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Assistance to the Development of the Mykolaiv Masterplan

Municipal Waste Management
Existing Situation, Report
Final

November 2023

COWI

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List of Abbreviations

ACAB	Association of co-owners of apartment buildings
CBEP	Central body of executive power
CMU	Cabinet of Ministers of Ukraine
CTEA	Classifier of types of economic activity
EIA	Environmental impact assessment
EPR	Extended producer responsibility
IMC	Intermunicipal cooperation
LA	Legal acts
LLC	Limited liability company
MCA	Mykolaiv City Administration
MW	Municipal waste
MWM	Municipal waste management
MWMP	Municipal waste management Plan
NERCEP	National Commission for State Regulation in the Field of Energy and Utilities
PET	Polyethylene terephthalate
PPP	Public-private partnership
RWMP	Regional waste management plan
SES	Sanitary epidemiological service
UC	Utility Company
WEEE	Waste from electrical and electronic equipment

1 Introduction

This report has been developed within the framework of the project “Technical advice to the Danish Ministry of Foreign Affairs regarding Mykolaiv - Denmark partnership” financed by the Danish Ministry of Foreign Affairs (MFA). The project, which has been entrusted COWI, is a framework contract, which, among others, includes assistance to the Mykolaiv City Administration (MCA) in developing the Mykolaiv Masterplan in close cooperation with an Italian company, One Works. Box 1-1 below provides information about COWI's contribution to the masterplan.

Box 1-1 COWI's contribution to Mykolaiv Masterplan in a nutshell

Mykolaiv Masterplan, which has been requested by the Mayor of Mykolaiv City, has a time horizon till 2050. It provides a compass for actions to be taken by the Mykolaiv City to ensure that it will develop into a thriving city attractive to its citizens and business community.

COWI and One Works assist Mykolaiv City Administration in developing the masterplan. In this work, COWI focuses on three sectors:

- Water and wastewater
- Energy, including power, district heating and renewable energy sources
- Solid waste management.

Mykolaiv City Administration meets every week with COWI and One Works to ensure proper coordination.

COWI has established a project organization consisting of a project management team and three sector teams of professionals, each headed by a Discipline Leader. Three sectoral Focal Points are responsible for monitoring cross-cutting activities, ensuring coordination between the parties and maintaining consistency in the deliverables.

To enhance transparency in the development of the Mykolaiv Masterplan, given its significant public interest and exposure, COWI has established three sector-specific Sounding Boards inviting all potentially interested parties to take part in these.

The principal audience for this report comprises the Mykolaiv City Administration (MCA) and One Works, given their central roles in the realization of this vision.

The report contains description of municipal waste (MW) generation and collection services as well as treatment of MW and recycling practices and potential. Besides the current chapter the report includes:

- Chapter 2: describes MW composition assessing type and quantities of MW in Mykolaiv city based on available information from officially available reports, information received by the consultant from MCA and other open sources of information

- Chapter 3: offers an estimate of MW generation in the city based on various available open sources in the absence of official data on MW generation for the period 2018-2022. An estimate attempts to consider possible aspects of the war impact

- Chapter 4: assessing recycling potential of MW in the city based on available data about MW generation and composition

- Chapter 5: includes an analysis of the MW collection and transportation system including assessment of the availability and condition of the vehicle fleet, presently applied collection methods, for various categories of waste collected including mixed MW, recyclables, bulky items, and green waste

- Chapter 6: describes MW treatment infrastructure during 2018-23, providing technical indicators for the existing landfill for the MW and a site for green waste storage

- Chapter7: provide information about so-called “wild” or unauthorised waste disposal sites

- Chapter 8 “Influence of the war on waste management system of the Mykolaiv City” briefly describe impact of the ongoing war on the MW management

- Chapter 9 “SWOT analysis of MW management system in Mykolaiv City” presents strength, weaknesses, opportunities and threats of the existing in the city MW management.

Four Appendixes provide description of the equipment used for MW management service in Mykolaiv by local service providers as well as brief description of the city’s waste disposal sites.

2 Waste composition

Understanding waste composition is crucial for effective waste management as it helps tailoring recycling and disposal strategies, thus reducing environmental impact. It aids in resource allocation and planning, optimizing recycling efforts and waste-to-energy processes. Additionally, it assists in identifying hazardous materials for proper management, ensuring public health and safety. Lastly, knowledge of waste composition supports sustainable practices, promoting a cleaner and healthier environment.

According to the results of MW composition investigation[1] for Mykolaiv City (Figure 2-1) about 22.4% is recyclables (5.65% - glass, 7.77 – paper and cardboard, 7.68% - plastics, including 23.7% - Polyethylene terephthalate (PET), 1.34% - metals). Organic waste (biowaste) is about 49.7% but varies from 43 up to 57%. Hazardous waste generated from households constitutes about 0.2%. Content of the components varies by season and are slightly different for waste generated from people living in multistorey buildings and private households[2].

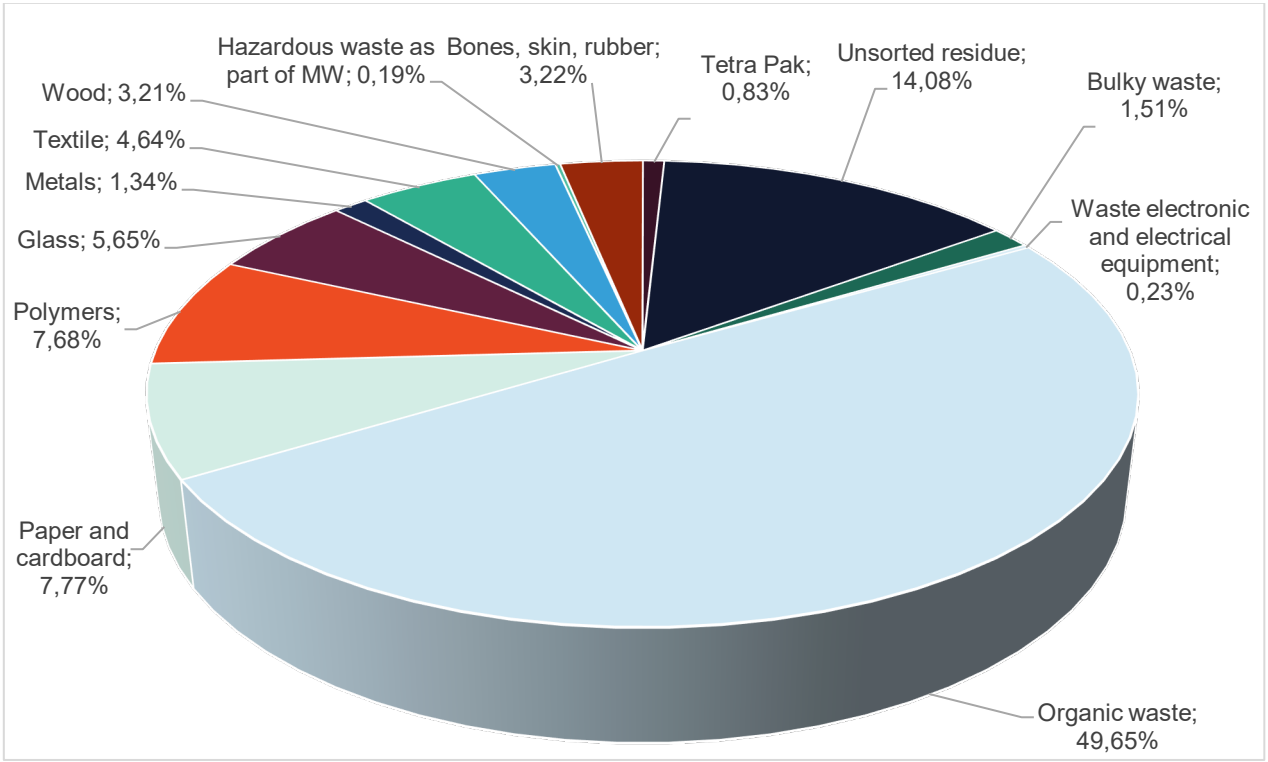

Figure 2-1 The average MW morphology composition in Mykolaiv City, 2020

[1] Report «Management Services (Assessment of the morphology of municipal waste for Mykolaiv city)" (Report under Agreementl # 111 of 19/02/2020). Report provided to Consultant by the MCA. Assessment of MW composition for Mykolaiv city has been carried out in 2020 for 4 seasons for MW from: Containers/ bags from private households; Containers from multistorey buildings; Commercial sector; and Vehicles delivered waste to the landfill from each district of Mykolaiv City.

[2] Does not include potential alterations in the composition of MW resulting from wartime activities and changes in people's quality of life, primarily due to the absence of on-field investigations conducted during the period of 2022-2023.

3 Waste generation

Knowing waste generation rates is vital for efficient resource allocation, enabling proper infrastructure planning and budgeting for waste management. It assists in tracking trends and identifying areas where waste prevention and recycling initiatives are needed, contributing to sustainability goals.

There is no formal reporting nor special study on MW generation in Mykolaiv city during 2018-2022.

Amount of collected MW couldn't serve as evidence of amount of generated waste as:

- Less than 100% of population is covered by MW collection service;
- Not all MW collected unofficially by so-called "grey" companies is delivered to municipal landfill and there is no information of the volumes they collect and deliver.

Sanitary cleaning scheme of the city[3] provides an estimate for MW generation based on collection norms for service provision and according to the weighted average annual rate of MW collection (m^3/person/year) which is about 2.42 m3[4]. Amount of MW calculated for 2023 estimated for the population increased to 478,000 people amounts to 1,168.32 thousand m^3 (183.977 thousand tonnes).

According to the latest available data provided by the city for 01.01.2022 the population is 469,545 people and adjusted amount of MW generated could be 1,168.38 thousand m^3 (178.933 thousand tonnes, with a density 157.47 kg/m^3). MW generation per capita is 381 kg/person/year.

Another approach to estimate MW generation could be based on the analysis of actual volumes of waste collection. For estimation an indicator 310 kg per capita MW has been used[5]. In this case the amount of MSW generated from the population is about 144,838 tonnes (919,783 m^3/year).

[3] The norms for provision of MW collection service approved by the Decision of the Executive Committee Mykolaiv City Council of August 25, 2021, No. 766

[4] The average annual rate of providing services for the removal of solid waste from multi-apartment and single-apartment buildings with the presence of all types of amenities – 1.95 m3/person/year, for multi-apartment buildings in the absence of one or two types of improvement (sewerage and/or heating) – 2.25; one-apartment houses with a courtyard in the absence of one or two types of improvement (sewerage and/or heating) – 3.59; weighted average annual rate is 1.98×329.008+3.43×141.003)/470.011 = 2.42 m3

[5] In 2022 UC «Mykolaivkomuntrans» collected 449,248 m^3 (71,040 t) of MW from 229,339 residents of the city. UC «Mykolaivkomuntrans» covers by the service as multistorey buildings as well a private household which allow consider data 310 kg per capita as representative for calculation

4 Recycling potential of the MW in Mykolaiv city

As the Masterplan have a horizon till 2050 year, the estimation of recycling potential is based both on presently applied technical solutions in Ukraine technical solutions, as well as forecasted technological developments in the future.

Based on analysis of the data of MW composition[6] the amount of each component has been calculated for estimated amount of MW generation (Table 4-1).

Table 4-1 MW components in Mykolaiv city, 2022

The name of the component of MW	Content, %	Quantitative indicator
Total amount of MW	100%	144,838 t*
Organic waste	49.65	71,912
Paper and cardboard	7.77	11,254
Polymers Including, PET	7.68 23.66	11,124 2,632
Glass	5.65	8,183
Metals	1.34	1,941
Textile	4.64	6,720
Wood	3.21	4,649
Hazardous waste as part of MW	0.19	275
Bones, skin, rubber	3.22	4,664
Tetra Pak	0.83	1,202
Unsorted residue	9.51	13,774
Bulky waste	1.51	2,187
Waste electronic and electrical equipment	0.23	333
Rejects	4.57	6,619

Source: calculated by the consultant based on the report data onf MW composition

** Estimated MW generation (see Chapter 3 Waste generation)*

Based on the present possibilities there is a recycling potential for traditional components like paper and cardboard, metals, glass, plastics. Amount of this components for 2023 was about 32,502 t (22.4%). Wood may also be considered as material for potential recycling. The pellets are normally recycled but MW includes other types of wood that are not being recycled.

Components which potentially could be considered as recyclables is organic waste (about 71,912 tonnes per year) but only in case if this organic will be composted and a compost will be produced. This is possible in case of separate collection of organic waste and depend on the efficiency of separate collection and the purity of input material. In case of low purity of organic waste (if it's sorted from mixed MW) only compost like output is possible to produce and it's not considered as recycling. Considering many uncertainties on this stage the consultant defines organic waste as long-term recycling potential category.

[6] Report «Management Services (Assessment of the morphology of municipal waste for Mykolaiv city)" (Approval # 111 of 19/02/2020). Report provided to Consultant by the MCA. Assessment of MW composition for Mykolaiv city has been carried ou in 2020 for 4 seasons for MW from: Containers/ bags from private households; Containers from multistorey buildings; Commercial sector; and Vehicles delivered waste to the landfill from each district of Mykolaiv City

Also, Tetrapack could be considered as partly recyclable material. There is only one facility in Ukraine at present which partly recycles it. But without introduction of extended producer responsibility (EPR) it will not work. Potential content of tetrapack on MW is about 1.83 (1,202 tonnes).

Waste from electrical and electronic equipment (WEEE) has not been considered as some parts of WEEE is not possible to recycle and there is no data on this share.

5 Waste collection system

A waste collection system is a structured process for gathering and managing various types of waste materials from homes, businesses, and public areas. It typically involves the systematic collection of mixed waste, recyclables, organic waste, and other waste categories through designated bins or containers. These collected materials are then transported to appropriate disposal facilities, recycling centres, or composting sites. Waste collection systems are essential for maintaining cleanliness, public health, and environmental sustainability within a community, and they vary in design and implementation based on local regulations and resources. Effective waste collection systems promote proper waste disposal and recycling practices.

5.1 Providers and coverage of the MW collection services

Services for MW collection are mainly provided by two utility companies that were selected as winners of the competition for the provision of MW collection services. Services are provided by UC "Obriy-DKP" in Korabelny district, and UC "Mykolaivcomuntrans" in Central, Zavodsky and Ingul districts. There are several subcontracting companies also offering MW collection services, however as these companies are frequently changing, they have not been included in this report. Furthermore, there are companies that independently handle MW collection, and there is a lack of information regarding certain aspects of these companies, including the volumes of MW they collect and the destinations to which this waste is delivered.

About 63% of citizens have been covered by MW collection service in 2022 by UC "Obriy-DKP" and UC "Mykolaivcomuntrans" (Table 5-1). Historical records of population coverage by the MW collection service were not maintained prior to 2022, which accounts for the unavailability of such data.

Table 5-1 Coverage of population by MW collection service in Mykolaiv City

District	Amount of population for the 01/02/2022*, people	Population covered by the MW collection service	% of people covered by MW collection service, %
Zavodski	121,291	229,339**	86.1%
Ingulski	130,337		
Centralny	147,350		
Korabelny	70,567	65,169**	92.35%
Total	469,545	294,507**	63%**

Source: calculated by consultant based on data provided by the city, CU companies and Statistical service. Calculations exclude people covered by the service by other providers from "grey sector"

** Last available data according to the Statistical service of Mykolaiv oblast (Data have been provided by the city)*

***Calculated by Consultant*

Other than UC "Obriy-DKP" and UC "Mykolaivcomuntrans" providers cover about 20% of MW delivered to the city landfill (Table 5-2 and Figure 5-1).

Table 5-2 *MW collection in Mykolaiv city, 2018 – 2022*, thousand m^3 (thousand t)

Service provider	2018	2019	2020	2021	2022
UC «Mykolaivkomuntrans»	401.6 (60.0)	421.4 (60.0)	438.8 (60.0)	468.2 (70.0)	449.2 (60.0)
UC «Obriy DKP»	123.4	148.9	169.3	156.6	74.6
Providers*	562.0				127.5

Other providers**		594.7	595.9	568.2	168.7
Total	1,087.0	1,165.0	1,204.0	1,193.0	819.9 (126.3)

Source: Calculated by expert based on data provided by city and providers of MW collection service (Compiled by an expert based on provided reporting forms 1-TPV (tables "Section 1. Collection and transportation of MW (TPV)")

** For 2022 providers included companies LLC "NIK-Spetzservice", LLC «Valan», Subsidiary Company KORUND-H, PE «Evako tochka», PE «Evako Mykolaiv»*

*** Other providers mean other enterprises that deliver waste with their own transport, this also includes industrial waste (non-hazardous)*

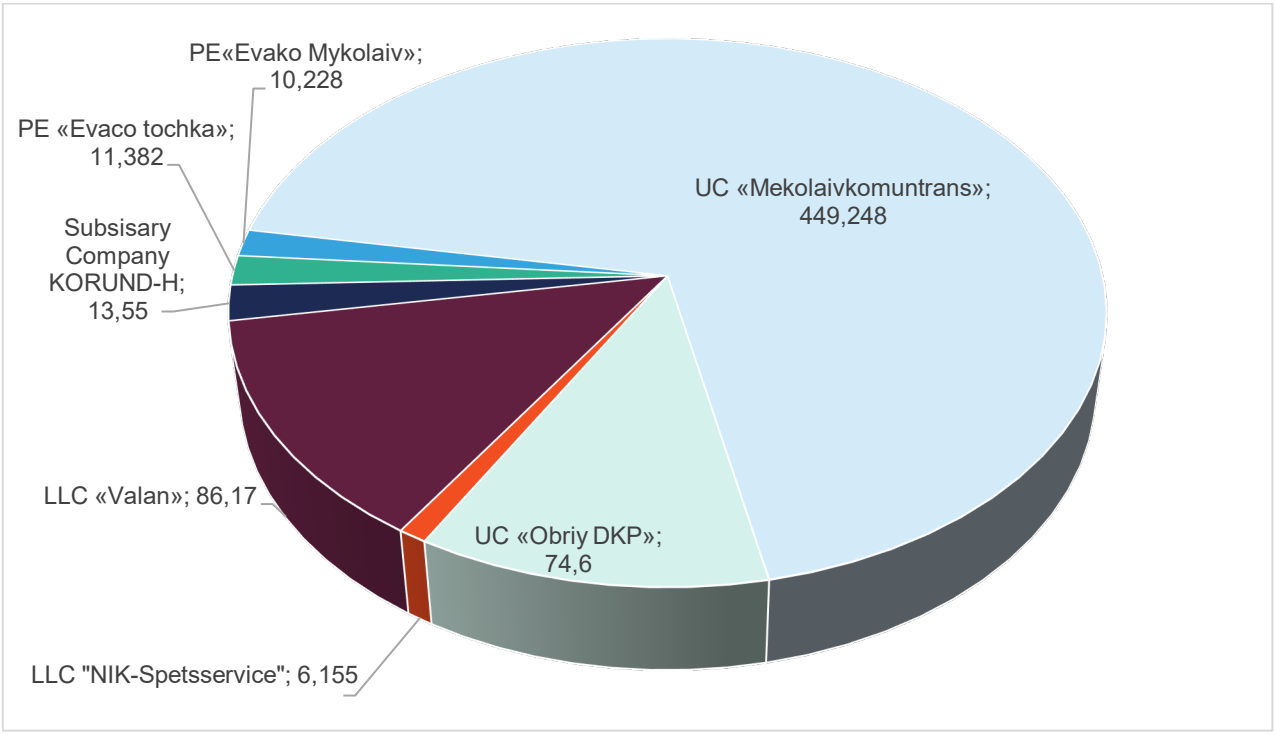

Figure 5-1 Market share of providers of MW collection services in Mykolaiv city in 2022

Primarily accounting of collected waste is kept in m^3 as the weighbridge at the landfill is currently non-functional.

From 2022, accounting of bulky waste started. Amount of collected bulky waste according to the reporting form “1-TPV” was about 12,000 m^3 (2000 tonnes) in 2022

All MW collected by mentioned companies are delivered to the Landfill of Mykolaiv city. A minor fraction of MW, amounting to less than 1% of the total MW generated, is subject to separate collection.

5.2 Collection system of mixed MW

MW collection service is carried out in two ways:

- by container scheme and
- collection of waste in bags from private sector.

Routes for MW collection are developed according to the schedules tacking into account frequency of containers emptying. Waste collection schedules are developed by the Utility companies

(providers of the service). The frequency of waste collection from container sites is calculated taking into account on the norms for MW collection[7].

The short description of MW collection system for Mykolaiv city is given in the Table 5-3 below.

Table 5-3 MW Collection system

The name of the district	Collection method		The frequency of waste collection	
	Multi-storey buildings	Private sector	Multi-storey buildings	Private sector
Korabelny	containers	bags	Every day (7 times per week)	1 time per week
Central	containers	bags	4 times per week*	1-2 times per week
Zavodsky	containers	bags	4 times per week*	1-2 times per week
Ingulsky	containers	bags	4 times per week*	1-2 times per week

Source: Data provided by the MW collection service providers

** Average data provided. The collection frequency depends on the container filling speed and depends on the filling speed and sizes of containers.*

5.3 Vehicle fleet and containers

There are about 5,010 containers located on 940 places for containers. More detailed information about containers which are on the balance sheet of municipal utility companies is presented in the Table 5-4 below. Most containers are in a poor condition and will need to be replaced with new ones.

Containers

Table 5-4 Containers which are on the balance sheet of municipal utility companies of Mykolaiv City

#	The name of item	Volume, m3	Amount of containers, units		
			UC "Mykolaivkomuntrans"	UC "Obriy-DKP"	Total for the CIty
1	Containers on wheels	1.1	2,095	447	2,542
2	Container	0.8	368	277	645
3	Metal container	0.75	613	105	718
4	Container on wheels	0.24	342	0	342
5	Container on wheels	0.12	232	0	232
6	Containers for MW separate collection	1.1	0	75	75
7	Containers for PET collection	0.69	448	0	448
8	Undeground containers	3.0			8*
Total amount of containers for MW collection			**3,650**	**904**	**5,010**

** 9 containers were installed in 2020, 1 container was destroyed in 2022*

Source: data provided by the MCA and clarified with Companies

[7] Decision of the Executive Committee of Mykolaiv City Council dated 08/25/2021 No. 766

Vehicle fleet

There are 31 trucks used for the waste collection, including:

- 20 vehicles for MW collection used by UC " Mykolaivkomuntrans" (+1 truck accommodated for PET separate collection) and 4 trucks used for bulky waste collection;
- 6 trucks for waste collection, including 2 Cargo dump trucks used by UC "Obriy-DKP"

The condition of the vehicle fleet for each MW collection company serving the city is detailed in the Appendix 1. Out of all the vehicles, only five exhibit wear level below 20%. However, most of these vehicles will require replacement with new ones soon.

One of the challenges for the Utility company is a poor state of the workshop (Figure 5-2) that requires maintenance, technological upgrade and extension to ensure timely maintenance of the vehicles (Figure 5-3).

Figure 5-2 Workshop of UC 'Mykolaivkomuntrans"

In October 2023, 14 garbage trucks (Figure 5-3) were donated to Mykolaiv by Denmark under the Danish-Mykolaiv partnership program. The recipient is the Office of Communal Property of the Mykolaiv City Council. According to information received by the consultant in November 2023, five trucks have been allocated to UC 'Mykolaivkomuntrans' and five to UC 'Obriy-DKP.

Figure 5-3 14 garbage trucks donated by Denmark to Mykolaiv in October 2023

Figure 5-4 Vehicles of UC 'Mykolaivkomuntrans"

To improve service level and to control the process UC "Mykolaivkomuntrans" has a video surveillance system that is installed, configured and connected to service on specialized vehicles (waste trucks).

This enables the company to conduct real-time monitoring of the quality of MW collection services while tasks are being executed. Video cameras are strategically placed to provide coverage of container sites during loading, while GPS trackers are installed on other vehicles engaged in waste collection and transportation, allowing for precise equipment location tracking.

5.4 Collection of hazardous waste generated from households

Box 2 Definition of the hazardous waste

Hazardous waste generated from households means waste that has one or more properties that make it hazardous, listed in the List of properties that make waste hazardous and this has been generated in households

There is no centralized system of collection of hazardous waste generated from households. There are several volunteering initiatives on these types of waste collection. Some networks of markets, shops etc. collect this waste and then transfer it to specialized companies. But no details information about this initiative is available. According to the data of MW composition the content of hazardous waste generated by households is about 0.19% from total MW.

5.5 Collection of bulky waste

Box 3 Definition of the bulky wase

For this chapter the bulky waste and repair waste used under the meaning of the Law of Ukraine “On waste management”[1]

- Repair waste - the remains of substances, materials, objects, products that were formed during conversion, re-planning or current repairs in a residential building, a separate apartment or a public building.
- Bulky waste - household waste that cannot be placed in containers up to 1.1 m3 in size.

For bulky waste the process is organized in the same way as for the waste from repair works (construction) waste. Those types of waste are collected separately from mixed MW. For this purposes Utility Companies have 94 containers with a capacity of 10m^3. All collected waste is delivered to the MW landfill. For population bulky waste and waste from repair works (construction) waste collection is a part of MW collection service and It’s covered by the contract on providing of the service. For all other categories of consumers, it’s a separate service provided under the separate contract.

At the website of UC “Mykolaivkomuntrans” there is the list of 57 addressees where the containers for bulky waste located [8]

Since February 1, 2022, UC "Mykolaivkomuntrans" has been keeping a separate statistical account of the volumes mentioned types of waste from population.

During 2022 about 12,000 m^3 or 2,000 t of bulky waste and waste from repair works has been collected by UC "Mykolaivkomuntrans" from population. However, and as mentioned before, due to the non-functionality of the weighbridge at the landfill, the tonnage of waste cannot be regarded as precise data.

5.6 Collection of green waste

Green waste, including cut branches and fallen leaves, is gathered at the locations where it is generated, typically during tree, bush, and lawn trimming performed by utility company personnel.

[8] https://mkt.mkrada.gov.ua/?page_id=432

Alternatively, it may be temporarily stored near designated container sites. Subsequently, this green waste is transported by dump trucks to a dedicated storage facility located in proximity to the city cemetery of Mykolaiv.

5.7 MW separate collection

According to the information received from MCA the MW separate collection is partly implemented in Mykolaiv city using about 428 containers for polyethylene terephthalate (PET) collection in 2023 which located near multi-storey buildings. To serve these containers one vehicle of UC "Mykolaivkomuntrans" FAW CA 1041 K26L2R5 BE 1207 EE is used (Figure 5-4).

The amount of collections of containers with PET for 2020 – 2023 presented in the Table 5-5 below.

Table 5-5 Amount of collections of containers with PET for 2020 – 2023 in Mykolaiv City

Year	Amount of containers collections	Container volume, m3	Volume of PET collected, m3
2020	4,963	0.69	3,424.5
2021	6,903	0.69	4,763.1
2022	5,815	0.69	4,012.4
2023 (6 months)	2,735	0.69	1,887.2

Source: Calculated by consultant based on data provided by the Company

Separately collected PET bottles are sorted by colours on the site of UC "Mykolaivkomuntrans", pressed into bales and delivered for company processing secondary raw materials.

UC "Mykolaivkomuntrans" deliver secondary raw materials to the LIC "EcoGreen Traid" based on the contract conditions.

Through this method, the city can collect around 15-20% of PET from the amount generated in the MW of the City.

Other types of recyclables such as paper, glass other plastics are not collected separately.

Figure 5-5 Vehicle FAW CA 1041 K26L2R5 for PET separate collection

The issue of MW separate collection implementation in 2018-2019 was worked out by the CU "Mykolaiv Development Agency" jointly with the housing and utility services department of the Mykolaiv City Council. During this period, a shift towards implementing separate waste collection was initiated within healthcare and educational institutions. Containers of varying sizes designed for the segregated collection of solid waste, along with accompanying printed materials, were procured for use within these establishments.

Today, this project is suspended due to the introduction of quarantine restrictions in 2020-2021, and martial law in Ukraine from 2022. In 2019 the pilot project on MW separate collection has been launched in the schools of Mykolaiv City[9] but also stopped results from online education (COVID and war).

[9] https://www.auc.org.ua/uspihy/u-vsih-shkolah-mykolayeva-zaprovadzheno-rozdilnyy-zbir-tpv

6 Municipal waste treatment infrastructure

Municipal waste treatment infrastructure refers to the facilities established to treat waste generated within a municipality or city. It typically includes sorting line, recycling centres, composting facilities, and landfills. Present chapter describes MW treatment infrastructure for the 2023.

Chapter includes description of existing:

- Landfill for MW of Mykolaiv City (subchapter 6.1)
- Disposal site for green waste storage (Subchapter 6.2)
- Private dumpsite for CDW and green waste (subchapter 6.3)
- Wild/unauthorised dumpsites (subchapter 6.4)

6.1 Landfill for MW of Mykolaiv City

There is a landfill for MW for the Mykolaiv City situated near Velyka Korenykha Village (Figure 6-1). The landfill has been in operation for more than 50 years (since 1972). According to the data provided by the city the planned time of the landfill operation is about 54 years (till 2026). The landfill is located on a land plot of 37.93 ha. Basic information on the landfill of Mykolaiv City is presented in the Appendix 2. The allocation of a land plot has been provided according to the Order of the Mykolaiv Rayon State Administration dated 03.04.2005 No. 51-h, according to the State act on the right to permanent use of a land plot No. 080031.

Figure 6-1 MW Landfill

Distance from the settlements:

- 0.87 km from the Velyka Korenykha village,
- 3.5 km from the Vesnyane village,
- 5.0 km from Mykolaiv City,
- 7.0 km from the Varvarivka microrayon,

Distance from watercourses and reservoirs:

- 1.7 km from the South Bug River, from water intake facilities
- 1.0 km from the water intake of Velyka Korenykha village. (Figure 6-2)

The average distance from the collection points (from areas of sanitary cleaning) to the MW landfill is about 20-25 km.

Figure 6-2 Location of the existing MW Landfill and tentative locations for new sites

Part of the Mykolaiv city landfill has also been designated as a temporary storage site for waste resulting from the demolition or damage to buildings and structures as a result of hostilities, acts of terrorism, sabotage or carrying out work to eliminate their consequences [10], in accordance with the order of the Mykolaiv Regional Military Administration of 25.01.2023 No. 26 -p.

The Figure 6-3 below shows a part of the landfill for MW for the Mykolaiv City where the demolition waste is temporary stored.

[10] Order of the Mykolaiv Regional Military Administration of 25.01.2023 No. 26 -p.,

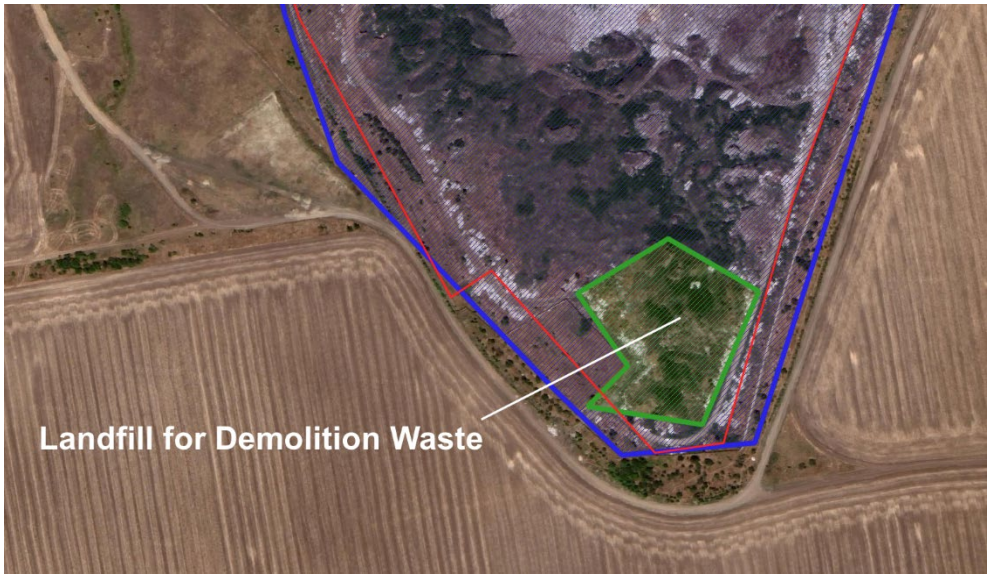

Figure 6-3 Area allocated at the MW Landfill for demolition waste storage (1ha area)

Total design capacity of the landfill is about 11.6 million t (57.944 million m^3). The average amount of landfilled MW / year was from 126 thous.t up to 182 thousand tonnes (1 million m^3/year). As of the end of 2020, the total volume of landfilled waste from the beginning operation of the landfill was 10.443 million tonnes (Table 6-1), as of end of 2022 – 10.751 million tonnes. The rest of Landfill capacity is about 900 thousand tones which could be enough for the operation during the next 5 years (in case if the same amount of MW will be landfilled as during the previous years).

The height of the landfilled waste layer during whole period of the landfill operation in average is about 6-12 m, the maximum reaches 17-21 m.

Table 6-1 Landfilling of MW in Mykolaiv Landfill, 2018 - 2022

Year	Total amount of landfilled waste (cumulative sum)		including				Designed capacity	
			from the beginning of landfill operation		During reporting period (one year)			
	mln m^3	mln t	mln m^3	mln t	mln m^3	mln t	mln m^3	mln t
2018	48.244	10.095	48.244	10.095	1.087	0.160		
2019	49.409	10.265	49.409	10.265	1.165	0.171		
2020	50.613	10.443	49.409	10.265	1.204	0.178	-/57.944	10.9/11.6*
2021	51.806	10.625	50.613	10.443	1.193	0.182		
2022	52.626	10.751	51.806	10.625	0.820	0.126		

** According to the Decision of the Executive Committee of Mykolaiv City Council[11] the time of landfill operation has been extended for 5 years. The SE Research, Design and Technology Institute of Urban Economy provided justification for this extension.*
Source: the data of reporting form "1-TPV" and register of waste disposal sites of Mykolaiv oblast, data provided by the utility company on MW service in Mykolaiv
Source: Compiled by an expert based on the submitted reporting forms 1-TPV (table "Section 3. Disposal of MW (1-TPV) at landfills (dumpsites)"

Remaining lifetime of the landfill is 5 years and the MCA have started the process for identifying a land plot for a new landfill. A land plot of about 21.5 hectares is planned to be be allocated close to

[11] https://mkrada.gov.ua/documents/40408.html

Vesnyane village of Mykolaiv district, Mykolaiv oblast (Figure 6-4)[12]. It's expected that the land plot will include a place for a sorting line.

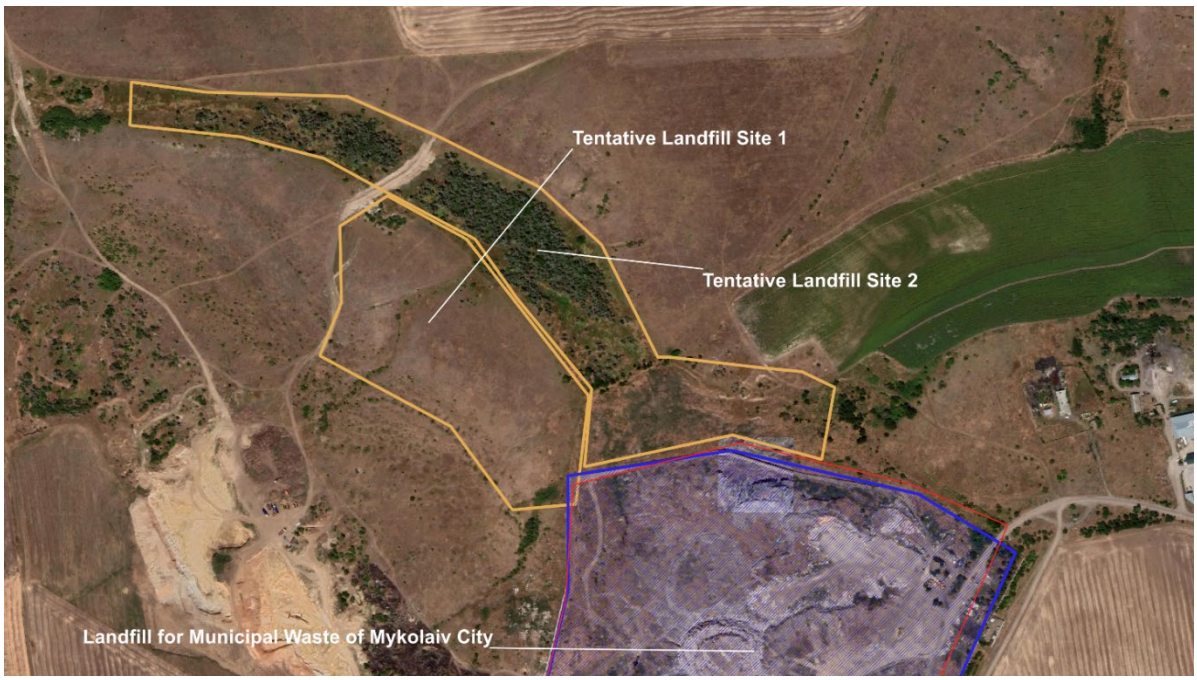

Figure 6-4 Planned new locations for MW landfill and sorting line

6.1.1 Management of the city landfill

The landfill site is fenced with reinforced concrete slabs, there is a system of landfill gas collection for its further recovery which is provided by independent Company. There is a weighbridge (Figure 6-5) on the landfill, but it doesn't work. The list of equipment working of the landfill presented in the Table 6-2 below.

Table 6-2 Special vehicles of the landfill

№	The name of the vehicle	Year of manufacture
1	Washing machine ЗИЛ 4333-62 BE 5598 AA	2003
2	DAF FARXF105/460T BE 5507 EX (fire truck)	2008
3	Bulldozer DM 7 54575 BE	2020
4	Crawler excavator ЄО-3223А 54593 BE	2020
5	Loader excavator ЕО 2626-01 53135BE	2016
6	Sand thrower, sweeper ВІВА МД-0804/00 BE 4429 CE	2017
7	Bulldozer T170M І№160090 BE T 01391	2016
8	Bulldozer T170M І№160093 BE T 01390	2016
9	Bulldozer Б10М І№162175 BE T 01393	2008
10	Bulldozer Б10М І№162168 BE T 01392	2008
11	Cargo dump truck - С Камаз 5511 1 BE 6675 AO	2008
12	Excavator ЕК-12 33634 BE	2008

[12] Decision of the Vesnyanska Village Council of the Mykolaiv Rayon of the Mykolaiv Region No. 38 dated 23/09/2021 "On granting permission for the development of a detailed plan and zoning of the territory for the formed land plot",

Source: data provided by the MCA

Figure 6-5 Weight bridge at the Mykolaiv landfill

Documentation regarding the accounting of waste delivered for landfill disposal is recorded. The data is systematically logged within the "MW Registration and Accounting Journal" following the prescribed format.

6.1.2 Environmental pollution mitigation measures

Both a base insulating layer (synthetic geomembranes) and a natural layer are absent. The underlying layers consist of clay and loam with a filtration coefficient ranging from 0.1 to 0.05 meters per day. Additionally, there are no in-place insulating layers or systems for the collection and treatment of leachates. Monitoring of the quality of soils, air and underground water is carried out through a special network of control and observation wells.

Groundwater at the bottom of the stream is at a depth of 1.8-3.2 m. Groundwater and underground water at the bottom of the ravine are not protected from contamination, on the slopes – the limestone horizon is protected by a layer of clay with a thickness of 15-27 m. The presence of filtration phenomena - runoff during the period of atmospheric precipitation and temporary flow along the stream during the period of atmospheric precipitation and snow melting, under channel runoff from the bottom of the stream into the South Bug River.

Monitoring of groundwater quality. Periodic control (twice a year) is carried out by the district SES on drinking water intakes of the Velyka Korenykha village. Monitoring of surface water quality is controlled twice a year by the district SES.

Also, the necessary area for the landfilling should be checked. The landfill is approaching the end of its operational lifespan, with approximately 5 years remaining. This period should be used for the establishment of a new landfill. the development of a new landfill, with due consideration for measures to divert municipal solid waste (MW) from landfill disposal, as initiated by the city. Additionally, an assessment of the required land area for landfilling purposes is deemed necessary as well as hydrogeological investigation of the planned for the allocation land plot

6.2 Disposal site for green waste storage

There is no sorting lines and transfer stations in Mykolaiv City.

There are no composting facilities for organic waste composting in Mykolaiv City.

Green waste (from parks, pruning branches) is generated on the grounds of residential areas, green areas and industrial areas of Mykolaiv City in the process of taking care of green spaces, cutting branches along the streets. This waste is collected either near container sites either at the place of providing works and then delivered by dump trucks to the separate site. This site (Figure 6-6) is purposed for the deposit of fallen leaves and other green waste. The site located near cemetery of Mykolaiv City (Ingulsky district, near the Mishkovo-Pohorilove village). Basic information about the site for green waste – see Appendix 3.

Figure 6-6 Site for the green waste storage (waste disposal site)

The site has officially required “Passport” and is listed in a special Register (registration number No. 39/4-28/01 of 10.02.2014) where it was been registered in 2014. There is no information whether the site was constructed in 2014. The site is not designed specifically for green waste, it does not have weighbridge or specially designed for the purpose fence. The site is being operated by UC “Mykolaivkomuntrans” since 2019

Following amount of waste (leaves and brunches) have been stored [13]:

- 2019 – 14.726 thousand m³;
- 2020 – 18.028 thousand m³;
- 2021 - 31.3305 thousand m³;
- 2022 – 24.838 thousand m³

According to the data of the sanitary cleaning scheme of the city as of 01.01.2022, there are 833.078 thousand m³ (2,776.42 tonnes) of fallen leaves on the site. As there is no weighbridge on the site tonnage could not be considered as accurate data.

Site accepts roots, branches, tops of trees (fallen leaves) in a mixed condition but some bulky waste has been observed on the site.

[13] Data provided by MCA

Figure 6-7 Location of the site for green waste storage

6.3 Private dumpsite for CDW and green waste

There is a private landfill near the city (Mykolaiv region, Mykolaiv rayon, village Mishkovo-Pohorilove, str. Gorky, 17) - Figure 6-8. According to the state property register the land plot under the dumpsite has a purpose “For supporting agriculture”. The challenge is that this dumpsite is being used by illegal providers of MW collection service and is according to information from the open sources does accept MW for landfilling. Basic information about the private waste disposal site (dumpsite) for C&D waste and green waste is presented in the Appendix 4.

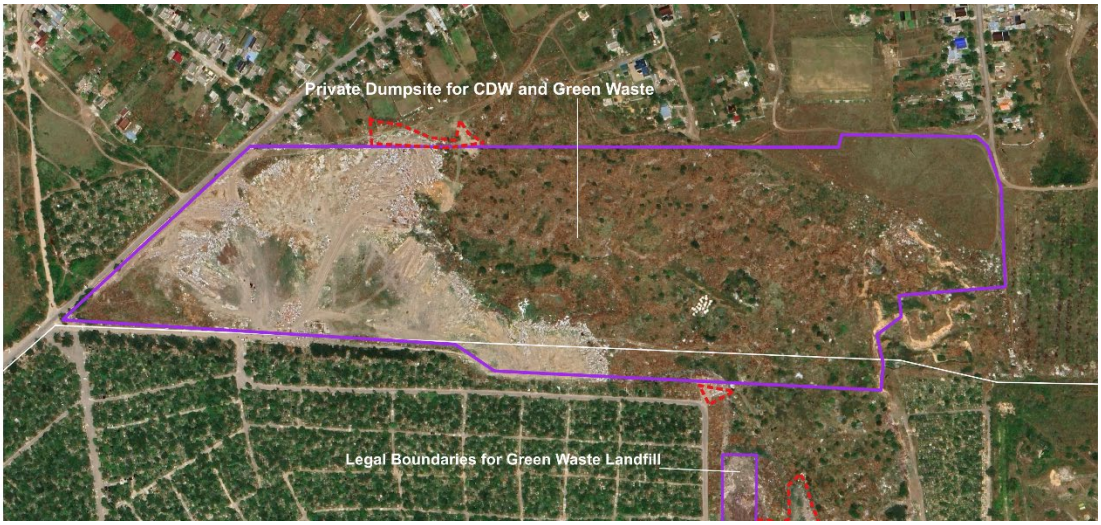

Figure 6-8 Location of private landfill

6.4 Wild (unauthorised) dumpsites

A draft Scheme of city sanitary cleaning from 01.05.2023 provided to consultant by MCA list 98 wild (unauthorized) dumpsites. The situation is changing during the year. Normally all wild sites are cleaned by the end of the year.

For the purposes of this report administrations of 4 city districts provided data about wild dumpsites for the period 2018 – 2023 (Table 6-3) Total volume of unauthorized MW dumping is about 71 – 87 thousand m^3 per year excluding one district which did not provide data on volumes. So, it is about 10% from generated MW in the city is disposed on the wild dumpsites.

Table 6-3 Volumes of MW on the wild dumpsites, 2018 - 2023

The name of the District	Volumes of waste on wild dumpsides, m3					
	2018	2019	2020	2021	2022	2023 (8 months)
Zavodski	20,073	21,140	25,848	27,195	28,559	25,550
Ingulski	na (33*)	na (32*)	na (32*)	na (32*)	na (31*)	na (23*)
Korabelny	6,516	8,075	8,004	8,507	11,689	na
Centralny	44,914	47,910	53,429	46,550,8	43,640	30,182
Total (excluding Ingulski district)	71,503	77,125	87,281	82,253	83,888	55,732**

Source: Data provided by City administrations of Ingulsky, Centralny, Zavodski, Korabelny Districts

** Number of wild dumpsites, units*

***Excluding Korabelny and Ingulski districts*

There is no information about the final disposal of the waste after cleaning wild dumpsites which makes it difficult to overview the amount and location of the waste from wild dumpsites. There is a lac of information from open sources about which companies are involved in this process, which areas they serve and where the waste generated during cleaning of wild dumpsites is delivered. UC "Mykolaivkomuntrans" doesn't provide cleaning of the wild dumps, UC "Obriy-DKP" provide this service but only to a part of Korabelny district. Other dumps are cleaned by companies which win the tender on PROZORRO[14] organised by district city administrations.

[14] The electronic public procurement system Prozorro is an online platform where public (state and municipal) employers announce tenders for the purchase of goods, works and services, and business representatives compete at auctions for the opportunity to supply it to respective employers. https://prozorro.gov.ua/about

7 Influence of the war on waste management system of the Mykolaiv City

War significantly impacts municipal waste management in various ways. Firstly, conflict zones tend to witness a surge in waste generation due to damaged infrastructure, population displacement, and increased consumption of packaged goods. The disruption of waste collection services during wartime can lead to uncollected waste piling up, posing health and environmental risks. Moreover, the scarcity of essential resources like fuel, equipment, and personnel further hinders regular waste collection and treatment. For the 2023 MW collection service provided on regular basis.

Mykolaiv City has reported no instances of damaged or destroyed infrastructure related to municipal solid waste (MW) management, including vehicles, containers, and the landfill. A new waste stream has emerged in the form of debris resulting from wartime activities, commonly referred to as demolition waste. MW Management of this type of waste provided in accordance with the requirement of the Resolution of the Cabinet of Ministers of Ukraine dated 27.09.2022 N1073[15] and addressed in a separate report “Demolition Waste - Existing Situation and Perspectives”.

[15] Resolution of the Cabinet of Ministers of Ukraine dated 27.09.2022 No. 1073 "On approval of the Procedure for handling waste generated in connection with damage (destruction) of buildings and structures as a result of hostilities, acts of terrorism, sabotage or carrying out works to eliminate their consequences and introducing amendments to some resolutions of the Cabinet of Ministers of Ukraine" https://zakon.rada.gov.ua/laws/show/1073-2022-%D0%BF#Text

8 SWOT analysis

This chapter provides a SWOT analysis summarizing analyses presented in previous chapters.

Box 8-1 SWOT analysis, Existing situation, Municipal waste

STRENGTHS	WEAKNESSES
✓ Legislation and environmental standards exist. ✓ Committed and motivated staff of utility companies and municipality ✓ Availability of well-trained and dedicated workforce ✓ Video surveillance system for waste trucks providing control MW collection process ✓ Separate recording of the bulky waste collection [16] ✓ Initiated separate collection of MW ✓ Landfill gas collection is in place	✓ Insufficient data collection and analysis for informed decision-making. Weak system of data systematisation ✓ Inconsistent enforcement of waste disposal regulations ✓ Short remaining lifetime of existing landfill ✓ A new land plot couldn't be an appropriate for the landfill based on the results of hydro geological investigations (need to consider alternative sites) ✓ Aging equipment and infrastructure and inadequate funding for system maintenance and improvement ✓ Weak system of MW separate collection ✓ Poor management site for the storage of green waste, bulky items are on the site ✓ Private dumpsite for the green waste which accept other types of waste ✓ No accurate data (in tonnage) on the delivery of waste to the landfill due to lack of operational weight bridges at the landfill ✓ Insufficient protection of ground water from the landfill emissions ✓ Big number of "wild" dumpsites and lack of information on services provided by "grey" providers
OPPORTUNITIES	**THREATS**
✓ Possibility to develop MWM system from scratch ✓ Potential reduction of the size of a new landfill through improved MW management and increased share of recycled MW ✓ Expansion of recycling and composting programs ✓ Adoption of technologies for waste separation, collection, recycling and energy recovery ✓ Grant opportunities for sustainable waste management initiatives ✓ Public education and awareness campaigns to boost recycling and waste reduction	✓ Potential legal and administrative and environmental challenges ✓ Rising waste generation due to change of habit and demolition waste may result with insufficient landfill capacity ✓ Delay in selecting location and preparation of a new landfill ✓ Unfair competition from private dumpsite and "grey" service providers ✓ Increased waste management cost in case of high ambitious plans, budgetary constraints and low level of affordability of population

[16] Introduced by UC "Mykolaivkomuntrans" on February 1, 2022

Appendix 1 Vehicle fleet of the MW collection service providers

	The name of the vehicle	Year of manufacture	Volume of vehicle body, m^3	Type of loading	Payload, t	Capacity of the vehicle body, m^3	Compaction indicator	Wear level, %
UC "Mykolaivkomuntrans"								
Vehicles (waste trucks)								
1	МАЗ 5337 А2 ВЕ 1665 ВО	2015	-	back	11.7	70	-	60%
2	МАЗ 5337 А2 ВЕ 1669 ВО	2015	-	back	11.7	70	-	73%
3	МАЗ 5337 А2 ВЕ 6315 ВО	2012	-	back	10.9	70	-	74%
4	МАЗ 5337 О2 КО 42601 ВЕ 5595АА	2003	-	back	5.9	45	-	62%
5	МАЗ 5337 О2 КО 42601 ВЕ 559□АА	2003	-	back	5.9	45	-	100%
6	МАЗ 5337 А2 ВЕ 6313 ВО	2006	-	back	7.1	45	-	100%
7	УАК УСВ-ZO ВЕ 1870 ЕК	2020	-	back	8.5	35	2-6	42%
8	Mercedes-Benz ECONIC 1828 ВЕ 0387 НА	2009	-	back	7.67	70	-	7%
9	Mercedes-Benz ECONIC 2628 ВЕ 4562 ЕХ	2009	16.2	back	12.36	85	2-6	7%
10	Mercedes-Benz 2628 ВЕ 9462 ЕХ	2004	-	back	14.0	100	-	5%
11	Mercedes-Benz ECONIC 2628 ВЕ 3191 ЕХ	2010	16.2	back	12.35	85	2-6	7%
12	МАЗ 5340 В2 ВЕ 6464 ВМ	2015	-	side	6.5	54	-	100%
13	МАЗ 5340 В2 ВЕ 6664 ВМ	2015	-	side	6.5	54	-	100%
14	МАЗ 5340 В2 ВЕ 7690 ВМ	2015	-	side	6.5	54	-	100%
15	МАЗ 5340 В2 ВЕ 7696 ВМ	2015	-	side	6.5	45	-	100%
16	МАЗ 5337 О2 ВЕ 1756 ВХ	2006	-	side	7.1	35	-	100%
17	УАК УСВ-Б1 ВЕ 4137 ЕН	2020	11.5	side	3.2	24	2-6	48%
18	СБМ 301/2 ВЕ 0411 ЕК	2019	11.5	side	3.5	24	2-6	40%
19	СБМ 301/2 ВЕ 9652 ЕК	2020	11.5	side	3.5	24	2-6	35%
20	КО4313ИЛ433362 ВЕ 4360 АА	2003		side	4,8	20	-	69%
Other vehicles used for bulky and repair waste collection								
1	ГАЗ-САЗ 3507-01 ВЕ 4860 ЕР	1992	10	na	3.7			22%
2	КАМАЗ 5511 ВЕ 1682 ЕР	1983	10	na				
3	КАМАЗ 5511 ВЕ 8829 ЕХ	1988	10	an				
4	ЕКСКАВАТОР-НАВАНТАЖУВАЧ	1986		na				
5	FAW CA 1041K26L2R5 ВЕ 1207 ЕЕ	2005		*PET collection				
Collection of liquid waste								
1	КО-503 Б ГАЗ 5319 ВЕ 9706 ВВ	1990	4	Liquid waste truck-C	3,7			43%
2	КО Камаз 5321 ВЕ 3793 АА	1987	10	Tank -C	11,3			43%
UC "Obriy-DKP"								
1	Vehicle -C, ВЕ 2328 ВІ	2012	18	back	20.5	18	4-6	48
2	Vehicle -C, ВЕ 3176 ВН	2012	18	side	20.5	18	3	48
3	Vehicle -C, ВЕ 3182 ВН	2012	18	back	20.5	18	4-6	48
4	Vehicle -C, ВЕ 3479 АО	2012	16	back	20.5	16	4-6	48
5	Vehicle -C, ВЕ 5597 АА	2004	13.7	Na	6.3	13.7	1-3	20
6	Cargo dump truck ВЕ 6316 АК	1985	6	Na	7.1	6	-	20

Appendix 2 Basic information on the Landfill for MW of Mykolaiv City

The name if indicator	Detailed information on indicator
The register # of the landfill and the date of the registration	19/4-12/D1 of 30.03.2009 with the last update form 29.05.2023
The name of the landfill	Landfill for MW of Mykolaiv City
Location of the landfill (coordinates)	Territory of Vesnianska Village council (46°56'32.0"N 31°52'46.4"E)
Company which operates the landfill	UC “Mykolaivkomuntrans”
Full name and address of the owner of the landfill	Executive Committee of Mykolaiv 54001, Mykolaiv, st. Soborna, 1
Type of the landfill	open surface bulk
Area, ha	37.9313
Planned time of operation, years	50 years. After May, 2023 [17] Decision of the Executive Committee of Mykolaiv City Council No. 327 dated 10.05.2023 – 54 years
Total design capacity	Till 2023 10.9 million tonnes After May, 2023 [18] Decision of the Executive Committee of Mykolaiv City Council No. 327 dated 10.05.2023 - 11.6 million tones (57.944 mln m^3)
Capacity, thousand m3/year	Average - 1000; 820 thousand m3 in 2022
Thousand tones/year	Average 218; 126 thousand tones in 2022
The rest of the landfill capacity, tonnes	(For the 10/05/2023 – 700 thousand tones [19]); according to the calculations – 900 thousand tonnes
Year of commissioning	1972
Cogeneration installation	A complex engineering facility with a biogas collection system owned by LLC “LNK” (biogas power plant based on the C 320 GS-L.L power generating module). Launched from 2015
The amount of electricity produced in 2020, kWh	5,242,996
The established sanitary and protective zone	500 m, (class II), is maintained
Data about the land plot of the landfill	
Cadastral number	4824280400:13:000:0001 [20]
Property	Communal property
Use	for other purposes for placement and maintenance of the landfill
Purpose	11.04 For placement and operation of main, auxiliary and auxiliary buildings and structures of technical infrastructure (production and distribution of gas, supply of steam and hot water, collection, purification and distribution of water)
Category	Land of industry, transport, communications, energy, defence and other purposes

Source: Data of the online Cadastre, data provided by MCA, Data of the register of waste disposal sites

[17] Decision of the Executive Committee of Mykolaiv City Council https://mkrada.gov.ua/documents/40408.html
[18] Decision of the Executive Committee of Mykolaiv City Council https://mkrada.gov.ua/documents/40408.html
[19] According to the data of the scheme of the sanitary cleaning of the city)
[20] https://kadastr.live/parcel/4824280400:13:000:0001

Appendix 3 Basic information about the site for green waste

The name of the indicator	The meaning
Registration number of waste disposal site, date of registration	39/4-28/D1 of 10.02.2014
Date of last revision	For the 01.01.2019
The name of the site, code	Department of Housing and Utilty Services of the Mykolaiv City Council; 03365707
Location of the site	Mykolaiv City, clay quarry street, near the city cemetery, 0.6-0.8 km from Mishkovo-Pohorilove village, Vitovski rayon, 4823383001;
Cadastral number of the land plot	4810136900:03:066:0002
Coordinated of the site at google map	46.983743, 32.089428
Full name and address of the owner of the site	Department of Housing and Utility Services of the Mykolaiv City Council
Characteristics of the site (volume, area, surface or underground type)	Amount of disposed waste - 2,592.18t; Designed capacity – 900,000t;
Site area: According to the data of Register of waste disposal sites according to the extraction for the land cadastr	2,000m^2 (0.2ha): (0.5 ha)
Characteristics of waste	Twigs, branches, tops of trees (fallen leaves) Code: 1.48.00 Class of hazard: 4
Purpose	B.03.15
Land category	land for residential and public development
The type of use	under placement of a landfill for storing fallen leaves
Form of ownership	Communal property

Appendix 4 Basic information about the private waste disposal site CDW and green waste

The name if indicator	Detailed information on indicator
The register # of the landfill and the date of the registration	12/4-6/D1 of 05.08.2005 with the last update form 01.01.2019
The name of the landfill	Landfill of waste
Types of waste for landfilling	* Waste from construction works, demolition and repair of buildings and structures, Remains of tree trimming and planting care.
Location of the landfill (coordinates)	57214, Mykolaiv region, Vitovsky rayon, village Mishkovo-Pohorilove, str. Gorky, 17 (46.986749, 32.082220)
Company which operates the landfill	Private company “Milcha”
Full name and address of the owner of the landfill	Ukraine, 57214, Mykolaiv region, Vitovsky district, Mishkovo-Pohorilove village, Naberezhna street, building 2
Type of the landfill	open surface bulk
Area, ha	21.9028 ha
Capacity, million tonnes	1 million tones
Type of the landfill	superficial mixed type
Data about the landplot of the landfill	
Cadastral number	4823383000:07:000:0140 [21]
property	State property
use	for the management of auxiliary
purpose	01.04 For supporting agriculture
category	Agricultural lands

Source: https://kadastr.live/parcel/4823383000:07:000:0140

** Based on the publications from open sources the landfill accepts other than mentioned in register types of waste https://nikvesti.com/ua/news/politics/69616*

[21] https://kadastr.live/parcel/4823383000:07:000:0140