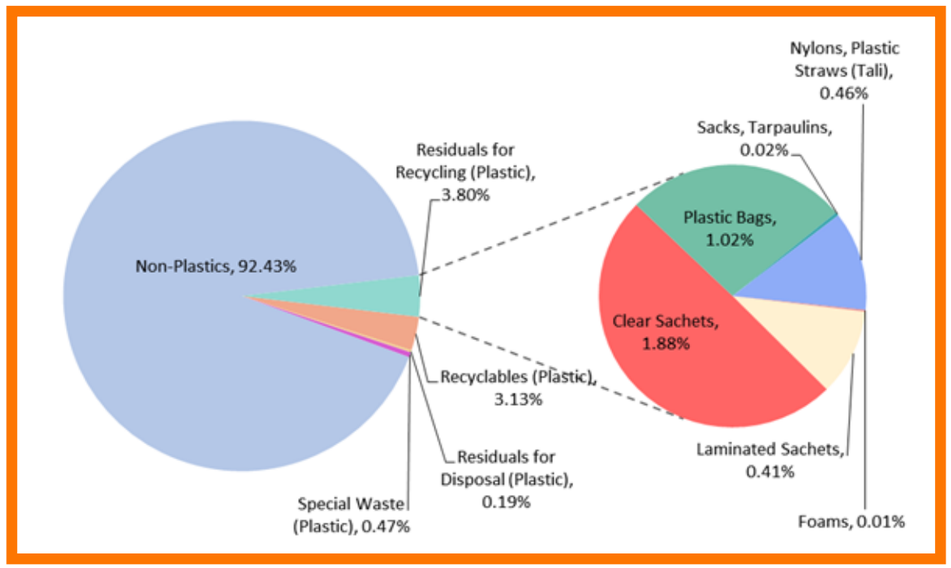


Figure 33. Port-Generated Residual Plastic Wastes with Potential for Recycling

Residual plastic wastes for disposal such as heavily soiled plastics, diapers, and napkins were also collected and found to be at 0.19% by total weight of the sorted samples (Figure 34).

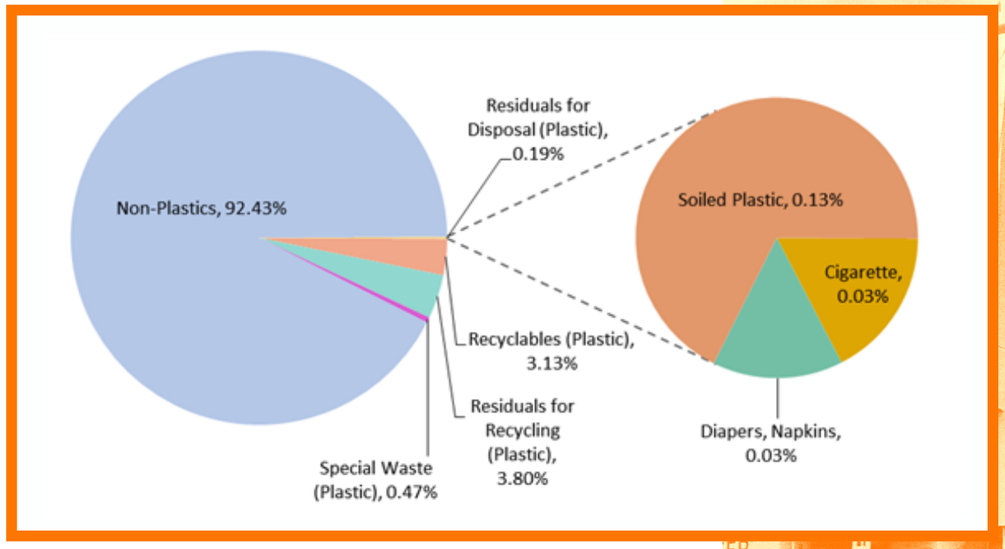


Figure 34. Port-Generated Residual Plastic Wastes for Disposal

Special plastic wastes were also collected from the port facilities and found to be at 1.77% by total weight. These range from healthcare wastes such as face masks to hazardous wastes such as pesticides and consumer electronic products (Figure 35).

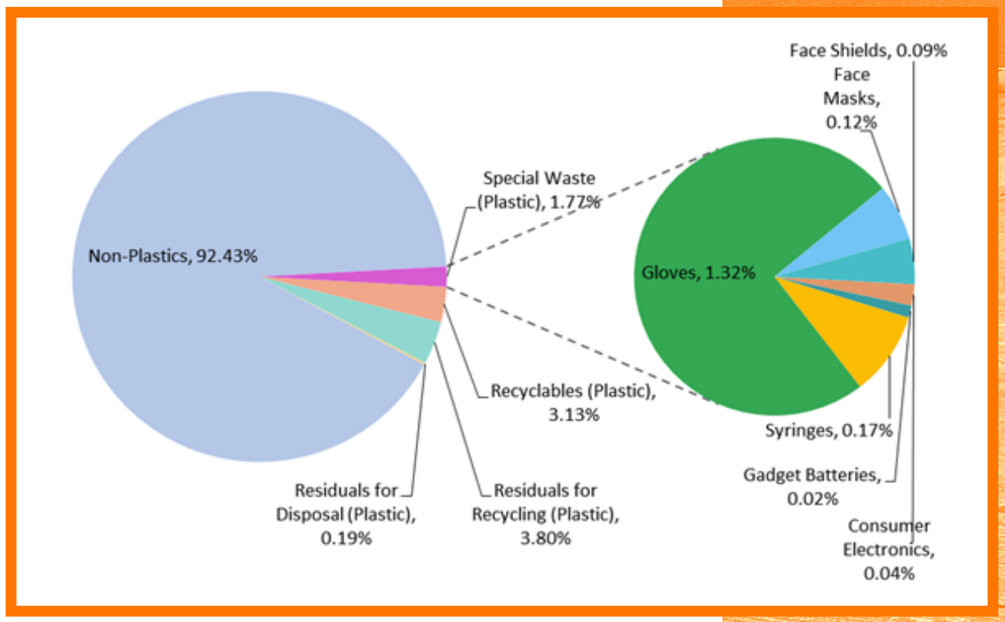


Figure 35. Port-Generated Special Plastic Wastes

Vessel Generated Waste

The generation rates for the vessels were calculated to be at 873.33 kg/day in total based on the vessel data collected from the WOBVIFs and the waste density data from the sorted wastes. Comparison of vessel generation rates during the pandemic and pre-pandemic shows the effect of the imposed travel restrictions to the amount of wastes received by ports from the vessels. The vessel-generated waste in a day has decreased by 72% during the pandemic considering the reduced number of vessel traffic in Port of Cagayan de Oro (Table 14).

Table 14. Vessel Waste Generation Rate for the Port of Cagayan de Oro

Vessel Type	Pre-COVID-19	COVID-19 (Current)			
	Daily Generation Rate (kg/day)	Daily Generation Rate (kg/day)	Per Vessel (kg.vessel/day)	Per Vessel Tonnage[26] (kg/gross tonnage/day)	Per Passenger (kg/passenger/day)[26]
Container, Passenger	527.83	145.92	29.18	0.00118	0.398
RoRo, Passenger	68.98	19.07	9.53	0.00192	
Container	76.61	21.18	4.24	0.00015	-
Liquid Bulk	21.10	5.83	5.83	0.01676	-
Total	**694.52**	**192.00**	**-**	**-**	**-**

With regards to waste composition, 29.02% of vessel-generated waste were biodegradable (Figure 36). The most abundant biodegradable waste was food waste at 16.21% of waste. Sweepings and garden waste were at 4.54% and 3.19%, respectively. Garden wastes from vessels generally come from plants aboard the passenger and/or cruise ships. Merchant ships may not have plants considering the provisions in other countries.

26 Calculated using the average passenger on board data from the statistic of PPA Statistics for the first two quarter of the year 2021.

Wood and agricultural/farm waste such as coconut and corn husks, which may come from the passengers or other cargo, were also found. Hair was found at low quantities in the waste sample (Figure 36).

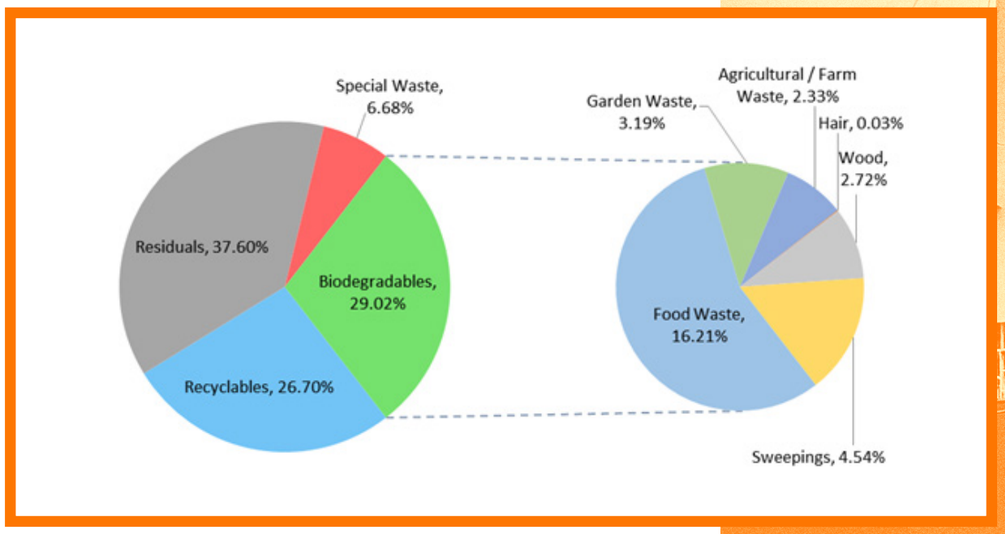


Figure 36. Vessel-Generated Waste Composition of Biodegradables

Recyclables were at 26.70% of the total vessel-generated waste with plastics being the highest (Figure 37). Papers, metals, and glasses were also collected.

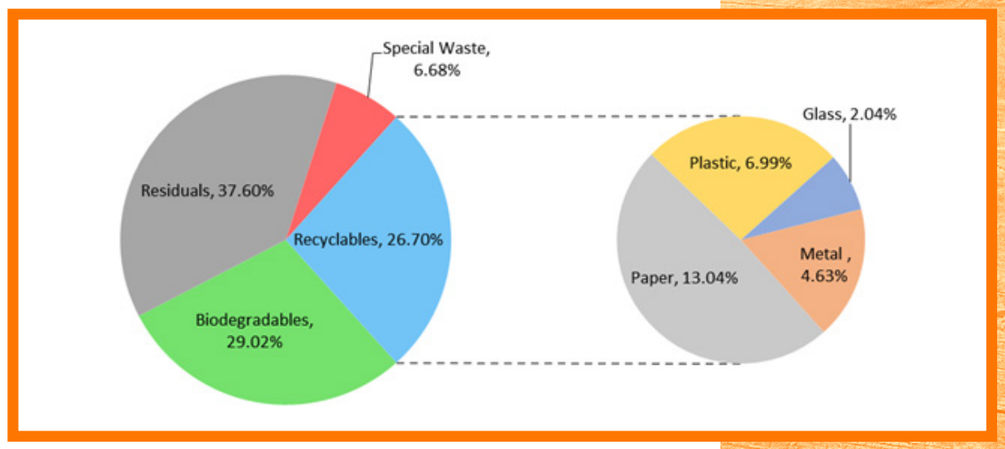


Figure 37. Vessel-Generated Waste Composition of Recyclables

Residual waste were at 37.60% of the total vessel-generated waste, the highest among the general categories (Figure 38). 30.84% of these residuals were those with potential for recycling. These included textiles, clear and laminated sachets, and plastic bags among others. The remaining residual wastes were for disposal at 6.76% of the total waste. These included paper cups, soiled plastics, diapers and napkins and tissue papers.

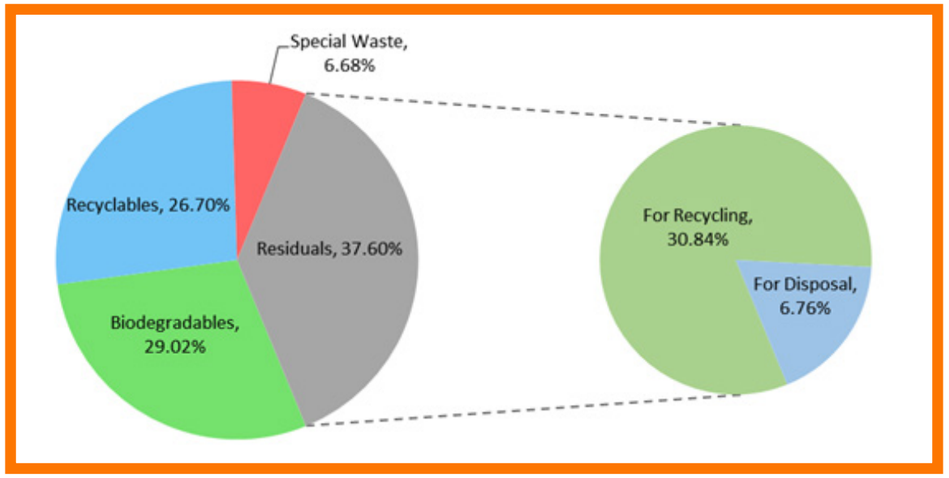


Figure 38. Vessel-Generated Waste Composition of Residuals

Special wastes were at 6.68% of the total waste sampled (Figure 43). Majority of these wastes were hazardous waste – paints and consumer electronics – at 4.37%. Bulky waste was at 1.82%; while, healthcare waste, which include face masks, was found at 0.49%.

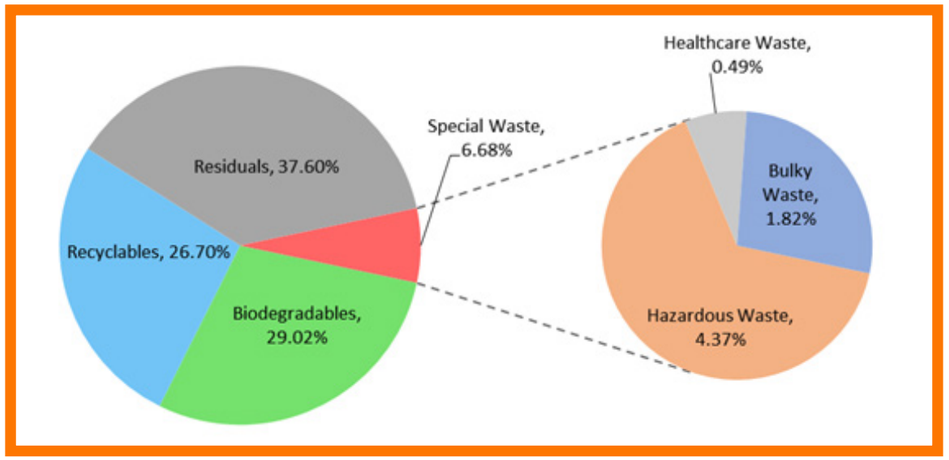


Figure 39. Vessel-Generated Waste Composition of Special

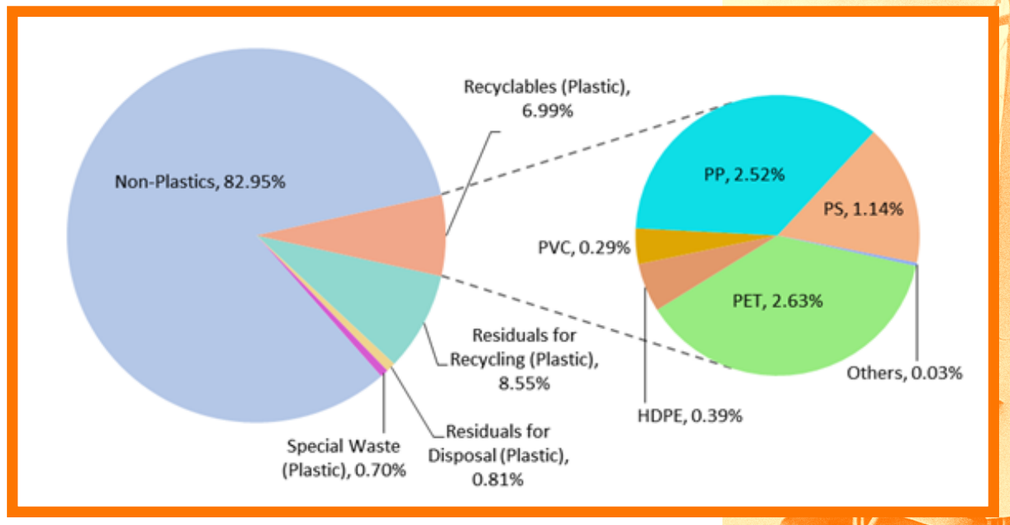


Figure 40. Vessel-Generated Recyclable Plastic Wastes

Of the collected wastes from the vessels, the recyclable plastic wastes were at 6.99% by total weight in which polyethylene terephthalate (PET) and polypropylene (PP) types of plastics constitute the largest. Polystyrene (PS), high-density polyethylene (HDPE), and low-density polyethylene (LDPE) plastic types were also present in the collected samples (Figure 40).

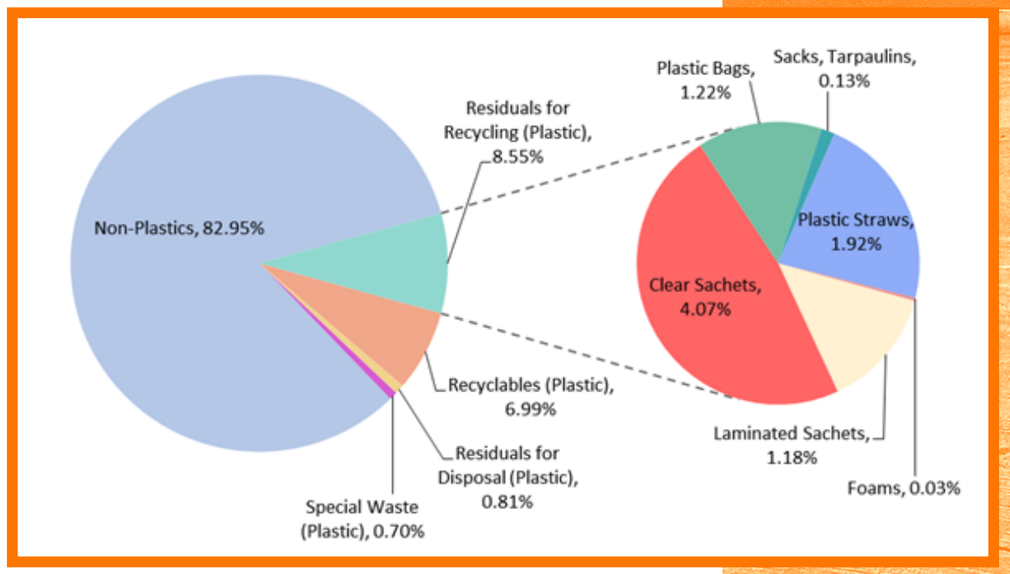


Figure 41. Vessel-Generated Residual Plastic Wastes with Potential for Recycling

Residual plastic wastes for disposal such as heavily soiled plastics, diapers, and napkins were also collected and found to be at 0.81% by total weight of the sorted samples (Figure 42).

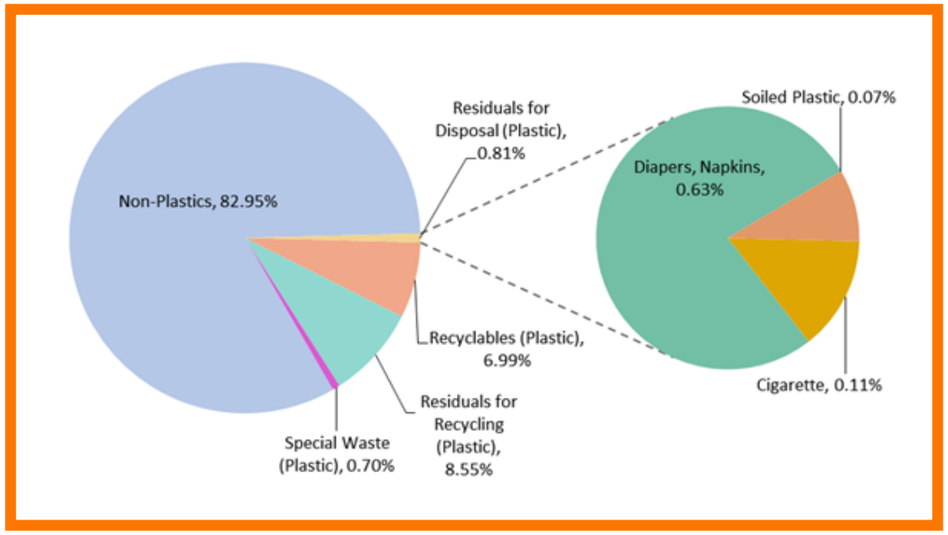


Figure 42. Vessel-Generated Residual Plastic Wastes for Disposal

Special plastic wastes were also collected from the vessels and were found to be at 0.70% of the total weight; and, were mostly face masks at 0.30% of the total weight. Face shiels and gloves were at 0.09% and 0.04%, respectively. Some hazardous wastes such as appliances, industrial and vehicle batteries, gadget batteries, and pesticide were also recorded (Figure 43).

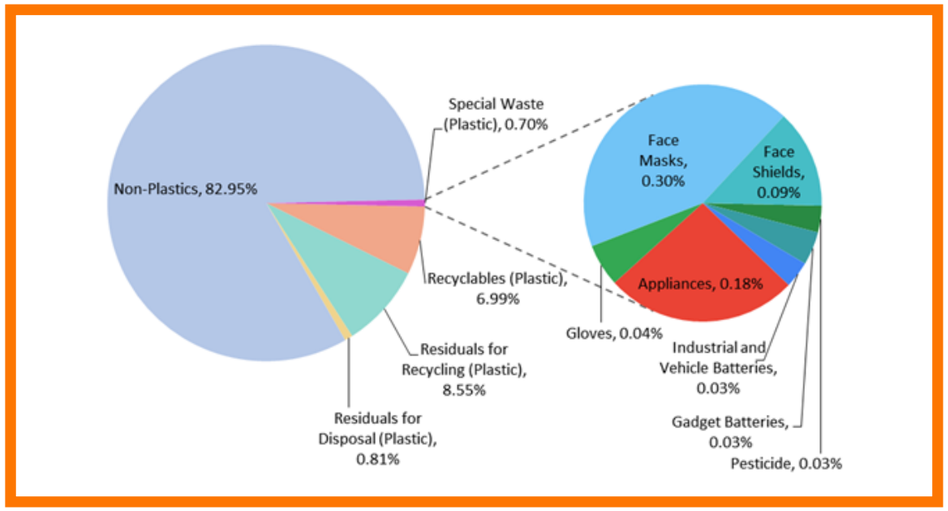


Figure 43. Vessel-Generated Special Plastic Wastes

Plastic Waste Leakage

Unmanaged wastes leaked out from the solid waste management system of the Port of Cagayan de Oro – both intentionally and unintentionally especially during the collection, formal 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 vessel-generated wastes are assumed to be the same.

Leakage from Collection Service

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.

The leakage potential for collection containers was determined to be on a low level which has a factor of 0.6. The containers stored at collection points in the port area are available in all facilities. The capacity of the bins is generally sufficient for generated waste but some dumping of waste around frequency of collection is adequate for what is required.

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 forklift. Wastes are also being transferred to the collection vehicle from a fixed collection container.

All primary transportation vehicles are covered, preventing exposure of waste to the open environment; hence, the leakage potential is low at a factor of 0. Collected wastes from both port facilities and vessels do not exceed the capacity of the dump trucks.

The leakage potential for the multiple handling of wastes is assessed to be low at a factor of 0. Collected waste is adequately transferred between multiple vehicles/people. There are also dedicated

facilities such as MRFs for the transfer of waste with high levels of waste containment. Wastes are also transferred directly into secondary transportation vehicles; and the waste leaking from some garbage during the transfer were swept at the end of the collection.

A total of 1.1% of the plastic wastes are leaked during collection when all influencing factors for leakage are combined.

Leakage from Formal Sorting in Materials Recovery Facilities (MRFs)

Potential plastic leakages from formal sorting in the MRFs of service providers and local government are assessed to be at low level with a factor of 5. Most of the sorting rejects are returned to the formal system, containers or depots in the vicinity are regularly serviced and the area is linked to a formal system. Most dumping or open burning of waste is not believed to have originated from the sorting activities (GIZ, 2020).

75% of plastic rejects are recycled and none of the recyclable plastics are disposed.

Hence, the calculated leakage from formal sorting is about 0.04%.

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).

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 both port wastes and vessel wastes does not exceed the capacity.

Most of the port-generated and vessel-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.

All collection vehicles in the port are fully covered. This has a low leakage potential at a factor of 0.

Multiplying all three leakage factors, the plastic leakage during transportation 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 the wind (windblown) or by water/landslides (GIZ, 2020).

The site where landfilling occurs is in an area where regular flooding or landslides affect very few parts of the site. The leakage potential is assumed to be low at a factor of 2.

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

Wastes are generally discharged in active cells or designated zones only and waste pickers are not allowed on 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 low at a factor of 0.5.

Waste is covered typically once a week with soil which gives a medium leakage potential at a factor of 0.4.

Burning of waste is illegal on site which gives a very high leakage potential of 1.

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. This has a medium level leakage potential with a factor of 60.

Most storm drains are well maintained – regularly cleaned several times a year. Litter traps are used on a handful of drain outlets and are well maintained. This gives a medium leakage potential with a factor of 0.3.

It is calculated that 82% of leaked plastic wastes in drains are being transferred to water bodies.

Waste Flow Diagram

A Waste Flow Diagram was generated using the calculated quantities in different stages of the solid waste management in Port of Cagayan de Oro (Table 15 and Figure 44).

Table 15. Amount of Waste per Stage

Stage		Amount (kg/year)	Amount (tons/year)
Generated Waste		360,293.00	360.29
Collected Waste		359,919.00	359.92
Recovered Waste		48,092.00	48.09
Transported Waste		311,815.00	311.81
Disposed Waste		311,138.00	311.14
Unmanaged Plastic Waste	Retained on Land	642.00	0.64
	Leaked to Drains	60.00	0.06
	Leaked to Waterways	361.00	0.36

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 waste 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 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).

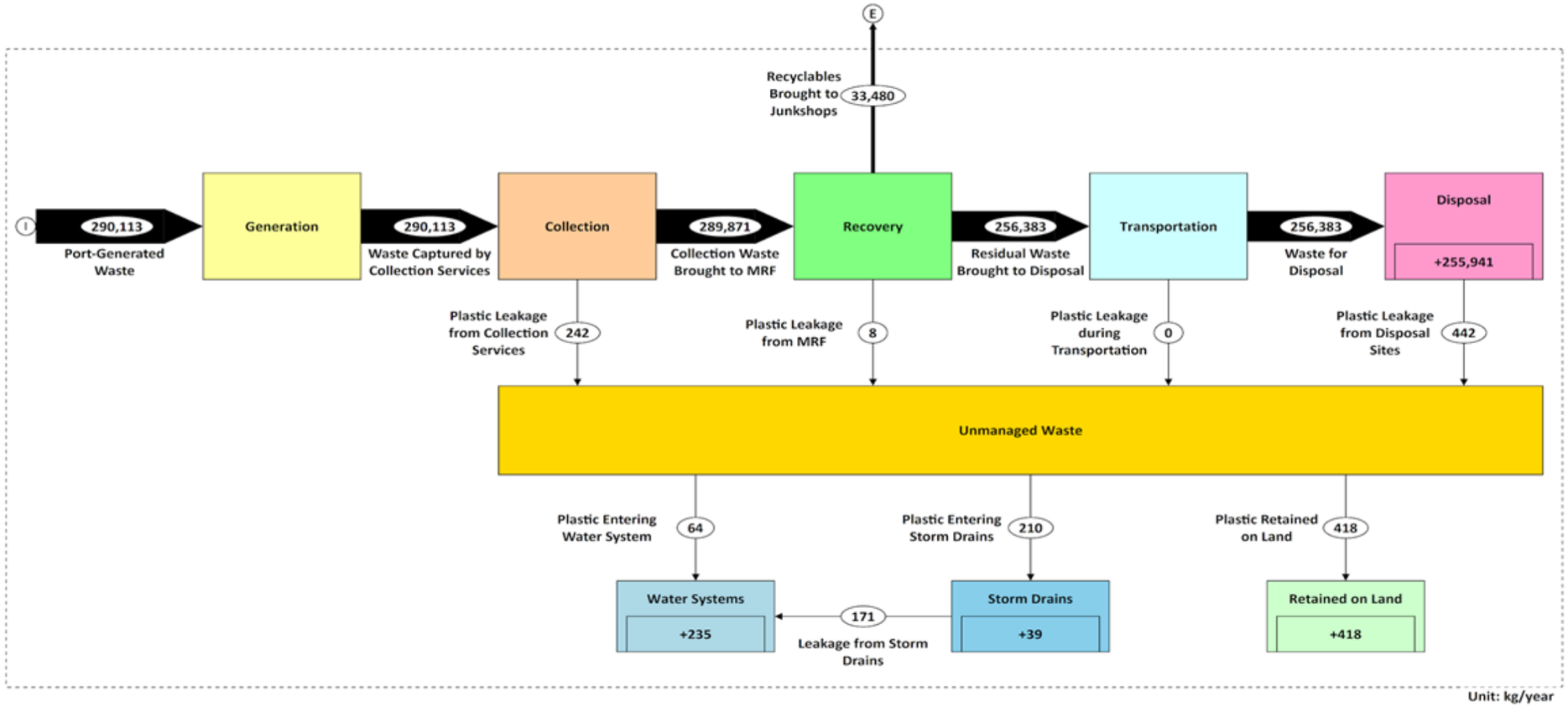


Figure 44. Solid Waste Flow Diagram in COVID-19 Scenario for Port of Cagayan de Oro

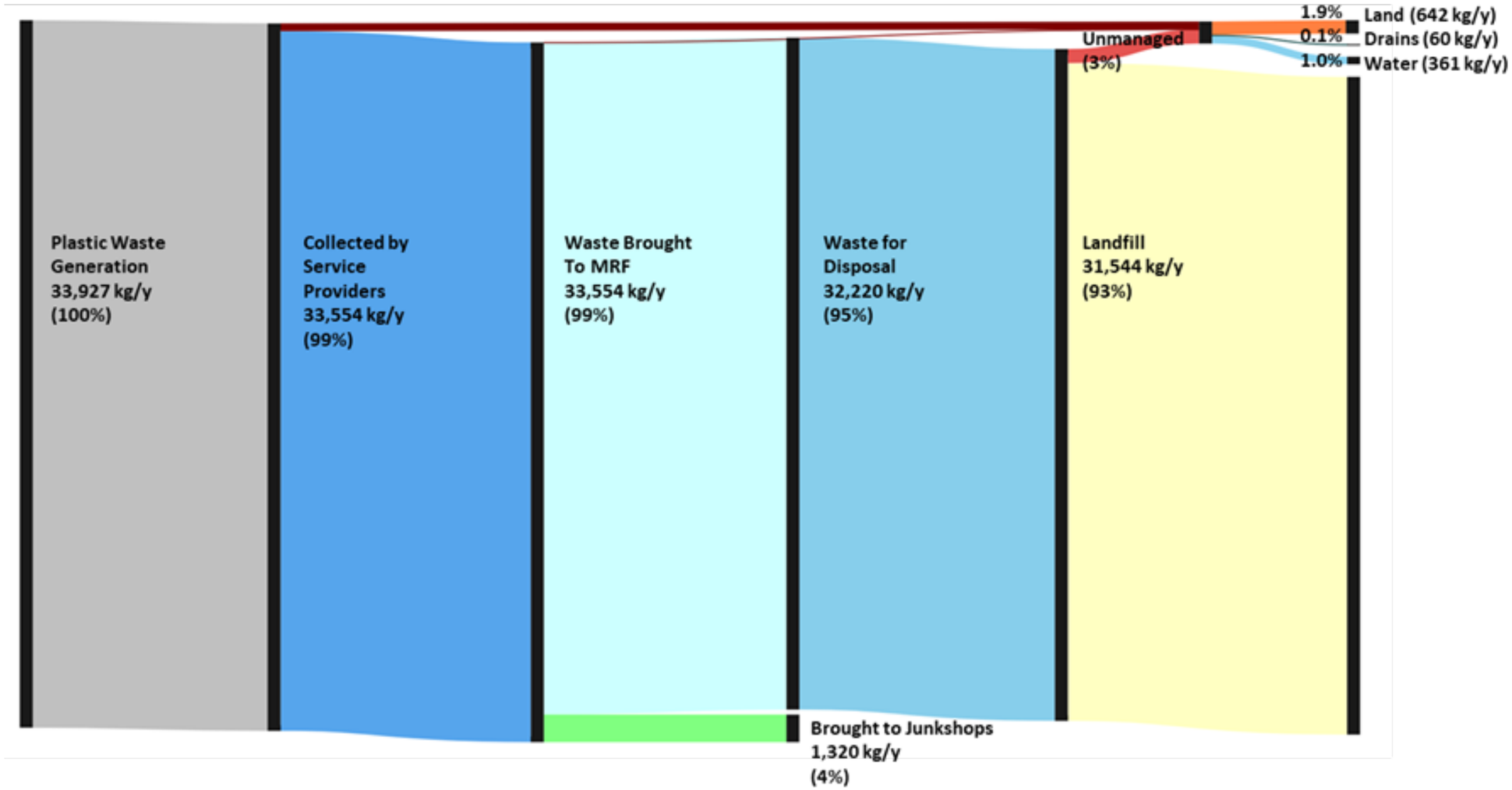


Figure 45. Waste Flow of Plastics in in COVID-19 Scenario for Port of Cagayan de Oro

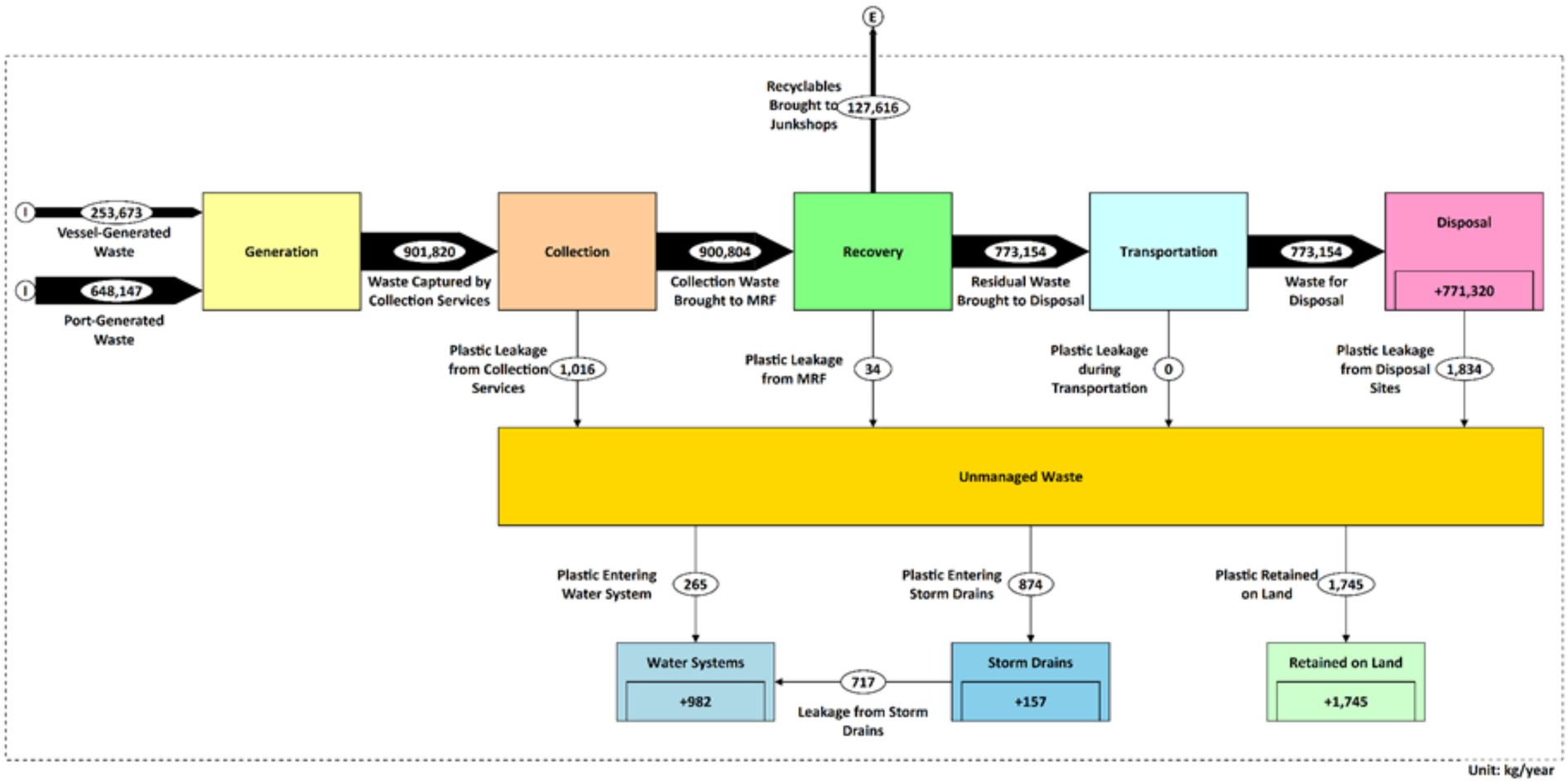


Figure 46. Solid Waste Flow Diagram in a Pre-COVID Scenario in Port of Cagayan de Oro

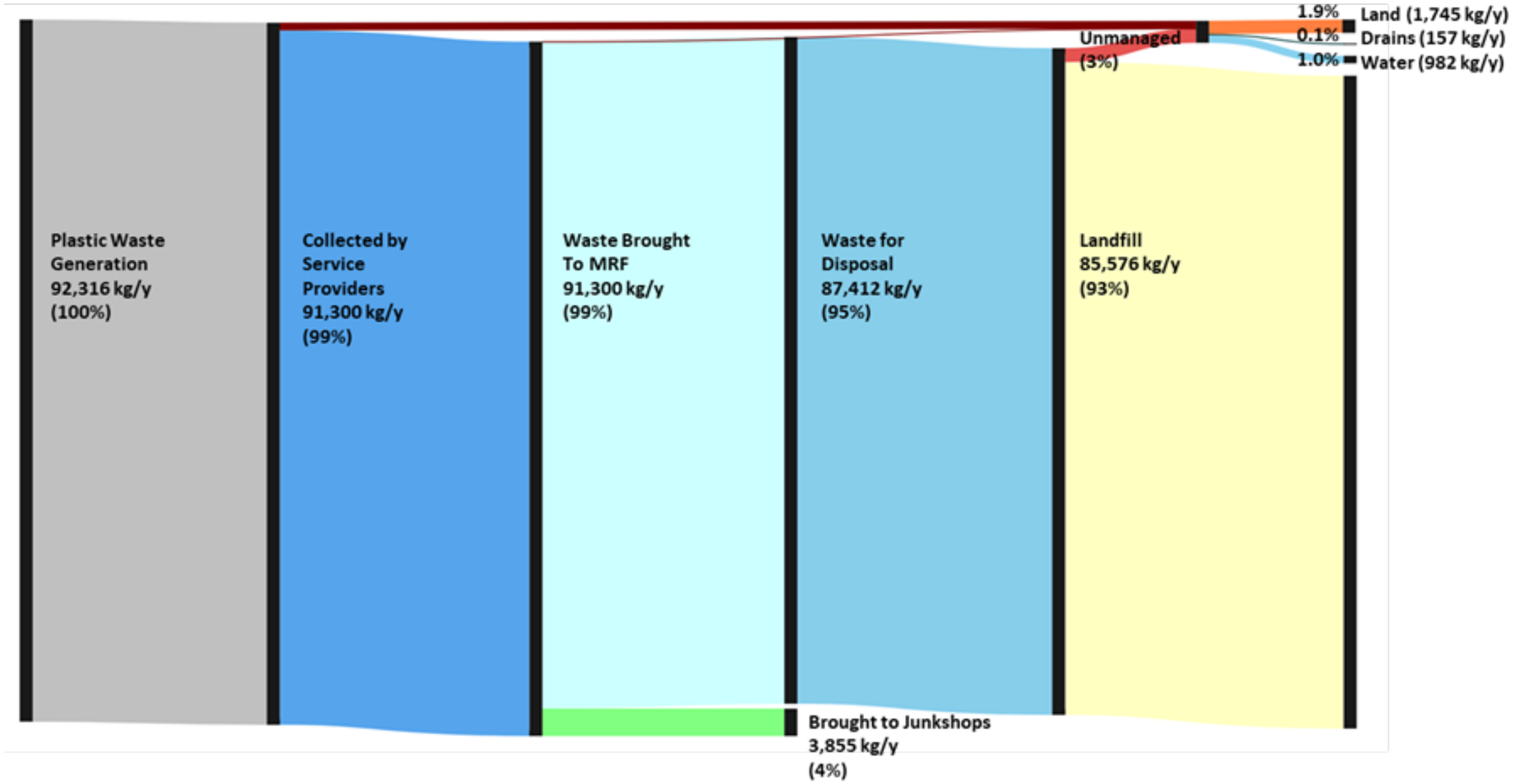


Figure 47. Waste Flow of Plastics in Port of Cagayan de Oro in Pre-COVID Scenario

OBSERVATIONS

There are several good practices and items for improvement observed at the Port of Cagayan de Oro.

Good Practices

Good practices were observed at the different stages of the waste management system of Port of Cagayan de Oro (Table 16). Most of which were observed during collection with the disinfection of the collection bins before and after the collection of wastes as part of the preventive measures for the spread of COVID-19 as one of the notable and commendable practices during this pandemic.

Table 16. Summary of Good Practices in terms of Waste Management at the Port of Cagayan de Oro

Stage	Port	Vessel
Generation	Mandates on usage of **single-use plastic bags**. PMO **regularly reports** the estimated waste generation of their port facilities to PPA. Cagayan de Oro LGU bans **usage of plastic bags** and promotes eco-bags. Plastic bags primarily used for wet market products.	Follows regulations stated in **MARPOL Annex V**. Available documentation of **waste generated by volume** through Waste On-Board Vessel Information Form.
Segregation	**Color-coded** waste segregation bins separating biodegradable (green), recyclable (red), non-biodegradable non-recyclable (blue), and medical wastes (yellow) Separating **hazardous wastes** such as contaminated oil. Most of the wastes in the collection points are contained in **black garbage bags**.	Mandatory **segregation** of wastes based on the PPA-PMO Operations Memorandum Circular No. 018-2018. **Appropriate containers** are used for different types of wastes. **Yellow waste bins** used to separate vessel-generated wastes from port-generated wastes.
Collection	All 17 **receptacles points** are also designated collection points for port generated wastes. **Disinfects the collection bins** before and after waste collection. **Weigh bridge available** at port. There is a **separate** collection for **hazardous wastes** that is special toxic wastes. After collection, the waste collectors properly **clean the area** around the collection point.	Mandated to **use containers** of wastes that are **kept sealed** except when adding or removing wastes. **Shore reception fee** as mandated by PPA Admin Order 01-2020. **Disinfects the collection bins** before and after waste collection. Waste collectors **wear proper protective equipment** throughout the conduct of waste collection. Dump truck has a **cover** for collected wastes and does not fill the container beyond its capacity.

Stage	Port	Vessel
Collection	The waste collection bins are **properly covered**. Garbage collection truck is **covered** with tarpaulin upon transportation.	After collection, the waste collectors **properly clean the area** around the collection point. The waste storage bins are **properly enclosed** and is not easily accessible to animals.
Recovery	Service providers **have their own MRFs**.	
Disposal	**Wastes are covered** by soil. No presence of **waste pickers.**	

Items for Improvement

There are also items for improvement observed at the different stages of the waste management system of Port of Cagayan de Oro that, when resolved, shall strengthen, and improve the currently implemented solid waste management system in the Port of Cagayan de Oro (Table 17).

Table 17. Summary of Items for Improvement and Suggested Solutions for the Waste Management System of the Port of Cagayan de Oro

Stage	Issues	Suggested Solution
Generation	**Waste generated per vessel data lacks accuracy** due to absence of measuring device for volume and tonnage of waste.	**Use of weighing scale and measure in terms of weight** instead of volume. **Prompt usage of weigh bridge** and minimizing fees depending on waste and vehicle tonnage.
Segregation	**Mismanaged** sorting area.	Construct a **collection receptacle that has divisions** designated for different types of wastes.
Segregation	Sorting area is **exposed to weather**. **Mixing of fines, sand, soil, and other aggregates** with port and vessel generated wastes.	**Strict implementation** of waste segregation. **Conduct IEC Campaign** about proper waste handling and segregation. **Segregate fines, sand, and** soil prior to collection of port and vessel-generated wastes. Place intended recovery bins for specific recoverable wastes, especially those of heavier density.
Collection	Waste bins **need upgrading** as rusting is observed.	Upgrade into **larger and better waste bins**. **Provide roofing** for all waste receptacles.
Recovery	**No storage facility** in the port for recovered wastes leading to the neglect in the sorting area / temporary storage area within the port. Informal waste recovery process conducted by City Central MRF for all port wastes. Sorters pick up recyclables at the dump truck, which might lead to other recyclable wastes in the pile to not be recovered.	There should be **a centralized MRF within the port** which will process all the recyclable and biodegradable wastes. **Improve coordination** between PPA management and waste haulers. Improve waste recovery process.
Disposal	**Fencing** can be **improved**. **Dirt road in landfill is dusty** during dry weather which may pose health hazards to people working in the landfill and along the way.	**Repair** damaged fences. **Water the dirt** road to minimize dust particles/ debris. **Procurement of additional equipment** such as compactors for faster covering of wastes.

Control Level of Recovery and Disposal Facilities

The vessel-generated wastes on the other hand are brought by Far East into the Pontillas Junkyard, which has basic control over all the entering wastes. There are clearly marked boundaries with supervised access control (Section III.C.4).

The City Central MRF, which collects recyclables at the sorting area within the port has basic control[27] over all the wastes entering the facility. It is registered with the LGU of CDO and has clearly marked boundaries over the facility area. There are no guards as the sorters and owner of the MRF themselves supervise the access control into the area. The facility is said to recover all biodegradable wastes and transform these into compost, and all recyclable wastes into either eco-bricks or sold into junkshops. It does not seem to however be engineered with process control. PPEs are worn by the sorters, and handwashing with water and soap is being practiced, athough some of them have been observed to not to follow these guidelines. The City Central MRF is also planned for renovation and upgrading.

The disposal site, EcoWaste Treatment and Disposal Facility, is found to be of improved control in accordance with the Waste Wise Cities Tool. The designated city SLF is a Category 3 SLF with leachate containment, slope stabilization, and erosion control. There are no gas vents and waste utilization plan for the dumped wastes. The need for gas vents is minimized as the wastes are disturbed and sun dried prior to the final soil covering, which subsequently minimizes the moisture content of the wastes. Wastes are also compacted using drum roller compactors. There are also functional weighbridges under construction for the SLF. There are also specific cells for active dumping. The disposal site, EcoWaste Landfill, is found to be of basic control since there is no gas and waste utilization and post closure plan yet (Section III.C.5). The collection service level at the port, on the other hand, is assessed to be of basic control in accordance with the Waste Wise Cities Tool.

27 Basic collection refers to receiving municipal solid waste collection service with basic frequency and regularity of at least once a week. There is also no separation of fractions during collections with designated collection points within 200 m served with basic frequency and regularity (UN Habitat, 2021).

RECOMMENDATIONS

Utilization of other plastic wastes, installation of a centralized MRF within the port, conduct of IEC campaigns, and improvement of the collection system and the disposal facility are recommended for the Port of Cagayan de Oro.

Utilization of Plastic Waste

About 9% of the generated wastes from ports and vessels are plastics based on the WACS results (Figure 45). The most abundant type of plastics are the clear and single-layer sachets (Figure 32 and Figure 41), PET and PP recyclables (Figure 33 and Figure 40). Utilizing these wastes may include bayong-making using clear or laminated sachets, upholstery, and decorative items from PET bottles and other 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.

Installation of Centralized MRF inside the Port

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 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.

The establishment of the MRF can be better achieved through partnerships with both private and public entities such as the Cagayan de Oro City LGU, DOST, DENR, PPA, MARINA, Far East, Oroport, EcoWaste, NGOs and other environmental groups (Figure 2).

Conduct of Information, Education and Communication Campaigns

Information, Education and Communication (IEC) campaigns can help strengthen the establishment of waste management plans and related mandates in the port facilities and vessels. 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. 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. 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 like certification and recognition, and economic incentives to prompt the establishments and businesses to use alternative products for plastics.

Campaigns for vessels and shipping lines can focus on the MARPOL requirements that are mandated through the PPA Administrative Order No. 2 of 2003, especially on the segregation of the waste on board. This helps service providers and junkshops in minimizing the leakage of plastic waste by decreasing the amount of waste that requires sorting.

Improvement of Collection System

About one percent (1%) of the plastic wastes are calculated to leak during collection (Figure 45). 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. It is also recommended to construct a collection receptacle that has divisions designated for different types of wastes including those for fines, sand, and soil. Additional plastic cages for the collection of PET bottles are recommended. Compactor trucks are also recommended to use. For future innovations, using automated systems for waste loading can be considered.

For vessel-generated wastes, waste segregation bins can be sorted and color-coded either according to the existing color-coding of waste bins for port-generated waste (Figure 9) or an improved scheme that is more in line with waste categories of the MARPOL standard (Table 3). Waste segregation bins for vessel-generated waste also minimizes the vessel waste's exposure to external factors at the quay collection points and enforces waste segregation onboard vessels.

Improvement of Disposal Facility

About two percent (2%) of the plastic wastes are calculated to leak during disposal (Figure 45). Construction of fencing and acquisition of proper compacting equipment are improvements to significantly reduce plastic leakage in the disposal facility. Testing for microplastic presence in the leachate pond can also help provide more data on possible micro-plastics leaking from the disposal facility.

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.

REFERENCES

ASEAN. (2021). ASEAN Regional Action Plan for Combating Marine Debris in the ASEAN Member States (2021-2025). Jakarta: ASEAN Secratariat.

Barnes, D. K., Galgani, F., Thompson, R. C., & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. Philosophical Transactions of the Royal Society B.

Cagayana de Oro City City Local Environment and Natural Resources Office. (2021). WACS - Brgy Macabalan. Cagayan de Oro, Philippines.

Cities Development Intitative for Asia. (2018, September 19). Cagayan de Oro City Implements Key Waste Management Investment Plans. Cagayan de Oro, Misamis Oriental, Philippines. Retrieved June 15, 2021, from https://cdia.asia/2018/09/19/cagayan-de-oro-city-implements-key-waste-management-investment-priorities/

COBSEA. (2019). Regional Action Plan on Marine Litter. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/30162/RAPMALI_19.pdf?sequence=1&isAllowed=y

Del Rosario, R. M., & Palmes, N. D. (2010, July 09). Bitan-ag Creek Water: Its Physical, Chemical, and Biochemical Characteristics. Mindanao Journal of Science and Technology. Retrieved November 2021, from https://cdo.ustp.edu.ph/wp-content/uploads/2017/12/6.-Bitanag-Creek-Water-Its-Physical-Chemical-and.pdf

DENR. (2019). NPOA on Marine Litter - Programmatic Cluster of Activities. Philippines.

Department of Environment and Natural Resources. (2013). DENR 2013-018: Designation of the Cagayan de Oro River Basin and Adjacent Rivers as Water Quality Management Area and Creation of Its Governing Board. Retrieved from http://119.92.161.2/portal/Portals/24/WQMA%20DAOs/DAO%202013-18%20-%20WQMA%20Cagayan%20de%20Oro.pdf

Department of Environment and Natural Resources. (2021). National Plan of Action for the Prevention, Reduction, and Management of Marine Litter.

Department of Environmental and Natural Resources. (2006, September). DAO-10_pdf.pdf. Retrieved November 2021, from National Solid Waste Management Bureau: https://nswmc.emb.gov.ph/wp-content/uploads/2018/01/DAO-10_pdf.pdf

Department of Environmental and Natural Resources. (2021). Mandate, Vission & Mission. Retrieved November 2021, from Department of Environmental and Natural Resources: https://www.denr.gov.ph/index.php/about-us/mission-vision

Department of Natural Resources. (2016, May 24). DAO-2016-08. Retrieved November 2021, from Environmental Management Bureau: https://emb.gov.ph/wp-content/uploads/2019/04/DAO-2016-08_WATER-QUALITY-GUIDELINES-AND-GENERAL-EFFLUENT-STANDARDS.pdf

Department of Trade and Industry. (2021). Region 10 - Regional Profile. Retrieved November 2021, from Deaprtment of Trade and Industry: https://www.dti.gov.ph/regions/region-10/profile/

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2020, September). Waste Flow Diagram. Retrieved from GIZ.de: https://www.giz.de/expertise/html/62153.html

DOTr. (2019, July 15). PHL's Biggest Port PTB Opens in Cagayan de Oro. Retrieved from DOTr: https://dotr.gov.ph/55-dotrnews/1008-phl-s-biggest-port-ptb-opens-in-cagayan-de-oro.html

Environmental Management Bureau. (2017, April). 3-Solid-Waste-1.8.pdf. Retrieved November 2021, from Environmental Management Bureau: https://emb.gov.ph/wp-content/uploads/2018/09/3-Solid-Waste-1.8.pdf

ESL Power Systems, Inc. (2021). Safety-interlocked Reefer Outlets. Retrieved November 2021, from ESL POwer Systems: https://eslpwr.com/reefer-outlets/#:~:text=ESL%20Safety%2Dinterlocked%20Power%20Modules,safe%2C%20simple%2C%20and%20durable.

Extended Producers Responsibility for Plastic Wastes Act. (2020, February 12). First Regular Session. Eighteenth Congress, Republic of the Philippines. Retrieved November 2021, from https://www.congress.gov.ph/legisdocs/basic_18/HB06279.pdf

Google Earth. (2021). Port of Cagayan de Oro. Retrieved from https://earth.google.com/web/search/cagayande+oro+port/@8.4980528,124.6617419,3.1459971a,1043.56706545d,35y,0h,0t,0r/data=CigiJgokCTaQed1v3zNAETaQed-1v3zPAGYedcKPlOzhAIceNQs9fPVPA

Google Maps. (2021). Macabalan, Cagayan de Oro. Retrieved June 11, 2021, from Google Maps: https://www.google.com/maps/place/Macabalan,+-Cagayan+de+Oro,+Misamis+Oriental /@8.4958764,124.6617144,1738m/data=!3m1!1e3!4m5!3m4!1s0x32fff2f3a0336ffb:0x7fb5ff732ef36f6d!8m2!3d8.4997038!4d124.6621469

Hach Company. (2020). Chemical Oxygen Demand (COD). United States of America: Hach Company. Retrieved from https://www.hach.com/parameters/chemical-oxygen-demand

International Maritime Organization. (1988). International Convention for the Prevention of Pollution from Ships (MARPOL). Retrieved May 31, 2021, from https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx

International Maritime Organization. (1988). International Convention for the Prevention of Pollution from Ships (MARPOL). Retrieved May 31, 2021, from https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx

International Maritime Organization. (2018). IMO Action Plan to Address Marine Plastic Litter from Ships. Retrieved June 11, 2021, from https://www.imo.org/en/MediaCentre/HotTopics/Pages/marinelitter-default.aspx

International Maritime Organization. (2019). What exactly is IMO? Retrieved from imo.org: https://www.imo.org/en/About/Pages/FAQs.aspx

iPrudential. (2019). Summary of Waste Onboard Vessels Collected (in cubic meters).

Jambeck, J. R., G., R., W., C., S., T. R., P., M., A., & A., ... L. (2015). Plastic waste inputs from land into the ocean. Science, 768-770.

Lagsa, B. (2017, January 18). Too much rain, garbage, clogged waterways caused Cagayan de Oro flood. Rappler. Retrieved October 2021, from https://www.rappler.com/nation/causes-cagayan-de-oro-floods

London Convention and Protocol. (1972). Retrieved June 9, 2021

Lu, C. (2019). Retrieved November 29, 2021, from unescap.org: https://www.unescap.org/sites/default/files/1.3_Approach%20to%20sustainable%20port%20dev_%20Lu%20Cheng_APECPSN.pdf

Marine Environment Protection Committee. (2016, October 28). RESOLUTION MEPC.277(70). Retrieved May 31, 2021, from https://www.amsa.gov.au/marine-environment/marine-pollution/current-marpol-texts

Marine Environment Protection Committee. (2016, October 28). RESOLUTION MEPC.277(70). Retrieved May 31, 2021, from https://www.amsa.gov.au/marine-environment/marine-pollution/current-marpol-texts

Maritime Industry Authority. (2020). MARPOL 73/78. Retrieved from Marina: https://marina.gov.ph/wp-content/uploads/2020/10/MARPOL-73_78.pdf

Maritime Industry Authority. (2021). About. Retrieved from Maritime Industry Authority: https://marina.gov.ph/about/
McKinsey & Company. (2015). Stemming the Tide: Land-based Strategies for a Plastic-Free Ocean.
McKinsey & Company. (2015). Stemming the Tide: Land-based Strategies for a Plastic-Free Ocean.
Merriam-Webster. (2021). Weighbridge. Retrieved November 2021, from Definition of Weighbridge by Merriam-Webster: https://www.dictionary.com/browse/weighbridge
NAMRIA. (2020). Philippine Administrative Boundary Shapefiles - PSA and NAMRIA. phl_adm_psa_namria_20200529_SHP.zip.
National Solid Waste Management Commission. (2020, September). Downloads. Retrieved November 2021, from Solid Waste Management Division: https://nswmc.emb.gov.ph/?page_id=50
NSWMC Resolution No. 1441, Series of 2021. (n.d.). Resolution Adopting the National Plan of Action for the Prevention, Reduction and Management of Marine Litter (NPOA-ML). Retrieved November 2021, from http://nswmc.emb.gov.ph/wp-content/uploads/2021/10/2021-NSWMC-Resolution-No.-1441-Series-of-2021-NPOA-ML1.pdf
PhilAtlas. (2021). Macabalan, Cagayan de Oro Profile. Retrieved October 28, 2021, from PhilAtlas: https://www.philatlas.com/mindanao/r10/cagayan-de-oro/macabalan.html#sectionDemog
Philippine Coast Guard. (2021). Mandates, Mission & Vission. Retrieved November 2021, from Philippine Coast Guard: https://coastguard.gov.ph/index.php/transparency/about-us/mission-vision
Philippine Ports Authority . (2021, June). Philippine Ports Authority Statistics. Retrieved June 14, 2021, from Philippine Ports Authority Official Website: https://www.ppa.com.ph/?q=content/statistics-1
Philippine Ports Authority. (2003, April). AO 002-2003. Retrieved November 2021, from Philippine POrts Authority: https://www.ppa.com.ph/sites/default/files/issuances_docs/AO%20002-2003.pdf
Philippine Ports Authority. (2004). PPA Memorandum Cicular No. 29-2004. Guidelines to Implement the Solid Waste Management System in the PPA and Directing its Strict Monitoring and Compliance. Retrieved November 2021, from http://www.pmocdo.ppa.com.ph/wp-content/uploads/2019/02/PPA-MO-29-2004.pdf
Philippine Ports Authority. (2017, May). Definition of Terms. Retrieved November 2021, from Philippine Ports Authority: https://www.ppa.com.ph/sites/default/files/Definition%20of%20Terms.pdf
Philippine Ports Authority. (2018, October 1). Mandatory Segregation and Proper Disposal of Vessel Generated Wastes. Cagayan de Oro, Misamis Oriental, Philippines. Retrieved June 15, 2021, from http://www.pmocdo.ppa.com.ph/wp-content/uploads/2018/10/PMO-MOC-OMC-018-2018-MANDATORY-SEGREGATION-AND-PROPER-DISPOSAL-OF-VESSEL-GENERATED-WASTES.pdf
Philippine Ports Authority. (2018). PPA AO 05-2018. The Port Environmental Policy (PEP). Retrieved November 2021, from https://www.ppa.com.ph/sites/default/files/issuances_docs/PPA%20AO%20No.%2005-2018%20%20The%20Port%20Environmental%20Policy%20%28PEP%29_0.pdf
Philippine Ports Authority. (2018, May 18). The Port Environmental Policy (PEP). Philippines. Retrieved May 31, 2021, from https://www.ppa.com.ph/sites/default/files/issuances_docs/PPA%20AO%20No.%2005-2018%20%20The%20Port%20Environmental%20Policy%20%28PEP%29_0.pdf
Philippine Ports Authority. (2019). Daily Solid Waste Monitoring Report.
Philippine Ports Authority. (2020, January). Prescribed Waste Reception Fee in all PPA Ports.

Philippine Ports Authority. (2021). Philippine Ports Authority. Retrieved June 2021, from Our History: https://www.ppa.com.ph/?q=content/our-history
Philippine Reef and Rainforest Conservation Foundation. (2021). About Us. Retrieved November 23, 2021, from PRRCF: http://www.prrcf.org/about-us/
Philippines News Agency. (2019, January 22). CDO to partially enforce waste segregation rule in July. Cagayan de Oro, Misamis Oriental, Philippines. Retrieved June 15, 2021, from https://www.pna.gov.ph/articles/1059686
PMO CDO. (2019, July 1). Port of Cagayan de Oro wins in APEC Port Services Network (APSN) Green Port Award System 2018. Port Eye. Philippines: PPA PMO CDO. Retrieved November 22, 2021, from http://www.pmocdo.ppa.com.ph/wp-content/uploads/2020/05/PPA-PMO-MOC-Port-Eye-Special-Edition-Vol.1-Issue-1-July-2019.pdf
PMO of Cagayan de Oro. (2021). Port of Cagayan de Oro. Retrieved June 11, 2021, from PPA PMO Misamis Oriental / Cagayan de Oro: http://www.pmocdo.ppa.com.ph/port-profile/port-of-cagayan-de-oro/
Port Calls Asia. (2018, December 10). Batangas, CDO win APEC green port awards. Retrieved October 28, 2021, from Port Calls Asia: https://www.portcalls.com/batangas-cdo-win-apec-green-port-awards/
PortCalls. (2018, May 23). PH Port Environment Policy to Take Effect on May 27. Retrieved from PortCalls: https://www.portcalls.com/ph-port-environment-policy-take-effect-may27/
Presidential Decree No. 979. (1974). Philippines. Retrieved May 31, 2021, from https://coastguard.gov.ph/index.php/related-links/29-auxiliary-menu/related-laws/191-presidential-decree-no-979#:~:text=%E2%80%94%20It%20is%20hereby%20declared%20a,the%20territorial%20jurisdiction%20of%20the
Quizon, A. (2005, August 3). Moving from Advocacy to Affirmative Action: Two NGO Cases from the Philippines. Retrieved from unpan1.un.org: http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN021061.pdf
Ravanera, O. R. (2002, June 29). The Dying Macajalar Bay. Retrieved from Sun Star Cagayan de Oro: http://www.sunstar.com.ph/static/cag/2002/06/29/oped/orlan.r..ravanera.html
Rech, S., Macaya-Caquilpan, V., Pantoja, J., Rivadeneira, M., Madariaga, D., & Thiel, M. (2014). Rivers as a source of marine litter--a study from the SE Pacific. Pubmed.gov.
Refaat, M. H. (2014, July). Sustainable Landscapes; the use of Eco Parks As a Tool for Sustaining the Living Landscape. International Journal of Education and Research, 2(7). Retrieved from https://www.ijern.com/journal/July-2014/45.pdf
Republic Act No. 9003. (2001, January 26). Retrieved May 19, 2021, from https://www.officialgazette.gov.ph/2001/01/26/republic-act-no-9003-s-2001/
Sea Knowledge Bank. (2017, October 23). MACAJALAR BAY , PHILIPPINES. Retrieved from Sea Knowledge Bank: https://seaknowledgebank.net/content/macajalar-bay
The Nerve. (2019). LGUs with ordinances to ban and/or regulate plastic use. Retrieved November 2021, from https://www.rappler.com/environment/many-ways-to-zero-waste-movement
Thevenon, F., Carroll, C., & Sousa, J. (2014). Plastic Debris in the Ocean: The Characterization of Marine Plastics and their Environmental Impacts. Situation Analysis Report, Switzerland: IUCN.
Tumampas, B. (1984). The Impact of the Cagayan de Oro Port Development Project on SKilled and Unskilled Labor. Journal of Philippine Development, 11(1).
UN Environment Programme. (2017). 11 - Sustainable Cities and Communities. Retrieved November 2021, from https://wedocs.unep.org/bitstream/handle/20.500.11822/22746/11_Sustainable%20cities%20and%20communities_

FINAL.pdf?sequence=1&isAllowed=y
UN Environment Programme. (2017). 12 - Responsible Consumption and Production. Retrieved November 2021, from https://wedocs.unep.org/bitstream/handle/20.500.11822/22747/12_Responsible%20consumption%20and%20production_FINAL.pdf?sequence=1&isAllowed=y
UN Environment Programme. (2017). 14 - Life Below Water. Retrieved November 2021, from https://wedocs.unep.org/bitstream/handle/20.500.11822/22749/14_Life%20below%20waterFINAL.pdf?sequence=1&isAllowed=y
UN Environment Programme. (2017). 17 - Partnership for the Goals. Retrieved November 2021, from https://wedocs.unep.org/bitstream/handle/20.500.11822/22752/17_Partnership%20for%20the%20goals_web_FINAL.pdf?sequence=1&isAllowed=y
UN Habitat. (2021). Waste Wise Cities Tool. Retrieved from UN Habitat: https://unhabitat.org/wwc-tool
UNDP Philippines. (2019, November 08). A problem as huge as the ocean. Retrieved from UNDP Philippines: https://www.ph.undp.org/content/philippines/en/home/blog/2019/a-problem-as-huge-as-the-ocean.html#:~:text=The%20National%20Plan%20of%20Action,the%20responsible%20national%20government%20agency.
United Nations. (2021, June 8). Retrieved from Sustainable Development Goals: https://www.un.org/sustainabledevelopment/oceans/
United Nations. (2021, June 8). Retrieved from Sustainable Development Goals: https://www.un.org/sustainabledevelopment/cities/
United Nations. (2021, June 8). Retrieved from Sustainable Development Goals: https://www.un.org/sustainabledevelopment/sustainable-consumption-production/
United Nations. (2021, June 8). Retrieved November 3, 2021, from Sustainable Development Goals: https://www.un.org/sustainabledevelopment/global-partnerships/
US EPA. (2021). Indicators: Dissolved Oxygen. United States of America: US Environmental Protection Agency. Retrieved from https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen
USGS. (2021). Biological Oxygen Demand (BOD) and Water. United States of America: United States Geological Survey. Retrieved from https://www.usgs.gov/special-topic/water-science-school/science/biological-oxygen-demand-bod-and-water?qt-science_center_objects=0#qt-science_center_objects
World Bank Group. (2021, March). Market Study for the Philippines: Plastics Circularity Opportunities and Barrier. Retrieved May 19, 2021
WWF Philippines. (2020, October). EPR Scheme Assessment for Plastic Packaging Waste in the Philippines. Retrieved May 19, 2021
WWF Philippines Inc. (2021). Solid Waste System Mapping.
WWF Philippines, I. (2021, March). Consultant for National and Selected Ports' Study. Retrieved from wwf.org.ph: https://wwf.org.ph/get-involved/join-us/careers/consultant-for-national-and-selected-ports-study/

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
Action 1. Preventing and Reducing Marine Litter from Land-Based Sources		
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
Action 2. Preventing and Reducing Marine Litter from Sea-Based Sources		
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
Action 3. Monitoring and Assessment of Marine Litter		
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
3.2.5.	Explore development of a regional marine litter and microplastic monitoring metadatabase/portal, as appropriate building on available global infrastructure, to facilitate the preparation of periodic regional reports.	Secretariat
Action 4. Activities Supporting the Implementation of COBSEA RAP MALI		
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

ANNEX C. SCHEDULE OF ACTIVITIES CONDUCTED IN PORT OF CAGAYAN DE ORO

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: - organization of clean-ups as a tool in educating and involving local stakeholders, communities, and media, in combination with public awareness campaigns; - 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; - 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.	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

Activity	October										
	8	9	10	11	12	13	14	15	16	17	18
Site Visit of Sanitary Landfill											
Check-in and Fieldwork Team Meeting											
Courtesy Call at PPA, PMO, MO/C and Port of Cagayan de Oro Visit											
Identification of Waste Collection Points and Sorter's Orientation											
WACS Day 1 for Port- and Vessel-Generated Waste											
WACS Day 2 for Port- and Vessel-Generated Waste											
WACS Day 3 for Port- and Vessel-Generated Waste											

ANNEX D. STAKEHOLDERS' LIST AND DATE OF INTERVIEW

Stakeholders	Date of Interview
Norwegian Training Institute	June 16, 2021
Philippine Liner Shipping Association	June 22, 2021
PMO Cagayan de Oro	June 28, 2021
2GO	June 30, 2021
Far East	June 30, 2021
Royal Caribbean	July 8, 2021
GreenAntz Cagayan de Oro	July 21, 2021
Barangay Puntod	July 26, 2021
Barangay Macabalan	July 26, 2021
Oroport	October 13, 2021
Centralized MRF c/o Ms. Evelyn Bahian	October 13, 2021
Junkshop c/o Mr. Rodilo Ancho	October 13, 2021

ANNEX E. GROSS TONNAGE OF VESSELS AT PORT OF CAGAYAN DE ORO

Vessel Name	Gross Tonnage (cbm)
LF Nine	5708.11
MTUG Hannah Louise v148	348.09
MV Filipina Nasipit	4242.17
MV Maligaya	82200.18
MV MC Trader	18887.42
MV South Star	12720.85
MV Span Asia 20 v. 163	14093.40
MV Span Asia 30 v. 139	8829.60
MV St. Francis Xavier	31670.53
MV Sta Therese of Child Jesus	47040.26
TA 10	11315.08
TA 19	8422.08
TA 21	25387.93

ANNEX F. CONTROL LEVEL OF RECOVERY FACILITIES

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

ANNEX G. CONTROL LEVEL OF DISPOSAL FACILITIES

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

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

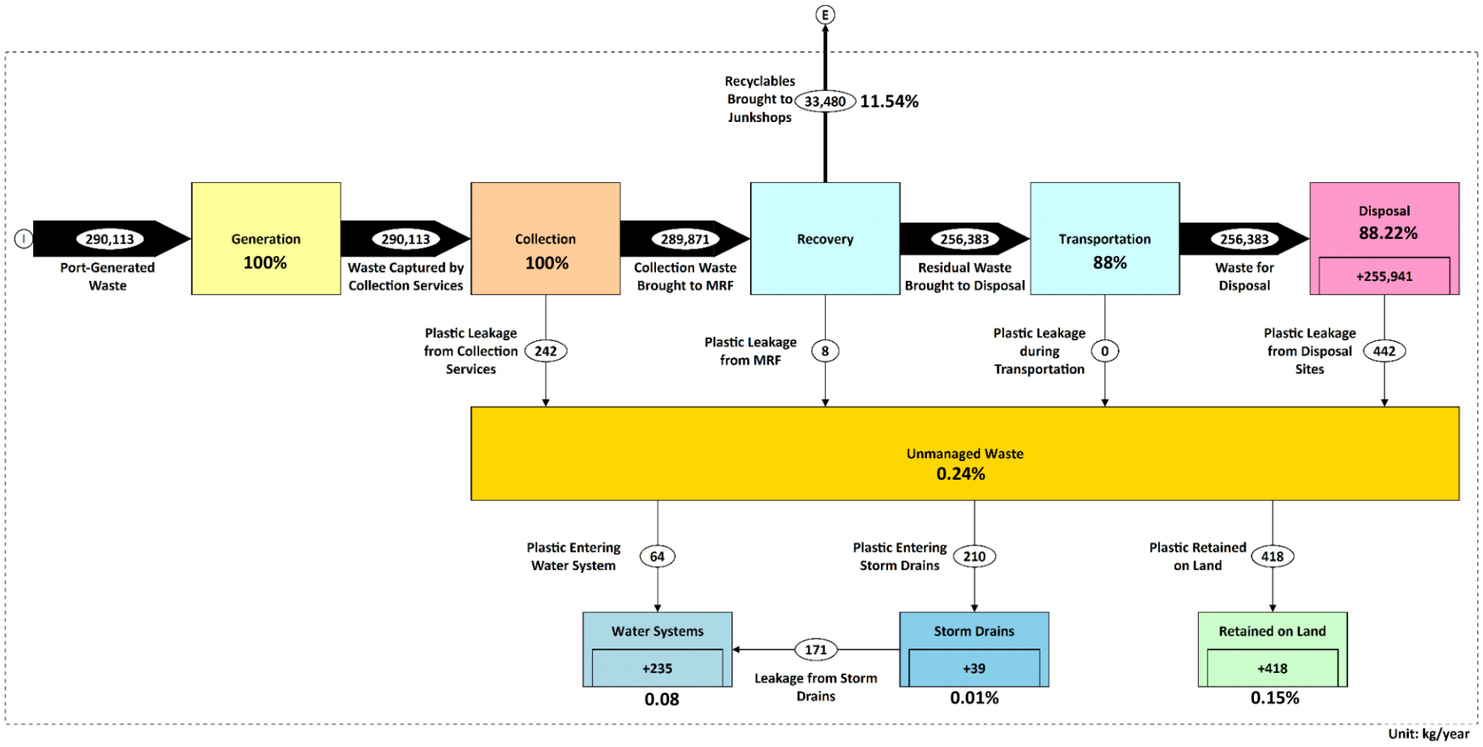
Leakage Influencer	Grade	Value	Percentage	Port-Generated Waste (kg/year)	Vessel-Generated Waste (kg/year)
Leakage from Collection Services					
Collection Containers	Low	0.6	1.10%	242	132
Loading Method	Medium	0.5			
Primary Transportation	Low	0.0			
Multiple Handling / Waste Transfer	Low	0.0			
Leakage during Formal Sorting					
Formal Treatment Plastic Reject Rate	% of Formally Collected Plastic	75%	0.04%	8	4
Disposal of Rejects	Low	5.0			
Leakage during Transportation to Disposal					
Capacity vs Load	Low	0.1	0.00%	0	0
Waste Containment	Low	0.1			
Vehicle Cover	Low	0.0			
Leakage from Disposal Facilities					
Environmental Hazards	Low	2.0	2.10%	442	235
Exposure to Weather	Medium	0.5			
Waste Handling	Low	0.5			
Coverage	Medium	0.4			
Burning	High	1.0			
Fencing	High	1.0			
Leakage in Storm Drains Entering Waterways					
Frequency of Rainfall / Storms	Medium	60.0	82.00%	210	113
Drain Cleaning	Medium	0.3			

Item	Grade	Value	Percentage
Fate of Plastic Leaked during Collection			
Level of Plastic to Land	High	0.8	61%
Level of Plastic to Drains	High	0.4	31%
Level of Plastic to Water Systems	Low	0.1	8%
Fate of Plastic Leaked from Formal Sorting			
Level of Plastic to Land	High	0.65	57%
Level of Plastic to Drains	High	0.4	35%
Level of Plastic to Water Systems	Low	0.1	8%
Fate of Plastic Leaked from Disposal Facilities			
Level of Plastic to Land	Medium	0.6	60%
Level of Plastic to Drains	Medium	0.3	30%
Level of Plastic to Water Systems	Low	0.1	10%

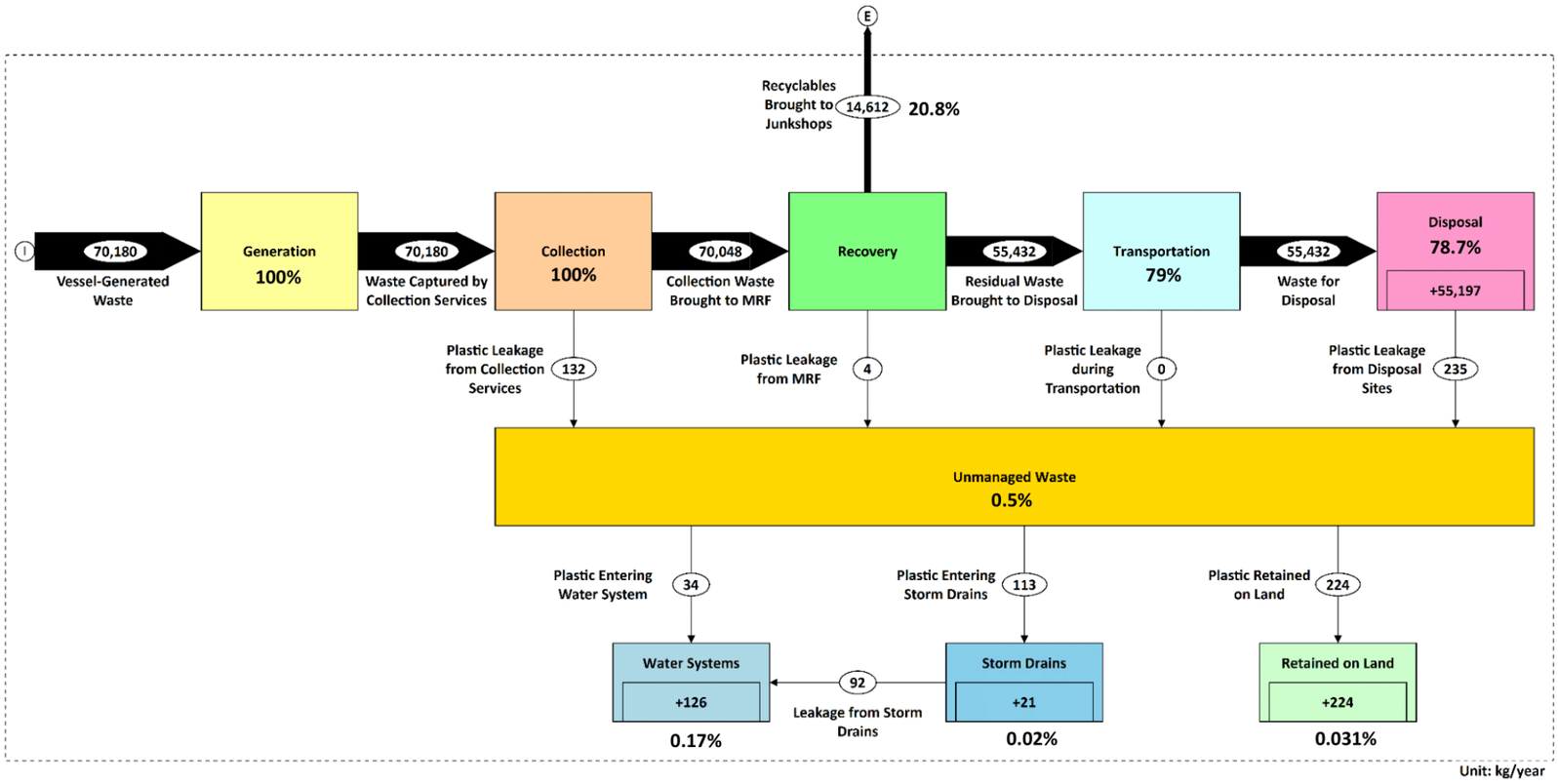
Fate of Plastic Leakage	Port-Generated Waste (kg/year)	Vessel-Generated Waste (kg/year)
Plastic Retained on Land	418	224
Plastic Waste Entering Storm Drains	39	21
Plastic Entering Water Systems	235	126

ANNEX I.

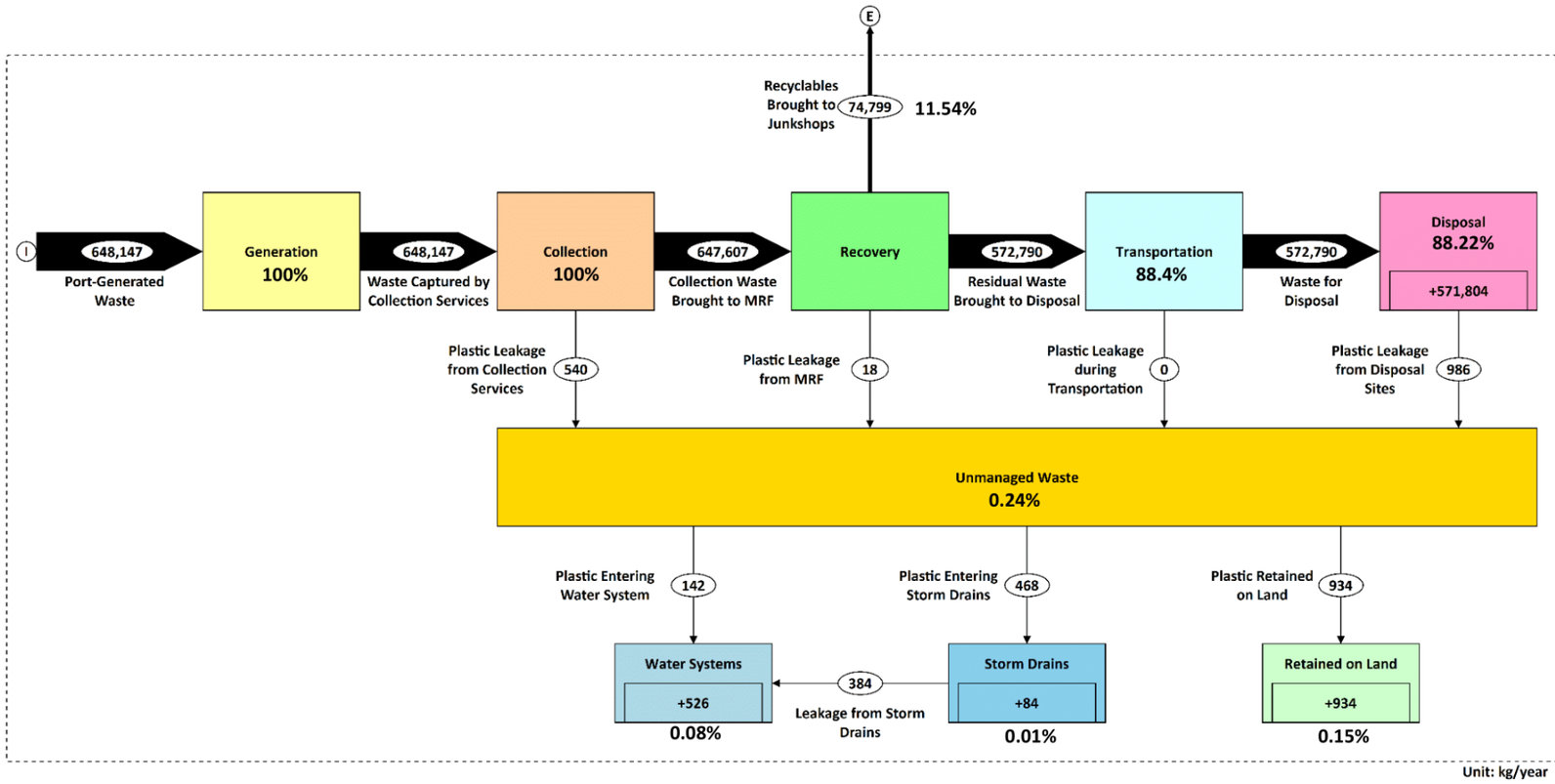
PORT AND VESSEL-GENERATED WASTE FLOW DIAGRAMS FOR COVID-19 AND PRE-COVID SCENARIO



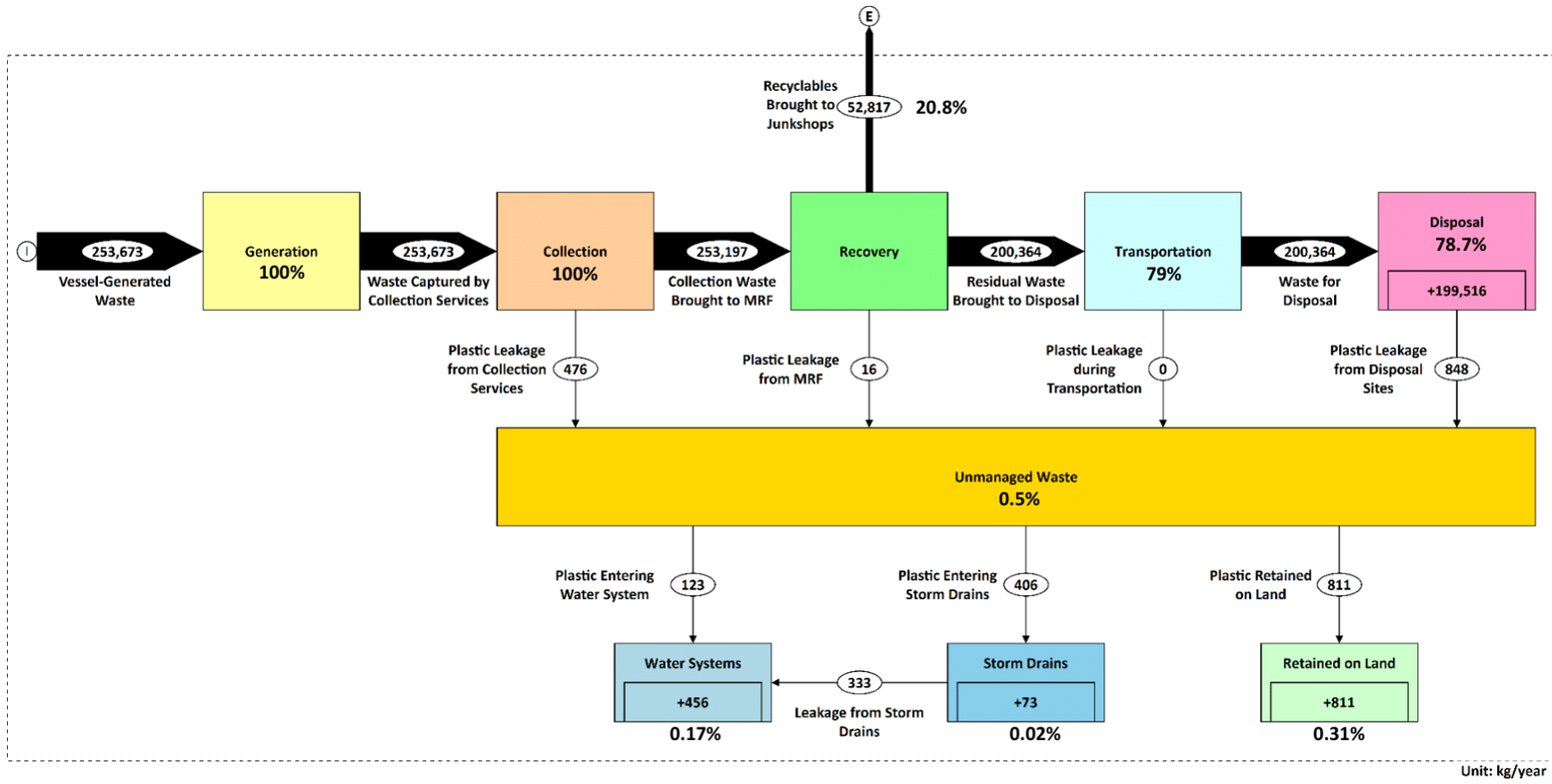
Port-Generated Waste Flow Diagram in Port of Cagayan de Oro for COVID-19 Scenario



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



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



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

WWF-Philippines

December 2021