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Enterprise**

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Acting Director of SE "NDKTI

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_____ M.G. Golyuk

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SCIENTIFIC AND TECHNICAL REPORT

"Analysis of the current waste management system: item 1.1 Analysis of the current waste management system in Uzhhorod and item 2.1. Analysis of green waste management in Uzhhorod" within the framework of the project implementation

"Contribution to sustainable management of municipal waste in Uzhhorod"

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Project manager:

Acting Deputy Director,

Head of the Department of Improvement of Settlements
and Waste Management,

Ph.D. in Technical Science

I. V. Satin

Kyiv - 2022

AUTHORS

Project manager:

Acting Deputy Director,
Head of the Department of Improvement
of Settlements and Waste Management,
Ph.D. in Technical Science

I. V. Satin

Head of the Laboratory of Strategic
Planning in the Field of Sanitary Cleaning
and Improvement of Settlements,
Ph.D. in Technical Science

T. I. Romanova

Head of the Laboratory for Strategic
Researches in Housing and Communal
Services

O. S. Panchenko

Research Fellow of the Laboratory of
Strategic Planning in the Field of Sanitary
Cleaning and Improvement of Settlements

S. V. Khitruk

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ABSTRACT

Report: 184 p., 2 parts, 47 tables, 32 figures, 11 annexes, 71 references.

WASTE MANAGEMENT SYSTEM, SEPARATE COLLECTION, SORTING, TREATMENT, MECHANICAL AND BIOLOGICAL TREATMENT, COMPOSTING, MSW LANDFILL, WASTE, MUNICIPAL WASTE, INDUSTRIAL WASTE, RESOURCE-VALUED COMPONENTS, SECONDARY MATERIALS, BIO-WASTE

Provision of the service "Analysis of the current waste management system: item 1.1 Analysis of the current waste management system in Uzhhorod and item 2.1. Analysis of green waste management in Uzhhorod" (hereinafter - the Analysis) is carried out on the basis of Contract No. 10/1 from 03.10.2022 (hereinafter - the Contract) between the State Enterprise "Scientific, Research Design and Technology Institute of Municipal Economy (Kyiv) and the Department of International Cooperation and Innovations of the Uzhhorod City Council of the Transcarpathian Region. The analysis is carried out as part of the implementation of the project "Contribution to the sustainable management of municipal waste in the city of Uzhhorod" (grant agreement NAKOPA-E- UKR.1-20 dated 14.11.2020), which is implemented with support funds from the budget of the Federal Ministry of Economic Cooperation and Development of Germany.

The analysis is carried out taking into account European approaches to waste management, which are based on the provisions of the European Directives on waste management, as well as on the provisions of national legislation.

The purpose of the Analysis is the need to develop a concept for the collection and treatment of municipal and commercial green waste, to create and provide a basis for the effective functioning of the waste management system in Uzhhorod on an innovative basis, to implement strategic planning, which will involve the implementation of a number of measures aimed at reforming and improving the system waste management in the city, choosing the optimal waste management system (identification of the infrastructure for collection, separate collection, processing, processing and disposal of waste; providing information on planned technologies and methods of waste management) and practical measures necessary for its implementation.

The implementation of the project corresponds to the "Strategy for the development of Uzhhorod-2030", approved by the Decision of session No. 1382 from 18.01.2019.

Receiving the Report: according to Contract No. 10/1 from 03.10.2022, SE "NDKTI MG", Kyiv, 35 Metropolitan Vasyl Lypkivskyi str.

INTRODUCTION

Provision of the service "Analysis of the current waste management system: item 1.1 Analysis of the current waste management system in Uzhhorod and item 2.1. Analysis of green waste management in Uzhhorod" (hereinafter - the Analysis) is carried out as part of the implementation of the project "Contribution to sustainable management of municipal waste in Uzhhorod" and is carried out taking into account European approaches to waste management based on the provisions of the European directives on waste management, as well as on the provisions of national legislation.

The implementation of the project corresponds to the "Strategy for the development of Uzhhorod-2030", approved by the Decision of session No. 1382 from 18.01.2019.

The purpose of the Analysis is the need to develop a concept for the collection and treatment of municipal and commercial green waste, to create and provide a basis for the effective functioning of the waste management system in Uzhhorod on an innovative basis, to implement strategic planning, which will involve the implementation of a number of measures aimed at reforming and improving the system waste management in the city, choosing the optimal waste management system (identification of the infrastructure for collection, separate collection, treatment, processing and disposal of waste; providing information on planned technologies and methods of waste management) and practical measures necessary for its implementation.

The main tasks of the research are:

regarding the Analysis of the current waste management system in Uzhhorod:

- analysis of legal and organizational frameworks;
- collection of socio-economic and demographic information;
- analysis of waste composition (visual analysis and sorting);
- general quantitative analysis of the waste system in Uzhhorod regarding the collection and treatment of secondary raw materials;
- formulation of approaches to the expansion of the separate collection of secondary raw materials in Uzhhorod.

regarding the analysis of waste management that is subject to biological decomposition in Uzhhorod:

- analysis of the legal and organizational framework;
- analysis of the waste system for the collection and treatment of municipal and commercial green waste;
- determination of the main sources of municipal and commercial green waste;
- assessment of the amount of green waste;
- assessment of the product sales market (compost).

When performing the works, materials and data were obtained by conducting surveys of the residents of Uzhhorod, calculations, factual studies, based on relevant requests to relevant institutions and the provided initial data, taking into account the specifics of neighbouring territorial communities of Uzhhorod, their influence on Uzhhorod in the field of waste management and consequences caused by military events.

The conducted Analysis " Analysis of the current waste management system: item 1.1 Analysis of the current waste management system in Uzhhorod and item 2.1. Analysis of green waste management in Uzhhorod" consists of two parts, which, in accordance with official information, data obtained by conducting actual research, and given initial data:

in the first part:

- normative legal acts and program documents of the European and national level are cited, in particular the National Waste Management Strategy, for the implementation of which an Analysis, a comparative Table of European and national legislation is carried out;
- features that play an important role in determining the parameters of the Analysis are displayed, in particular:

- characterization of the natural and geographical state of Uzhhorod with the selection of territorial features that are important for solving waste management issues (relief, geological features, seismic-tectonic characteristics, climatic conditions, landscape features of the relief, soil characteristics, hydrology, natural resource potential, nature protection territories);
- dynamics and features of the demographic and social development of Uzhhorod over the past ten years and a ten-year development forecast (population by type of settlement; income of the population in general and per person); actual and forecast data on the population of the city; actual and forecast data on the dynamics of indicators of the average disposable income of the city population;
- the dynamics and peculiarities of the economic development of Uzhhorod over the last ten years and a ten-year development forecast (a brief description of the national economic complex), the existing transport network;
- general description of the current waste management system in Uzhhorod;
- description of the current state by types of waste in Uzhhorod is presented, in particular, the following components are presented - sources of generation and volumes of waste, quantitative characteristics of waste, the possibility of their reuse; waste management system; available waste treatment infrastructure; problems and threats related to waste and measures taken to solve them by the following types of waste:
 - municipal waste (municipal solid waste);
 - hazardous waste (especially waste oil products; waste containing persistent organic pollutants);
 - industrial waste (except mining industry waste);
 - construction and demolition waste;
 - waste electrical and electronic equipment;
 - waste batteries and accumulators;
 - medical waste;
 - other specific types of waste;
- SWOT analysis of the state of the waste management system in Uzhhorod;
- cooperation and influence of neighboring territorial communities of Uzhhorod in the field of waste management;
- results of the visual analysis of the municipal solid waste composition of Uzhhorod;
- general description of municipal solid waste and up-to-date information on the composition of municipal solid waste is provided - the generalized predicted morphological composition of municipal solid waste generated in Uzhhorod and the mass of components by morphological groups in the composition of mixed municipal solid waste is determined);
- analysis of the system of collection and processing of resource-valuable components of municipal waste (secondary raw materials) in Uzhhorod;
- data regarding the determination of the volume of waste that can be recycled;
- determined material and resource potential of municipal waste in Uzhhorod;
- formulation of approaches to the expansion of separate collection of secondary raw materials in Uzhhorod;
- ways of development of the field of waste management are presented - technical and financial and economic analysis, within which the chosen method of development of the field of waste management is justified.

in the second part:

- normative legal acts and program documents of the European and national level are cited, in particular the National Waste Management Strategy, for the implementation of which an Analysis, a comparative Table of European and national legislation is carried out;
- general description of the system of collection and treatment of municipal and commercial green waste in Uzhhorod is provided;

- main sources of municipal and commercial green waste in Uzhhorod are determined;
- assessment of the amount of green waste in Uzhhorod was carried out.
- assessment of the market for the sale of products obtained from the processing of municipal and commercial green waste (compost) is carried out;
- recommendation for improving the management of green waste and composting.

The results of the analysis will provide an opportunity to determine ways to improve the area of waste management in Uzhhorod, including the implementation of measures aimed at reforming and improving the waste management system available on the territory of the city, and the implementation of appropriate waste management, establishment of a separate waste collection system, determination of the necessary waste treatment technology, arrangement of infrastructure, including waste treatment facilities (including sorting), which will ensure effective collection, removal and treatment of waste in accordance with state norms, standards and rules and agreed with EU Directives, will contribute to the support of the directions of state policy in the field of waste management, which aims to ensure the comprehensive use of material and raw materials and to promote the maximum possible processing of waste through the direct, repeated or alternative use of valuable components in order to save natural materials and energy resources.

GLOSSARY

Municipal waste means waste generated in the course of human life and activity in residential and non-residential buildings (solid, bulky waste, construction and demolition waste, liquid, except for waste related to the production activities of enterprises) and is not used at the place of their accumulation.

Waste as a secondary raw material means waste for the disposal and processing of which there are appropriate technologies and production-technological and/or economic prerequisites in Ukraine.

Waste management means actions aimed at preventing the formation of waste, its collection, transport, sorting, storage, treatment, processing, utilization, disposal, neutralization and landfill, the supervision of such operations and the after-care of disposal sites.

Waste management operations mean the collection, transport, storage, sorting, treatment (processing), utilization, disposal, neutralization and landfill of waste.

Waste collection means the activity related to the extraction, accumulation and placement of waste in specially designated places or objects, including sorting of waste for the purpose of further utilization or disposal.

Separate collection of waste means the separate collection of waste depending on its type, characteristics and composition in a way that will facilitate its further treatment.

Waste storage means the temporary placement of waste in specially designated places or objects (before their utilization or disposal).

Collection and storage of waste as secondary raw materials - activities related to the collection, purchase, acceptance, storage, treatment (processing), transportation, sale and supply of such waste to processing enterprises for disposal, as well as the provision of services in this area.

Waste sorting means the mechanical division of waste according to its physico-chemical properties, technical components, energy value, commodity indicators, etc. in order to prepare waste for utilization or disposal.

Treatment (processing) of waste means the implementation of any technological operations related to changing the physical, chemical or biological properties of waste, with the aim of preparing it for environmentally safe storage, transport, utilization or disposal.

Recycling means any recovery operation by which waste is reprocessed into products, materials or substances for their original or other purposes. This operation includes the reprocessing of organic material but does not energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Transportation of waste means the transportation of waste from the places of its generation or storage to the places or objects of processing, utilization or disposal.

Waste utilization means the use of waste as secondary material or energy resources.

Waste disposal means operations with waste that does not lead to its utilization.

Waste landfill means the final deposit of waste upon its disposal in specially designated places or facilities in such a way that the long-term harmful impact of waste on the natural environment and human health does not exceed the established standards.

Waste management facilities means places or facilities used for the collection, storage, sorting, treatment, processing, utilization, disposal, neutralization and landfill of waste.

PART I
Analysis of the existing waste management system in Uzhhorod

CHAPTER I. LEGAL AND ORGANIZATIONAL FRAMEWORK

In accordance with the Terms of Reference, **the main purpose of the Analysis** is the necessity of developing a concept for the collection and reprocessing of municipal and commercial green waste. Other tasks are the following: to create and ensure the basis for the effective functioning of the waste management system in Uzhhorod city on an innovative basis; to implement strategic planning, which will involve the implementation of a number of measures, aimed at reforming and improving the waste management system in the city, choosing the optimal waste management system (determining the infrastructure for collection, separate collection, processing, treatment and disposal of waste; providing information on planned technologies and methods of waste management) and practical measures necessary for its implementation.

The analysis bases on the provisions, their updates and modifications of the following European Directives:

- Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives;
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste;
- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC;
- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control);
- Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC;
- Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification);
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment;
- European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste;
- Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE);
- Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC;

and following national-level documents:

- ✓ Law of Ukraine "On Waste" (from March 5, 1998 with subsequent amendments);
- ✓ Law of Ukraine "On Environmental Protection" (from June 25, 1991 with subsequent amendments);
- ✓ Law of Ukraine "On Local Self-Government in Ukraine" (from May 21, 1997, with subsequent amendments);
- ✓ Law of Ukraine "On Housing and Communal Services" (from November 9, 2017, as amended);
- ✓ Law of Ukraine "On Improvement of Settlements" (from September 6, 2005, with subsequent amendments);
- ✓ Law of Ukraine "On Ensuring Sanitary and Epidemic Welfare of the Population" (from February 24, 1994 with subsequent amendments);
- ✓ Law of Ukraine "On Environmental Impact Assessment" (from May 23, 2017);
- ✓ Law of Ukraine "On Strategic Environmental Assessment" (from March 20, 2018);
- ✓ National waste management strategy in Ukraine until 2030 (Order of the Cabinet of Ministers of Ukraine from November 8, 2017, No. 820);

✓ National waste management plan until 2030 (Order of the Cabinet of Ministers of Ukraine from February 20, 2019, No. 117).

For Analysis, the provisions of the following documents takes into account:

- Regional waste management plan of the Transcarpathian region until 2030, approved by the Order of the Transcarpathian regional state administration from 12/21/2021 No. 1051;
- Waste management strategy in Transcarpathian region until 2030;
- City development strategy "Uzhgorod-2030", approved at the XXXII session of the VII convocation of the Uzhhorod City Council.

The guiding principles of resource and waste management in European countries are set out in directives. See Annex A for the main provisions of the European directives concerning waste management.

The national legal framework in the field of waste management is currently undergoing a phase of intensive updating, changes and improvement, taking into account Ukraine's obligations under the Association Agreement with the EU. See Annex A for the main normative acts related to waste management and currently in force in Ukraine.

Table 1.1 shows the comparison of European and national legislation in the field of waste management.

In conclusion, based on the comparison results, Ukrainian legislation in the field of waste management is not yet entirely in line with European approaches and principles. In particular, inconsistency regarding the units of municipal solid waste accounting: in Ukraine, accounting is done in cubic meters, and in European countries is in kilograms.

On June 20, 2022, Draft Law No. 2207-1-d "On waste management" was adopted. The relevant Law No. 2320-IX will enter into force on July 9, 2023. The document is the foundation for building a circular economy based on recovery and rational consumption of resources, which today is part of the European Green Course. This Law was developed in accordance with the requirements of Directive 2008/98/EC on waste and Council Directive 1999/31/EC on the landfill of waste.

In particular, the implementation of the main European principles of waste management into national legislation is foreseen: the introduction of the waste management hierarchy, the main requirements for extended producer responsibility, and the introduction of a system of long-term waste management planning at the national, regional and local levels. Implementation of the National list of waste will contribute to the harmonization of the list of waste with the European one and will use in the accounting and reporting system in the field of waste management.

The Draft Law establishes the procedure for the collection, transportation and treatment of municipal waste, ensures the implementation of their separate collection and recycling, and provides requirements for the quality provision of waste management services and the charging of fees for such services.

The Law "On Waste Management" will bring national legislation closer to the European Union legislation.

Table 1.1. Comparison of European and national legislation in the field of waste management

EU Directive	Laws of Ukraine, normative legal acts, the content of which reflects the provisions of the EU Directives
<p>Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives</p>	<ul style="list-style-type: none"> ● Law of Ukraine "On Waste" (from March 5, 1998, with subsequent amendments) ● Draft Law No. 2207-1-d "On Waste Management". The relevant Law No. 2320-IX will enter into force on July 9, 2023. ● Waste oils: Resolution of the Cabinet of Ministers of Ukraine from December 17, 2012 No. 1221 "Some Issues of Collection, Transportation, Storage, Processing (Treatment), Utilization and/or Neutralization of Waste Oils (Oils)" (title in the version of Resolution of the Cabinet of Ministers of Ukraine No. 1198 from November 25, 2015)
<p>Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste as amended by Regulation (EC) 1882/2003</p>	<ul style="list-style-type: none"> ● Order of the Minregion from December 1, 2010 No. 435 "On Approval of the Regulations for the Operation of Municipal waste landfill" ● Order of the Minregion from November 30, 2006 No. 396 "On Approval of the Methodology for the Implementation of Two-stages Transportation of Municipal solid waste" ● Order of the Minregion from August 1, 2011 No. 133 "On Approval of the Methodology for Separate Collection of Municipal solid waste"
<p>Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC</p>	<p>Practically absent. Fragmentary provisions are given in various normative documents:</p> <ul style="list-style-type: none"> ● Law of Ukraine "On Environmental Protection" (general requirements for environmentally safe waste management) ● Law of Ukraine "On Waste" (framework of waste management) ● Related laws: Subsoil Code of Ukraine, Mining Law of Ukraine, etc. ● Highly specialized issues: DBN "Tailing storage facilities and sludge accumulators. Part 1. Design. Part 2. Construction", Order of the Ministry of Industrial Policy from 17.08.2004 No. 412 "On the Approval of the Regulation on the Design of Internal Waste Disposal and Storage of Production Waste", Order of the State Committee of Ukraine for Urban Planning and Architecture from 19.12.95 No. 252 "On the Approval of the Survey Methodology and Certification of Hydrotechnical Structures of Systems of Hydraulic Extraction and Storage of Industrial Waste", Decree of the CMU from 1998 No. 03.08.1998 No. 1216 "On Approval of the Procedure for Maintaining a Register of Waste Disposal Sites"

EU Directive	Laws of Ukraine, normative legal acts, the content of which reflects the provisions of the EU Directives
Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)	Is lacking
European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste	Is lacking <ul style="list-style-type: none"> ● Law of Ukraine "On Limiting the Circulation of Plastic Bags in the Territory of Ukraine" (from June 1, 2021)
Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)	Is lacking <ul style="list-style-type: none"> ● Order of the Minregion No. 15 from January 22, 2013 "On Approval of Methodological Recommendations for the Collection of Waste Electrical and Electronic Equipment in Municipal solid waste" is advisory
Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC	<ul style="list-style-type: none"> ● Law of Ukraine "On Chemical Current Sources". This law does not apply to all types of batteries and accumulators. Currently, chemical current sources are removed from the scope of regulation of the Law of Ukraine "On Waste". ● Order of the Ministry of Industry of Ukraine, the Ministry of Economy of Ukraine, the Ministry of Environmental Protection and Nuclear Safety of Ukraine No. 223/154/165 from 12.31.96 "On Approval of the Regulation on the Procedure for Collecting and Processing Spent Lead-acid Batteries"
Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances, as amended by Directive No. 2003/105/EC and Regulation (EC) 1882/2003	Is lacking
Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles	Law of Ukraine "On Utilization of Vehicles" (from July 4, 2013, with subsequent amendments)
Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)	Is lacking
Council Directive of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage	<ul style="list-style-type: none"> ● DBN B.2.5-75:2013 "Sewerage. External Networks and Structures. Basic Provisions of design" ● Order of the Minregion from 12.12.2018 No. 341 "Procedure for Reuse of Treated Wastewater and

EU Directive	Laws of Ukraine, normative legal acts, the content of which reflects the provisions of the EU Directives
sludge is used in agriculture (86/278/EEC)	Sediment when its Compliance with Standards for Maximum Permissible Concentrations of Pollutants" <ul style="list-style-type: none"> ● DSTU 7369:2013 "Wastewater. Requirements for Wastewater and its Sediments for Irrigation and Fertilization"
Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment	<ul style="list-style-type: none"> ● Resolution of the CMU from March 10, 2017 No. 139 "On Approval of the Technical Regulation on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment"
Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants	Is lacking <ul style="list-style-type: none"> ● Law of Ukraine "On the Ratification of the Stockholm Convention on Persistent Organic Pollutants" (from April 18, 2007) ● Decree of the CMU No. 589-r from 25.07. 2012 "On the Approval of the Plan of Measures for the Implementation of the Stockholm Convention on Persistent Organic Pollutants" ● Law of Ukraine "On Pesticides and Agrochemicals" (from March 2, 1995 with subsequent amendments)
Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment	Law of Ukraine "On Environmental Impact Assessment" (from May 23, 2017)
Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment	Law of Ukraine "On Strategic Environmental Assessment" (from March 20, 2018)

CHAPTER II. SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF UZHGOROD

2.1 Characteristic of the natural and geographical state of Uzhhorod

Uzhhorod is the regional center of the Transcarpathian Region, located in the western part of the region in the foothills of the Carpathians. The territory of the city occupies an area of about 40 sq. km, conventionally divided into 17 microdistricts, which bear historically formed names.

The city is located in close proximity to the borders with European countries. The western line of the territorial boundary of the city coincides with the State border of Ukraine with Slovakia. The distance to the nearest European capitals is Budapest – 330 km, Bratislava – 490 km, Warsaw – 550 km, Vienna – 555 km. Uzhhorod is located at a distance of 788 km by road and 898 km by railway from the capital of Ukraine, Kyiv¹.

2.1.1 Relief and geological features

The ancient part of the city is located on the right bank of the Uzh River and lies on seven hills named Zamkovyi, Kalvariia, Universytetskyi, Chervenysia, Shakhtynskyi, Onokivskyi, Horianskyi, and the younger part is on the left bank, where the Transcarpathian lowland begins, which is a part of the Middle Danube Plain.

The length of the city from north to south is 12 km, and from east to west is 5 km. The highest point of Uzhhorod is Velyka Daibovetska mount - 224 m. In the vicinity of Uzhhorod, near the village Dravtsi, loess layers remain to this day².

In geostructural, the territory of the city is confined to the western part of the Transcarpathian internal depression.

The city is located on the border of two districts the Chop-Mukachevo depression and the Vihorlat-Hutyn mountain range. Thus, the geological structure of the territory is heterogeneous.

The Vihorlat-Hutyn mountain range represents the northern part of the city and consists of tuffogenic-sedimentary rocks of great thickness (up to 600 m). These rocks are overlain by clays and loams of the Quaternary age. Deposits of the Hutyn Formation are mainly represented by crystalline rocks, and partly by clays. The thickness of the last ranges from meters to several tens of meters. The greatest thickness is observed in the north-eastern part of the city.

The thickness of covering deluvial deposits also ranges from 0 to several meters. In the valley of the river, the rocks of the Hutyn Formation are eroded to a considerable depth and covered by alluvial gravel and boulder-pebble deposits. In most wells, tuffogenic-sedimentary crystalline rocks with a thickness of up to 80 m or more are found under the sole of gravel.

Andesites are found only in the northern part of the Uzh valley. On the plain, the rocks of the Hutyn Formation gradually sink (to the south) under the Quaternary deposits to a depth of more than 250 m.

The geological structure of the alluvial plain includes thick strata of alluvial Quaternary deposits – gravel with interlayers of clay and sand covered by clay deposits. The total thickness of alluvial deposits in the valley of the Uzh river ranges from 5-10 m to 35-45 m, on the Chop-Mukachevo plain up to 250 m. Both are underlain by rocks of the Hutyn Formation.

Almost everywhere, the gravel of the Mynai Formation is overlain by alluvial clay soils (loams, clays, less often sandy loams) with a thickness of up to 5-8 m. The outcrops of gravel on the day surface or close to the surface (up to 2 m) are confined to the floodplain of the Uzh River³.

¹ <https://old.rada-uzhgorod.gov.ua/uzhgorod/koncepcia3>

² <http://carpathian-heritage.org.ua/ua/heolohiia>

³Uzhhorod, Transcarpathian region. Making changes to the city's master plan. Explanatory note, Kyiv, 2015

2.1.2 Seismic and tectonic characteristics

Seismically active zones surround Ukraine in the southwest and south. These zones are Transcarpathian, Vrancea (Romania), Crimean-Black Sea and South-Azov.

Table 2.1 shows the seismic intensity in points on the scale from DSTU B.V.1.1-28 (according to Annex A of the DBN B.1.1-12:2014 "Construction in Seismic Areas of Ukraine") for Uzhhorod.

Table 2.1. Seismicity for Uzhhorod

Settlement	Maps of the ZSR-2004		
	A	B	C
Uzhhorod	7	7	8

The territory of Uzhhorod belongs to seismically active zones; the standard (background or input) intensity of seismic shaking in Uzhhorod is 7 points on the MSK-64 scale.

2.1.3 Climate conditions

In terms of natural and climatic conditions, Uzhhorod is located in a lowland landscape zone. Warm air freely enters the city from the south, and the Carpathian mountain massif protects the city from cold northern winds and extends the duration of the warm period of the year.

The average annual air temperature in the city is 9.3°C. The warmest month of the year is July (20.5°C), and the coldest is January (-2.8°C).

The city is located in a zone of sufficient moisture. Precipitation throughout the year is caused mainly by cyclonic activity. Cyclones moving from the Atlantic Ocean and the Mediterranean Sea bring up to 80% of the annual amount of moisture to the city. In addition, the proximity of mountains contributes to the orographic intensification of precipitation. On average, 700-800 mm of precipitation falls in the city per year. They are distributed unevenly throughout the year. The main part of precipitation falls in the warm part of the year, which is 64% of the annual norm.

Throughout the year, winds from the southeast prevail (27%). A high proportion of windless days is 24%. The probability of strong winds (10 m/s and more) is only 2%. On average, there are only 91 days without sunlight during the year due to high cloud cover. The average duration of sunlight is 1 926 hours per year⁴.

2.1.4 Landscape features

In geomorphology, Uzhhorod is located on the border of the transition from the volcanic Vihorlat-Hutyn range to the Transcarpathian lowland, which is clearly visible in the relief. The old part of the city lies on the hills, and the younger part is on the left bank of the Uzh River, where the Transcarpathian lowland begins, which is a part of the Middle Danube Plain.

The spurs of the Vihorlat-Hutyn range are represented by low elevations in the north and east, as well as separate remnants (Zamkova Hora) in the central part of the city. The lowlands characterize by relatively small surface slope angles, mostly up to 10-12%, and slight dismemberment of the territory. The existing beams have a cut depth of up to 50 m (a beam in the area of the brandy plant) and characterize by gentle slopes. Areas of slopes with surface slopes of 12% have a limited distribution within the lowlands and are limited, as a rule, to outcrops of crystalline rocks on the day surface.

The lowland part of the city is Chop-Mukachevo depression and the Uzh River valley. The relief of this territory is flat with small surface slopes and the presence of closed depressions in which meltwater and rainwater accumulate. Within the boundaries of the Uzh River, there are floodplains

⁴ <https://old.rada-uzhgorod.gov.ua/uzhgorod/koncepcia3>

and the I supra-flood terrace, which are periodically inundated by floods. The floodplain of the Uzh can be traced in the floodplain part and within the boundaries of the Chop-Mukachevo Plain.

In the central part, the river is embanked on both sides and the floodplain terrace is practically absent here. The floodplain is separated from the I supra-flood terrace by a ledge 2-3 m high, within the Chop-Mukachevo Plain, the height of the ledge increases downstream to 4-6 m. In some places, the ledge clearly defined in the relief is absent and the border between the floodplain and the I supra-flood terrace is blurred and unclear.

The absolute levels of the alluvial plain vary from 113 m in the southwestern border of the city to 125 m in the northeastern part of the Chop-Mukachevo Plain. The general slope of the surface has a south-western direction⁵.

2.1.5 Characteristics of soils

Heavy soils with a predominance of sod type are typical for Uzhhorod, as well as the region as a whole. The highest content of humus (3%) in the soils of the southern outskirts of the city, and the lowest (0.52%) is in the soils of the eastern part. In the northern part of the city are turf-brown-podzolic non-gley and gley unwashed and slightly washed light loamy soils and their variations. In the southern part, soddy, deep non-gley and silty, light loamy soils and their subsoils prevail. The soil cover characterizes by relative diversity, which is due to the size of the city's territory and its geomorphological features. The city is rich in deposits of brick and tile raw materials, coal, and natural stone.

Soil conditions are favourable for the improvement and formation of a system of green plantings.

Most of the plots of land occupied by agricultural crops are located on the outskirts of the city and are privately owned by citizens or leased by them⁵.

2.1.6. HYDROLOGY

Surface waters

According to hydrographic and water management zoning, the territory of Uzhhorod belongs to the basin of the Tisza River, which is completely located within the boundaries of one region Transcarpathian⁶.

The Uzh River flows through the city from east to west and is a tributary of the Tisza River. The length of the river within the city is 10.5 km. The width of the channel ranges from 30 to 60 m, the banks are partially reinforced with stone masonry. The Uzh River is a tributary of the Laborets River. The largest tributaries of the Uzh River are the Luta and Turya rivers⁷.

The Uzh River is a border river; it begins in the Polonynian Beskids (near the Uzhotsky Pass). The height of the source is 971 m and near the state border is 102.4 m above sea level⁵.

The basin of the river is located on the spurs of the Carpathians and only above the city of Uzhhorod opens onto the plain. The afforestation of the catchment area is 57%. The valley is winding, V-shaped in the upper reaches, in the Zhornava village has the appearance of a gorge, and below the Uzhhorod is already vaguely defined. The banks are steep, with a height of 1-2 m, sometimes up to 6-8 m. The bottom of the river is stony, in the V. Berezhnyi village is gravel, and in Uzhhorod and below the banks the bottom is muddy.

The soil-forming rocks of the Tisza River basin are Quaternary sediments and weathering products of tertiary and volcanic rocks.

⁵Uzhhorod, Transcarpathian region. Making changes to the city's master plan. Explanatory note, Kyiv, 2015

⁶https://buvrtyssa.gov.ua/newsite/?page_id=18150

⁷Klymenko V. G. Hydrology of Ukraine: Study guide for geographer students. - Kharkiv: V. N. Karazin KhNU, 2010. - 124 p.

Table 2.2. The main tributaries of the Uzh River⁸

River	Length, km	Catchment area, sq. km
Uh (r.)	13.0	86.0
Ulychka (r.)	27.0	207
Ublia (r.)	25.0	217
Liuta (l.)	47.5	274
Turia (l.)	49.3	467

Table 2.3. The average long-term flow of the Uzh River⁸

River	Catchment area, sq. km (within Ukraine/general)	Length, km (within Ukraine/ general)	Average water consumption, cub. m
Uzh River	1,970/2,750	107/133	29.3

Table 2.4. Hydrographic characteristics of the Uzh river⁸

Name	Where it falls	Distance from the mouth of the main river, km	River length, km		Catchment area, sq. km	
			ful l	within Ukraine	full	within Ukraine
Uzh River	Laborets	–	13 3	106	2,75 0	1,970

Within the Uzhhorod district, the speed of the Uzh River is not high, because of which part of the sediment settles, so the river flows in its own sediments.

The annual maximum level is usually observed in the cold period. Its height in normal years is 1.5-2.0 m, and in exceptionally high-water years is 2.5-3.0 m. The intensity of the level rise reaches 2.2-3.0 m/day.

In the summer-autumn period, numerous rain floods are observed, the duration of which in the lower reaches is 5-17 days. In the lower reaches of the river, the maximum flows of rain floods (floods of the warm period) are much lower than the maximum flows of mixed floods (floods of the cold period).

The ice cap is unstable, some sections of the river freeze throughout the winter, there is no ice cap on the river in warm winters; in severe winters, the river is covered with ice; the average thickness of the ice is 20-25 cm, the maximum is 81 cm (winter 1963-64, V. Bereznyi village). Sometimes bottom ice forms on the river.

Water belongs to the hydrogencarbonate class. Water mineralization reaches the highest values in the period of low water up to 204 mg/l, and the lowest in periods of floods is 133 mg/l. The water is soft, tasteless and odourless, suitable for consumption; in Uzhhorod, water is polluted by discharges from industrial enterprises.

Underground waters

The territory of the city is located within the boundaries of the Transcarpathian artesian basin, where underground waters are mainly layered in nature and lie in neogene and anthropogenic sediments.

Within the territory, aquifers are developed in the sediments of the Ilnytsia, Hutyn, Chop Formation and the aquifer of Quaternary alluvial deposits. The latter is of practical importance for the organization of centralized water supply.

On the territory of Uzhhorod, there are more than 20 artificial mineral waters (wells) and natural (springs), valuable in a therapeutic sense. Thus, in the Horkyi park there is the mineral water of the

⁸ Klymenko V.G. Hydrology of Ukraine: Study guide for geographer students. - Kharkiv: V. N. Karazin KhNU, 2010. - 124 p.

Yesentuki 17 type, in Bozdoskyi park is Narzan type, but the use of which is characterized as limited and irrational⁹.

2.1.7 Natural resource potential and protected areas

The territory of Uzhhorod in its modern limits is 3,622 hectares; the green zone is 1,574 hectares.

The flora of the city is represented by parks (Bozdoskyi (58 ha), Pidzamkovyi (3.5 ha), Botanical Garden (3.2 ha), rockery "Zakarpatis" (0.5 ha)), squares, boulevards and embankments ("Friendships of Peoples" (6.0 ha), Dovzhenka St. (0.23 ha), Zhupanatska St. (1.5 ha), Pravoslavna embankment (3.0 ha), Pionerska embankment (9.5 ha), alpine garden (0.07 ha)).

The nature reserve fund of the city includes

- monument of horticultural art of national significance "Botanical Garden of Uzhhorod State University";

- monuments of garden and park art of local significance (parks: Bozdoskyi, Pidzamkovyi, Druzhiba, regional hospital, Dendrosad Laudona);

- natural monuments of local importance - individual trees and wells.

The nature reserve fund in Uzhhorod is a component of the ecological network and is 161 hectares (4.7% of the city's area). Almost 290 hectares of the city area are occupied by gardens and vineyards. The streets and embankments are lined with fruit and ornamental trees. The city is surrounded by a forest massif from the northwest.

The total amount of green spaces for public use is 82.83 hectares. Based on the calculation of the area of the greening of the city, for general use per 1 inhabitant is 8.6 sq. m with a norm of 10 sq. m¹⁰.

2.2 Dynamics and features of the demographic and social development of Uzhhorod

2.2.1 Population of Uzhhorod

According to the data of the Main Department of Statistics in the Transcarpathian Region, the population living in the territory of Uzhhorod as of January 1, 2022, was 115.449 thousand people.

Uzhhorod is the smallest regional center and the 38th city in Ukraine by population. The city accounts for 9.3% of the population of the Transcarpathian Region, including 24.7% of the urban population.

2.2.2 Dynamics of the demographic development of Uzhhorod in the last ten years

Table 2.5 shows the total actual population of Uzhhorod for the last 10 years.

Table 2.5. The number of the actual population of Uzhhorod (as of January 1)¹¹

Indicator	Year									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total, thousand people	116.3	115.9	115.5	115.2	114.007	113.996	114.898	115.512	115.542	115.449

⁹Uzhhorod, Transcarpathian region. Making changes to the city's master plan. Explanatory note, Kyiv, 2015

¹⁰ <https://old.rada-uzhgorod.gov.ua/uzhgorod/koncepcia3>

¹¹ <http://www.uz.ukrstat.gov.ua/>

The city is one of the few regional centers of Ukraine that has positive demographic development trends. The average and median ages of the city's population (38.2 years and 36.9 years, respectively) remain among the lowest in the country, despite gradual growth over the past 12 years¹².

2.2. 3 Incomes of the population

In the IV quarter of 2021, the average monthly salary of a full-time employee of enterprises, institutions and organizations of the city increased compared to the corresponding period last year and amounted to 12,617 hryvnias, which is 109.3% to the average level in oblast¹³. The highest level of salary in the city is among employees employed in financial activities, public administration, transport and communications.

Fig 2.1 shows the dynamics of the average monthly salary of a full-time employee of enterprises, institutions and organizations of the city for 2013-2020 and the forecast until 2024.

In the sphere of social protection, labor and employment, there is a tendency to decrease salary arrears. As of October 1, 2021, the salary arrears for Uzhhorod amounted to 117.1 thousand UAH (in 2020 was 241.2 thousand UAH). Only one enterprise - SE "Transcarpathian Research and Design Institute of Land Management" - owes its employees.

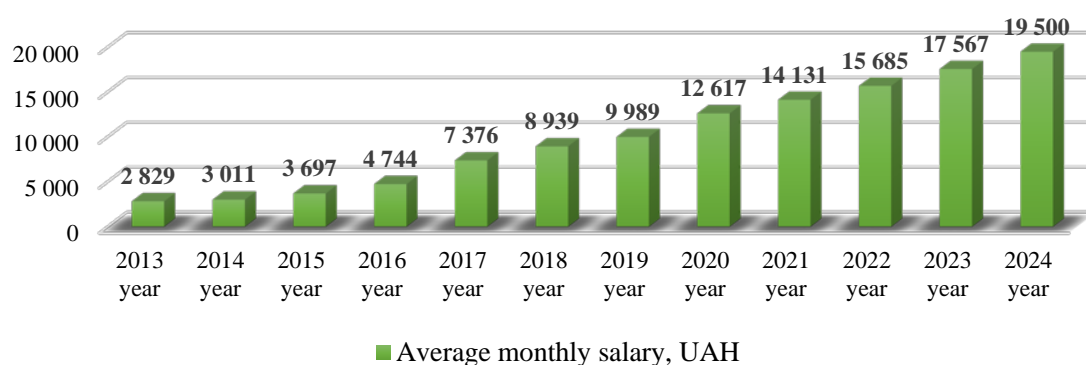


Fig. 2.1. Dynamics of the average monthly salary of a full-time employee of enterprises, institutions and organizations of Uzhhorod for 2013-2020 and forecast for 2021-2024, UAH

2.3 Dynamics and features of the economic development of Uzhhorod

2.3.1 Brief description of the national economy

By economic development, the Transcarpathian Region belongs to the industrial-agrarian type with a developed resort and tourist economy¹⁴.

The economic development of Uzhhorod is moderate and does not distinguish it from other territories. The most developed areas of the city's economy are industry, trade and public catering, which are provided with adequate infrastructure and have sales markets in the country and beyond. There are a number of enterprises with foreign investments in the city (148 enterprises with foreign investments). Small and medium-sized businesses in the city are developing at a faster rate than in Ukraine¹⁵.

¹² https://rada-uzhgorod.gov.ua/uploads/sites/2/2018/10/uzhgorod_final-Strategiya-Uzhgorod-2030.pdf

¹³ http://www.uz.ukrstat.gov.ua/press/2021/expr_v025.pdf

¹⁴ <https://www.tpp.uzhgorod.ua/ukr/page-116.html>

¹⁵ <https://rada-uzhgorod.gov.ua/initiativa-evropeyskoi-komisii-meri-za-ekonomichne-zrostannya>

The economy of Uzhhorod consists of production (industry, construction and forestry) and non-production (other types of economic activity) sectors; small business sectors (small businesses and individual entrepreneurs). The non-production sphere prevails over the production sphere (approximately 3:1)¹⁴.

Industry plays a key role in the production sphere. Mining and processing industries take the leading positions in the total volume of industrial products sold. The priority branches of industry are chemical, and mechanical engineering, the production of electricity, gas and water, light, waste treatment, and food and furniture production. More than 5,000 subjects of economic activity work in the economic complex of the city.

The main types of economic activity of subjects of the small business sector of Uzhhorod are wholesale and retail trade, real estate transactions, processing industry, construction and provision of paid consumer services to the population. Largely, the sectoral specialization of the city's small business entities is due to the development of the trade and distribution infrastructure, where, in addition to wholesale and retail trade facilities of various formats, 14 markets for the sale of food and non-food goods operate¹⁶.

Uzhhorod is one of the most attractive cities in Ukraine for investment. In the investment attractiveness rating, the city has an Invest A+- rating, which means high investment attractiveness and low sensitivity to investment risks.

Since 2014, there are no large enterprises in the total number of business entities in Uzhhorod, and there is a tendency to increase the share of small and micro-enterprises, which is evidence of the increasing orientation of the city's economy to small business¹⁶.

List of industrial enterprises of Uzhhorod¹⁷:

1. Private joint stock company "Electrodvigun" Uzhhorod Plant - production of alternating current electric motors of general industrial purpose for household use.
2. Zavod Konvektor, LLC produces AKOG gas convectors, ozonators.
3. Modul M, PJSC - former plant "Uzhhorodprilad" is a manufacturer of electronic and industrial equipment.
4. Turbogaz Uzhhorod, LLC is a manufacturer of equipment for the oil and gas and mining industries.
5. Uzhhorod Cognac Plant.
6. RENER is a group of energy companies, construct of solar and hydroelectric power plants.
7. UNGWIRE, LLC is a producer of finished automotive cable products.
8. Uzhhorod sewing factory (Parada).
9. Interfil, LLC is a manufacturer of cosmetics and household goods.

According to the Environmental Passport of the Transcarpathian Region¹⁸, the company TrioTrans, LLC (Uzhhorod, 6 Granitna str.) accumulates industrial waste on its territory, namely piece wood waste: 263.2 tons of waste was actually generated at the company in 2020, 21.4 t accumulated by the end of 2021.

2.3.2 Dynamics and features of economic development over the last ten years

Industry remain the leading sector in the economy of Uzhhorod. During 2013-2020, the positive dynamics of the growth of the sale of industrial products were maintained, although, in 2020, a decrease in the sale of industrial products by the city's enterprises was observed (Fig. 2.2), which is connected with the spread of the coronavirus.

Table 2.6 shows the dynamics of indicators of economic and social development of Uzhhorod for 2013-2020, as well as the forecast until 2024.

¹⁶ <https://www.tpp.uzhgorod.ua/ukr/page-116.html>

¹⁷ <http://surl.li/dloac>

¹⁸ <http://surl.li/dloac>

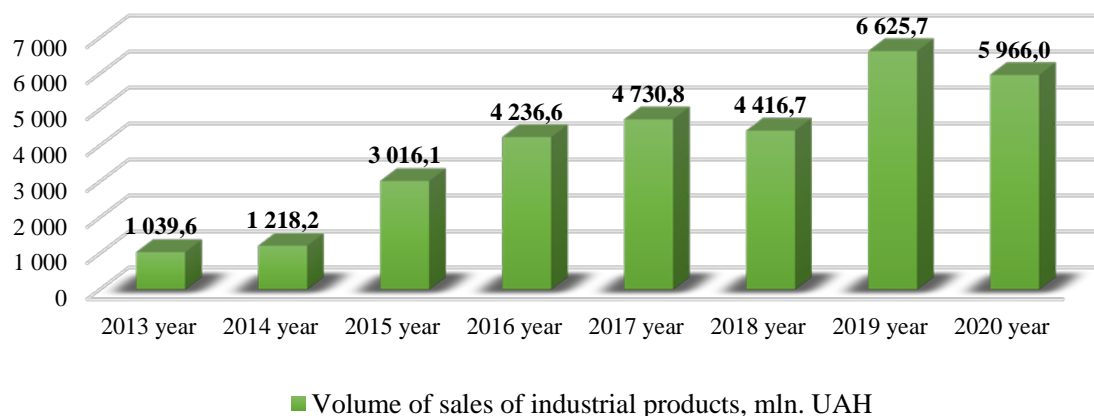


Fig. 2.2. Dynamics of the volume of sales of industrial products in Uzhhorod for 2013-2020, mln. UAH

Priority branches of the industry remain chemical, mechanical engineering, production of electricity, gas and water, light, waste treatment, food and furniture production¹⁹.

About a third of the orders in the industrial sector go to foreign partners with whom relevant contracts have been concluded. These are mainly orders related to the processing of customer raw materials. Fava-Technics LLC, Ungwire LLC, Uzhhorod sewing factory, JSC work under such conditions, most of these enterprises worked for the export of goods.

The driving factor of the socio-economic development of Uzhhorod is investment activity. About 150 enterprises with foreign investments work in the city. Austria, Germany, Hungary, the Czech Republic, Cyprus, France, Slovakia, and Italy took the most active part in international investment cooperation. In total, about 350 groups of goods produced in the city are exported outside the country, worth 3 billion hryvnias every year. The investment passport of Uzhhorod is constantly updated on the official website of the city council.

The city authorities are actively expanding cooperation with international partners and establishing partnerships with twin cities, there are currently 23. The city is implementing 10 grant projects in partnership with twin cities within the framework of the 2014 - 2020 Poland-Belarus-Ukraine, 2014-2020 Hungary-Slovakia-Romania-Ukraine, Romania-Ukraine 2014-2020 Programmes.

Tourism is becoming increasingly important for the development of the city's economy. On the territory of Uzhhorod, a network of tourist and recreational and hotel facilities has been developed, which in 2021 will include about 50 accommodation facilities. 5 tourist operators and about 60 travel agencies operate in the city.

¹⁹ <https://rada-uzhgorod.gov.ua/sotsialno-ekonomichniy-rozvitok-mista#kvi3wwwkiw>

Table 2.6. Dynamics of the main indicators of the economic and social development of Uzhhorod 2013-2020 and the forecast²⁰

Indicators	2013	2014	2015	2016	2017	2018	2019	2020	2021 (confirm)	2022 (plan)	2023 (plan)	2024 (plan)
Volume of sold industrial products (goods, services) at current prices, excluding VAT, total (million hryvnias)	1,039.5	1,255.5	3,023.9	4,220.0	4,730.8	4,416.6	6,625.7	5,966.0	7,000.0	7,266.0	7,607.0	7,987.0
Remuneration fund (without military personnel) million hryvnias. *-employees at enterprises, institutions and organizations of monthly accounting (million hryvnias)	–	–	–	–	3,684.8	3,684.8	4,244.9	5,002.5	6,307.0	7,145.0	7,840.0	8,624.0
Number of small enterprises per 10,000 of the actual population (units)	137.0	141.0	149.0	121.9	139.0	–	153.0	–	155.0	156.0	157.0	158.0
Average monthly salary of full-time employees (UAH)	2,829	3,011	3,697	4,744	7,376	8,939	9,989	12,617	14,131	15,685	17,567	19,500
Arrears for the payment of salary to employees of economically active enterprises of the city (thousand UAH)	700.0	600.0	900.0	800.0	–	362.1	0	340.8	0	0	0	0
Average annual actual population (thousands of people)	116.1	115.7	115.3	114.6	114.0	114.4	115.5	115.5	115.5	115.4	115.5	115.6
Foreign trade turnover of goods and services:	–	–	–	–	–	–	–	–	–	–	–	–
Export volume (million USD)	111.0	123.0	98.6	92.8	157.7	159.2	165.5	–	150.1	140.2	170.3	172.2
Import volume (million USD)	477.3	410.0	83.3	90.9	114.1	118.7	119.8	–	135.0	150.2	190.3	195.5

²⁰Compiled according to the data of the "Program of economic and social development of Uzhhorod" (2015-2021 years). Forecast indicators according to the "Program of economic and social development of the Uzhgorod urban territorial community for 2022". <https://rada-uzhgorod.gov.ua/sotsialno-ekonomichniy-rozvitok-mista#kvi3wwwkiv>

2.3.3 Forecast of economic development

The strategic goal of the development of the industrial potential of Uzhhorod is to increase the competitiveness of industrial enterprises on the basis of attracting investments in the modernization of production facilities, the activation of innovative activities, the introduction of energy-efficient, resource-saving technologies in the processes of creating products, the expansion of international cooperation²¹, as well as in the types of economic activities that have potential development (hotel and restaurant business, tourism and recreation, transport and logistics, consumer and business services)²².

Among the priority tasks and expected results of the city's development for 2022, the following should be highlighted:

- energy efficiency and environmental protection;
- ensuring effective management of the green economy and revitalization of the green city;
- continuation of reclamation of the existing landfill and construction of a new modern complex for the processing of municipal solid waste;
- development of storm sewer networks, sewerage and drainage systems throughout the city, as well as modernization of wastewater treatment equipment;
- development of service infrastructure (a network of cafes, restaurants, hotels), formation of a cluster of tourist services and ensuring the proper quality of services, including expanding the possibilities of using the premises of the first floor for public functions.

One of the tasks of the strategic goal of the Development Strategy of Uzhhorod²³ "3. To ensure sustainable environmental safety and a clean environment, the functioning of the system of revival and constant self-renewal of the "green" and blooming city, its natural objects and protective zones" involves "3.1.5. Implement a system for collecting "green" waste and the wet fraction of MSW (food waste) with subsequent utilization for compost or biogas production."

2.3.4 Transport network

Uzhhorod is the largest transport hub of the Transcarpathian region. External connections between the city and its suburban area are provided by air, rail and road transport.

Automobile roads. Three European highways pass through the city – E50, E58, E573, two international highways M06, M08 and the national highway H13 (Fig. 2.3).

The M-06 Kyiv-Chop international road of state importance approaches the city from the south-eastern side. The specified road has a significant load, connecting Uzhhorod with Lviv, Rivne, Zhytomyr, Kyiv.

Along the eastern side of Uzhhorod runs international highway M-08 Uzhhorod Bypass - checkpoint "Uzhhorod", which connects highway M-06 Kyiv-Chop with the checkpoint, diverting transit traffic from the main network of the city.

From the north-eastern side, there is the national road of state importance N-13 Lviv-Sambir-Uzhhorod.

Almost all roads that pass to the city have a satisfactory road surface. The elements of the transverse profile correspond to the current intensity of traffic on these roads.

²¹ <https://rada-uzhgorod.gov.ua/sotsialno-ekonomichnyi-rozvitok-mista#kvi3wwwkiv>

²² <https://rada-uzhgorod.gov.ua/initsiativa-evropeyskoi-komisii-meri-za-ekonomichne-zrostannya>

²³ https://rada-uzhgorod.gov.ua/uploads/sites/2/2018/10/uzhgorod_final-Strategiya-Uzhgorod-2030.pdf

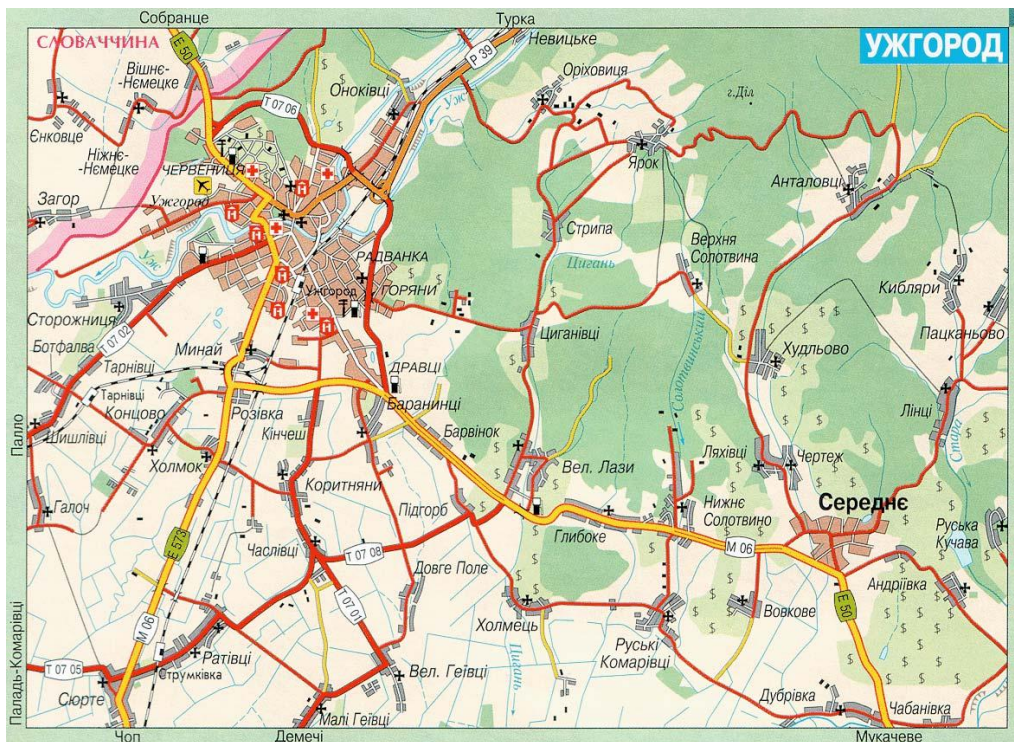


Fig. 2.3. Detailed road map of Uzhhorod²⁴

Street network. The planning structure of Uzhhorod is formed according to a radial-ring scheme, therefore the main traffic load falls on the central part of the city. The total length of street networks is approximately 240 km. 9 bridge structures are operated on city roads, including 5 reinforced concrete, 2 metal, 2 stone. There is one pedestrian and three transport bridge crossings over the Uzh River in the city.

In the city, there are three overpasses above the railway, which are located at the intersection of the streets: Budyteliv, Ruska and bypass road.

In addition, the city has an organized network of one-way streets in the central part of the city: Voloshyna, Pidhradska, Dukhnovycha, Luchkaia, Koriatovycha, Fedyntsia, Krylova, Ferentsia Rakotsi, Hoidy, Lomonosova, Mukachivska, Ruska, Mytraka, Peremohy (from Svobody Avenue to Lva Tolstoho str.), Babushkina Avenue.

Pedestrian streets for today are the embankment on both banks of the Uzh River from the bridge crossing in the middle of Svobody Avenue to the existing pedestrian bridge, Korzo str., part of the Voloshyna str., Teatralna Square and ta Shandora Petefi Square, a section of Pravoslavna embankment (in the area of the existing pedestrian bridge).

The total length of the main streets of Uzhhorod is 112 km, including citywide is 48 km, district is 64 km. The density of the main street network is 2.5 km/sq. km.

Railways. The Uzhhorod railway junction is located on the main electrified route Lviv-Sianky-Chop, which is connected by the line to Slovakia, Uzhhorod 2-Pavlove-derzhkordon-Matytvsi (Slovakia).

Railway station "Uzhhorod" by the nature of work is cargo, cross-border and transmission, by the scope of work it is classified as extracurricular. Works in 3 directions: Uzhgorod-Sianky, Uzhhorod-Chop, Uzhhorod 2-Pavlove. The Uzhhorod branch of the Lviv Railway annually transports 3.5 million tons of cargo and sends more than 10 million passengers, including suburban transportation.

The Transcarpathian Regional KP "International Airport "Uzhhorod" carries out **air transportation**. The year of birth of the airport is considered 1924. The airport was intensively used

²⁴ <http://www.ua-maps.com/map-86/print>

in 1987-1990, when it received 18 planes a day and transported 146,000 passengers annually. The airport has been open to international traffic since 1992. The total area of the airfield is 97.12 hectares. The paved runway is 2,040 m long and can accommodate aircraft AN 24, AN 26, YAK 40, YAK 42, L 410, CESNA, FALKON.

Currently, with the military aggression of the Russian Federation against Ukraine, airlines have suspended flights indefinitely.

Checkpoints. In Uzhhorod, there is an international passenger and cargo checkpoint "Uzhhorod-Vyshnie Niemetske" for road traffic on the state border of Ukraine with the Slovak Republic, and an international checkpoint "Uzhhorod-Airport" for air traffic.

2.4 Specificity of neighbouring territorial communities, their impact on Uzhhorod in the field of waste management and the consequences caused by military action

Specificity of neighbouring territorial communities in the field of waste management

Uzhhorod territorial community borders the Onokivska, Baranynska and Kholmkyvska territorial communities.

The largest landfill in Transcarpathian is located on the territory of the Baranynska territorial community in the village Barvinok. This community can also be considered as a location for the establishment of a central waste treatment facility.

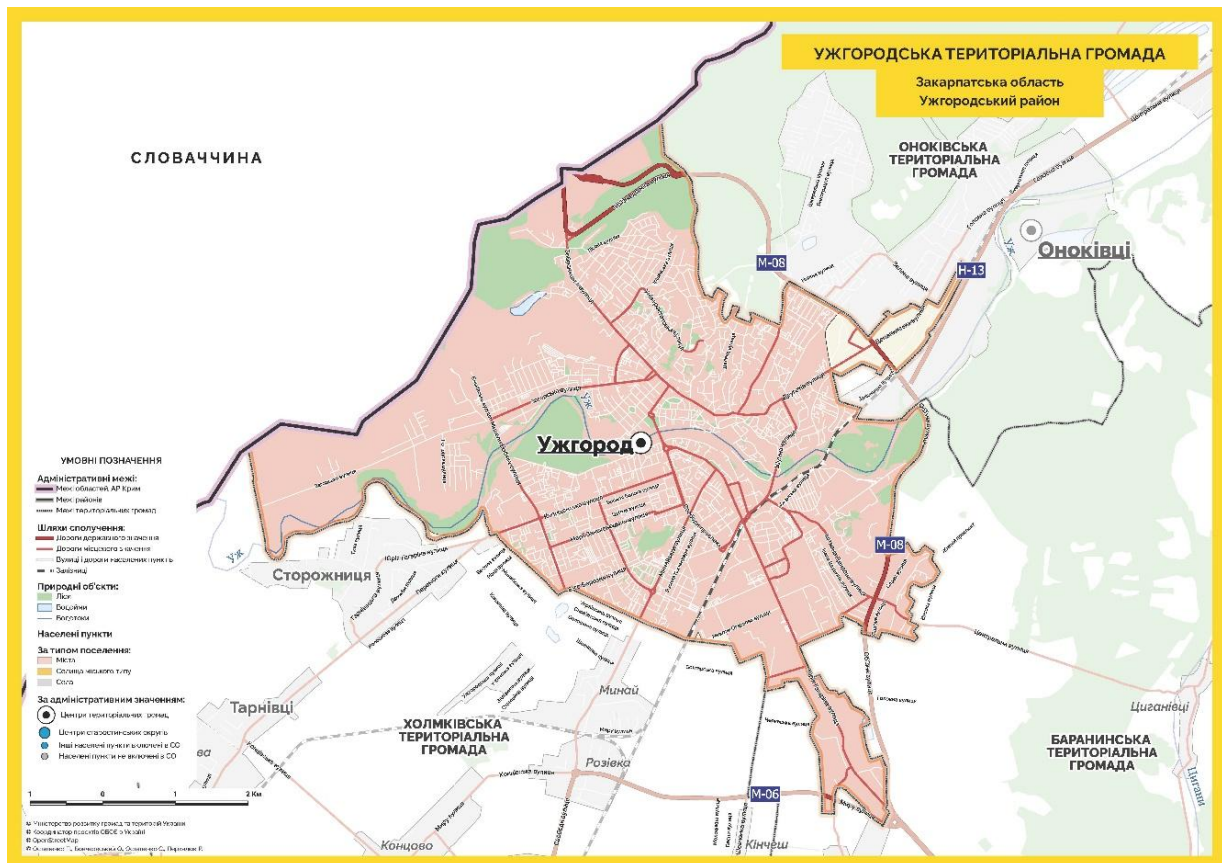


Fig. 2.4. Map of the Uzhhorod territorial community²⁵

Neighboring communities, in this case, can be taken into account as a potential area of coverage for the municipal waste management service. Thus, the construction of a central waste treatment facility will be economically more favorable if it serves the surrounding communities.

²⁵<http://surl.li/dlogs>

Consequences caused by military events

No direct damage to equipment, machines and mechanisms, structures and buildings of waste management facilities on the territory of Uzhgorod was detected.

As a result of military events, as of October 1, 2022, about 50,000 internally displaced persons live in Uzhgorod. This caused a sharp increase in the amount of waste in the city. As of October 1, 2022, about 50,000 internally displaced persons live in Uzhhorod. According to Ms Natalia Yakubyk, Director of AVE Uzhhorod LLC, the amount of waste in the city has increased sharply by 18%. In March 2022, the average daily rate was 871 cubic meters per day, at that time in January and February this figure was 740 cubic meters²⁶.

During the war, the largest recycling station in the region "Proektna, 3" did not stop working, despite the drop in prices for recycled materials. Because of the Russian aggression, the station made certain adjustments to its work and now accepts only waste paper, polyethylene film, PET bottles and transparent glass²⁷.

According to the results of analyzing the available data regarding the natural conditions and socio-economic characteristics of Uzhhorod, the key factors that must be taken into account for the formation of waste and green waste management system are:

- peculiarities of the relief of the city - the location of part of the city on the hills;
- historical city with a valuable preserved architectural and planning heritage and individual houses;
- the tendency to increase the number of the population in the city;
- increase in the number of internally displaced persons;
- development of local tourism.

²⁶ <https://ekosfera.org/yak-zminylas-sytuacziya-z-vidhodamy-na-zakarpatti-za-2-misyaczi-vijny/>

²⁷ <https://pravdaje.com.ua/yak-zminylas-sytuacziya-z-vidhodamy-na-zakarpatti-za-2-misyaczi-vijny/>

CHAPTER III. ANALYSIS OF THE CURRENT STATE OF THE WASTE MANAGEMENT SYSTEM IN UZHGOROD

3.1 GENERAL CHARACTERISTICS OF THE WASTE MANAGEMENT SYSTEM IN UZHGOROD

The waste management system includes a set of measures for collection, transportation and treatment, including the creation of waste treatment facilities, including waste disposal facilities.

Waste means any substances, materials and objects formed in the process of production or consumption, as well as goods (products) that have completely or partially lost their consumer properties and have no further use at the place of their formation or detection and from which their holder discards or intends or is required to discard or must dispose of by utilization or disposal.

The situation with waste both in Ukraine and in the Transcarpathian region is characterized by the presence of a large amount of generated waste both in industry and in households, and their accumulation in the territory of settlements, the use of outdated technologies and waste management infrastructure or their absence, including utilization and disposal of waste is carried out improperly, the use of waste as a secondary raw material is low, implemented economic tools are ineffective or have low ineffectiveness.

The goals and objectives of the field of waste management must be consistent with EU Directives and the Strategy for the development of this field in Ukraine. In the Transcarpathian region, including Uzhgorod, the goal is to cover all residents with an organized system of waste collection and transportation, which should be cost-effective and ensure effective collection and transportation of municipal waste (MW). Municipal solid waste management must be carried out in accordance with state norms, standards and rules. One of the main directions of state policy in the field of waste management is to ensure the integrated use of material and raw materials and to promote the maximum possible utilization of waste through direct, repeated or alternative use of valuable components.

3.2. CURRENT STATE OF THE WASTE MANAGEMENT SYSTEM BY TYPES OF WASTE IN UZHGOROD

All waste in Uzhgorod includes two main groups: communal or municipal solid (domestic waste from the sphere of consumption and everyday life, which is taken care of by the city council) and industrial waste (production waste). These two groups, in turn, are divided into subgroups of waste, which differ in their properties, aggregate state, places of formation, collection and disposal technologies, processing and utilization, etc. The largest group of waste is municipal waste, in which municipal solid waste (MSW) is the main subgroup.

3.2.1 GENERAL CLASSIFICATION AND CHARACTERISTICS OF MUNICIPAL WASTE

Municipal waste mean mixed and/or separately collected waste from households, including waste paper, cardboard, glass, plastic, wood, textile, metal, packaging, bio-waste, waste electrical and electronic equipment, waste batteries and accumulators, hazardous waste from the household, bulky and repair waste, as well as mixed and/or separately collected waste from other sources, if this waste is similar in composition to municipal waste.

According to the place of generation, municipal waste (MW) is divided into waste from residential buildings (high-rise buildings and individual buildings); waste from administrative premises of enterprises, organizations and institutions, offices, agencies; waste from educational institutions of preschools and children's institutions; waste of public cultural and household and other institutions; waste from hospitals, pharmacies, sanatoriums, rest houses; waste of trade enterprises (markets, shops, kiosks); waste of railway stations, airports, etc.

According to the morphological composition, MW is divided into food waste, bones, paper, cardboard, wood, textiles, polymer materials (plastic, polymer film, PET bottles, etc.), leather, rubber, ceramics, glass, metals (ferrous and non-ferrous), etc.

Municipal waste generated in Uzhhorod includes municipal solid waste (MSW) (including recyclables and bio-waste), bulky waste (BW), construction and demolition waste (CDW), hazardous waste (HW) as part of municipal, waste electrical and electronic equipment (WEEE).

Municipal solid waste is mixed waste from the residential sector, administrative institutions, and commercial establishments, which contains resource-valuable components (recyclable raw materials) and bio-waste (waste from green areas, food waste, and other plant waste).

Secondary raw materials - waste as secondary raw materials include the waste that can be used in industry as secondary raw materials or from which products can be directly manufactured (paper, cardboard, glass, polymers, household scrap metal, as well as part of the organic component of municipal waste (mainly of plant origin)).

Green waste is waste generated in the adjacent areas of residential areas (including the private sector), green areas of the city and industrial zones in the process of taking care of green areas.

Food waste is food products that have become waste.

Bulky waste means an independent subgroup of MW, which due to their overall dimensions does not fit into standard containers. These are old furniture, refrigerators, washing machines, large plumbing products, tree trunks, etc.

Construction and demolition waste means the remains of substances, materials, objects, and products that were formed during conversion, redevelopment or current repair in a residential building, a separate apartment or a public building, are considered as an independent mixed group of waste in the class "Construction work waste, demolition of buildings and structures..." (code 451 according to the State Classifier of Ukraine DK 005-96 "Waste Classifier"²⁸).

Hazardous waste generated in everyday life means fluorescent mercury lamps, mercury thermometers, chemical sources of current (acid and alkaline accumulators, batteries, capacitors, etc.), remnants of household appliances, office equipment, etc., which contain heavy metals and other toxic or poisonous substances. HW are partially present in the total volume of MSW.

Waste electrical and electronic equipment means any electrical and electronic equipment, including all components, assemblies and consumables that are components of the equipment.

Municipal solid waste, by its composition and place of generation, does not fully fall under one code of the Waste Classifier, because it is mixed waste and the places of its generation are all non-industrial objects of the city.

Municipal waste does not include waste from industry, agriculture and forestry, fishing and aquaculture, septic tanks, sewerage networks and waste from their treatment, including sewage sludge, end-of-life vehicles, construction and demolition waste, street garbage, and medical waste.

Permanent, temporary and pendulum (day) residents and guests of the city are sources of municipal waste generation in Uzhhorod. The objects of the formation of municipal waste are residential buildings, administrative and public organizations and institutions, trade and household service enterprises, and institutions of culture, education, medicine, recreation and entertainment.

3.2.1.1 MUNICIPAL WASTE MANAGEMENT SYSTEM

Municipal waste management system in Uzhhorod is a complex of measures for the collection, transportation and treatment (recovery/disposal) of municipal waste, which includes the activities of municipal waste disposal facilities (municipal waste landfills for waste disposal) and business entities that carry out separate municipal waste management operations (enterprises for waste transportation and landfill) within the city.

²⁸ <http://plast.vn.ua/DK005-96.html>

As of 2022, in Uzhhorod, the system for municipal waste management from all generators (households and from other sources, if this waste is similar in composition to municipal waste) is as follows:

- collection of municipal waste - separate collection of individual components of municipal waste is partially carried out, with the aim of their further treatment (re-use/recycling/recovery) and their processing;
- transportation of municipal waste is carried out - mixed to the waste disposal site (MWW), separately collected waste components - to the relevant business entities;
- treatment of municipal waste by removing mixed MSW to a landfill and sorting separately collected MSW components (preparation process for further treatment), MSW recovery does not occur.

There is no system of communal waste collection points, which are provided for by the National Waste Management Strategy until 2030 on the territory of Uzhhorod.

BUSINESS ENTITIES IN THE FIELD OF WASTE MANAGEMENT

Two enterprises in Uzhhorod in 2022, according to the provided data, were involved in the field of municipal solid waste management: AVE-Uzhhorod, LLS (Uzhhorod, 7, Pravoslavna Embankment) (transportation) and Communal Motor Vehicle Enterprise-072801 (KP “KATP-07280”) (Uzhhorod, 3 Pogorelova st.) (landfill).

As of 01.01.2022 (according to 1-TPV data for 2021), 90% of the city's population is covered by services for the transportation of municipal solid waste. MSW is collected using a container system.

As of 2022 AVE-Uzhhorod, LLC's special vehicle fleet is 60% obsolete. Table 3.1 illustrates a more detailed description of the technical support of the municipal solid waste collection system in Uzhhorod.

Table 3.1. Technical support of the municipal solid waste collection system in Uzhhorod (2012-2021)²⁹

Characteristic	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Coverage of the population by municipal solid waste collection services (%)	*	*	*	65	71	94	95	95	95	90
Number of enterprises in the field of municipal solid waste management (units), total, incl.	*	*	*	2	2	2	2	2	2	2
- communal	1	1	1	1	1	1	1	1	1	1
- private	*	*	*	1	1	1	1	1	1	1
Number of workers in the field of municipal solid waste management, total (persons), incl.	*	*	*	78	90	106	106	106	102	104
- in communal	23	21	20	20	20	20	20	20	20	21
- in private ones	*	*	*	58	70	86	86	86	82	83
Number of garbage	*	*	*	17	15	11	11	14	15	17

²⁹ Data from 1-TPV forms, 2012-2021

Characteristic	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
trucks at enterprises, total (units), incl. on balance:										
- communal companies	*	8	8	8	7	–	–	–	–	–
- private	*	*	*	9	8	11	11	14	15	17
Deterioration of special vehicles, %	*	*	*	*	*	50	60	70	50	60
- communal companies	*	94.0	95.4	96.8	98.0	–	–	–	–	–
- private	*	*	*	0.44	50	50	60	70	50	60

*Data not available

COLLECTION, TRANSPORTATION AND TREATMENT OF MUNICIPAL WASTE BY TYPES

Municipal solid waste (MSW) (mixed)

In order to reduce the amount of recyclable material in the composition of MSW, the population is encouraged to hand it over to reception points and a system of centralized separate collection of MSW is partially implemented with the aim of separating individual components of MSW as secondary raw materials - separate collection of resource-valuable components into a separate container (or several containers) with further transportation on special recycling lines.

The existing municipal solid waste management system in Uzhhorod includes their initial accumulation in waste collection containers for mixed and separate collection of municipal solid waste (PET bottle, glass, paper), located at container sites, and collection and transportation by specially equipped vehicles (garbage trucks) to the city municipal waste landfill (Fig. 3.1). For waste collection in those areas of the city, where the possibility of passage of garbage transport and its maneuvering is limited, the containerless method is used by using bags (black or with appropriate marking).

For the collection of MSW, both planned yard and planned municipal waste collection systems are used (container method using non-changeable containers for municipal solid waste of different capacities, metal and plastic (including euro-containers 1.1 cub. m, containers 240 l) and the containerless method. The choice of the type of containers for MSW and their arrangement is carried out independently by local self-government bodies. Residents, janitors, cleaners, etc., remove MSW from the premises (mainly in plastic bags) and put them in garbage containers. Some of the containers are installed in groups at container yards, and some are installed one at a time. Arrangement of container sites is not always carried out in accordance with the requirements of current legislation, including DSanPin "State sanitary standards and rules for maintaining the territories of populated areas".

The planned yard system for collecting mixed MV is used to collect waste in the residential sector from residents of multi-apartment buildings, individual houses of individual manor buildings (which have installed waste collection containers) and partly from organizations, institutions and enterprises (container method). The planned apartment system is for waste collection in the areas of manor buildings (containerless method).

Thus, from residents of multi-apartment buildings and individual houses of manor buildings (which have installed waste collection containers), partially from organizations, institutions and institutions, municipal solid waste transportation is carried out according to a modern planned and regular system, in which waste generators at a convenient time take out waste into containers, where according to the schedule, waste is loaded into garbage trucks and taken out for placement at a municipal waste landfill.



MSW containers on container yard



separately installed MSW containers



containers for recycling at the container yard



separately installed containers for recycled materials



special bag with the corresponding marking



equipped container yards



underground site for collecting MSW (maintenance of the new building on Hoyda St.)



collection of MSW by specially equipped vehicles



transportation of MSW by specially equipped transport to MSW landfill

Fig. 3.1. MSW management in Uzhhorod

Although MSW removal is carried out according to a planned and regular system for the residents of manor building, the use of the planned apartment system is less convenient, which forces them to take out waste only at a certain set time (day of the week). Residents take MSW out of the premises (mainly in plastic bags or other containers) and store them near the houses, then the bags are loaded into a garbage collection vehicle that moves according to the set route and schedule, and taken to the municipal waste landfill. Also, residents of private sector houses carry out partial burial and processing (feeding food waste to domestic animals, burning, turning it into manure) of municipal waste on their own in their estates.

MW management is carried out on a contractual basis between the waste generator (consumer of services) and business entities that carry out separate waste management operations (service providers) according to a planned and regular system according to routes and schedules developed by transport companies. Payment for services is made according to approved tariffs.

In Uzhhorod, the procurement of secondary raw materials is practised through procurement acceptance points and other procurement networks that accept: waste paper (cardboard, paper), glass (glass and scrap glass), PET bottles, some types of polymer film, metals (ferrous and non-ferrous, aluminium cans) etc. Secondary raw materials are collected and distributed to the population, trade establishments (wholesale bases, markets, department stores, department stores, mega markets, supermarkets, shops, kiosks, etc.), and other organizations and enterprises. After sorting at collection points, the recyclables are transported by specially equipped transport to a specialized enterprise for sale.

In the Environmental Passport of the Transcarpathian Region as of January 1, 2021³⁰ it is indicated that a separate collection of municipal solid waste (glass, plastic, waste paper and scrap metal) has been implemented in Uzhhorod. In the city, there is a recycling center "Proektna, 3". Resource-valuable municipal solid waste components are transferred to specialized enterprises (there are 51 economic entities in the oblast, 11 is in Uzhhorod). The collected waste is mainly sent for realization outside the oblast.

See Annex B for the list of business entities that collect and provision waste as secondary raw materials in Uzhhorod and Transcarpathian region (according to the "Environmental Passport of Transcarpathian region for 2021").

Bio-waste (and green waste)

Green waste is formed in the adjacent areas of residential areas, green areas of Uzhhorod and industrial zones in the process of taking care of green areas, are collected in the places of formation (during the performance of work by employees of communal enterprises, for example, when trimming trees, bushes and lawns) or accumulate at container sites, after which they are transported by dump trucks to a site for storing such waste and a MSW landfill (Fig. 3.2). Separate statistical accounting of volumes of green waste generation and transportation is not conducted.



Fig. 3.2. Area for storage and crushing green waste (branches)

³⁰ <http://surl.li/dloae>

The population of the private sector of Uzhhorod, after carrying out work on their homesteads, either compost part of it on the territory of their own households, or also carries out the transportation of all organic waste (including leaves and grass) by their own transport or ordered transportation from a communal service.

The issue is considered in more detail in Part II of this Analysis.

Bulky waste (BW)

BW is collected separately from other types of MW into special containers for the collection of BW (Fig. 3.3), which are installed at container sites where there is a need and a place to install such containers, then, as they accumulate, they are transported to the waste disposal site (MSW landfill) by special vehicles: according to the conditions of a typical individual public contract on provision MSW management services with a municipal solid waste management service provider (from the population category) and under individual contracts for the provision of BW waste transportation services with a the transportation of municipal waste with a service provider for MSW management - for other consumers (who do not fall under the population category) according to approved tariffs. From houses of individual manor buildings, where special containers are not installed, municipal solid waste is collected by municipal solid waste management service providers according to developed separate collection and removal schedules or by order. Starting in 2021, a separate statistical record of the volumes of generation and transportation of BW is in place, the transportation of which is carried out by the enterprise for consumers of the population category.



Fig. 3.3. BW management in Uzhhorod

Due to the insufficient number of installed containers and violations by residents of the rules for collecting and transporting of BW, they often accumulate in places not designated for this purpose (Fig. 3.4).



Fig. 3.4. Accumulation of BW at container sites

Construction and demolition waste (CDW)

CDW is collected separately from other types of MW in special containers for collecting CDW. Accumulation also occurs in bags near container sites and/or private estates (from residents of all types of buildings) (Fig. 3.5). As they accumulate, CDW is transported to the waste disposal site (MSW landfill) by special vehicles: according to individual contracts for the provision of services for the transportation of municipal waste with a service provider for MSW management - from the population category and for other consumers (who do not fall under the category of the population) according to tariffs (separate contracts between the waste owner and the transportation service provider). There is no separate statistical accounting of the volume of the formation and transportation of CDW.



Container for collecting CDW



Accumulation of CDW in the city



Fig. 3.5. CDW management in Uzhhorod

Hazardous waste (as part of municipal waste) (HW)

Hazardous waste can create a significant danger for the natural environment and human health and require special methods and means of handling it. Households, organizations and institutions, vehicle maintenance and service, medical institutions, etc., are the sources of HW generation. There is no separate collection of hazardous waste as part of municipal waste (acceptance/collection/removal of hazardous waste as part of municipal waste from the population), separate collection of hazardous waste as part of municipal waste in the territory of the Transcarpathian Region.

A system of separate collection, accounting of the volumes of accumulation and transportation for further disposal of hazardous waste (as part of municipal waste) from the population (used electrical and electronic devices, lamps containing mercury, chemical current sources, batteries and accumulators, machine parts with heavy metals (the so-called high-tech waste); containers with the remains of paints, varnishes, inks, dyes, glues, lubricants, oil products, cosmetics, unidentified chemicals; medical waste (unused drugs; disposable syringes, etc.) generated by the population in the residential sector; cutting, piercing and other trauma-dangerous objects, etc.), has not been implemented in Uzhhorod.

At present, in the city, hazardous waste is collected together with other waste without sorting at the collection stage, therefore, their transportation to specialized enterprises does not take place centrally - most of the hazardous waste is taken away and accumulated at the waste disposal site. There are no containers for the collection of municipal waste. Voluntary or private organizations, retail chain stores, individual institutions of the education system, gas station chains, and others conduct as a public action the collection of used batteries in special boxes, which are then transferred to specialized enterprises for further processing. Hazardous waste (as part of municipal waste) from institutions, organizations and enterprises is transferred by them directly to specialized enterprises for disposal under the relevant contracts. There are no studies on the volume of HW and their nomenclature.

In Uzhhorod, the population has the opportunity to hand over, on a paid basis, some types of waste (fluorescent lamps, mercury thermometers, used batteries) to enterprises that have a license in accordance with the List of licensees for the management of hazardous waste³¹, published on the official website of the Ministry of Environmental Protection and Natural Resources of Ukraine (Annex C). In Transcarpathian Region, according to the data of the List, there are 2 enterprises that carry out hazardous waste management operations. Technological equipment for the disposal of hazardous waste is available at "New Ecosvit" LLC (Uzhhorod, location: Uzhhorodskyi district, Kinchesh village, microdistrict "Bazy").

Medical waste, vehicle waste, etc. are also occasionally found at the MSW landfill as part of the MW (Fig. 3.6). The system of centralized management of vehicle waste (old abandoned cars, worn tires, discarded batteries, used oils, motor and other lubricants, filters, coolants, etc.) is absent. Enterprises engaged in the operation, repair and maintenance of vehicles and in which these wastes are generated conclude contracts directly with organizations that are engaged in the collection and disposal of such wastes. Vehicle waste from private individuals is often taken to a landfill together with municipal waste. Places of formation are public and private sector, garage cooperatives of the city territory.



Accumulation of medical waste as part of municipal waste



Vehicle waste

Fig. 3.6. Hazardous/specific waste (as part of municipal waste) on the territory of Uzhhorod

Waste electrical and electronic equipment (WEEE)

WEEE collection system from the population in Uzhhorod has not yet been established. Currently, WEEE is accumulated at container sites (Fig. 3.7), collected together with other municipal waste without sorting at the collection stage, transported and accumulated at a MSW landfill.



Waste electrical and electronic equipment



Fig. 3.7. Accumulation of WEEE on the territory of Uzhhorod

³¹ License register (hazardous waste management) (June 8, 2022) // <http://surl.li/ahbla>

MUNICIPAL WASTE TREATMENT FACILITIES

Treatment of municipal waste consists of its recovery and/or removal, including preparation of waste for such operations, and depends on the adopted technological scheme of municipal waste collection. Recovery/disposal of municipal waste takes place at waste treatment facilities in accordance with the accepted treatment technology (lists of MSW recovery/disposal operations are provided in the Law of Ukraine "On Waste Management"). The most common operation for the disposal of municipal waste after the operation for its recovery, which does not involve further processing of the waste, is its burial, namely, the unusable residue.

As of 2022, municipal waste generated on the territory of Uzhhorod is taken for disposal to the waste disposal site (MVV) – the municipal waste landfill of Uzhhorod (in the village Barvinok) (MVV passport dated February 19, 2008, registration number No. 5-a (Annex D)). The environmental safety category of MVV is "A" (low risk). The established sanitary and protective zone of the MVV is 500 m and is maintained. The owner of the MVV is KP "KATP-072801" (Uzhhorod, 3 Pogorelova St.).

The location of the municipal waste landfill in Uzhhorod (in the village Barvinok) is Transcarpathian Region, Uzhhorod district, village Barvinok, distance from the settlement is 3.2 km from Uzhhorod, distance from watercourses and reservoirs is 2.0 km, from water intake structures is 2.3 km. The design area of the municipal waste landfill is 9.0 hectares (3 hectares of which are occupied by landfill). In addition to the main structure - the MSW storage area - the elements of the municipal waste landfill are access roads with a hard surface, an economic zone, main structures and networks of the municipal waste landfill.

The municipal waste landfill of Uzhhorod (in the village Barvinok) is operational and has been functioning since November 1998 under the project of ZFDPRI "Ukrkomundorproekt" (Uzhhorod). The estimated term of its operation is 25 years. At the MVV, there is documentation regarding the accounting of receipt and disposal of waste in accordance with agreements and the accounting of transport flights. As of January 1, 2022, the total volume of disposal waste amounted to 5.741 million cub. m.

The MSW landfill is of the open surface bulk type, geomorphologically, it is located on a slope, and three underground storage sites (pits) have been built on the allocated land. The absolute surface marks are 134.5 m (top) and 124.5 m (bottom). The capacity of the aeration zone is 2.0 m, and the composition and structure are natural loam. The depth of underground water is 5.0 m, conditionally protected. Groundwater is spontaneous and seasonal, located at a depth of 4.0-5.0 m. The presence of filtration phenomena is runoff during precipitation.

Waste sorting before disposal and measures for their disposal is not carried out at the landfill; waste is stored for disposal in layers with clay layers.

Means of protecting the environment from pollution at the municipal waste landfill in Uzhhorod (in the village Barvinok): there is no bottom insulating screen, and there is a perimeter embankment and earthen drainage ditches.

Observation (monitoring) of the quality of underground water is carried out by the exits of underground (drainage) water to the surface, by the quality of soils, atmospheric air and surface water by the city SES.

Another existing infrastructure of waste treatment in Uzhhorod (garbage sorting lines, waste transfer stations, installations for incineration and other methods of thermal treatment of municipal waste, facilities for recycling biodegradable waste, facilities for anaerobic decomposition, facilities for mechanical-biological waste treatment) is absent, new facilities planned by the Regional Plan have not been built.

NORMS FOR THE ACCUMULATION OF MUNICIPAL WASTE

Table 3.2 illustrates the norms for providing services for the transportation of municipal waste³².

Table 3.2. Norms for the provision of municipal waste transportation services in Uzhhorod

No.	Name	Unit	Daily volume of municipal waste formation on the average in a year		Volume of MSW formation on average in a year		Density
			kg	l	kg	m ³	kg/m ³
1. Residential buildings							
1.1	One-apartment houses with a courtyard in the absence of one of the types of landscaping - central heating	1 resident	1.105	6.36	403.33	2.32	173.74
1.2	Apartment buildings in the absence of one of the types of improvement - central heating	1 resident	1.37	6.28	500.05	2.29	218.33
2. Enterprises, institutions and organizations							
2.1	Hotel	1 place	1.44	7.3	525.6	2.66	197.26
2.2	Hostel	1 place	0.81	3.7	295.65	1.35	218.92
2.3	Medical institutions:						
	- hospital	1 place	1.25	8.1	456.25	2.96	154.32
	- polyclinic	1 visit	0.01	0.063	3.65	0.02	158.73
2.4	Administrative institutions and organizations	1 workplace	1.12	4.7	408.8	1.71	238.3
2.5	Educational institutions:						
	- institution of higher education	1 student	0.13	0.68	47.45	0.25	191.18
	- school	1 pupil	0.986	0.48	35.99	0.17	205.42
	- children's preschool	1 place	0.273	1,2	99.65	0.44	227.5
2.6	Trade enterprises:						
	- market	1 m ² of retail space	0.18	0.675	60.93	0.23	266.67
	- grocery store	1 m ² of retail space	0.33	1.8	111.71	0.61	183.33
	- hardware store	1 m ² of retail space	0.13	0.75	44.01	0.25	173.33
2.7	Catering enterprises:						
	- restaurant	1 place	1.09	4.8	397.85	1.75	227.08
	- cafe	1 place	0.64	3,4	233.6	1.24	188.24

Note: MSW generation norms for generation objects, which are not specified in the table, are applied by analogy to objects similar in type of activity

The norm for the provision of services for the transportation of bulky waste is set at 0.09 cub. m/inhabitant per year (approved by the Decision of the Executive Committee of the Uzhhorod City Council from 15.06.2022 No. 219 "On approval of the norms for the provision of services for the transportation of bulky waste in Uzhhorod"³³).

³² <https://rada-uzhgorod.gov.ua/media/1/%D1%80-192.pdf>

³³ <http://surl.li/dsjxs>

TARIFFS FOR MUNICIPAL WASTE MANAGEMENT SERVICES

Tariffs for municipal waste management services were approved by the Decision of the Executive Committee of the Uzhhorod City Council from February 4, 2022 No. 14 "On tariffs for municipal waste management services"³⁴ (Table 3.3).

Table 3.3. Tariffs for municipal waste management services in Uzhhorod

No	Type of municipal waste	Tariff for the service of municipal waste management, UAH/m ³ (with VAT)*		
		general	transportation	landfill
1	Solid	185.60	158.99	26.61
2	Bulky	263.17	236.56	
3	Construction and demolition	299.18	272.57	

Note: *Tariffs for municipal waste management services are established in accordance with the Law of Ukraine "On Housing and Communal Services" and based on calculation materials provided by LLC "AVE-Uzhhorod" (transportation) and KP "KATP-072801" (landfill).

VOLUMES OF GENERATION, TRANSPORTATION AND DISPOSAL OF MUNICIPAL WASTE

Accounting for the generation and further MW management is carried out according to form 1-TPV (reporting of the Ministry of Community and Territorial Development of Ukraine (Minregion)), as well as form 1-waste (State Statistics Service of Ukraine). Information from the listed two sources is usually not comparable. For the purposes of this Analysis in the part related to MW, Minregion data are taken as a basis. In this Analysis data analysis is carried out for municipal waste management as a whole, since the accounting is kept without dividing into municipal waste generated in households and waste similar to municipal waste generated in organizations and institutions of the city. According to the received data (form 1-TPV), in Uzhhorod from 2016 to 2021 there was a tendency to increase the volumes of municipal waste generation and disposal at the municipal waste landfill (Table 3.4, Table 3.5). However, in 2021, the volume of MSW generation amounted to 260,871 thousand cub. m, which is 0.6% less than in 2020 (Fig. 3.8), the volume of disposal at the MSW landfill in 2021 was 319,302 thousand cub. m, which is 1.5% less than in 2020 (Fig. 3.9), which is related to the difficulty of recording and transmitting data due to the epidemiological situation.

The available volumes of waste generation and transportation from Uzhhorod indicate that part of the territories, for various reasons, are not sufficiently covered by the system of organized waste collection. Despite the fact that almost 90% of the population is covered by municipal waste collection services, from time to time spontaneous (unauthorized) dumps are formed on the territory of the city, near container sites, roadsides, in parks, gullies and ravines (Fig. 3.10), therefore constantly work is being carried out to identify and eliminate them. See Annex E for the list of places of formation of spontaneous dumps in Uzhhorod.

³⁴ <http://surl.li/dsjxt>

Table 3.4. Volumes of collection and transportation of municipal waste (according to the data of form 1-TPV) (AVE-Uzhhorod, LLC) (2016-2021)

Type of waste	Year	Collection volumes		Volumes of transportation		including on					Amounts received for processing and/or disposal	Volumes of waste after sorting are those of the selected raw materials and valuable components	Volumes of processed residue, including transported to the landfill
						points of secondary raw materials		landfills		waste processing enterprises, t			
		cub. m	t	cub. m	t	cub.m	t	cub. m	t	t	cub. m	cub. m	cub. m
Mixed municipal solid waste	2016	185,496	61,823	185,496	61,823	-	-	185,496	61,823	-	-	-	-
	2017	194,537	35,912	-	-	-	-	194,537	35,912	-	-	-	-
	2018	227,821	68,346	227,821	68,346	-	-	227,821	68,346	-	-	-	-
	2019	239,562	59,883	239,562	59,883	-	-	239,562	59,883	-	-	-	-
	2020	262,400	65,600	262,400	65,600	-	-	262,400	65,600	-	-	-	-
	2021	250,120	-	250,120	-	-	-	250,120	-	-	250,120	250,120	250,120
Bulky waste	2016	-	-	-	-	-	-	-	-	-	-	-	-
	2017	-	-	-	-	-	-	-	-	-	-	-	-
	2018	-	-	-	-	-	-	-	-	-	-	-	-
	2019	-	-	-	-	-	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-	-	-	-	-	-
	2021	9,981	-	9,981	-	-	-	-	9,981	-	9,981	9,981	9,981
Others	2016	-	-	-	-	-	-	-	-	-	-	-	-
	2017	-	-	-	-	-	-	-	-	-	-	-	-
	2018	-	-	-	-	-	-	-	-	-	-	-	-
	2019	-	-	-	-	-	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-	-	-	-	-	-
	2021	770	-	770	-	770	770	-	-	-	-	-	-
Total	2016	186,366.1	62,209.3	185,469	61,823	-	-	185,469	61,823	299.192	-	-	-
	2017	194,537	35,912	-	-	-	-	194,537	35,912	-	-	-	-
	2018	227,821	68,346	227,821	68,346	-	-	227,821	68,346	-	-	-	-
	2019	239,562	59,883	239,562	59,883	-	-	239,562	59,883	-	-	-	-
	2020	262,400	65,600	262,400	65,600	-	-	262,400	65,600	-	-	-	-
	2021	260,871	200.7	260,871	200.7	770	200.7	260,101	-	-	260,101	260,101	260,101

Table 3.5. Volumes of disposal of municipal waste (according to the data of form 1-TPV) (KP "KATP-072801" of the Uzhhorod City Council) (2012-2021)

Type of waste	Year	Volumes of landfilling at the landfill, cub. m	including	
			from the beginning of landfill operation, cub. m	for the reporting period, cub. m
Mixed municipal solid waste	2012	3,083,000	2,823,600	259,400
	2013	3,256,400	3,083,000	173,400
	2014	3,436,430.5	3,256,400	180,530.5
	2015	3,622,605.5	3,436,930.5	185,675
	2016	3,853,612	3,622,652	230,960
	2017	4,121,487	3,853,612	267,875
	2018	4,429,475	4,121,487	307,988
	2019	4,750,751	4,429,475	321,276
	2020	5,074,243	4,750,751	323 492
	2021	5,392,795	5,074,243	318,552
Bulky waste	2012	342,300	323,800	18,500
	2013	342,700	342,300	400
	2014	343 118	342,700	418
	2015	343 548	343 118	430
	2016	344,083	343 548	535
	2017	344,703	344,083	620
	2018	345 418	344,703	715
	2019	346 164	345,418	746
	2020	346,924	346,164	760
	2021	346,674	346,924	750
Total	2012	3,425,300	3,147,400	277,900
	2013	3,599,100	3,425,300	173,800
	2014	3,780,048.5	3,599,100	180,948.5
	2015	3966153.5	3,780,048.5	186,105
	2016	4,197,695	3,966,200	231,495
	2017	4,466,190	4,197,695	268,495
	2018	4,774,893	4,466,190	308,703
	2019	5,096,915	4,774,893	322,022
	2020	5,421,167	5,096,915	324,252
	2021	5,740,469	5,421,167	319,302

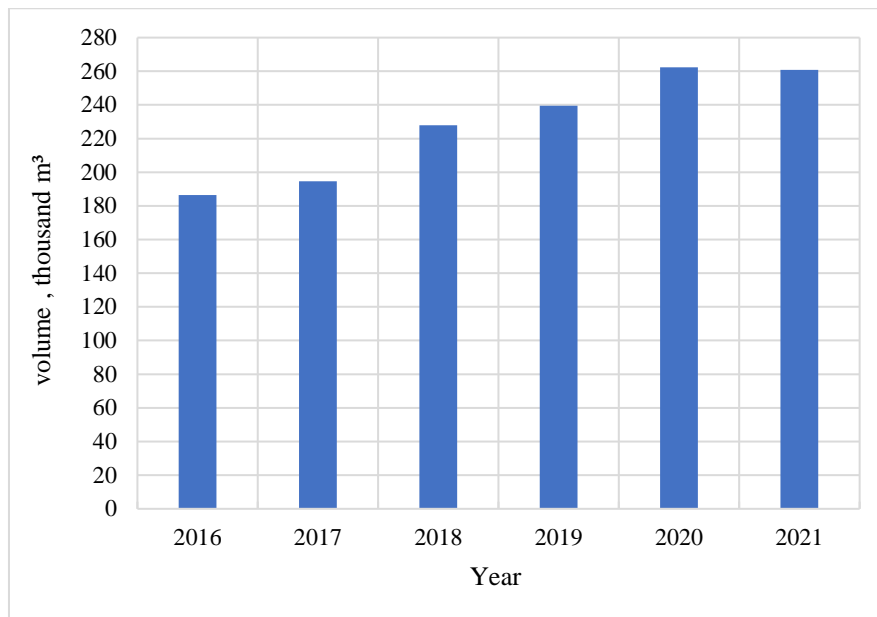


Fig. 3.8. Generation of municipal waste in Uzhhorod, 2016-2021, thousand cub. m
(according to available data provided by AVE Uzhhorod, LLC)

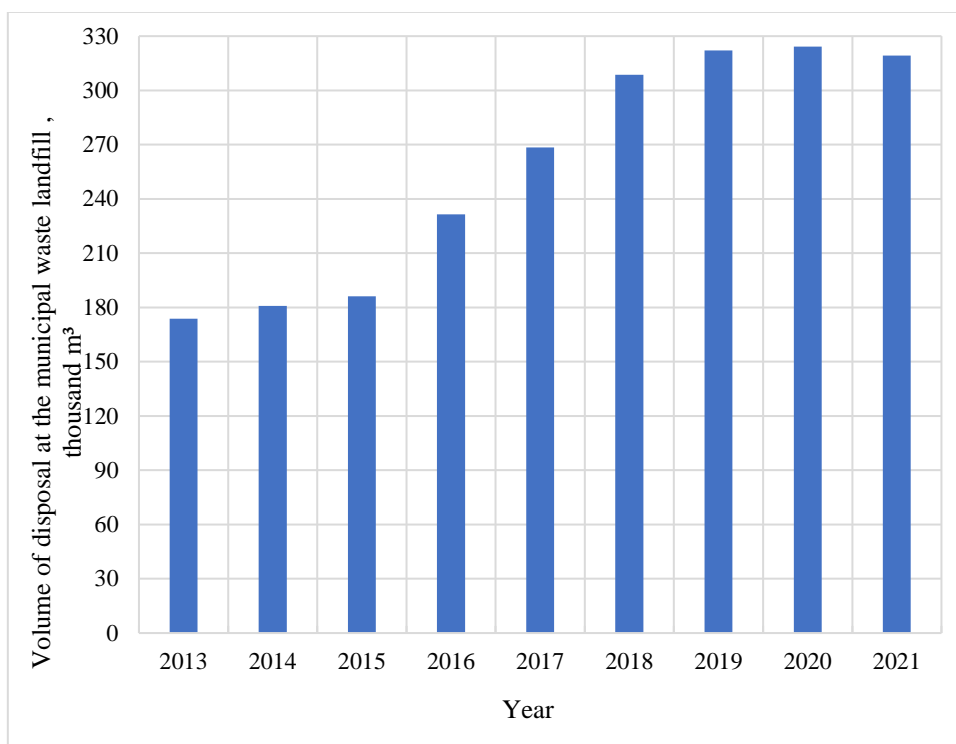


Fig. 3.9. Volumes of disposal of municipal waste at the MSW landfill in Uzhhorod, 2013-2021, thousand cub. m
(according to available data provided by KP "KATP-072801")



Fig. 3.10. Spontaneous dumps for municipal waste on the territory of Uzhhorod

3.2.1.2 PROBLEMS AND THREATS RELATED TO MUNICIPAL WASTE

Problems	Threats
<i>Sanitary and environmental</i>	
The state of MSW landfill and the presence of spontaneous dumps in the city, the presence of which does not meet the requirements of eco-safety, the operation is carried out without complying with the proper requirements, which leads to environmental pollution and poses a significant threat to the health of the population, especially when there are local sources of water supply (wells) next to undeveloped landfills of residents or during the ignition of landfills	The construction of a new landfill requires the allocation of a large area of land
According to the reporting forms 1-TPV, the landfill is overloaded	
Insufficient coverage of the population with municipal solid waste transportation services, which is the reason for the appearance of spontaneous dumps and the burning of municipal waste by the population in open space	
The lack of a developed infrastructure for municipal waste processing, which leads to a constant increase in the load on a functioning MSW landfill	
<i>Socio-economic</i>	
Limited financing for the implementation of environmental protection measures for waste management leads to inhibition of the development of municipal waste management infrastructure and to the continuation of the practice of their burial	Funds from the budgets will not be allocated to solving waste management issues
<i>Institutional</i>	
Absence of organic waste processing points, waste incineration plants and other waste disposal methods	
The lack of a clear accounting and information exchange mechanism, which leads to incomparability of data from different sources regarding the same waste indicators and, accordingly, to the complication of monitoring the situation and planning future activities	
Lack of a number of data, in particular, regarding the morphological	

Problems	Threats
composition of municipal waste, the implementation of primary accounting in cub. m, lack of information on the management of waste from the city's infrastructure	
Insufficient institutional capacity of local government bodies for municipal waste management, in particular excessive burden on officials who are responsible not only for waste management, but also other duties related to land use issues, etc.	

In order to obtain the public opinion and determine the efficiency of waste management in the territory of Uzhhorod, in particular, the quality of the municipal waste management service, identify the problems and needs of the city's residents, for the possibility of improving the provision of this service and determining ways of further reforming the waste management system, a sociological survey was conducted in October-November 2022.

According to the results of the survey (see Annex F), it was established that the majority of respondents are dissatisfied with the situation with waste management in the city, 96.6% support the implementation of separate collection, 71.1% are ready to increase the payment for the service of municipal waste management in the implementation of European management practices.

3.2.1.3 MEASURES TAKEN TO SOLVE EXISTING PROBLEMS AND THREATS RELATED TO MUNICIPAL WASTE

The main measures to solve existing problems and threats related to municipal waste are the prevention of waste suitable for recycling and recovery from entering municipal waste landfills by expanding the practice of separate collection of municipal waste, increasing the level of coverage of the population with the service of municipal waste removal, developing the MW processing infrastructure, implementation of a clear accounting mechanism and information exchange to control the situation and plan future activities in the field of MW management.

Gradually, in order to maximize the use of resource-valuable component waste in Transcarpathian Region, appropriate conditions are being created to attract investors for the purpose of building waste processing plants, implementing technologies for the use of alternative fuels, establishing a system for collecting, sorting and processing waste, reducing the number of waste disposal sites.

One of the problems of building new landfills for the collection and processing of municipal solid waste, as well as plants for the utilization of municipal solid waste in Transcarpathian, is the scarcity of land. In mountainous areas, it is almost impossible to find such land plots that would meet construction and sanitary standards for such construction. When planning the waste management system in the region, the removal of municipal waste from mountainous settlements to lowlands is envisaged, which causes additional social tension among the population of these areas. It is extremely difficult to obtain the consent of the population during public hearings according to the current legislation. Therefore, it is proposed to regulate this problem for the Transcarpathian region at the legislative level, as an exception, so that the allocation of such land plots takes place as measures to prevent ecological and man-made disasters.

Measures to eliminate unauthorized dumps and proposals to prevent their creation

The facts of the detection (statements, reports) of unauthorized dumps on the territory of the settlement are considered at the meeting of the commission on the management of stray waste, which determines the amount, composition, properties, cost of waste, the degree of their danger to the environment and human health, and takes measures to determine the owner of the waste. As a result, an act is drawn up and handed over to the local state administration/local self-government body to resolve the issue of further handling of stray waste. Ensuring the liquidation of unauthorized dumps (independently or by the decision of authorized bodies) is the authority of local self-government

bodies in the field of waste management. In order to prevent or reduce the volume of generation of stray waste, detected unauthorized dumps are taken into account.

The reason for the appearance of unauthorized dumps on the territory of settlements is the imperfection of the municipal waste management system (mostly in the private sector), including insufficient coverage of the population with municipal solid waste removal services, and low fines for violations of environmental legislation.

Measures to eliminate unauthorized dumps and proposals to prevent their creation are reduced to solving the issue of bringing waste management to the settlement to the requirements of current legislation.

Implementation of complex interrelated measures proposed in the Waste Management Programs in Uzhhorod will create conditions and help prevent the formation of spontaneous dumps on the territory of the city. The main ones are technical re-equipment of the MSW collection system (acquisition and renewal of the fleet of special machinery and equipment necessary for the performance of works and ensuring their continuity (collection and transportation of municipal waste), arrangement of sites for bulky waste and municipal waste, renewal of the fleet of containers for the collection of MSW, including special containers for the collection of secondary raw materials, CDW and BW), organization and establishment of a comprehensive system of municipal waste collection (including the implementation of a system of separate collection of municipal waste) and transportation of municipal waste from private households, compliance with municipal solid waste removal schedules and liquidation of existing spontaneous dumps and their reclamation within the city limits. In addition, in order to ensure compliance with environmental protection legislation and prevent the placement of spontaneous dumps, it is necessary to:

- intensification of work with the population, entrepreneurs, institutions and organizations regarding the conclusion of Agreements on the provision of services for municipal waste management (municipal waste removal services);
- carrying out campaigning and explanatory, environmental, educational and educational work with the population with the involvement of activists of public organizations regarding the need to comply with the rules of proper maintenance of the city territories, waste management, prevention of the formation of unauthorized dumps, implementation of separate collection of individual components of waste, etc. in order to improve environmental safety, including the systematic dissemination of such information through mass media and social networks.

It is important to control the implementation of all measures in accordance with the powers and in accordance with the current legislation.

All this will prevent the creation of unauthorized dumps in the city, save funds for their elimination, and thereby reduce the burden on the natural environment.

In addition to the implementation of the measures of the current regional and local programs, active informational and educational work is carried out regarding the management of municipal waste, including improving the qualifications of representatives of local self-government bodies and educational work among the population.

3.2.2 HAZARDOUS WASTE MANAGEMENT SYSTEM (INCLUDING SPENT PETROLEUM PRODUCTS; WASTE CONTAINING PERSISTENT ORGANIC POLLUTANTS)

Table G.1 (Annex G) shows the data on the management of waste of the I-IV hazard class and the volumes of their generation during 2012-2020 in Uzhhorod. Table G.2 (Annex G) shows the waste of I-III hazard class and volumes of their generation during 2017-2020 (according to the data of the Main Department of Statistics in Transcarpathian Region³⁵).

³⁵ Source: <http://www.uz.ukrstat.gov.ua/>

The management of hazardous waste generated by business entities is carried out directly by the business entities themselves, as well as with the involvement of specialized organizations that have the appropriate licenses.

State supervision (control) of compliance with the requirements of legislation on waste management, in particular, with regard to compliance with the requirements of documents of a permissive nature for carrying out operations in the field of waste management, transportation of hazardous waste through the territory of Ukraine, is carried out by the State Environmental Inspection.

To carry out operations in the field of hazardous waste management, 2 business entities of Transcarpathian Region have licenses from the Ministry of Environmental Protection and Natural Resources of Ukraine (Annex C).

Waste oils are petroleum products that, during their operation, have undergone changes in some of their properties regulated by regulatory documentation³⁶.

Waste oils include:

- lubricating and cooling fluids that contain halogens (non-emulsified), spent in metal forming processes (including forging, welding, pressing, drawing, turning, cutting and sawing);
- waste lubricants (oils) - hydraulic, motor, transmission and other lubricants (oils), brake and other fluids for insulation and heat transfer, which have become unsuitable for such use;
- absorbents, filter and wiping agents contaminated with oils;
- lubricating and cooling fluids that contain halogens (non-emulsified), spent in metal forming processes.

Waste oils are included as hazardous waste in Section A of the Yellow List of Waste, approved by the Resolution of the Cabinet of Ministers of Ukraine from 13.07.2000 No. 1120 (Official bulletin of Ukraine, 2000, No. 29, Article 1217), and are treated under the conditions the business entity has a license for the right to carry out business activities in the field of hazardous waste management. The appropriate license and technological equipment for the utilization or processing of hazardous waste are available at New Ecosvit, LLC (Uzhhorod district, Kinchesh village). This business entity collects and disposes of waste oils in the oblast.

The main sources of waste oils are:

- vehicle maintenance (replacement of automotive lubricants);
- maintenance of mechanical and hydraulic industrial equipment (replacement of lubricants);
- maintenance of electric transformers and other power electrical equipment (replacement of lubricants).

The waste management system of waste oils is carried out in accordance with current legislation. Entities of business activity submit annual reporting No. 1-Waste "Generation and waste management", which is the basis of official statistical information for determining the volumes of waste oils generated within the city. However, a problematic issue is the lack of a proper accounting system for waste oils and control of operations carried out with the specified hazardous waste, especially in cases of replacement of lubricants in vehicles. The insufficient level of accounting and control in this area causes a significant part of hazardous waste to enter the natural environment, and irrational handling of used lubricants. A significant part of operations with waste oils, which belong to hazardous waste, takes place in the shadow sector of the economy.

Table G.3 (Annex G) shows the available statistical data on the waste oils management in Uzhhorod and the volumes of their formation during 2012-2020.

³⁶ Order of the Ministry of Defense of Ukraine from 08.12.2016 No. 662 "On approval of the Instruction on quality control of fuel and lubricant materials and special fluids in the state aviation of Ukraine"

Problems and threats associated with waste oils that may arise in the future:

Problems	Threats
<i>Environmental and sanitation</i>	
Pollution of water bodies due to improper disposal of waste oils	Deterioration of the situation in the absence of any actions aimed at the disposal of waste oils
<i>Socio-economic</i>	
Use of outdated technologies for handling waste oils	
<i>Institutional</i>	
Limited financial resources of business entities for the purchase of equipment for the processing and disposal of waste oils	Uncontrolled removal of waste oils to municipal waste landfill

Waste containing persistent organic pollutants (POPs)

POPs have toxic properties, show resistance to decomposition, are characterized by bioaccumulation and are the object of transboundary transfer by air, water and migratory species, and are also deposited at a great distance from the source of their emission, accumulating in terrestrial and aquatic ecosystems.

Persistent organic pollutants are a class of highly hazardous chemicals that pose a serious global threat to human health and the environment.

Ukraine is one of the parties to the Stockholm Convention on POPs³⁷, according to which it has a list of obligations in the field of its management and clearly stated deadlines for their implementation.

According to the Stockholm Convention, two types of POPs are distinguished:

1) created intentionally - for use in industry, production, agriculture, etc. (Annexes A and B of the Convention);

2) formed unintentionally as by-products of high-temperature processes in the presence of chlorine and organic substances (Annex C of the Convention), as well as some other processes.

A special group of hazardous waste consists of unsuitable and prohibited chemical plant protection products.

In 2006-2012, the Ministry of Environmental Protection and Natural Resources of Ukraine carried out work on ensuring environmentally safe collection, transportation, storage, processing and disposal of chemical plant protection products, as a result of which all unsuitable pesticides from the territory of Transcarpathian Region were removed for destruction.

3.2.3 INDUSTRIAL WASTE MANAGEMENT SYSTEM

Industrial waste - production waste - everything that is formed in the process of production or after the completion of its cycle, except for products in the form of energy or matter - objects of production (including from the economic activity of enterprises and organizations).

The sources of industrial waste are all industrial enterprises in Uzhhorod.

Management of industrial waste is carried out by economic entities themselves in accordance with current legislation.

Table G.4 (Annex G) shows the available statistical data on the management of industrial waste in Uzhhorod and the volumes of its generation during 2012-2020.

Problems and threats related to industrial waste:

Problems	Threats
<i>Sanitary and environmental</i>	
Clogging of the territory with household and industrial waste	Continuation of littering of the territory with municipal and industrial waste

³⁷ https://zakon.rada.gov.ua/laws/show/995_a07#Text

Problems	Threats
Depletion of resources of enterprise waste disposal sites	Contamination of adjacent territories at the end of the operational period of waste disposal sites in the absence of any actions regarding the management of this type of waste
<i>Socio-economic</i>	
The use of outdated technologies and equipment causes a significant amount of industrial waste	Social tension among the population living near industrial enterprises, with unresolved problems of significant accumulation of production waste
Significant amounts of industrial waste are removed to municipal waste landfill	
Low level of disposal of large-tonnage waste of 3, 4 hazard classes with significant volumes of their formation, which require significant land areas and financial resources for disposal	
A significant amount of waste accumulated during operation, in specially designated places or facilities	
<i>Institutional</i>	
Violations of current legislation by business entities in the field of industrial waste management	
Lack of effective economic levers to encourage enterprises to independently solve their own environmental problems	
Lack of control of the raw material balance of production and the quality of the natural environment in places of waste accumulation	

3.2.4 MINING INDUSTRY WASTE MANAGEMENT SYSTEM

The mining industry waste management system in Uzhhorod is carried out by accumulative enterprises on the general principles of mining industry waste management.

Table G.5 (Annex G) shows the available statistical data on the treatment of waste from the mining industry in Uzhhorod and the volumes of their generation during 2012-2020.

Problems and threats related to mining industry waste

Problems	Threats
<i>Sanitary and environmental</i>	
Clogging of the territory with municipal and industrial waste	Continuation of littering of the territory with municipal and industrial waste
Accumulation of oil-contaminated soils and ferrous metal scrap stored on the territory of mining enterprises	
<i>Socio-economic</i>	
Low level of disposal of large-tonnage waste of 3, 4 hazard classes with significant volumes of their formation, which require significant land areas and financial resources for disposal	Social tension among the population living near industrial enterprises, with unresolved problems of significant accumulation of waste from the extractive industry
<i>Institutional</i>	
Violations of current legislation by business entities in the field of handling industrial waste, including waste from mining industry	

3.2.5 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT SYSTEM

Construction and demolition waste is generated during the construction of new buildings/structures, their reconstruction and final demolition. Construction and demolition waste is a significant and untapped resource.

The generation of construction and demolition waste directly depends on:

- prospective development of the city, as well as infrastructure for transport, drainage, etc.;
- strategies for maintaining old residential areas;
- strategies for demolishing old buildings, non-residential premises on the site of industrial development, etc.;
- future development of transport infrastructure.

It is possible to distinguish the following groups of economic activities regarding the generation of construction and demolition waste:

- construction of new buildings (in the domestic construction market, there is an increase in the volume of investments in the construction of new neighbourhoods, supermarkets, shopping and office centers, warehouses, industrial workshops for new productions, etc.);
- restoration of old buildings;
- demolition of old buildings, non-residential premises on the site of industrial development.

Waste varies greatly in terms of volume and composition, depending on the actual activity that leads to its generation, as well as the time and place of its generation. Therefore, planning the future amount and composition of construction and demolition waste is a difficult task. The main part of construction and demolition waste comes from private enterprises. There is a tendency to increase the volume of this type of waste.

Construction and demolition waste is used in the production of crushed stone, bricks, concrete and reinforced concrete structures, in the construction of roads, sites, as backfill material, etc.

Contractors carrying out the construction of new and demolition of old buildings are responsible for disposal and removal.

Data on the management of construction and demolition waste in Uzhhorod and the volumes of their generation for the period 2012-2020 (by categories of materials) are not available in statistical forms.

An additional study (survey) of industrial enterprises should be conducted regarding the volume of generation and disposal of construction and demolition waste, and information on places of removal of construction and demolition waste needs to be clarified. Removal of such waste should take place at specialized landfills, which may be in communal ownership.

The Ministry of Environmental Protection and Natural Resources of Ukraine ensures the formation and implementation of state policy in the field of waste management (including construction and demolition waste), and state supervision (control) of compliance with the requirements of legislation on the management of waste and hazardous chemicals. Within the limits of its competence, the Ministry of Environmental Protection and Natural Resources of Ukraine provides regulatory and legal regulation on issues related to licensing conditions for the conduct of economic activities for the implementation of operations in the field of hazardous waste management; maintaining registers of waste disposal sites and waste generation, processing and disposal facilities; maintaining a waste passport, etc., and including being responsible for creating infrastructure for processing waste from construction and repair works.

The responsibility and financing of measures for the utilization and disposal of construction and demolition waste are assigned to construction companies.

Construction and demolition waste become especially urgent due to the fact that the service life of old buildings is running out, and the consequences caused by military events are in effect.

Problems and threats related to construction and demolition waste

Problems	Threats
<i>Sanitary and environmental</i>	
Lack of monitoring of the composition of construction and demolition waste, including hazardous components	Increasing environmental hazards at MSW landfill
<i>Socio-economic</i>	
The presence of unaccounted sources of construction and demolition waste (private companies, private estates)	Overloading of MSW landfill
<i>Institutional</i>	
Removal of bulky, construction and demolition waste from the population has not been introduced	

3.2.6 ELECTRICAL AND ELECTRONIC EQUIPMENT WASTE MANAGEMENT SYSTEM

Waste electrical and electronic equipment (WEEE) means devices that work with the help of electricity or an electromagnetic field, the service life of which has expired or the owner intends to get rid of them by recycling or disposal.

WEEE also includes all components, assemblies and consumables that are part of electrical and electronic equipment at the time of its disposal, in accordance with Directive 2012/19/EU on waste electrical and electronic equipment.

WEEE is generated in households, business entities, and other in organizations and institutions.

Taking into account the European orientation of Ukraine and the implementation of the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their member states, on the other hand, there is a need to take into account the requirements of Directive 2012/19/EU on waste electrical and electronic equipment regarding WEEE management. According to this Directive, the separate collection of WEEE is the main requirement for the further processing of this waste and the prevention of environmental pollution by hazardous substances, while consumers (population) and retail outlets selling small-sized household electrical and electronic devices must be actively involved in the collection of WEEE. In Uzhhorod, there is no centralized system of collection and accounting of WEEE from the population, and therefore there is no reliable data on the volumes of their generation, as well as the system of processing this type of waste. There are market operators – subjects of entrepreneurial activity, who collect and provision certain types of waste as secondary raw materials, which accept scrap metal and non-ferrous metals, polymers, as well as other types of secondary raw materials.

Directive 2012/19/EU regulates the minimum rate of separate collection of used electrical and electronic equipment from households in the amount of 6-8 kg per 1 resident per year.

Table G.6 (Annex G) shows the available statistical data on the WEEE management in Uzhhorod and volumes of their formation during 2012-2020.

Problems and threats associated with WEEE

Problems	Threats
<i>Sanitary and environmental</i>	
The entry of WEEE together with municipal waste into municipal waste landfill and dumps, where their destruction and pollution of the surrounding area takes place	Destruction of WEEE that is already in landfill and the danger of harmful substances entering the body of humans and animals, damage to soil, water, and plants
Burning WEEE causes the formation of toxic substances	

Problems	Threats
<i>Socio-economic</i>	
An increase in the number of new electronic and electrical devices, and therefore an increase in the amount of generation of this type of waste	Growth in the volume of WEEE generation
<i>Institutional</i>	
Absence of a law regulating the management of WEEE (there is a draft law "On waste electrical and electronic equipment")	Uncontrolled removal of WEEE from the population to municipal waste landfill and dumps
Lack of an institutional structure for the handling of WEEE, including extended responsibility of manufacturers of electronic and electrical equipment, at the state and, therefore, at the regional level	
Low institutional capacity of local self-government bodies in the field of management of hazardous WEEE generated by the population	
Absence of a functioning WEEE management system generated by the population	
Lack of an organized system for the collection and further disposal of WEEE generated by the population	

3.2.7 HAZARDOUS WASTE MANAGEMENT SYSTEM (USED BATTERIES AND ACCUMULATORS)

Disused chemical current sources are chemical current sources that are unfit for operation by the decision of the consumer due to physical, obsolescence, irreparable defect or for other reasons. Used batteries and accumulators include any batteries or accumulators that, according to the consumer's intention, are unsuitable for further use.

Waste management of spent batteries and accumulators from the population in the region is carried out together with municipal waste. There are no infrastructure facilities for processing spent batteries and accumulators that meet the requirements of current legislation.

Table G.7 (Annex G) shows the available statistical data on the management of waste batteries and accumulators in Uzhhorod and the volume of their generation during 2012-2020.

Problems and threats related to waste batteries and accumulators

Problems	Threats
<i>Sanitary and environmental</i>	
Getting batteries together with municipal waste to MSW landfill and dumps, where their destruction and pollution of the surrounding area takes place	Destruction of batteries that are already at the landfill and the danger of harmful substances entering the body of humans and animals, damage to soil, water, and plants
During fires at the municipal waste landfill and dumps in the warm period of the year, the burning of batteries can cause the formation of toxic substances	
<i>Socio-economic</i>	
The growing number of electronic devices that require batteries and accumulators for use	The increase in the volume of batteries
<i>Institutional</i>	
The absence of a law that would regulate the management of battery waste (currently there is only a draft law "On waste electrical and electronic equipment", "On batteries and accumulators")	Uncontrolled removal of used batteries and accumulators from the public to municipal waste landfill and dumps
Lack of an institutional structure for the management of waste batteries and accumulators at the state, and	

Problems	Threats
therefore also at the regional level	
Low institutional capacity of local self-government bodies in the field of management of waste batteries and accumulators generated by the population	
Lack of a functioning management system for waste batteries and accumulators generated by the population	
Lack of an organized system of collection and subsequent disposal of waste batteries and accumulators generated by the population	

3.2.8 MEDICAL WASTE MANAGEMENT SYSTEM

Medical waste is generated as a result of medical care in institutions that, in accordance with the established procedure, have received a license to carry out economic activities for medical practice. Medical institutions are responsible for their utilization and disposal.

Treatment of medical waste consists of the following stages: collection within institutions; waste sorting during collection; labelling; decontamination; transportation and transfer of waste to storage containers within the institution and their temporary storage; transportation of waste by the transport of specialized organizations (business entities that have a license to handle hazardous waste) with which contracts have been concluded to places of disposal.

According to the Order, 4 categories of medical waste are distinguished:

- category A - epidemically safe medical waste;
- category B - epidemically dangerous medical waste;
- category C - toxicologically hazardous medical waste;
- category D - radiologically hazardous medical waste.

Wastes generated by medical activities pose a potentially higher risk to humans than any other type of waste. From 75-80 percent of the waste generated by health care institutions that do not come into contact with the biological fluids of patients, infectious patients, are similar in composition to municipal waste, namely: glass waste (bottles, vials, cans, etc.), paper, stationery accessories, packaging, furniture, written-off soft inventory (robes, bed linen), diagnostic equipment that has lost consumer properties. The remaining 10-25 percent of medical waste belongs to the category of hazardous and can be risk factors for the natural environment and human health.

Medical waste management *is* regulated by the Law of Ukraine "On Waste", "National waste management strategy in Ukraine until 2030", "National waste management plan until 2030", the Order of the Ministry of Health of Ukraine "On the approval of the state sanitary and anti-epidemic rules and norms for the treatment of medical waste" from June 8, 2015 No. 325 and other regulatory and legal documents in this area.

Table G.8 (Annex G) shows the available statistical data on the treatment of medical waste in Uzhhorod and the volume of its generation during 2012-2020.

Problems and threats related to medical waste

Problems	Threats
<i>Sanitary and environmental</i>	
The entry of medical waste, including biological material contaminated with bacteria and viruses, into municipal waste landfill, which constitutes an environmental hazard	Increasing the danger of municipal waste landfill, which receive medical waste
<i>Socio-economic</i>	
Limited opportunities for medical institutions to purchase high-quality equipment for the treatment of medical waste	Aesthetic unattractiveness of municipal waste landfills where medical waste falls

<i>Institutional</i>	
Limited financial resources of medical institutions for setting up medical waste management systems	Lack of a modern medical waste management system in accordance with European standards
Lack of systematization of data on medical waste management. Accounting for such waste is carried out according to two systems: 1) waste classifier DK 005-96 and summarized by statistical authorities; 2) inside medical institutions according to categories A, B, C, D	
Absence in the oblast of an institutional structure, the authority of which includes the issue of medical waste management at the regional level	

3.3 SWOT ANALYSIS OF THE STATE OF THE WASTE MANAGEMENT SYSTEM IN UZHGOROD

Strengths	Weakness
<ol style="list-style-type: none"> 1. Availability of regional and local program documents in the field of environmental protection, including waste management. 2. Interest of foreign investors in implementing projects in the field of municipal waste management 3. The significant potential of Uzhhorod in readiness for the implementation of the latest waste management systems 4. Support of citizens regarding the implementation of modern methods and technologies of collection, transportation, processing, and disposal of waste according to European principles 	<ol style="list-style-type: none"> 1. Insufficient financing of measures in the field of waste management provided for by local and regional program documents from the state and local budgets. 2. Absence of municipal waste processing facilities and a high percentage of their landfilling. 3. The level of implementation of separate collection and coverage of municipal waste collection services needs to be increased. 4. The need to strengthen the monitoring system of the municipal waste landfill. 5. Outdated material and technical base of service providers for collection and transportation of municipal waste. 6. Formation of spontaneous dumps on the territory of the city, getting into the containers for green waste, construction and demolition waste, hazardous as part of municipal
Opportunities	Threats
<ol style="list-style-type: none"> 1. Entry into force the Law of Ukraine "On Waste Management" and normative legal acts in the field of waste management. 2. Consolidation at the legislative level of economic mechanisms for stimulating economic entities and the population to reduce the volume of waste generation. 3. Favorable conditions for attracting investments in the field of waste management 4. Established communication between the city authorities and the population, implementation of pilot projects in the field of waste management, including educational, informational, etc. 5. Creation of new jobs at waste processing facilities. 	<ol style="list-style-type: none"> 1. Pollution of environmental components in connection with the appearance of spontaneous dumps. 2. Landfilling of hazardous waste as part of municipal, construction and demolition waste, green waste at the landfill. 3. Burial of resource-valuable components of municipal waste suitable for disposal. 4. Increasing social tension regarding the state of waste management. 5. Difficulty in allocating new land plots for waste disposal sites and waste treatment facilities. 6. Limited financial capacity of the population to pay the tariff for waste management services

3.4 COOPERATION BETWEEN TERRITORIAL COMMUNITIES IN THE FIELD OF WASTE MANAGEMENT

Cooperation of territorial communities in the field of waste management is a tool thanks to which communities can implement projects that cannot be implemented alone, improve the quality of service provision, and receive additional income. For the successful implementation of the above, detailed planning, calculation of possible risks, drawing up of a contract and successful communication are necessary.

As of 2022, cooperation in the field of waste collection between the communities of Transcarpathian Region is very limited due to the existing large difference in the standards of providing such services to the population, in particular, that part of it that lives in mountainous areas. In reality, many communities do not have waste collection services at all.

"Strategy of waste management in Transcarpathian Region until 2030"³⁸ provides that waste collection services will be organized at the district level. This will require the cooperation of local governments in planning, organizing and contracting for the provision of relevant municipal waste collection services.

The creation of large regional municipal waste landfills and waste treatment facilities is a more cost-effective solution compared to separate municipal waste landfills that provide services within only one district. As part of the Transcarpathian Region, it is recommended to build four regional municipal waste landfills, to which waste from the entire region will be transported, including Uzhhorodskiyi, to which waste from Uzhhorodskiyi, Perechynskiyi and Velikoberezhnyanskyi districts will be transported.

The formation of cooperation initiatives of territorial communities is very important for increasing the efficiency of waste removal costs.

A number of benefits can be achieved through greater and better cooperation in waste management, including:

- dissemination and harmonization of knowledge and experience;
- introduction of a new quality of services for citizens;
- improving the quality of service;
- more efficient use of vehicles and equipment;
- increasing economies (due to scale) by jointly concluding a contract for the maintenance of territories;
- increasing opportunities for the introduction of technologies favorable to the environment;
- diversification/distribution of costs/risks on the way to implementing a joint initiative.

3.5 ANALYSIS OF THE STATE OF THE ENVIRONMENT AND THE IMPACT OF THE WASTE DISPOSAL SITE

3.5.1 ANALYSIS OF THE STATE OF WATER POLLUTION

The territory of the municipal waste landfill in the village Barvinok, according to the map of hydrological zoning of Ukraine³⁹, belongs to the Tyso-Latorytsk region with a significant amount of water. According to the hydrochemical zoning map of Ukraine⁴⁰ the territory of the municipal waste landfill in the village Barvinok belongs to the territory of distribution of hydrocarbonate-calcium surface waters.

According to the data of the passport of the waste disposal site of the municipal waste landfill in the village of Barvinok is located at a distance of 3.2 km from Uzhhorod. The distance from reservoirs and water intake structures is maintained in accordance with established sanitary norms

³⁸ https://oda.carpathia.gov.ua/sites/default/files/imce/strategia_vidhody_2030.pdf

³⁹ <https://geomap.land.kiev.ua/zoning-7.html>

⁴⁰ <https://geomap.land.kiev.ua/zoning-8.html>

and rules. The sanitary protection zone of the municipal waste landfill is 500 meters. The distance of the municipal waste landfill from the water intake facilities is 2.3 km. The depth of underground water is 5 m, conditionally protected. Groundwater is natural, seasonal, 4-5 m. Groundwater quality is monitored by underground (drainage) water exits to the surface.

The distance from the edges (sides) of the landfill for municipal waste storage to the water protection zone of the nearest water body in the western direction is ~1800 m (flooded lake Nilachka).

In connection with the lack of water in the observation wells, to assess the state of contamination of water resources, it was decided to take water from the nearest landfill site in the village Barvinok of an open source located in the direction of Uzhhorod - flooded lake Nilachka (Fig. 3.11).

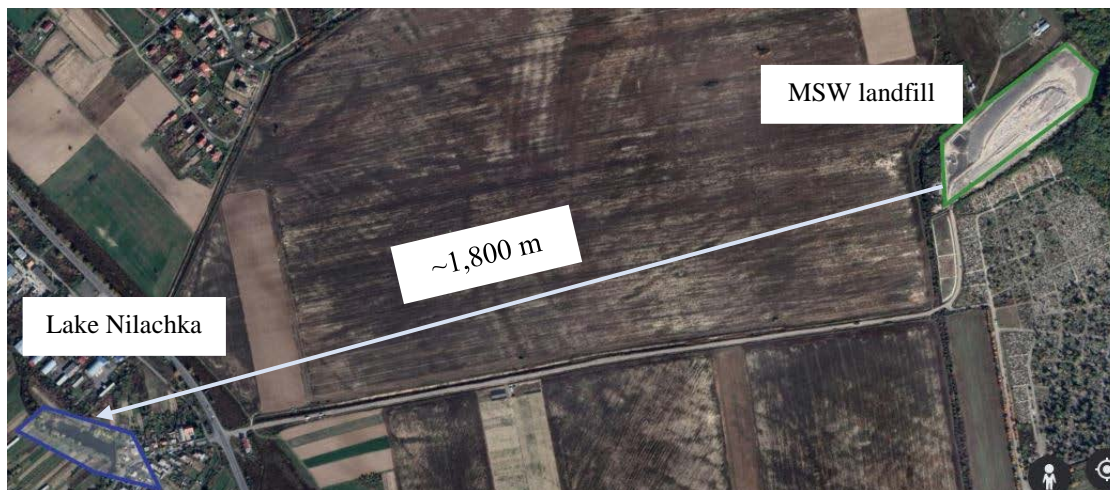


Fig. 3.11. Scheme of water sampling for analysis the impact of the municipal waste landfill on Uzhhorod

Sampling and analyzes were carried out by the Complex Laboratory of Natural Environmental Pollution Observations of the Transcarpathian Regional Center for Hydrometeorology (Fig. 3.12). The sampling depth is 0.2 m, the temperature is 13.5°C.



Fig. 3.12. Sampling of water samples from lake Nilachka

Spectrophotometer "Ulab 102" and pH meter "pH-150MA" were used for measurements. See Annex H for water sampling protocols and measurement results.

Table 3.6 shows the results of measurements that were used to assess the quality of surface water in the zone of influence of the municipal waste landfill in the village Barvinok.

Table 3.6. Water quality in lake Nilachka

No	Indicator	Concentration
1.	Hydrogen indicator, pH units	8.410
2.	Ammonium ion NH_4^+ , mg/dm^3	0.170
3.	Nitrite ion NO_2^- , mg/dm^3	0.008
4.	Nitrate ion NO_3^- , mg/dm^3	0.580
5.	Phosphate ion PO_4^{3-} , mg/dm^3	0.280
6.	Total phosphorus, mg/dm^3	0.412
7.	Chloride ion Cl^- , mg/dm^3	30.130
8.	Sulfate ion SO_4^{2-} , mg/dm^3	32.060
9.	Biochemical oxygen consumption of BOD_5 , mgO_2/dm^3	7.230
10.	Dichromate oxidizability of COD, mgO/dm^3	56.000

The measurement results were compared with Annex 11 to the State Sanitary Rules for Planning and Development of Settlements, approved by the Order of the Ministry of Health of Ukraine No.

173 dated 19.06.96⁴¹, as well as with Annex 2 to the Hygienic Water Quality Standards of Water Bodies for Drinking, Household and other Needs of the Population (item 6)⁴², approved by the order of the Ministry of Health from 02.05.2022 No. 721, which specifies the maximum concentration limit of chemical substances in the water of water bodies to meet the drinking, household and other needs of the population.

The following indicators were within the normative values (according to the Order of the Ministry of Health from 02.05.2022 No. 721): ammonium nitrogen – 0.7 mg/dm³ (MPC 2.0 mg/dm³), nitrate ions – 0.58 mg/dm³ (MPC 45.0 mg/dm³), nitrite ions – 0.008 mg/dm³ (MPC 3.3 mg/dm³), phosphate ions – 0.28 mg/dm³ (MPC 3.5 mg/dm³), chloride ions – 30.13 mg/dm³ (MPC 350.0 mg/dm³), sulfate ions – 32.06 mg/dm³ (MPC - 500.0 mg/dm³).

Indicators of organic pollution exceeded the maximum permissible concentration, in particular, COD was exceeded by almost 2 times the normative value. An excess of the content of organic compounds indicates the contamination of the lake with organic compounds due to its possible contamination by domestic, industrial and agricultural effluents.

In addition, local residents who live near lake Nilachka noted that in the 50s of the last century, Nilachka was a flowing river, and after the construction of the Dravtsi massif, it became a lake. Water from Nilachka is not used by local residents, there is also a car wash near the lake.

Therefore, the pollution of Nilachka was not caused by the impact of the municipal waste landfill in the village Barvinok.

For a more detailed assessment of the impact of the landfill in the village Barvinok is recommended to conduct a study of groundwater from the regular wells of the municipal waste landfill in the village Barvinok.

3.5.2 ANALYSIS OF SOIL CONDITION

To assess the impact of the municipal waste landfill in the village Barvinok on soil condition soil samples were collected at three points: from the body of the landfill site, at a distance of 50 m from the body of the landfill site and at a distance of 100 m from the landfill site.

Taking into account the fact that leachate containing heavy metals is usually the source of soil pollution at municipal waste landfills, it was decided to measure heavy metals in the selected soil samples.

The selection of soil samples was carried out by the specialists of the SE "NDKTI MG" (Fig. 3.13), and the analysis was carried out by the specialists of the Uzhhorod Border State Control and Toxicological Laboratory.



Fig. 3.13. Sampling of soil at the landfill site in the village Barvinok

⁴¹ <https://zakon.rada.gov.ua/laws/show/z0379-96/print>

⁴² <https://zakon.rada.gov.ua/laws/show/z0524-22#Text>

See Annex H for the study of soil samples. Table 3.7 shows the results of analyzed soil samples.

Table 3.7. Results of the study of soil samples in the zone of influence of the municipal waste landfill in the village Barvinok

No.	Index, units measurement	Indicator value			Indicator value according to regulatory document
		Place of sampling			
		From the body landfill	In 50 m from the body landfill	In 100 m from the body landfill	
1.	Mobile phosphorus, mg/kg	5.48	43.57	35.24	-
2.	Ammonium content, mg/kg	19.24	6.14	4.18	-
3.	Nitrate content mg/kg	128.99	181.59	167.45	No more than 130
4.	Available forms of nitrogen (N-NO ₃ ⁻ +N-NH ₄ ⁺), mg/kg	147.93	187.73	171.63	-
5.	Hydrogen indicator of water extraction soil (pH), units pH	7.14	6.80	6.64	-
6.	Hydrogen index of saline soil extracts (pH), units pH	6.08	6.21	5.66	-
7.	Zinc content, mg/kg	≤0.0004	≤0.0004	≤0.0004	Not more than 23.0
8.	Nickel content, mg/kg	≤0.001	≤0.001	≤0.001	Not more than 4.0
9.	Cobalt content, mg/kg	≤0.001	≤0.001	≤0.001	Not more than 5.0
10.	Cadmium content, mg/kg	≤0.002	≤0.002	≤0.002	No
11.	Copper content, mg/kg	≤0.004	≤0.004	≤0.004	Not more than 3.0
12.	Hygroscopic moisture, %	1.53	1.18	1.13	-

Assessment of the impact of the municipal waste landfill in the village Barvinok on the soil was carried out by comparing the obtained values with the normatively permissible ones for heavy metals and nitrates in accordance with the Hygienic regulations of the permissible content of chemical substances in the soil, approved by the Order of the Ministry of Health No. 1595 from 14.07.2020⁴³.

According to the results of the analyses, a very high content of total nitrogen was found in all the selected soil samples, and the content of nitrates was exceeded. The increased content of nitrogen compounds is associated with agricultural activity, which does not indicate a direct impact of the municipal waste landfill in the village Barvinok on soil.

Heavy metals, namely zinc, nickel, cobalt, cadmium and copper, were not detected in all samples.

Thus, the activities of the municipal waste landfill in the village Barvinok do not violate the normative condition of soils.

3.5.3. ANALYSIS OF ATMOSPHERIC AIR QUALITY

To determine air pollution, air samples were taken at the sanitary protection zone border of the landfill for municipal solid waste storage (500 m) and near the landfill at points towards Uzhhorod (at a distance of ~ 200-300 m from the body of the landfill). Fig. 3.14 shows the sampling scheme.

⁴³ <https://zakon.rada.gov.ua/laws/show/z0722-20#top>

Sampling and analyses of air samples were carried out by the Integrated Laboratory of Natural Environmental Pollution Observations of the Transcarpathian Regional Center for Hydrometeorology (Fig. 3.15). Sampling was carried out in accordance with the requirements of regulatory documents. For air sampling, a pneumatic unit UP 1111/5A SRZ was used, for measurements a gas analyzer "CM-2-CO".

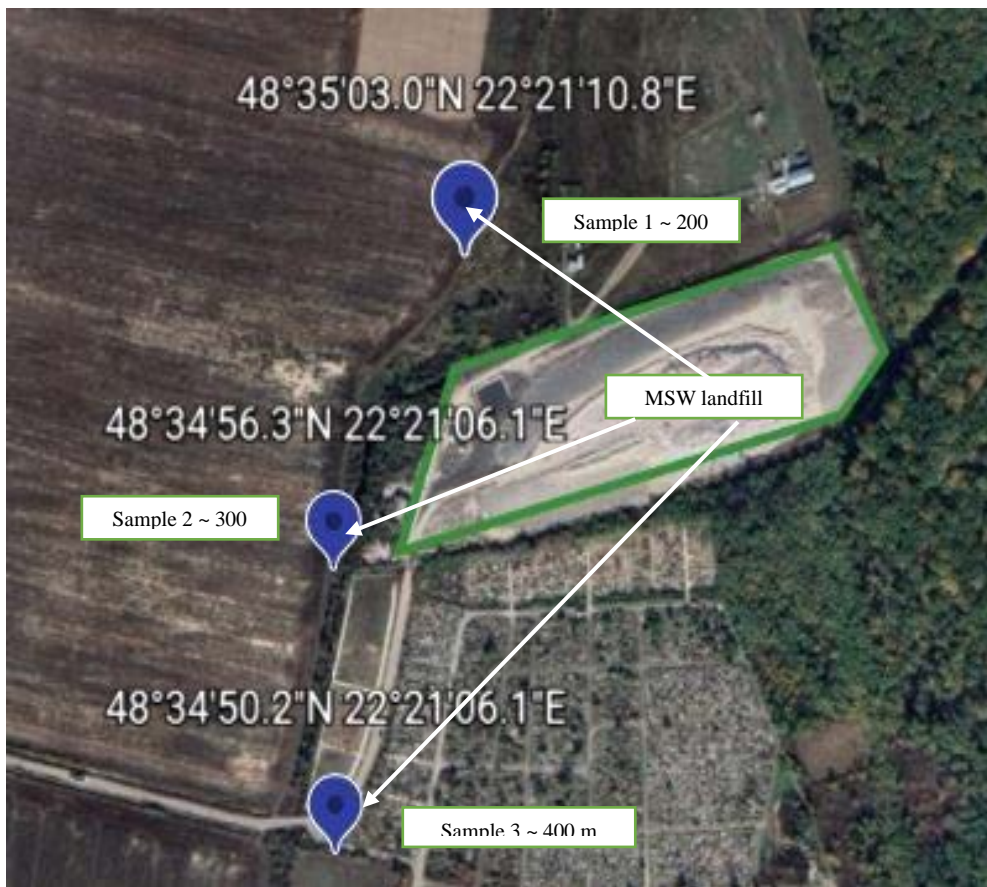


Fig. 3.14. Air sampling scheme for analyses the impact of the municipal waste landfill in the village Barvinok



Fig. 3.15. Sampling of air near the municipal waste landfill in the village Barvinok

See Annex L for air sampling protocols and measurement results.

To assess the concentration of the main pollutants coming from the municipal waste landfill in the village Barvinok (sulphur dioxide, nitrogen dioxide, formaldehyde, carbon monoxide) values of the permissible content of chemical and biological substances in the atmospheric air of populated areas (approved by the Order of the Ministry of Health from January 14, 2020 No. 52) were used⁴⁴.

Table 3.8 shows the results of measurements that were used to assess the air quality in the zone of influence of the municipal waste landfill in the village Barvinok.

Table 3.8. Atmospheric air quality in the zone of influence of the municipal waste landfill in the village of Barvinok

No	Date of sampling	Time of sampling	Concentration, mg/m ³			
			Dioxide sulfur	Dioxide nitrogen	Formaldehyde	Oxide carbon
1	13.10.2022	09.57-10.16	0.023	0.084	0.010	0.57
2	13.10.2022	10.25-10.44	0.029	0.098	0.011	0.99
3	13.10.2022	10.55-11.14	0.019	0.089	0.009	0.95
MPC (maximum one-time limit)⁴⁵, mg/m³			0.5	0.2	0.035	5.0

According to the results of the analyzes (Table 3.8), at the time of conducting analyses on atmospheric air samples for the content of sulfur dioxide, nitrogen dioxide, formaldehyde and carbon monoxide, the concentration of the studied substances met the requirements of the hygienic standards for the permissible content of chemical substances in it.

It is worth noting that there was practically no wind at the time of the research. Therefore, it is recommended, for a more in-depth analysis of the impact of the municipal waste landfill in the village Barvinok on the state of atmospheric air, to conduct additional studies of the quality of atmospheric air in windy weather and under other hydrometeorological conditions.

3.5.4 Analysis of the impact of waste on ensuring fire and epidemiological safety of residents

At the landfill site in the village Barvinok (Fig. 3.16) the main types of the following work are performed: reception, storage and isolation of municipal solid waste. Storage is carried out by the card method. The delivery of municipal solid waste to the landfill is carried out by special vehicles, and the storage of work cards is carried out by a bulldozer using the push method. A compacted layer of municipal solid waste with a height of 2 m is isolated with a layer of soil with a height of 0.25 m. In addition to the main structure - the area of storage of municipal solid waste - the elements of the landfill are the access road, the economic zone, the main structures and the networks of the landfill site. The waste disposal site is located at a distance of 3.2 km from Uzhhorod. The distance from reservoirs and water intake structures is maintained in accordance with established sanitary norms and rules. The sanitary protection zone of the municipal waste landfill is 500 m.

According to the information from the passport of the MVV the landfill in the village Barvinok lacks a bottom insulating screen, there is a perimeter embankment and earthen drainage ditches. There is a leachate collection and disinfection system.

In DBN B.2.4-2-2005 "Municipal solid waste landfills. The main provisions of the design" it is established that municipal solid waste moistening is carried out in the warm season during fire-hazardous periods in order to prevent self-ignition of municipal solid waste, reduce dust generation, and also in case of a decrease in the degree of compaction of waste. Water consumption for spilling is taken at the rate of 10 liters per 1 m³. Water consumption for external fire extinguishing is 10 l/s.

⁴⁴ <https://zakon.rada.gov.ua/laws/show/z0156-20/print>

⁴⁵ <https://zakon.rada.gov.ua/laws/show/z0156-20/print>



Fig. 3.16. Municipal waste landfill in the village Barvinok

Municipal waste landfill in the village Barvinok is equipped with the necessary fire-fighting measures: there is a pool with leachate at the landfill, which is used to water the landfill several times a day to prevent fires, and there is a special machine that also provides irrigation of the landfill⁴⁶.

There is no information on biogas generation parameters.

In the process of operating a municipal waste landfill, various risks of impact on the surrounding natural environment are possible. The assessment of the types and amount of expected waste, emissions (discharges), water, air, soil and subsoil pollution, noise, vibration, light, heat and radiation pollution as a result of the implementation of the planned activity was developed on the basis of the "Methodology for the development of the assessment of the impact on the surrounding natural environment for municipal solid waste management facilities"⁴⁷ (approved by the Order of the MCTD of Ukraine from January 10, 2006 No. 8) (Table. 3.9).

Table 3.9. Assessment by types and amount of exposure risks (waste, emissions (discharges), water, air, soil and subsoil pollution, noise, vibration, light, heat and radiation pollution as a result of activities)

Direction of influence	Impact characteristics
Waste	In case of detection and identification of hazardous waste during work, it is necessary to take measures for their removal and disposal in accordance with the requirements of the current legislation of Ukraine
Surface and underground water	Operation of a municipal waste landfill may contain uncontrolled discharges of pollutants from the body of the municipal waste landfill. Leaks can be controlled only by reclamation and revitalization of the municipal waste landfill

⁴⁶ <https://www.0312.ua/>

⁴⁷ <https://zakon.rada.gov.ua/rada/show/v0008667-06#Text>

Direction of influence	Impact characteristics
Soil and subsoil	<p>Operation of a municipal waste landfill may contain uncontrolled discharges of pollutants from the body of the municipal waste landfill. The absence of a geomembrane and an effective drainage system contribute to leachate leakage.</p> <p>Leaks can be controlled only by reclamation and revitalization of the municipal waste landfill</p>
Atmospheric air	<p>During the work, and movement of equipment, the following pollutants may be formed: dinitrogen oxide, carbon oxide, substances in the form of suspended solid particles (microparticles and fibers), methane, carbon dioxide, nitrogen dioxide. Currently, according to the results of laboratory-instrumental studies, these substances are produced in small quantities without exceeding the MPC norms.</p> <p>It is possible to influence the level of pollutants by observing the technical regulations in accordance with the "Rules for the operation of municipal waste landfills"⁴⁸ (approved by the Order of MCTD from 01.12.2010 No. 435)</p>
Acoustic influence	<p>During the works, from the movement of equipment, etc., additional noise load occurs. During the operation of the municipal waste landfill, the level of technological noise at the border of the sanitary protection zone will not exceed 75 DB</p>
Light, thermal and radiation pollution	<p>There may be isolated cases of radioactively contaminated household items entering the landfill. These can be household items from hospitals that use radiation for therapeutic purposes. In order to make such cases impossible, equipment for radiation control of garbage trucks should be installed at the control-passage area of the municipal waste landfill in accordance with the requirements of DBN B.2.4-2-2005</p>
Flora and fauna	<p>Impact on local fauna and flora is not expected</p>
Technological risks/accidents that may affect public health	<p>Since the disposal of mixed municipal waste is accompanied by the formation of landfill gas, there is a high probability of spontaneous combustion of the municipal waste landfill body. Therefore, the potential for spontaneous fires in the warm season should be taken into account. To manage this impact, it is necessary to ensure the availability of a sufficient number of water containers and fire-fighting equipment at the landfill site, provide detailed training of workers, limit access to the work area, provide workers with appropriate protective equipment (in particular, methane concentration detectors, etc.). The employees of the municipal waste landfill must carefully observe the "Rules for the operation of municipal waste landfills" (approved by the Order of MCTD from 01.12.2010 No. 435)</p>
Epidemiological impact on the population	<p>The municipal waste landfill poses an indirect threat to the epidemiological situation. Thus, municipal waste can directly pose a threat to workers at a municipal waste landfill and be a source of dangerous infections through local animals, such as dogs, rodents, birds, etc.</p>

⁴⁸ <https://zakon.rada.gov.ua/laws/show/z1307-10#Text>

Direction of influence	Impact characteristics
	<p>To manage this impact, it is necessary to carefully follow the "Rules for the operation of municipal waste landfills" (approved by the Order of MCTD from 01.12.2010 No. 435). The landfill must meet the modern requirements of DBN B.2.4-2-2005 "Municipal solid waste landfills". When leaving the municipal waste landfill, specialized vehicles must pass a wheel and body wash station. Special sound and bioacoustics equipment is installed to scare away birds. Employees of the landfill must be equipped with personal protective equipment and instructed in safety rules when working with municipal waste</p>

CHAPTER IV. ANALYSIS OF WASTE COMPOSITION (VISUAL ANALYSIS AND SORTING)

The composition of municipal solid waste (MSW) is a very important characteristic, as it is decisive when choosing technologies for processing, utilizations, neutralization and choosing equipment for waste processing. It distinguishes:

- the composition of MSW according to their types (mixed MSW, food waste (bio-waste), bulky waste (BW), electrical and electronic equipment waste (WEEE), green waste (garden waste), yard and street garbage, construction and demolition waste (CDW), hazardous waste (HW), medical (hospital) waste (specific waste), etc.;

- the morphological composition of municipal solid waste is the structure of their components (materials, substances, products), expressed as a percentage by mass (paper, cardboard, wood, black and non-ferrous metal scrap, plastics, textiles, bones, glass, leather, rubber, stones, ceramics, other).

At the time of developing the Analysis, there is no current information on the composition of municipal solid waste in Uzhhorod, therefore field studies (visual analysis and sorting) were conducted to determine the morphological composition of the city's municipal solid waste.

The main goal of research into the morphological composition of municipal solid waste generated in Uzhhorod is to obtain data on the content of valuable raw material components in them, so the research was carried out according to the appropriate nomenclature of morphological components (the main ones are cardboard and paper, glass, metals, polymers, organic components of waste, which are capable of biological decomposition).

4.1 GENERAL CHARACTERISTICS OF MSW

Municipal solid waste from Uzhhorod are characterized as a heterogeneous mixture of an indefinite number of objects, materials, and substances with a wide variety of mechanical, physico-chemical, and other properties. The composition of this mixture is unpredictable and random, since various materials used in everyday life and production can fall into the composition of MSW, and at the same time it is predictable in terms of its main components. The morphological composition of municipal solid waste depends on the structure of the objects of municipal solid waste generation, the time of year, urban planning characteristics of the city, socio-economic conditions of life of the population and its general educational and cultural level, the level of material support, the level of housing improvement and living conditions, the technology of packaging materials and containers, technology and systems of wholesale and retail trade, etc.

Municipal solid waste is divided into three main groups: mixed municipal solid waste (from the residential sector, non-production sector: administrative institutions and commercial establishments, and the production sector of the city); bulky waste and construction and demolition waste, which are generated in the process of current housing repairs by residents. Mixed municipal solid waste, hazardous waste, hazardous waste and industrial waste of the III-IV hazard class, which are allowed to be buried at the municipal waste landfill, are supplied for disposal at the municipal waste landfill.

Municipal solid waste components are mixed at the stage of their formation, transportation and at the municipal waste landfill. During transportation, the density of MSW increases. The density of municipal solid waste at the landfill before tamping is on average 0.5 t/m³.

According to the data received by SE "NDKTI MG", the nomenclature of morphological components of municipal solid waste includes paper, cardboard, wood, black metal scrap, non-ferrous metal scrap, plastic, textiles, bones, glass, leather, rubber, stones, ceramics and unsorted residue.

4.2 METHODS OF CONDUCTING EXPERIMENTAL STUDIES OF THE MORPHOLOGICAL COMPOSITION OF MSW

Research on the morphological composition of municipal solid waste was carried out at the sites of municipal solid waste generation in Uzhhorod in the autumn season (September 2022).

The morphological composition of municipal solid waste is determined within three days.

Specially trained and instructed workers (hereinafter referred to as sorters) are involved in the study on the determination of the morphological composition of MSW. Briefing on sorting methods, safety and occupational health and safety techniques is carried out before the start of field research.

Sorters are provided with overalls and personal protective equipment. Sorters are issued daily with plastic bags for a separate collection of MSW components.

The landfill sites were chosen randomly.

Sorters collect the components of MSW determined by their morphological composition into plastic bags. Components are divided into components by materials or marking. For example, bottle caps are unscrewed and bottles are emptied of liquid. Components are cleaned of dirt and liquid. Shovels are used to fill the bags. After the selection of individual components, the remaining MSW, which cannot be sorted, is loaded into the bags.

The weighing of municipal solid waste components in plastic bags, as well as the rest of the waste, is carried out one by one. The sorter records the weight for each type of material sorted on the sampling form, reviews the form, and then records the weighing results. After weighing, the filled bags are removed to the reception card of the municipal waste landfill.

Processing of research results is carried out in the following order:

- determine the mass of each sorted municipal solid waste component by summing up the corresponding weighing data;
- determine the total mass of the sorted sample by summing up all the data obtained during the weighing of municipal solid waste components and their residue;
- taking as 100% (by mass) the mass of MSW that was sorted, calculate the content (in percentage) of each MSW component;
- determine the average morphological composition of municipal solid waste accumulated at waste collection sites.

4.3 STATISTICAL ANALYSIS OF EXPERIMENTAL RESULTS

Methods of descriptive statistics and interval evaluation of sample data are used for statistical processing of experimental research results.

The average arithmetic content of the municipal solid waste component per month is determined by the formula, %:

$$\bar{x} = \frac{\sum x_i}{n}, \quad (4.1)$$

where x_i - the content of the component in the sample (by mass), %;
 n - the number of samples, units.

The standard error of the mean is determined by the formula:

$$s_x = \frac{s}{\sqrt{n}}, \quad (4.2)$$

where s - the standard deviation calculated on the sample data.

The value of the standard deviation is determined by the formula:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}, \quad (4.3)$$

To calculate the error with a small number of measurements (up to 30), the Student coefficient t is introduced, which depends on the confidence probability P and the number of measurements n .

Thus, the error of a series of measurements is determined by the formula:

$$\Delta x = s_x \cdot t, \quad (4.4)$$

Similarly, the arithmetic mean, standard error, and standard deviation are determined when summarizing annual data.

4.4 RESULTS OF EXPERIMENTAL STUDIES ON THE DETERMINATION OF THE MORPHOLOGICAL COMPOSITION OF MUNICIPAL SOLID WASTE GENERATED IN UZHGOROD

Field studies on the determination of the morphological composition of municipal solid waste were conducted taking into account the Order of MCTD from 16.02.10 No. 39 "On the approval of methodological recommendations on the determination of the morphological composition of municipal solid waste"⁴⁹.

Field studies were conducted on the territory of MSW container sites. A total of 12 municipal solid waste samples weighing at least 40 kg each were taken. Table 4.1 shows the generalized data of in-situ measurements of the morphological composition of municipal solid waste generated in the city of Uzhgorod. Table 4.2 shows the masses of components by morphological groups in the composition of mixed municipal solid waste.

Table 4.1. Generalized predicted morphological composition of MSW generated in Uzhgorod

No.	Name of the morphological group	Content of components by morphological groups (by mass), %
1	Cardboard and paper	3.20
2	Glass and ceramics	29.20
3	Metals	0.60
4	Plastics	5.65
5	Waste electrical and electronic equipment	2.40
6	Bio-waste	38.60
7	Rubber and leather	2.00
8	Textile	0.50
9	Construction and demolition waste	6.50
10	Hazardous waste	2.10
11	Unsorted remainder	9.25
	Total	100.00

Table 4.2. Mass of components by morphological groups in the composition of mixed municipal solid waste in Uzhgorod

No.	Name of the morphological groups	Name of the municipal solid waste component	Components contents (by mass), (%)
1	Cardboard and paper	Cardboard	1.70
		Paper	0.50
		Composite paper	1.00
2	Glass and ceramics	Glass bottles are white and transparent	8.40
		Colored glass bottles	19.00
		Window glass	0.50
		Ceramics	0.90

⁴⁹ <https://zakon.rada.gov.ua/rada/show/v0039662-10#Text>

No.	Name of the morphological groups	Name of the municipal solid waste component	Components contents (by mass), (%)
		Other types of glass	0.40
3	<u>Metals</u>	Black metals	0.50
		Non-ferrous metals	0.10
4	<u>Plastics</u>	PET bottles	1.10
		HDPE containers	0.90
		Other plastic materials	2.80
		PP plastic	0.40
		Composite plastic	0.45
5	<u>Waste electrical and electronic equipment</u>	Small household appliances	0.90
		Computer Engineering	1.50
		Televisions and other devices that contain an electron beam tube	–
6	<u>Organic waste</u>	Plant food	27.50
		Non-vegetable food	5.20
		Fallen leaves and grass	3.80
		Branches and plant wood	2.10
7.	<u>Rubber and leather</u>	Rubber and leather	2.00
8	<u>Textile</u>	Textile	0.50
9	<u>Repair (construction and demolition) waste*</u>	Concrete	–
		Asphalt	–
		Lumber	–
		Drywall	–
		Soils	–
		Mixed construction waste	6.50
10	<u>Hazardous waste</u>	Paint	0.05
		Vehicle waste and their equipment	0.95
		Used oils	–
		Accumulators	0.20
		Mixed harmful household products	–
11	The residue of municipal solid waste after removal components		9.25
	Total weight of the municipal solid waste sample		100

Notes : *– waste as a part of mixed municipal solid waste

Data on the morphological composition of MSW characterize the content and potential volumes of selection and use of raw and valuable components of MSW, and therefore are the basis for the development of technical and economic feasibility studies (FS) and the drafting of business projects for waste sorting.

CHAPTER V. GENERAL QUANTITATIVE ANALYSIS OF WASTE COLLECTION AND TREATMENT SYSTEM IN UZHGOROD REGARDING SECONDARY RAW MATERIALS

Waste as secondary raw materials include the waste that can be used in industry as secondary raw materials or from which products can be directly manufactured. Waste as secondary raw materials can include paper, cardboard, glass, polymers, and household scrap metal, as well as the organic component of municipal waste (MW).

5.1 ANALYSIS OF THE SYSTEM OF COLLECTION AND TREATMENT OF RESOURCE-VALUABLE COMPONENTS OF MUNICIPAL WASTE (SECONDARY RAW MATERIALS) IN UZHGOROD

Separate collection of resource-valuable components of waste materials (recyclable raw materials) in Uzhgorod is carried out at the local level and includes:

1) a container fleet for resource-valuable components of KMP type of classes 1-4 according to DSTU 8476:2015 (with a capacity of up to 1.3 m³) (for collecting waste paper (cardboard, paper), glass (glassware, scrap glass), PTEF bottles);

2) a system of collection points for secondary raw materials (for the collection of the main types of secondary raw materials, including those collected from municipal solid waste: waste paper (cardboard, paper), glass (glassware, scrap glass), PETF bottles, some types of polymer film, metals (ferrous and non-ferrous), textiles, etc.) (see Annex B for the list of business entities that collect and process waste as secondary raw materials in the territory of the Transcarpathian region).

In the territory of Uzhgorod, secondary raw materials come from various sources, but a larger share (more than 80%) is given to collection points directly by the population. In the absence of collection points in certain areas of the city, secondary raw materials are mostly placed in garbage containers, including those for mixed waste. Practically the entire territory of the residential development of the city is covered by spontaneous groups or individual collectors of secondary raw materials, which select them from the places of initial accumulation (in garbage containers, etc.) and hand them over to collection reception points. Collection points of secondary raw materials are placed on the territory of the city chaotically (unsystematically and unevenly), which is inconvenient for local residents and spontaneous collectors, as they are forced to transport (carry) recycled materials. There are also illegal points and vendors.

Lists of secondary raw materials and their acceptance prices are different in different collection points, waste paper (cardboard paper), metals (black and non-ferrous of all kinds), PTEF bottles, some types of polymer film and plastics, glass containers and sometimes broken glass are most often accepted.

Secondary raw materials are collected and handed over to procurers by enterprises, organizations, institutions, city residents, janitors, temporarily unemployed citizens and others. Secondary raw materials are collected from municipal solid waste at all stages of their handling: during the formation of municipal solid waste (in residences, administrative premises, offices, shops, markets, department stores, megamarkets, shopping centers, etc.), during the initial accumulation of municipal solid waste in garbage containers on the premises territories, during collection and removal of municipal solid waste by garbage transport, at landfills for disposal of municipal solid waste (final disposal).

Containers for the separate collection of recyclable materials are installed in most of the residential buildings of the city, but the quality of the separate collection is unsatisfactory, especially in euro-containers for recyclable materials. Mostly mixed municipal waste is found in these containers, as well as in the containers of unseparated residue, which are standing next to each other, which not only leads to malfunctions and breakage of the container but also reduces the quality of recyclable materials. Recyclable materials are better collected in mesh (transparent) containers of various designs, which differ significantly from euro-containers in appearance.

In the vast majority of commercial establishments (markets, large department stores, megamarkets, department stores, etc.), secondary raw materials are systematically selected and delivered to collection points or taken to processing plants directly by employees of these establishments.

The content of recyclable materials in municipal solid waste, which is finally placed at a municipal waste landfill, is somewhat lower since it is also collected at a municipal waste landfill, directly on the operating card. The components of secondary raw materials that enter the landfill as part of mixed municipal solid waste are wet and contaminated, so they are only partially collected, and partially buried together with other components of municipal solid waste, and therefore lost as secondary raw materials, turning into dangerous pollutants of the natural environment, especially polymers.

Mixed municipal solid waste, which is taken to a municipal waste landfill, contains many organic components capable of biological decomposition, such as food waste, green waste and other plant residues. Such waste is very difficult to sort manually on waste sorting lines and must be processed by mechanized methods followed by composting.

Despite the fact that part of the secondary raw materials is handed over to the population at collection reception points, as well as collected by spontaneous collectors from containers, mixed municipal waste from the residential sector (apartment buildings) contains a lot of secondary raw materials (cardboard, paper, polymers, metal, glass, leather, rubber, textile, wood) and organic components (bio-waste). In containers for mixed municipal waste, wet recyclables are contaminated and of poor quality, and in containers for separate collection, recyclables are mostly dry, clean and of good quality. Available volumes of higher-quality collected secondary raw materials from the administrative and commercial sector of waste generation, which are more suitable for manual sorting and selection of secondary raw materials and can be taken to sorting lines and processed together with separately collected secondary raw materials.

5.2 THE CONTENT OF RESOURCE-VALUABLE COMPONENTS IN THE MUNICIPAL SOLID WASTE OF UZHGOROD

According to the data obtained as a result of field studies on the determination of the morphological composition of MSW generated in Uzhgorod (Table 4.1, Table 4.2), the content of valuable components that can be used as secondary raw materials in the composition of the city's MSW is 36.85 % (by mass), of which the largest share is glass – 27.4%, plastics (plastic packaging and PET bottles) – 5.65%, waste paper (cardboard and paper) – 3.2%, metals – 0.6%. About 36.5% is organic waste.

Glass and ceramics. The total content of glass and ceramics in mixed municipal solid waste is 29.2%, of which the largest share is glass-colored bottles (19.0%) and white and transparent bottles (8.4%).

Polymers. Polymer materials are valuable secondary raw materials. The content of polymer materials is 5.65%, of which PET bottles are 1.1%, HDPE containers are 0.9%. It should be noted that according to the results of research in other cities of Ukraine, which are similar to Uzhgorod, the content of PET bottles and HDPE containers in the places of formation is somewhat higher, and is approximately 6-7% and 3-6%, respectively.

Cardboard and paper. The content of cardboard and paper, as well as composite paper in the total mass of mixed MSW is 3.2%. About 30% of cardboard and paper are contaminated with biodegradable food waste and saturated with moisture. Since cardboard and paper lose their marketability and quality during the collection process, the content of high-quality waste paper and paper makes up 70% of the total volume of mixed municipal solid waste.

Metals. The content of metals in the total mass of mixed municipal solid waste is not significant (up to 0.6%, including non-ferrous metals 0.1%), which is explained by their selection by residents before entering the municipal solid waste collection sites.

Food (organic) waste. The fractions of food waste include biodegradable waste, namely the remains of vegetables, fruits, gardening waste and other remains of vegetable and non-vegetable food. The research results show that the largest content in the total mass of mixed municipal solid waste during the period of field studies is wet biodegradable food waste, which is 38.6%. According to reference data, the moisture content of food waste is 70-90% (by mass). The presence of food waste in the composition of mixed municipal solid waste leads to the formation of leachate during the transportation and disposal of waste and becomes a source of biogas generation at the municipal waste landfill.

In the process of sorting the total volume of municipal solid waste generated, the volume of selected individual fractions will be much smaller, since a significant proportion of waste (waste, paper, polymers, especially film and packaging) lose its original appearance during the collection and storage process, which leads to a decrease in the volume and content of potential recyclables, which can be sent to sorting.

However, the sale of PET bottles, some polymers, glass containers and broken glass does not require additional preparation and certain qualifying conditions, which puts this type of raw material among the attractive ones for processing enterprises.

5.3 DETERMINATION OF THE MATERIAL AND RESOURCE POTENTIAL OF MUNICIPAL WASTE IN UZHGOROD

Data on the averaged morphological composition of municipal waste indicate sufficient secondary resource potential in Uzhgorod.

Table 5.1 shows the obtained calculation data regarding the material and resource potential of the city's municipal waste for 2023-2035.

Table 5.1. Material and resource potential of municipal waste in Uzhgorod

Name	% content	2023	2025	2027	2029	2031	2033	2035
Volume of waste generation, t	100.00	50,396.00	50,901.22	51,411.50	51,926.90	52,447.47	52,973.26	53,504.32
The content of resource-valuable components, t:	36.85	18,570.93	18,757.10	18,945.14	19,135.06	19,326.89	19,520.65	19,716.34
- cardboard and paper, t	3.20	1,612.67	1,628.84	1,645.17	1,661.66	1,678.32	1,695.14	1,712.14
- commercial broken glass, t	27.40	13,808.50	13,946.93	14,086.75	14,227.97	14,370.61	14,514.67	14,660.18
- metals, t	0.60	302.38	305.41	308.47	311.56	314.68	317.84	321.03
- PET bottle, t	1.10	554.36	559.91	565.53	571.20	576.92	582.71	588.55
- plastic packaging, t	4.55	2,293.02	2,316.01	2,339.22	2,362.67	2,386.36	2,410.28	2,434.45
Bio-waste, t	36.50	18,394.54	18,578.95	18,765.20	18,953.32	19,143.33	19,335.24	19,529.07
Other, t	26.65	13,430.53	13,565.18	13,701.17	13,838.52	13,977.25	14,117.37	14,258.90

Notes: the following assumptions were made during the calculations: 1) the population during the forecasting period remains unchanged; 2) indicators of waste generation per inhabitant will increase every year by 0.5% (according to the recommendations of the World Bank); 3) coefficients of selection of secondary raw materials in the categories "cardboard and paper" - 0.5; "commodity glass" - 0.8; "metals" - 0.7; "PET bottle" - 0.8; "plastic packaging" (PND, PDV grade 2, low-pressure film) - 0.6

Data on the volumes of separate collection of secondary raw materials and their collection through collection points in Uzhgorod indicate potential opportunities for expanding this line of activity. However, the volume of separate collection and procurement of secondary raw materials through collection reception points is limited by the content of secondary raw materials in municipal waste.

Also, the indicated volumes of secondary raw materials are potential, the achievement of which is possible in practice under the condition of the implementation of various modern technologies of sorting and selection of secondary raw materials.

In order to achieve in-depth processing of municipal waste (up to 60-80%) and a significant reduction of the load on landfills and dumps, it is necessary, simultaneously with the expansion of the volume of separate collection and collection of secondary raw materials, to create sorting and processing complexes with technologies for processing not only separately collected secondary raw materials, as well as unseparated residual mixed municipal waste.

CHAPTER VI. RECOMMENDATIONS REGARDING THE FORMULATION OF APPROACHES TO EXPANDING THE SEPARATE COLLECTION OF SECONDARY RAW MATERIALS IN UZHGOROD

One of the main directions of the state policy in the field of waste management is to ensure the integrated use of material and raw materials and to promote the maximum possible utilization of waste through direct, repeated or alternative use of valuable components. Separate collection of waste is the first step of the waste treatment stage and aims at its further processing (reuse/recycling/treatment). Models of the separate collection are formed depending on the accepted model of waste management, which is determined by the relevant approved regional waste management plan (if available). The separate collection as the first step of the municipal waste treatment stage ensures the efficiency of the entire treatment process.

6.1 GENERAL MEASURES FOR THE DEVELOPMENT OF THE FIELD OF MUNICIPAL WASTE MANAGEMENT

The long-term goal of the development of the waste management industry is to achieve the current EU waste processing standards, which are partially already mandatory for compliance under the Association Agreement between Ukraine and the EU, which will require several steps, including the gradual achievement of separate collection targets waste and processing of the most important fractions (respectively at the level of 60% and 50% of the total volume of MSW), which are subject to reuse.

In the field of municipal waste management, the National Waste Management Strategy in Ukraine until 2030⁵⁰ provides for special measures:

- 1) prevention and minimization of municipal waste generation;
- 2) increasing the level of municipal waste processing;
- 3) introduction of composting of the organic component of municipal waste in private households, including suburban areas of cities;
- 4) creation by local self-government bodies in settlements with a population of more than 50,000 of specialized communal waste collection points, taking into account the area, density and population of the settlement, which will ensure the collection and acceptance of the following types of waste:
 - hazardous waste as part of municipal waste;
 - bulky waste (furniture, large household items, etc.);
 - secondary raw materials;
 - waste electrical and electronic equipment, waste batteries, accumulators;
 - garden and park waste of biological origin (grasses, leaves, branches, etc.);
 - construction and demolition waste;
- 5) creation of a network of collection points in regional centers for the reuse of used furniture, household appliances, clothes and other goods.

Local self-government bodies should organize constant campaigning work regarding the sanitary and ecologically safe handling of municipal solid waste and the need for conscious active participation of all segments of the population in the implementation of separate collection of municipal solid waste components, including resource-valuable components (recyclables).

⁵⁰ <https://zakon.rada.gov.ua/laws/show/820-2017-%D1%80#Text>

6.2 APPROACHES TO THE EXPANSION OF SEPARATE WASTE COLLECTION IN UZHGOROD

6.2.1 EXPEDIENCY OF SEPARATE COLLECTION OF WASTE

The methods and means of separate collection of municipal solid waste components, their transportation and processing are selected taking into account their morphological composition, the annual volume of formation, the need for secondary energy and material resources, organic fertilizers, economic factors and other requirements.

One of the most important processes in the proposed concept of municipal waste management is the process of sorting it through the introduction of a separate collection of secondary raw materials. When handling municipal solid waste, it is necessary to take into account that they contain valuable recyclable components: paper, cardboard, glass, polymer materials, and metals.

Sorting waste is dividing it into components that can be used as secondary raw materials and that require special processing or preparation for storage at a special landfill that meets modern environmental and sanitary-hygienic requirements. When implementing the system of separate collection of municipal solid waste, it is necessary to take into account the provisions, requirements and recommendations of "Methods of separate collection of municipal waste"⁵¹(approved by the Order of MCTD from August 1, 2011 No. 133).

The population accumulates a significant amount of secondary raw materials, therefore the organization of its collection is a task of particular importance. Separate collection of waste, based on the organization of a selective collection of waste from the population and legal entities, encouraging consumers to separate waste collection, is carried out by excluding the cost of operations for handling separately collected (sorted) useful components of waste from the fee for the service of waste management.

The market of secondary raw materials in Ukraine is actively developing. The selection of the most valuable waste components (primarily PET containers) is being adjusted. Glass and glass containers are in demand. This trend will develop, therefore there is a need and real prerequisites for increasing the volume of harvesting and disposal of secondary raw materials, including paper and cardboard, polyethylene, non-ferrous and ferrous metals, polyethylene terephthalate, glass scrap. In Uzhgorod, there is a prospect for the development of the secondary raw materials market, which cannot be ignored.

The organization of separate collection of municipal solid waste will make it possible to obtain a significant reduction in the volume of municipal solid waste subject to disposal (disposal), improve the ecological situation and receive funds from the sale of secondary raw materials. Therefore, separate collection of waste is one of the most promising ways to solve the municipal solid waste problem.

Further processing of separately collected secondary raw materials is environmentally acceptable, energy- and resource-saving production, leading to the saving of the most valuable, and at the same time, strategically important materials. The introduction of a separate collection of waste allows not only to reduce the damage caused to the environment by waste, to financially support the least well-off citizens, but also to obtain valuable secondary raw materials for industry, the natural sources of which are not limitless.

6.2.2 EXPEDIENCY OF SORTING SEPARATELY COLLECTED SECONDARY RAW MATERIALS

The city of Uzhgorod is faced with the task of reducing the amount of municipal waste that is taken to the MSW landfill for landfilling, one of the solutions of which is the sorting of municipal solid waste with the separation of secondary raw materials. The selection of secondary raw materials

⁵¹<https://zakon.rada.gov.ua/laws/show/z1157-11#Text>

from MSW collected in containers or loaded into garbage trucks is allowed only at specialized enterprises for sorting and processing MSW in accordance with the requirements of waste legislation and sanitary legislation. It is expedient to carry out sorting and processing of MSW with sufficient volumes of waste, which allow achieving of economic efficiency of using the sorting facility.

Therefore, it is expedient to provide for the separate collection of individual components of waste materials (separation of secondary raw materials). Separated municipal solid waste components are further sent for processing as raw materials at specialized enterprises, and unseparated municipal solid waste components are sent to the existing municipal waste landfill (in the future - to the regional municipal waste landfill).

In order for secondary raw materials to have a market value, separately collected waste must be brought to certain quality criteria, so it is proposed to carry out their additional sorting. When sorting, it is advisable to focus on sorting by types and properties of raw materials in the first place: PET bottle - by color; glass - by color; metals - by type (except aluminium can); polyethylene packaging - by types, etc. Additional sorting according to individual characteristics of the type of secondary raw materials will make it possible to form higher-quality commodity batches and increase the price of secondary raw materials and thus increase the economic efficiency of sorting, as well as reduce the number of individual components of municipal solid waste for disposal at a municipal waste landfill.

Taking into account the presence of the total amount of separated municipal solid waste (recyclable raw materials) in Uzhhorod, separate collection with subsequent transfer to the sorting facility is the most economically justified of all known strategies for waste management and reducing the volume of municipal solid waste placement in landfills, which requires the least expenditure of budget funds.

6.2.3 TECHNICAL ASPECTS OF SEPARATE COLLECTION OF MUNICIPAL WASTE IN UZHHOROD

To improve the efficiency of separate collection of all types of municipal solid waste, it is recommended to hold public and educational actions on the collection of individual components with the involvement of residents of Uzhhorod, create information resources in social networks with the aim of popularizing eco-education and basic actions of residents regarding waste management, and create an educational space with the aim of popularizing basic knowledge about the best practices of waste management and developing public educational (reference) materials describing the actions of residents regarding the management of municipal waste.

Separate collection of resource-valuable components of municipal waste (secondary raw materials) is carried out at the local level and includes:

- container park (update) for resource-valuable components of the KMP type of classes 1-4 according to DSTU 8476:2015⁵² (with a capacity of up to 1.3 cub. m);
- creation of specialized municipal waste collection points that accept the following types of waste:
 - hazardous waste as part of municipal waste;
 - bulky waste (furniture, large household items, etc.);
 - secondary raw materials;
 - waste electrical and electronic equipment, waste batteries and accumulators;
 - garden and park waste of biological origin (grass, leaves, branches, etc.);
 - construction and demolition waste.

Based on the fact that specialized communal waste collection points are implemented in settlements with a population of more than 50 thousand people, for Uzhhorod 2 waste collection points were accepted.

⁵² DSTU 8476:2015. Containers for household waste. General technical requirements// https://zakon.isu.net.ua/sites/default/files/normdocs/1-10795-dstu_8476_2015.pdf

Separate collection of biodegradable waste (food waste, mainly of vegetable origin) is carried out at the local level and includes:

1) stimulation and encouragement by local self-government bodies of city residents to separate collection and composting of the organic component of municipal waste, primarily in private households of individual manor buildings. This does not require the development of infrastructure, it is not taken into account in the financial and economic indicators.

Separate collection of hazardous waste as part of municipal waste. The collection of hazardous waste as part of municipal waste is carried out in the following ways:

- specialized communal waste collection points;
- mobile (transport) hazardous waste collection points.

Separate collection of waste batteries, accumulators and WEEE until the introduction of the principle of extended producer responsibility in Ukraine and the implementation of the collection system at the national level, can be carried out within the framework of pilot projects in the following directions:

- creation of specialized communal waste collection points;
- creation of mobile (transport) collection points for hazardous waste and WEEE.

Separate collection of other waste: bulky waste, construction and demolition waste, and repair waste from the population. The method of organization of collection is determined independently by the relevant local self-government bodies and includes the following:

- creation of specialized communal waste collection points;
- implementation of the collection system (can be collected at container sites near homes in portal roller containers of the KZR or Big Bag type) and removal of hazardous waste and repair waste from the population according to the application scheme;
- removal of construction and demolition waste from the city territory separately from other types of waste according to the specified schedule.

6.2.4 MAIN INFRASTRUCTURE OBJECTS OF THE MUNICIPAL WASTE COLLECTION SYSTEM IN UZHGOROD

Based on the available initial data and local conditions, it is planned to create and develop the main infrastructure facilities of the municipal waste collection system in Uzhgorod (Table 6.1), which include:

- specialized communal waste collection points;
- container system for separate collection of municipal waste;
- container system for collecting mixed municipal waste.

Table 6.1. System infrastructure objects collection of municipal waste

Location	Population	Specialized communal waste collection points	Collection points for repeated using goods which were in use	Centers for collection waste for their repair for the recycling	Underground containers
	persons	units	units	units	units
Uzhgorod	115,542 ⁵³	2	1	1	14

Notes: the calculations take into account the arrangement of underground containers in the central part of Uzhgorod; the cost of installing 1 underground container is 350,000 UAH.

⁵³ <https://decentralization.gov.ua/newgromada/3892>

Waste collection points for reuse and recycling of used goods

In accordance with the National Waste Management Strategy in Ukraine until 2030, the creation of a network of collection points for the reuse of used furniture, household appliances, clothes and other goods in regional centers by 2030 is envisaged.

Accordingly, in Uzhhorod, it is necessary to create 1 collection point for the reuse of furniture, household appliances, clothes and other goods that were in use. These points can be created as a component of the volume-spatial plan of specialized communal waste collection points with a separate room, or separately.

Waste collection centers for their repair for reuse

In accordance with the National Waste Management Strategy in Ukraine by 2030, it is envisaged to create waste collection centers for their repair with the purpose of reuse (primarily waste electrical and electronic equipment) 100 centers in Ukraine as a whole by 2023 and 250 centers by 2030, respectively. It is assumed that 1 center should be built in Uzhhorod (as of 2030).

Container system for collecting municipal waste

As of January 2022, 90% of the population of Uzhhorod is covered by municipal waste collection services. That is, 11,554 people are not provided with services of centralized transportation of municipal waste. In order to provide this part of the population with municipal waste transportation services, it is necessary to increase the fleet of containers⁵⁴.

For the reporting year 2021, 250,120 cub. m of municipal waste was generated in Uzhhorod from the residential, administrative and commercial sectors. According to calculations, 2.165 cub. m of MSW/year (corresponding to 436.2 kg of MSW/year) or 5.93 l/day (corresponding to 1.195 kg/day) per inhabitant. The average estimated density of waste is 201.49 kg/m³ (Source: "On the approval of norms for the provision of waste removal services in Uzhhorod", approved by the Decision of the executive committee of the Uzhhorod City Council from 13.05.2020 No. 192). Thus, the additional number of containers to cover the entire city with the municipal waste collection service is 75 containers (with a capacity of 1.1 cub. m) (Table 6.2).

When setting up a container system for the separate collection of municipal waste, it is proposed to install underground containers in the central part of Uzhhorod. See Annex I for the approximate locations of underground containers. This will not only partially solve the problem of the lack of free space on the territory of the city, including that necessary for the installation of a larger number of containers for municipal waste due to their large volumes, and will satisfy the increase in existing sanitary and hygienic requirements. Examples of the installation of this type of containers in the cities of Ukraine are presented in Annex I.

Table 6.2. Quantitative parameters of container fleet renewal

Name	Estimated volumes of additional containers by year							
	2023	2024	2025	2026	2027	2028	2029	2030
Containers to achieve 100% collection service coverage	75	–	–	–	–	–	–	–
Total	75	–	–	–	–	–	–	–

Notes: it is accepted that the purchase of containers for the renewal of the park due to physical wear occurs constantly at the expense of the existing tariff for municipal waste management; the calculations assume that the cost of 1 container is 15,000 hryvnias as of 2023

⁵⁴ Methodical recommendations on the organization of collection, transportation, processing and disposal of municipal waste // <https://zakon.rada.gov.ua/rada/show/v0176662-10#Text>

6.3 TECHNOLOGICAL OPTIONS FOR TREATMENT RECEIVED MUNICIPAL WASTE IN UZHGOROD

In accordance with the National Waste Management Strategy in Ukraine by 2030, it is necessary to achieve the target indicator of 30% landfilling of municipal solid waste, i.e. to ensure a reduction in the volume of landfilling with the help of a set of measures for the separate collection of municipal solid waste with the extraction of resource-valuable components and their further direction for processing, composting of the waste component, which is biodegradable, in private households and mixed waste treatment activities.

Achieving such an indicator is possible only if a central municipal waste processing facility is built. Since more than 50,000 tons of municipal waste is generated per year in the catchment area of Uzhgorod with a forecast growth of 0.5% every year, the calculations consider two technological options for the central treatment facility:

1) construction of a mechanical-biological waste treatment complex with anaerobic fermentation (MBT complex);

2) construction of a sorting station.

As a rule, mechanical-biological treatment complexes or mechanical sorting stations are built with an optimal capacity of at least 50,000 tons per year. The construction of sorting stations or the MBT complex allows to an increase in the volume of extracted resource-valuable components and obtains secondary raw materials of better quality. These factors affect the economic performance of these facilities. Data on the average morphological composition of municipal waste indicate sufficient secondary resource potential in Uzhgorod (Table 5.1).

6.3.1 BUILDING OF THE COMPLEX OF MECHANICAL AND BIOLOGICAL WASTE TREATMENT

Technological schemes of completeness of MBT complexes

The first technological option – the construction of an MBT complex – has three main possible technological schemes for the completion of MBT complexes:

A) sorting of municipal waste with the extraction of secondary raw materials; obtaining alternative fuel RDF/SRF (up to 30% of the total mass of waste), composting of bio-waste (up to 40% of the total mass) and landfilling of unsorted residue and inert waste;

B) sorting of municipal waste with the extraction of secondary raw materials; anaerobic fermentation of bio-waste to obtain biogas (up to 40% of the total mass); landfilling of unsorted residue and inert waste;

C) sorting of municipal waste with the extraction of secondary raw materials; stabilization of bio-waste (up to 40% of the total mass) and landfilling of unsorted residue and inert waste.

Technological configuration scheme and material balance of the MBT complex in Uzhgorod

There are no guaranteed RDF/SRF consumers in Uzhgorod and Transcarpathian Region. At the same time, transportation over long distances outside the region is also considered economically impractical. Composting of separated bio-waste at MBT complexes is aimed at obtaining technical compost in accordance with the requirements of SOU ZhKH 10.09-014:2010. The quality of such compost sharply narrows the scope of its application to reclamation. It should be noted that technical compost cannot be sold under market conditions. But in conclusion, there is an economic inefficiency in using such an MBT option. The use of bio-waste for anaerobic fermentation will significantly reduce the amount of waste and obtain biogas, which can be used in cogeneration plants to obtain electrical energy.

Thus, for the conditions of Uzhgorod, it is accepted the technological variant of the MBT complex according to variant B, which includes the following blocks:

- mechanical sorting and treatment unit (sorting and grinding);

- biological treatment unit: anaerobic decomposition with biogas production and further utilization of biogas in a cogeneration unit.

Table 6.3 shows the calculated parameters of the material balance of the MBT complex for Uzhhorod.

The staff list of employees of the MBT complex for the accepted design capacity of the enterprise is adopted in accordance with the requirements of GBN B.2.2-35077234-001⁵⁵ (listed in Table 6.4).

Table 6.3. Estimated parameters of the material balance of the MBT complex

Parameter	Units	Value
Total population served	person	115,542
Volume of waste generation	t/year	50,396
Design capacity of the MBT complex (1 shift per day)	t/year	50,000
	%	100
Extraction of resource-valuable components	t/year	13,900
	%	≈28
Biogas formation	cub. m/year	1,260,000
Volume of bio-waste for fermentation (input)	t/year	18,000
	%	36
Residue destined for landfill (excluding residues after fermentation)	t/year	18,100
	%	36

Notes: The following is used in the calculations: electricity consumption 65 kWh per design ton of municipal solid waste; production capacity is 25 t/hour; number of working days per year is 365; shift of 8 hours (sorting shop); in the calculations, the density of methane under standard conditions is 0.67 kg/m³ (DSTU ISO 13443:2015 Natural gas. Standard conditions).

Table 6.4. Approximate staff list of employees of the MBT complex

No	Profession and position	Calculated number of positions
1	Administrative and managerial employees	8
2	Reception department and waste sorting	35
3	Workshop for anaerobic fermentation of bio-waste extracted from municipal solid waste	15
4	Cogeneration plant for biogas utilization	13
	Total	71

The principle of operation of the MBT complex

Mixed municipal waste and separately collected secondary raw materials (shortened cycle) are subject to mechanical and biological processing. As a result of this process, the reactivity of waste and its potential for the formation of hazardous substances are reduced, which allows the remains to be buried at the municipal waste landfill in safe conditions. Mechanical and biological processing helps to reduce the volume of waste, due to obtaining materials for further use and obtaining energy.

Mechanical and biological treatment include control of emissions of hazardous substances and neutralization of odours in closed systems. Exhausting air from the equipment is collected and subject to cleaning. Wastewater formations are also treated at local treatment plants.

The technological process is easily adapted to changing the morphological composition of municipal solid waste and increasing the daily capacity of the complex. The complex can be located in different areas, but at the shortest possible distance from the geometric center of the largest concentration of waste generation.

⁵⁵GBN V.2.2-35077234-001:2011 "Enterprises for sorting and processing solid municipal waste. Requirements for technological design" // <http://surl.li/cbyrg>

During mechanical sorting, crushing, extraction of metals, separation of inert fractions, and extraction of secondary raw materials or their classification takes place. The sorted materials are pressed into bales and sent to the temporary storage area. Mechanical sorting can be complemented by manual sorting.

The biological process in the adopted version is aimed at obtaining biogas and reducing the amount of bio-waste. The anaerobic process takes place without access to oxygen in closed reactors - methanetanks. The most common method of anaerobic fermentation in the EU is dry (Fig. 6.1).

The process of anaerobic fermentation lasts 18-21 days. After that, the original biomaterial is dehydrated and stabilized. After that, the stabilized residues are sent to the landfill. 70-170 cub.m of biogas can be obtained from 1 ton of bio-waste. After preliminary cleaning, the obtained biogas can be used in cogeneration plants to obtain electrical energy.

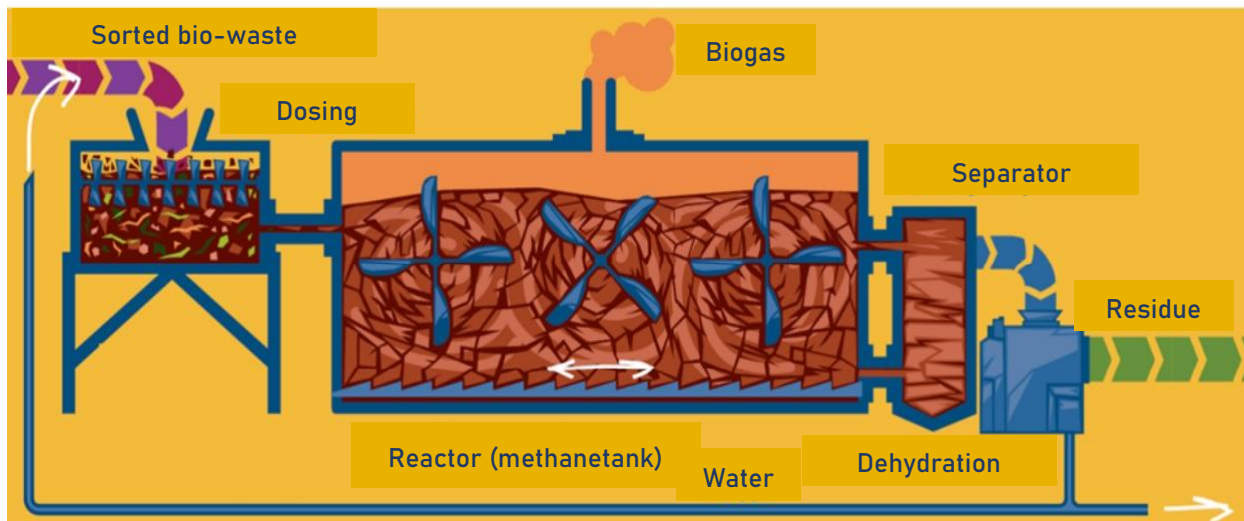


Fig. 6.1. Schematic representation of the process of dry anaerobic fermentation

The advantages of the MBT complex are a significant reduction in the volume of waste and the release of harmful gases and leachate during the disposal of residues at a municipal waste landfill; the ability to remove secondary materials and prepare them for sale; the possibility of obtaining electrical energy due to biogas cogeneration. The main drawback is high capital and operating costs.

To place the buildings of the MBT complex, it is necessary to use communal warehouses or free territories reserved by the state (when their purpose is changed). For the conditions of Uzhhorod, the targeted area of the MBT complex is 2.0 hectares, and the recommended location of the MBT complex is specified in Annex J.

Examples of similar MBT complexes and technological equipment used in Germany

Over the past ten years, the technology of mechanical and biological treatment of municipal waste has been brought to a high technological level. Currently, there are more than 100 plants with an average capacity of 100,000 t/year in EU countries.

Examples of similar complexes in Germany:

- MEAB mbH, Schenaihe (www.meab.de);
- Zweckverband Abfallwirtschaft Saale-Orla, Pesnek (www.zaso-online.de);
- MBA Lübeck (www.entsorgung.luebeck.de/ueber_uns/unsere_anlagen/mba.html);
- MBA Neumünster GmbH, Neumünster (www.mba-nms.de);
- WEV GmbH, Grosspesna (www.e-wev.de).

Examples of technological equipment used in Germany:

- 1) Grinding equipment:
 - HAMMEL Recyclingtechnik GmbH, Bad Salzungen (www.hammel.de);
- 2) Sorting and separating equipment:

- EuRec Technology GmbH, Merkers (www.eurec-technology.com);
 - Mogensen GmbH & Co. KG, Wedel (www.mogensen.de);
 - Spaleck – Förder- und Separiertechnik (www.spaleck.de);
- 3) Magnetic separators:
- Steinert Electromagnetbau GmbH, Köln (www.steinertglobal.com);
 - IMRO Maschinenbau GmbH, Uffenheim (www.imro-maschinenbau.de);
 - Wagner Magnete GmbH & Co. KG Spann- und Umwelttechnik, Heimertingen (www.wagner-magnete.de);
- 4) Systems for cleaning technical air:
- LTB Lufttechnik Bayreuth GmbH & Co. KG, Goldkronach (www.ltb.de);
 - Dürr Systems GmbH Environmental and Energy Systems, Stuttgart (www.durr-cleantechnology.com/de).

6.3.2 CONSTRUCTION OF A SORTING STATION FOR SECONDARY RAW MATERIALS

Technological process of the configuration of the secondary raw materials sorting station in Uzhhorod

At the sorting station of secondary raw materials, only separately collected individual components of waste materials are sorted - separated secondary raw materials. The purpose of the secondary raw materials sorting station is to obtain sorted components for further market sale, namely PET bottles of different colors or granulate, scrap glass, low-pressure film, scrap metal, low-pressure plastic, waste paper, etc.

When processing secondary raw materials, mainly mechanical processes of varying degrees of automation are performed. The principle of the technology consists in the sequence of screening, mechanical or manual classification, and pressing. The equipment of the station depends on the specifics of the morphological composition of municipal waste and the presence of guaranteed consumers of certain components.

After sorting of light packaging materials, sorted types of plastic are processed for polymer granules or grinding of certain types of materials of a certain quality.

Fig. 6.2 shows the technological scheme of the sorting station for secondary raw materials.

Sorting station equipment has relatively low energy consumption. For the installed capacity of the station, energy consumption will be 65 kWh per one design ton of secondary raw materials. The energy needs of the station will increase with the expansion of the configuration of the technological scheme.

The approximate area of the site for placing the facilities of the station for the conditions of Uzhhorod is 0.5 hectares, the recommended location of the station for sorting secondary raw materials is specified in Annex J.

The special advantages of the sorting station for secondary raw materials are a technologically simple process, small capital costs, a flexible scheme of equipment operation, the possibility of expanding the configuration and a small number of personnel. The main disadvantages are the sorting of only separately collected secondary raw materials, which makes it impossible to achieve national indicators for the disposal of municipal waste (up to 30%) and the problems with the processing of bio-waste, which increase the danger of municipal waste landfills, are not solved.

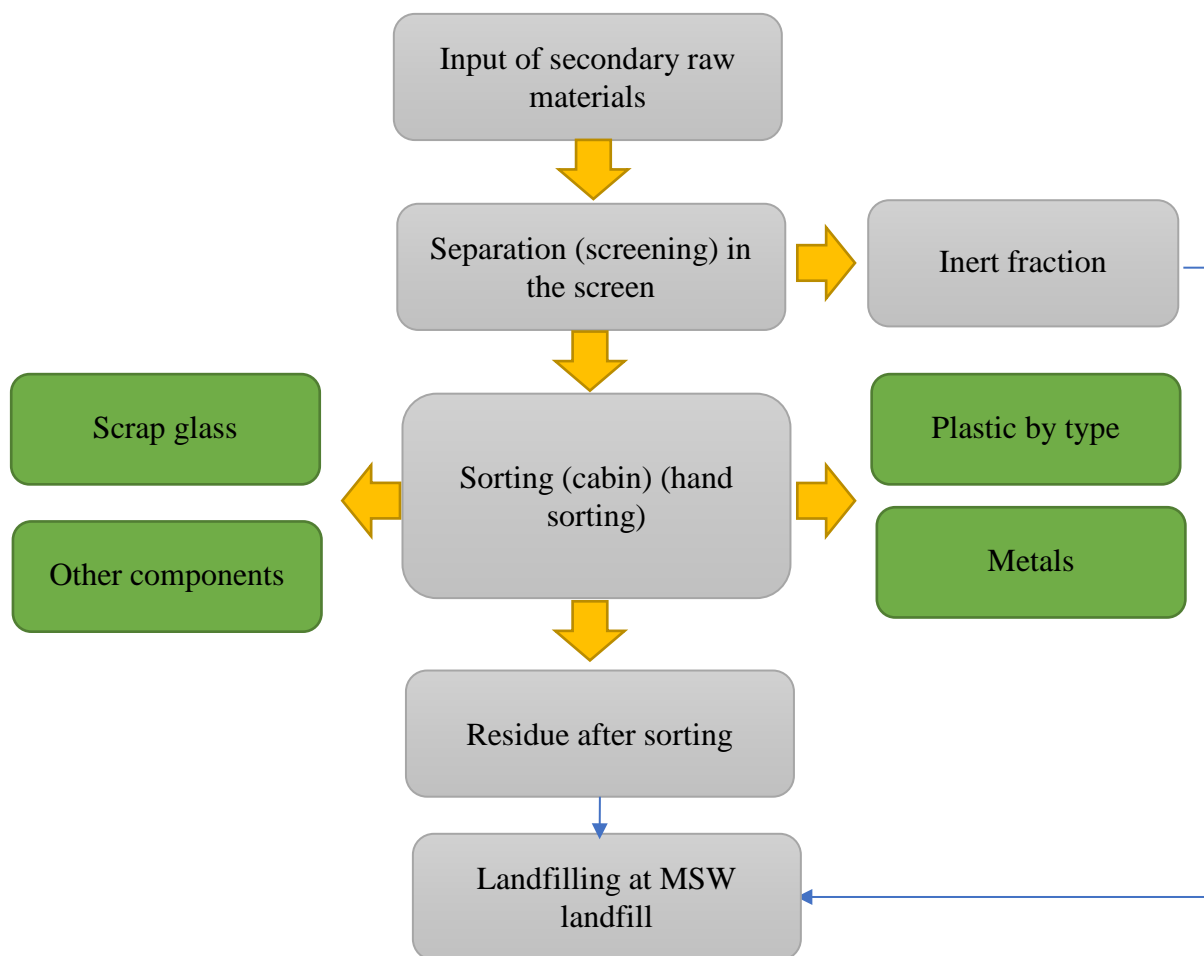


Fig. 6.2. Technological scheme of the sorting station for secondary raw materials

Material balance of the secondary raw materials sorting station in Uzhhorod

Table 6.5 shows the calculated parameters of the material balance of the secondary raw materials sorting station for Uzhhorod.

Table 6.5. Estimated parameters of the material balance of the secondary raw materials sorting station

Parameter	Unit	Value
Total population served	person	115,542
Volume of waste generation	t/year	50,396
Estimated volume of separately collected secondary raw materials	t/year	13,900
Design capacity of the sorting station (1 shift per day)	t/year	13,900
	%	100
Extraction of resource-valuable components	t/year	8,340
	%	≈60
The remainder destined for landfilling (from the total formation)	t/year	5,560
	%	93

The staff list of employees of the secondary raw materials sorting station for the adopted design capacity of the enterprise is adopted in accordance with the requirements of GBN B.2.2-35077234-001 (Table 6.6).

Table 6.6. Approximate staff list of employees of the secondary raw materials sorting station

No	Profession and position	Estimated number of positions
1	Administrative and managerial employees	3
2	Reception department and waste sorting	18
	Total	21

Examples of similar sorting stations and technological equipment for their work, applied in Germany

Similar sorting stations are located in many European cities. Examples of Germany are WAA Iserlohn⁵⁶, Sortieranlage Leipzig⁵⁷, Suez Environment⁵⁸, Remondis⁵⁹ and others.

The equipment that is used for the operation of the sorting station belongs to the common arsenal used for mechanical processes in the field of waste processing. The following examples of best practices in Germany are following:

1) Conveyor lines/dispensers:

- Rudnick + Enners Maschinen- u. Anlagenbau GmbH, Alpenrod (www.rudnick-enners.de);
- Ludden & Mennekes, Meppen (www.ludden.de);
- Spezialmaschinen & Recyclingtechnik, Chemnitz (www.sr-recyclingtechnik.com);

2) Packet breakers:

- Matthiessen Lagertechnik GmbH, Krempe (www.bagsplitter.com);

3) Separators and units for sieving:

- Mogensen GmbH & Co. KG, Wedel (www.mogensen.de);
- EuRec Technology GmbH, Merkers (www.eurec-technology.com);
- Spaleck – Förder- und Separiertechnik (www.spaleck.de);

4) Magnetic and induction metal separators:

- Steinert Elektromagnetbau GmbH, Köln (www.steinertglobal.de);
- IMRO Maschinenbau GmbH, Uffenheim (www.imro-maschinenbau.de);
- Wagner Magnete GmbH & Co. KG, Heimertingen (www.wagner-magnete.de);

5) Presses:

- HSM GmbH + Co. KG, Salem (www.hsm.eu)
- Bomatic–Umwelt- und Verfahrenstechnik GmbH, Hamburg (www.bomatic.de)
- Erdwich Zerkleinerungs-Systeme GmbH, Kaufering (www.erdwich.de)
- MeWa Recycling Maschinen und Anlagenbau GmbH, Gechingen (www.mewa-recycling.de);

6) NIR technique:

- Tomra Systems GmbH (www.tomra.de)
- Sesotec GmbH (www.sesotec.com).

Additional information on the processing of secondary raw materials can be obtained from the website of the Federal Association of Secondary Raw Materials and Waste Treatment⁶⁰ and the website of the dual system⁶¹.

⁵⁶ <http://www.lobbe.de/>

⁵⁷ <http://www.alba.info/>

⁵⁸ <http://www.suez-deutschland.de/>

⁵⁹ <http://www.remondis.de/>

⁶⁰ <http://www.bvse.de/>

⁶¹ <http://www.recycling-fuer-deutschland.de/>

6.4 PROPOSALS REGARDING THE ORGANIZATION OF DISPOSAL OF MUNICIPAL WASTE OBTAINED AFTER TREATMENT IN UZHGOROD

The most common operation for the removal of municipal solid waste after the operation for its recovery, which does not involve further processing of the waste, is the burial of a part of municipal solid waste, namely, the unusable residue. All processing residues, subject to compliance with the specified criteria, can be sent to a landfill. The disposal must be orderly and ensure reliable and controlled storage of unusable residual municipal solid waste, therefore their disposal is allowed only at landfills specially equipped for this purpose.

As of 2022, the municipal waste landfill in Uzhgorod (in the village Barvinok) needs revitalization and reclamation. The cost of reclamation is 600,000 euros/ha. Based on the fact that the area of the municipal waste landfill is 9 hectares, the total cost of reclamation is 5.4 million euros.

When calculating the necessary aggregate costs, the following components must be included:

- costs for the construction of a new landfill site or maps of a landfill site (if necessary);
- expenses for the purchase of equipment in order to bring it up to the requirements of DBN V.2.4-2-2005 "Municipal solid Waste Landfills" (with amendments No. 1 and No. 2)⁶²;
- costs for operating a municipal waste landfill;
- costs for closing and reclamation of a municipal waste landfill;
- costs of care after the closure of a municipal waste landfill (this criterion is taken into account in accordance with the task of the National Waste Management Strategy, the National Waste Management Plan and the planned changes to the legislation on the approximation of the regulatory and legal regulation of Ukraine regarding waste to the requirements of the Directive 1999/31/EC on the landfill of waste).

6.5 MAIN TECHNICAL AND ECONOMIC ASPECTS REGARDING THE EXPANSION OF THE SEPARATE COLLECTION OF SECONDARY RAW MATERIALS IN UZHGOROD AND THE ANALYSIS OF THE AVAILABILITY OF THE PROPOSED OPTIONS

6.5.1 ASSESSMENT OF THE LEVEL OF AFFORDABILITY OF THE TARIFF FOR MUNICIPAL WASTE MANAGEMENT SERVICES

The costs of collecting waste and transporting it to the central waste treatment facility and the costs associated with burying the residual part of waste are decisive for the amount of the tariff for municipal waste management services.

In accordance with the provisions of the "Methodical recommendations for the development of regional waste management plans"⁶³ (approved by the Order of the Ministry of Environmental Protection and Natural Resources from 10.09.2021 No. 586), it is recommended to consider an economically affordable tariff for waste management to be paid by the population at the level of 1-1.5% of the average monthly income per resident.

Table 6.7 shows the estimated level of availability of the tariff for municipal waste management services and its projected growth in Uzhgorod.

The Decision of the executive committee of the Uzhgorod City Council from February 4, 2022 No. 14 established the tariff for municipal waste management services (Table 6.8). In comparison, the current tariff for municipal waste management service in Uzhgorod is 928.8 UAH/t, and the recommended level of tariff availability is 1,893.00 UAH/t.

⁶² <https://www.minregion.gov.ua/napryamki-diyalnosti/building/tech-reg/normuvannia/derzhavni-ta-galuzevi-budivelni-normi/>

⁶³ <https://mepr.gov.ua/documents/3514.html>

Table 6.7. Assessment of the level of affordability of the tariff for municipal waste management services in Uzhhorod

Indicator	Year						
	2023	2024	2027	2029	2031	2033	2035
Average disposable income per person	–	–	–	–	–	–	–
thousand UAH per year	189.3	208.7	230.1	253.7	279.7	308.4	339.9
thousand UAH per month	15.77	17.39	19,17	21,14	23,31	25.69	28,33
The level of availability of the tariff for services in the field of waste management	–	–	–	–	–	–	–
1% of the average disposable income, UAH/person/year	1,893.00	2,087.03	2,300.95	2,536.80	2,796.82	3,083.50	3,399.56
1.5% of the average disposable income, UAH/person/year	2,839.50	3,130.55	3,451.43	3,805.20	4,195.23	4,625.25	5,099.33
1% of the average disposable income, UAH/person/month	157.75	173.92	191.75	211.40	233.07	256.96	283.30
1.5% of the average disposable income, UAH/person/month	236.63	260.88	287.62	317.10	349.60	385.44	424.94

Notes: the calculations assume that wages in Uzhhorod will increase by 5% every year

Table 6.8. Tariffs for waste management services in Uzhhorod as of 2022

Tariff for municipal waste management service		Tariff for municipal waste management service (with VAT)		Scope municipal waste management service	
transportation AVE-Uzhhorod, LLC	landfilling KP "KATP-072801"				
UAH/cub.m (with VAT)	UAH/ cub.m (with VAT)	UAH/ cub.m	UAH/ton	thousand cub. m	thousand tons
158.99	26.61	185.60	929.8*	252.66	50.4

Notes: * the tariff for the municipal waste management service in mass units is obtained by recalculation through the average density, which is taken as 0.201 t/m³

6.5.2 FINANCIAL AND ECONOMIC INDICATORS OF THE FUNCTIONING OF THE CENTRAL WASTE TREATMENT FACILITY IN UZHGOROD

The financial and economic indicators of the functioning of the central waste treatment facility in Uzhhorod were evaluated in comparison, according to two technological options:

- 1) construction of the MBT complex;
- 2) construction of a sorting station for secondary raw materials.

The indicators of the specified options largely depend on the volume of waste to be sorted and the morphological characteristics of the waste.

Calculations regarding the determination of the main estimated financial and economic

indicators of the central waste processing facility and predictive parameters of their functioning were performed using the results of field studies of the morphological composition of municipal solid waste in Uzhhorod.

6.5.2.1 IMPLEMENTATION OF THE MBT COMPLEX IN UZHGOROD

Table 6.9 shows the capital costs for the construction of an MBT complex with anaerobic fermentation and biogas utilization in a cogeneration plant in Uzhhorod. Table 6.10 shows the operating costs of the MBT complex in Uzhhorod.

Table 6.9. Investment (capital) costs for the construction of MBT complex with anaerobic fermentation and biogas utilization (CAPEX for MBT for biogas production)

Expenses	Estimated value, million UAH (million EUR)
Mechanical sorting shop	163.8 (4.5)
Biological processing shop	145.6 (4)
Equipment for the production of electrical energy (1 MW)	32.7 (0.9)
Construction and installation work	138.3 (3.8)
Design and author supervision	21.8 (0.6)
Total	502.2 (13.8)

Notes: as of November 15, 2022, the euro to hryvnia exchange rate was accepted at 36.4 hryvnias for 1 euro

Table 6.10. Operating costs of the MBT complex with anaerobic fermentation and biogas utilization, million UAH

Expenses	Forecast	Year 1	Year 3	Year 5	Year 7	Year 9	Year 11	Year 13
Electricity, million UAH*	3%	4.81	4.96	5,10	5.26	5.41	5.58	5.74
Salary, million UAH	3%	13.44	13.84	14,26	14.69	15,13	15.58	16.05
Technical service equipment, million UAH	1%	18.00	18,18	18.36	18.55	18.73	18.92	19,11
Transportation, million UAH	3%	1.10	1.13	1.17	1.20	1.24	1.28	1.31
Total	–	37.35	38,11	38.89	39.69	40,51	41.35	42,21

Notes: *the electricity tariff of PJSC "Zakarpattiaoblenergo" for voltage class 2 as of January 1, 2022 is UAH 1,480.39 per 1MW hour, excluding VAT; the installed capacity of the complex is assumed to be 65 KW/t; transportation takes into account additional transportation related to the operation of the complex; the wage fund is accepted according to the average wage in Transcarpathian Region, taking into account the accepted number of employees

Table 6.11 shows the forecast of income from the sale of secondary raw materials in Uzhhorod, received at the complex of MBT in Uzhhorod. The cost of secondary raw materials as of October 2022 is shown in Table K.1 (Annex K).

In the calculations, it is assumed that the creation of a central municipal waste processing facility in Uzhhorod goes beyond the capacity of the local budget, therefore funds from service providers or investment funds (credit) from international financial institutions may be involved. Other expenses related to the purchase of equipment, machines and means for the implementation of the municipal waste management service in Uzhhorod are covered by the local budget or a special fund of the regional budget (if there is an approved regional waste management plan in the region).

Table 6.11. Estimated forecast of income from the sale of secondary raw materials (MBT complex in Uzhhorod)

Secondary raw materials	Years						
	2023	2025	2027	2029	2031	2033	2035
	million UAH						
Cardboard and paper	2.42	2.69	3.00	3.52	3.72	4.14	4.61
Commercial glass	19.88	22.14	24.66	28.97	30.57	34.05	37.91
Metals	3.92	4.36	4.86	5.71	6.02	6.70	7.47
PET bottle	7.22	8.04	8.96	10.53	11,11	12.37	13.77
Plastic packaging	24.76	27,58	30,71	36.08	38.08	42.40	47.22
Total	58,21	64.82	72.18	84,81	89.50	99.66	110.98

Notes: the following assumptions were made during the calculations: 1) indicators of waste generation per inhabitant will increase by 0.5% every year (according to the recommendations of the World Bank); 2) coefficients of selection of secondary raw materials in the categories "cardboard and paper" - 0.5; "commodity glass" - 0.8; "metals" - 0.7; "PET bottle" - 0.8; "plastic packaging" (PND, PDV grade 2, low-pressure film) - 0.6

In calculations for Uzhhorod for the implementation of the MBT complex, the terms of granting a loan were adopted, similar to those in the loan agreement of Khmel'nitsky. The loan term is 13 years. Percentage is 5.75% per annum, one-time commission is 1.2%. Table 6.12 shows an indicative estimate of loan repayment costs by year for the implementation of the MBT complex in Uzhhorod.

Table 6.12. Indicative assessment of loan repayment costs by year (MBT complex)

Years	Year 1	Year 2	Year 4	Year 7	Year 10	Year 13
Reimbursement on credit, million UAH	59.6	62.5	73.4	83.8	97.0	107.0

Notes: the calculation is made taking into account the annual loan rate of 5.75% and the projected growth of the euro exchange rate by 5% annually

The difference between the recommended and existing tariff for waste management in Uzhhorod during the implementation of the MBT complex presents as the "contribution to the tariff" as a separate indicator. It was conducted an iterative assessment of the contribution to the increase in the tariff for waste management at the end of the first year of project implementation (Table 6.13). According to the calculations, it can be seen that the tariff for the municipal waste management service at the beginning of 2024 will be 1,866 UAH/t with an economically recommended tariff of 2,087 UAH/t, which is equal to an internal rate of return (IRR) of 10% and a payback period of 6-7 years. Based on the current rate of service provision, the tariff for the population will be 373 UAH/cub. m per year.

Table 6.13. Contribution to the increase in the tariff for waste management

Indicator	Tariff contribution levels					
	0.5	0.6	0.7	0.8	0.9	1
Contribution to the tariff, million UAH	34,17	37.96	42,18	46,87	52.07	57.86
Credit compensation, million UAH	-62.54	-62.54	-62.54	-62.54	-62.54	-62.54
Operating expenses, million UAH	-37.35	-37.35	-37.35	-37.35	-37.35	-37.35
Sales revenue, million UAH	58,21	58,21	58,21	58,21	58,21	58,21
Profit, million UAH	-7.51	-3.72	0.50	5.19	10.40	16,18

Notes: when estimating costs and revenues, it is assumed that the electric energy received from the cogeneration plant is used for own needs

Evaluation of the financial and economic indicators of the implementation of the MBT complex in Uzhhorod performed with assumptions and is not final. Clarification of the technical and economic

indicators of the implementation of the MBT complex in Uzhhorod it is recommended to carry out at the stage of Feasibility Study when developing design documentation.

6.5.2.2 IMPLEMENTATION OF THE CONSTRUCTION OF A SORTING STATION FOR SECONDARY RAW MATERIALS IN UZHGOROD

Table 6.14 shows the capital costs for the construction of a sorting station for secondary raw materials in Uzhhorod. Table 6.15 shows its operating costs.

Table 6.14. Investment (capital) costs for the construction of a sorting station for secondary raw materials

Expenses	Estimated value, million UAH
Mechanical sorting line with building structures, pressing equipment	12.0
Construction and installation work	7.0
Design and author supervision	1.0
Total	20.0

Table 6.15. Operating costs of the sorting station for secondary raw materials

Expenses	Forecast	Year 1	Year 3	Year 5	Year 7	Year 9	Year 11	Year 13
Electricity, million UAH *	3%	0.14	0.14	0.15	0.15	0.16	0.16	0.17
Salary, million UAH	3%	4.80	4.94	5.09	5.25	5.40	5.56	5.73
Technical service equipment, million UAH	1%	0.10	0.10	0.10	0.10	0.10	0.11	0.11
Transportation, million UAH	3%	0.20	0.21	0.21	0.22	0.23	0.23	0.24
Total	–	5.24	5.40	5.56	5.72	5.89	6.06	6.24

Notes: *the electricity tariff of PJSC "Zakarpattiaoblenergo" for voltage class 2 as of January 1, 2022 is UAH 1,480.39 per 1 MWh, excluding VAT; the installed capacity of the station is assumed to be 35 KWh; transportation takes into account additional transportation related to the operation of the station; the wage fund is accepted according to the average wage in Transcarpathian region, taking into account the accepted number of employees

In the calculations, it is assumed that the creation of a central municipal waste treatment facility in Uzhhorod possibly at the expense of local budget funds or funds of service providers. Other costs related to the purchase of equipment, machines and means for the implementation of municipal waste management services are charged to the local budget or a special fund of the regional budget (if there is an approved regional waste management plan in the region).

In accordance with the requirements of Clause 1 of the "Procedure for the formation of tariffs for municipal waste management services" (approved by the Resolution of the Cabinet of Ministers of Ukraine from 26.07.2006 No. 1010), in the event of the introduction of separate collection of municipal waste during the establishment of tariffs for municipal waste management services waste does not include the cost of handling operations with separately collected useful components of such waste. Therefore, the assessment of the impact on the tariff of the planned activity of the secondary raw materials sorting station in Uzhhorod was not carried out.

Evaluation of the financial and economic indicators of the construction of a sorting station for secondary raw materials in Uzhhorod performed with assumptions and is not final. Clarification of the technical and economic indicators of the construction of a sorting station for secondary raw materials in Uzhhorod is recommended to carry out at the stage of Feasibility Study when developing design documentation.

6.5.3 INFRASTRUCTURE OBJECTS IN THE FIELD OF MUNICIPAL WASTE MANAGEMENT IN UZHGOROD RECOMMENDED FOR CONSTRUCTION

In order to expand the possibilities of the system of separate collection of secondary raw materials in Uzhhorod, based on the obtained results of research and calculations, it is recommended to plan for construction the infrastructure facilities in the field of municipal waste management (Table 6.16), and equip additional equipment and means of the municipal waste collection system (Table 6.17).

Table 6.16. Infrastructure facilities in the field of a municipal waste management plan for construction

Name	Technology	Design power, thousand tons	Planned year of introduction into exploitation	General estimated cost, million UAH
Construction of a mechanical-biological waste treatment complex with anaerobic fermentation (MBT complex)	Mechanical sorting; manual sorting; pressing of secondary raw materials; anaerobic fermentation with the production of biogas; utilization of biogas in a cogeneration plant	50	2024	502.2
Construction of a sorting station for secondary raw materials	Mechanical sorting; manual sorting; pressing of secondary raw materials	15	2024	20.0

Notes: as of November 15, 2022, the euro to hryvnia exchange rate was accepted at 36.4 UAH for 1 Euro

Table 6.17. Planned additional equipment and means of the municipal waste collection system

Name	Number	Planned year of introduction into exploitation	General estimated cost, million UAH
Creation of specialized communal waste collection points	2	2025	It is determined by Design documentation
Creation of a mobile (transport) reception point for hazardous waste	1	2025	2.0
Creation of collection points for reuse of used goods	1	2025	It is determined by Design documentation
Creation of a waste collection center for their repair for reuse	1	2025	It is determined by Design documentation
Installation of underground container structures in the historic central part of the city	14	2024	4.9
Purchase of containers to ensure coverage of the waste collection service	75	2023	1.125

6.6 RECOMMENDATIONS REGARDING THE EXPANSION OF SEPARATE COLLECTION OF SECONDARY RAW MATERIALS IN UZHGOROD

The main conclusions and recommendations regarding approaches to the expansion of separate collection of resource-value components of municipal waste (secondary raw materials) in Uzhgorod are aimed at improving the ecological and sanitary state of the city, as follows:

1. It is necessary to increase the level of coverage of the municipal waste removal service from 90% to 100% of the population of Uzhgorod by 2024. At the same time, it is necessary to equip all sites with containers for a separate collection of secondary raw materials.
2. Effective extraction of secondary raw materials and processing of municipal waste is possible only if a central waste treatment facility is created. Two technological options are proposed: a) construction of an MBT complex with anaerobic fermentation and biogas cogeneration and b) construction of a sorting station for secondary raw materials.
3. The technical and economic evaluation demonstrates the effectiveness in reducing up to 40% of the total amount of waste for disposal at the landfill site when implementing the option with the construction of a complex of MBT with anaerobic fermentation and biogas cogeneration. The construction of a sorting station for secondary raw materials will reduce the landfill percentage to only 93%. Capital costs for the creation of the MBT complex are estimated at 502.2 million UAH, and the costs of creating a sorting station are estimated at 20.0 million UAH.
4. The technical and economic evaluation of the option with the construction of the MBT complex with anaerobic fermentation and biogas cogeneration shows that the level of the tariff for municipal waste management services at the start of commissioning of the MBT complex will be UAH 1,866 /t (the economically recommended tariff will be 2,087 UAH/t), which is equal to an internal rate of return (IRR) of 10% and a payback period of 6-7 years. More accurate calculations are possible during the Feasibility Study.
5. In order to meet the requirements of the National Strategy for Waste Management in Ukraine until 2030 and to meet the requirements of Directive No. 2008/98/EU in Uzhgorod, it is necessary to provide for the creation of specialized municipal waste collection points, a mobile hazardous waste collection point, and the creation of collection points for the reuse of goods, which were in use, the creation of a waste collection center for their reuse, as well as the installation of underground container structures in the historic central part of the city.

These approaches will allow not only reduce the volume of municipal waste landfills and their negative impact on the environment but will also provide an opportunity to obtain secondary raw materials, increase the amount of resource recovery, remove hazardous waste as part of municipal waste, ensure the collection and removal of waste in the most economically feasible way and ensure sustainable waste management systems in the territory of Uzhgorod.

GENERAL CONCLUSIONS

1. In recent years, the national legal framework for waste management has been undergoing intensive changes to bring it closer to EU legislation. The regulatory and legislative framework of Ukraine in the field of waste management has a sufficiently extensive number of documents of various levels. Currently, there are no regulatory and legal obstacles to the implementation of the creation of an effective waste management system in Uzhhorod in accordance with EU standards in the following areas: waste management planning, implementation of preparatory work, provision of waste collection and transportation, separate collection of waste, creation of waste treatment facilities, landfilling, ensuring reporting and public participation. At the same time, the principle of extended producer responsibility has not been implemented, which reduces the attractiveness of infrastructure projects for investors.
2. Uzhhorod is one of the few regional centers of Ukraine that has positive demographic development trends. In the future, the number of the city's population will grow, and in the pessimistic scenario, it will remain unchanged. Over the past 10 years, the dynamics of population income growth have been noted. The economic development of Uzhhorod is moderate and will maintain the trend in the future. Uzhhorod is one of the most attractive cities in Ukraine for investment. In the investment attractiveness rating, the city has an Invest A+- rating, which means high investment attractiveness and low sensitivity to investment risks.
3. As a result of Russian aggression, the prices of secondary raw materials fell significantly and the costs of transporting waste increased. Due to the increase of internally displaced persons in Uzhhorod, the amount of municipal waste generation increased by 18%.
4. The results of a sociological survey in Uzhhorod indicate dissatisfaction with the situation with waste management in the city. However, 96.6% of respondents support the introduction of separate collections, and 71.1% of respondents are ready to increase the payment for the service of municipal waste management when implementing European management practices.
5. The morphological composition of municipal waste in Uzhhorod shows the content of approximately 36% of resource-valuable components (cardboard and paper, polymer materials, commodity glass, and metals). When mixing, part of the cardboard and paper gets dirty. Therefore, the efficiency of extraction of resource-valuable components depends on the selected technological scheme, methods of collection and transportation, and the effectiveness of educational activities with the population.
6. The morphological composition of municipal waste indicates the presence of 38.6% of bio-waste. Of them, 32.7% is food waste, and the rest is green waste. The entry of bio-waste into a municipal waste landfill for disposal causes the formation of leachate, greenhouse gases and biogas, which in turn increases the risk of spontaneous combustion.
7. In general, the morphological composition of municipal waste in Uzhhorod indicates a violation by the population regarding the use of the municipal waste collection system. It is recommended that efforts be made to prevent green waste, batteries, accumulators, waste electrical and electronic equipment, and construction and demolition waste from entering municipal waste collection containers.
8. The level of coverage of the municipal waste removal service needs to be increased to cover 100% of the population of Uzhhorod by 2024. At the same time, it is necessary to equip all sites with containers for a separate collection of secondary raw materials.
9. In order to meet the requirements of the National Strategy for Waste Management in Ukraine until 2030 and to meet the requirements of Directive No. 2008/98/EU in Uzhhorod, it is necessary to provide for the creation of specialized municipal waste collection points, a mobile hazardous waste collection point, and the creation of collection points for the reuse of goods, which were in use, the creation of a waste collection center

for their reuse, as well as the installation of underground container structures in the historic central part of the city.

10. Effective extraction of secondary raw materials and processing of municipal waste is possible only if a central waste treatment facility is created. Two technological options are proposed: a) the construction of an MBT complex with anaerobic fermentation and biogas cogeneration and b) the construction of a sorting station for secondary raw materials.
11. The technical and economic assessment demonstrates the effectiveness in reducing up to 40% of the total amount of waste for disposal at the landfill when implementing the option with the construction of the MBT complex with anaerobic fermentation and biogas cogeneration. The area of the site for the location of the complex is 2.0 ha. The construction of a sorting station for secondary raw materials will reduce the landfill percentage to only 93%. Capital costs for the creation of the MBT complex are estimated at 502.2 million UAH, and the costs of creating a sorting station are estimated at 20.0 million UAH.
12. The approximate number of workplaces in the MBT complex is 71 people, and the sorting stations are 21 people.
13. The technical and economic evaluation of the option with the construction of the MBT complex with anaerobic fermentation and biogas cogeneration shows that the level of the tariff for municipal waste management services at the start of the commissioning of the MBT complex will be 1,866 UAH/t (the economically recommended tariff will be 2,087UAH/t), which is equal to an internal rate of return (IRR) of 10% and a payback period of 6-7 years. More accurate calculations are possible during the Feasibility Study.

PART II
ANALYSIS OF THE SYSTEM OF COLLECTION AND PROCESSING OF MUNICIPAL
AND COMMERCIAL GREEN WASTE

CHAPTER I. LEGAL AND ORGANIZATIONAL FRAMEWORK

The legal and organizational framework for waste management and, in particular, municipal waste, is considered in Part I " Analysis of the existing waste management system in Uzhhorod" - Section I "Legal and organizational framework". Table 1.1. shows a comparison of European and domestic standards for green waste management.

Currently, the concept of "green waste" in Ukraine is not fixed at the legislative level.

Waste management of the infrastructure of settlements in Ukraine is currently carried out on the same basis as municipal waste management. Urban infrastructure waste includes urban improvement facilities (gardens and parks, cemeteries, markets, etc.), including green waste (branches, fallen leaves) and street litter.

Based on the results of the comparison, the following conclusions can be drawn. The concept of "green waste" and the issue of managing this type of waste will be introduced into Ukrainian legislation when the Law of Ukraine "On Waste Management" enters into force on 09.07.2023 as a component of bio-waste. Bio-waste generators will be able to independently process bio-waste on homestead, country and garden plots through composting in accordance with the rules established by the central executive authority.

In addition, the above-mentioned law provides for the reduction of landfilling of biodegradable waste, which fully meets the requirements of Council Directive No. 1999/31/EC of April 26, 1999 on the landfill of waste as amended by Regulation (EC) 1882/2003.

Table 1.1. Comparison of European and national legislation in the field of green waste management

European directives	Provisions on green waste	Ukrainian legislation, the content of which reflects the provisions of EU Directives	Provisions on green waste
<p>Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives</p>	<p>"bio-waste" means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants</p> <p>Article 22. Bio-waste provides for the following for Member States:</p> <ul style="list-style-type: none"> o that bio-waste is either separated and recycled at the source, or collected separately and not mixed with other types of waste. 	<p>Absent for bio-waste, waste from green areas.</p> <p>The Law "On Waste Management", which will enter into force on 09/07/2023</p>	<p>bio-waste - waste that is subject to anaerobic or aerobic decomposition, such as food waste or food industry waste at all stages of production and consumption, green waste.</p> <p>Article 31. Rights and obligations of generators of municipal waste</p> <p>1. Generators of municipal waste have the right to:</p> <ol style="list-style-type: none"> 1) receive complete and reliable information about the safety of municipal waste processing facilities in the prescribed manner; 2) to process bio-waste

European directives	Provisions on green waste	Ukrainian legislation, the content of which reflects the provisions of EU Directives	Provisions on green waste
	<p>Member States may allow waste with similar biodegradability and compostability that meets the appropriate European standards or any equivalent national standards for compostable and biodegradable packaging to be collected together with bio-waste.</p> <ul style="list-style-type: none"> o Member States shall take measures to encourage: <ul style="list-style-type: none"> (a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste; (b) the treatment of bio-waste in a way that fulfils a high level of environmental protection; (c) the use of environmentally safe materials produced from bio-waste. 		<p>independently through composting on homestead, country and garden plots in accordance with the rules established by the central executive body, which ensures the formation of state policy in the field of housing and communal services.</p>
<p>Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste</p>	<p>It provides for a reduction in landfilling of biodegradable waste</p>	<p>Absent for bio-waste, green waste. The Law "On Waste Management", which will enter into force on 09/07/2023</p>	<p>Article 6. Separate collection of waste in settlements is carried out for such types of waste as paper and cardboard, plastic, glass, metal. At the same time, conditions are created to ensure separate collection of bio-waste, textiles, hazardous waste as part of municipal and other types of waste subject to separate collection.</p>

European directives	Provisions on green waste	Ukrainian legislation, the content of which reflects the provisions of EU Directives	Provisions on green waste
			<p>Article 40. It is planned to reduce the landfill of biodegradable waste through the development of the National Program for the Reduction of Bio-waste Landfill, which is approved by the Cabinet of Ministers of Ukraine. The national program for reducing bio-waste disposal can be a component of the National Waste Management Plan.</p>

CHAPTER II. ANALYSIS OF THE COLLECTION AND PROCESSING SYSTEM OF MUNICIPAL AND COMMERCIAL GREEN WASTE

One of the types of municipal waste is vegetable waste, in the classification of which a distinction is made between waste from tree clearing works and waste from wood processing.

The composition of waste from wood removal works includes:

- branches (branches of trees, bushes, etc., with or without leaves, freshly cut or dry);
- twigs (branches of trees without leaves up to one meter long);
- substandard (non-liquid) wood (branches of trees more than one meter long, trunk dead, emergency, dead wood, pieces of trunks formed during pruning);
- brushwood (waste from clearing bushes with a length of 2 m and a diameter of up to 6 cm);
- brushwood (thorns up to 2 m long);
- stumps;
- leaves and needles.

The composition of wood processing waste includes:

- lumpy waste (stem wood clippings);
- sawdust

Municipal and commercial green waste is waste from green areas, which an organic waste of plant origin, are formed on the territory of Uzhhorod in green areas, areas of residential and industrial zones of certain districts of the city.

2.1 Current system of green waste management in Uzhhorod

Green waste management includes a set of measures for their collection, transportation and treatment, including the creation of facilities for their treatment, including waste disposal facilities.

Works on the care of green areas, collection and transportation of green waste on the territory of Uzhhorod are carried out by the Communal Enterprise "Communal Road Maintenance Enterprise" of the Uzhhorod City Council (KP "KSHEP") (Uzhhorod, 3 Proektna St.).

2.1.1 Collection

The separate collection of individual components of green waste in Uzhhorod is carried out as part of the general system of municipal solid waste (MSW) collection - without separating waste from green areas from the total volume of municipal solid waste.

Green waste is collected at the places of generation (when performing work by employees of communal enterprises, for example, when trimming trees, bushes and lawns (Fig. 2.1)) or accumulates at container sites or containers designed for the collection of such waste, installed by KP "KSHEP"⁶⁴ (Fig. 2.2).

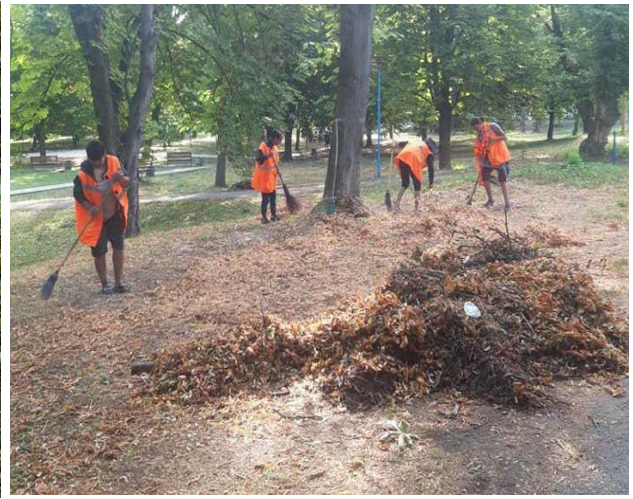
According to the "Uzhhorod Landscaping Rules"⁶⁵ (approved by the Decision of the Uzhhorod City Council "On Approval of Uzhhorod Landscaping Rules" No. 136 dated 26.12.2006): it is prohibited to dispose of green waste (grass, branches, wood, leaves) for long-term storage within the boundaries of city streets and roads and in residential areas, as well as near sites for temporary accumulation of municipal solid waste, dump in places not designated for this purpose and arrange unauthorized dumps.

⁶⁴ <http://surl.li/dtokf>

⁶⁵ https://old.rada-uzhgorod.gov.ua/download/s/pravyla_blahoustroju.pdf



Trimming and removal of trees



Sweeping fallen leaves



**Mowing the grass:
on the bank of the Uzh River**



on the premises

Fig. 2.1. Collection of green waste on the territory of Uzhhorod⁶⁶



Fig. 2.2. Euro containers for collecting fallen leaves on the territory of Uzhhorod

However, according to the on-site observations of specialists of SE "NDKTI MG", it was established that as of September-October 2022, part of the city's population, after carrying out works, including on private plots of individual buildings (private sector), carries out the removal of part of

⁶⁶ <https://www.facebook.com/kpksep/photos/>

the received green waste to container sites for municipal solid waste and stacks them near containers intended for temporary accumulation of municipal solid waste or near container sites for municipal solid waste (Fig. 2.3), setting up unauthorized dumps on the streets of Uzhhorod. This approach is unacceptable, as landfills are a serious source of air and water pollution.



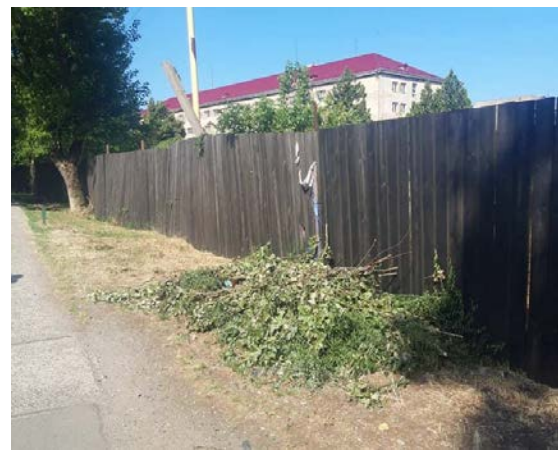
Near municipal solid waste containers



Near the container sites for municipal solid waste



**In zones of individual buildings
(private sector)**



Within city streets and roads

Fig. 2.3. Accumulation of green waste on the territory of Uzhhorod

According to the “Uzhhorod Landscaping Rules”, burning green waste (branches, fallen leaves, grass) is prohibited, homeowners are personally responsible for burning the listed waste within the city limits. However, it has been established that there are cases of burning of waste from green spaces by residents - on private plots of individual buildings (private sector) and on uncontrolled unauthorized dumps to reduce the volume of accumulated waste, due to the lack of organized collection points, or their availability, which significantly worsens the ecological situation on the territory of Uzhhorod.

2.1.2 Transportation

In accordance with the "Uzhhorod Landscaping Rules", green waste from enterprises, institutions, organizations, individuals and legal entities of the city is transported to a specially designated site or a municipal waste landfill by concluding appropriate contracts with specialized enterprises of the city. Section 5 of the Landscaping Rules stipulates that in the period from October 1 to April 1, it is necessary to timely clean the territories of leaves, removed annual plants and take them to the established sites.

As of 2022 in Uzhhorod a special site for the collection and storage of bio-waste is not allocated, the waste from the green areas after collection is transported by specially equipped transport to the

municipal waste landfill in the village Barvinok - municipal ones are transported by KP "KSHEP" (as needed and accumulated), commercial ones - on the basis of relevant contracts (by order). The population has the opportunity to order from the communal service individual removal of the received green waste.

Fig. 2.4 shows the process of ensuring the collection and transportation of green waste from the places of generation and collection from the territory of the city by KP "KSHEP".



Fig. 2.4. Removal of green waste from places of formation and collection on the territory of Uzhhorod

To ensure the functioning of KP "KSHEP", as the holder of certain territories (green areas of general use), there is a need to update the material and technical base used by the enterprise.

2.1.3 Treatment

In Uzhhorod, there are no separate infrastructure facilities for green waste management, including their treatment, which function in accordance with the requirements of current legislation. Treatment of all received green waste takes place by landfilling them in a municipal waste landfill in their natural form, which is irrational in modern conditions of constant reduction of raw materials and increase in their cost. Waste of vegetable origin such as grass, leaves, and chopped tree branches are suitable for treatment into compost, which is needed to maintain soil fertility in green areas of the city and ensure the proper condition of green areas (lawns, flower beds, bushes, trees). Grass clippings and autumn leaves are excellent raw materials for compost. Cut branches are used as mulch after grinding in specialized crushers.

For Uzhhorod, there is a need to create green waste management in order to enable the introduction and use of modern management practices and methods of their treatment.

2.2 Conclusions regarding the state of the green waste management in Uzhhorod

One of the types of waste in Uzhhorod is green waste, which is generated in the adjacent areas of residential areas (including the private sector), green areas of the city and industrial zones in the process of taking care of green areas.

Separate collection of green waste in Uzhhorod is not carried out centrally at the local level - waste is collected at the places of generation or accumulated at/near container sites, after which it is transported to the municipal waste landfill for disposal, without additional treatment. Green waste management generated in residential buildings of individual construction (houses of the private sector) of the city with a plot of land has a specific feature - maintaining order and cleanliness involves residents solving such issues as seasonal pruning of trees and cleaning of fallen leaves, their collection and independent removal of waste due to the lack of a centralized management system for this type of waste. Often there are natural landfills of green waste, arranged in unauthorized places, and seasonal burning of fallen leaves, which harm not only nature but also residents who live in the immediate vicinity.

According to the results of the analysis of the current state of green waste management in Uzhhorod, the method of their collection, the level of availability of separate collection, problems and features of management - the issue of green waste management is not fully resolved, especially in the private sector, in particular - the places and methods of their collection, transportation, treatment are not defined, and the existing practice in the city at all stages (collection, transportation, treatment) has significant negative consequences (of an ecological nature and in the field of health care), despite some progress in improving the situation other types of waste management systems.

Ensuring appropriate maintenance of green areas for public use, and first of all in the central areas of Uzhhorod, is a necessary component of its socio-economic development, the implementation of its strategic choice as a European city and tourist center. A correctly planned system of green areas, removal and treatment of plant waste at the base of the urban structure, provided it is constantly supported, is able to change the ecological situation for the better and significantly improve the appearance of the city. An important issue regarding any waste is its treatment. Removal of waste of organic origin from the total amount of municipal solid waste, including green waste, increases the term of use of the municipal waste landfill several times and minimizes the burden on the environment. In addition, green waste has a resource potential when a certain processing technology is implemented. Therefore, for Uzhhorod, the implementation of a planned and regular system of green waste collection, the arrangement of container sites in accordance with the requirements of current legislation, and the creation of a facility for the management of such waste are relevant. It is important that the methods used should be convenient and effective.

The green waste management system in Uzhhorod needs improvement and effective decision-making, which will ensure the implementation of the measures of the National Waste Management Plan in Ukraine until 2030 and the directions of the National Waste Management Strategy in Ukraine until 2030, taking into account the features of the economic and social development of the city based on European standards.

The main goal of implementing a systematic approach to green waste management in the city is to develop and improve the quality of services in general in the field of waste management and create conditions for improving the living standards of its population.

CHAPTER III. MAIN SOURCES OF MUNICIPAL AND COMMERCIAL GREEN WASTE

The sources of green waste in the city are green areas of the city for various purposes, which consist of:

- public green spaces (parks, squares, embankments, etc.);
- green areas of limited use (plantations on the territories of public and residential buildings, schools, children's institutions, health care institutions, industrial enterprises, warehouse areas, etc.);
- special purpose green plantings (plantings along the streets, in sanitary protection and security zones, in the territories of cemeteries, high voltage power lines, roadside plantings within the city limits, protective, water protection, fire protection and other plantings).

The listed objects are the source of the formation of branches, knots, twigs, brushwood, unseasoned wood, stumps, grass and leaves (needles), which in the course of year-round care for green areas of various purposes must be collected, transported and processed as green waste.

According to the State Classifier of Ukraine DK 005-96⁶⁷, the following nomenclature can be attributed to green waste:

- 0201.2.1.01 Trimmings of tree trunks and crowns;
- 0201.2.1.02 Root trimmings of trees;
- 0201.2.1.03 Twigs, branches, tops of trees;
- 0201.1.1 Planting material waste.

In addition, fallen leaves are formed, which are not included in the State Classifier of Ukraine DK 005-96 as waste.

Works on the maintenance of green spaces, which lead to the formation of waste and remnants of branches, leaves, tree trimmings, grass, fallen leaves:

- a) pruning of trees, bushes, flower beds, which is seasonal and does not take place throughout the year;
- b) circumcision:
 - rejuvenating pruning is performed only on those trees that can withstand trimming and pruning well and whose top has begun to dry, and the growth of shoots has stopped;
 - during annual inspections of green areas, emergency trees are identified;
 - pruning of creeping plants (lianas);
- c) formation of tree crowns;
- d) mowing lawns;
- e) planting seeds.

Natural processes and phenomena that lead to the formation of the remains of branches and leaves:

- natural fall of leaves in plants (leaf fall);
- ageing of plants and diseases;
- destruction of plants as a result of natural phenomena.

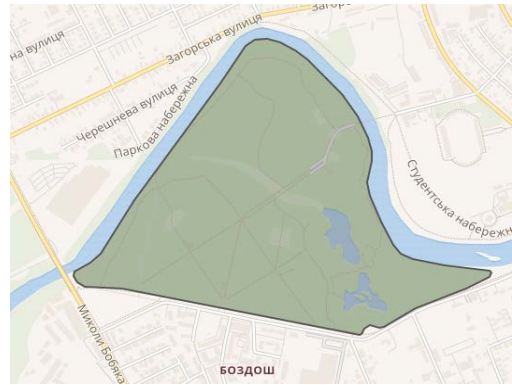
There is a seasonality in the generation (collection) of green waste: leaves - September, October, and November; other waste from tree-clearing works - evenly from September to April-May (wood-clearing works are not carried out during the growing season); wood processing waste - constantly throughout the year, which must be taken into account when planning the business entity's activities in the field of waste management. For example, in the autumn period, the removal of fallen leaves, branches and weeds from the territory of the private sector of the city is problematic due to the increase in the amount of waste during this period and, accordingly, the costs of its removal.

Fig. 3.1 shows the main existing public green spaces in the territory of Uzhhorod.

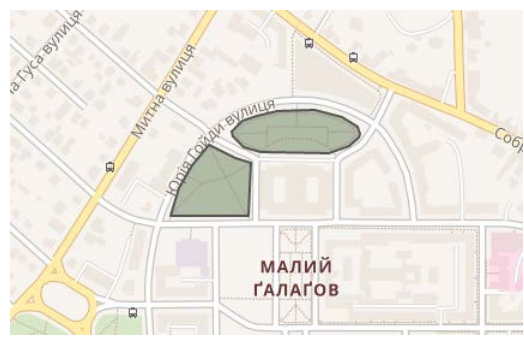
⁶⁷ <https://zakon.rada.gov.ua/rada/show/va089217-96#Text>



Park "Pydzamkovy" (district of Pidgradska Street) (4.0 hectares)



Recreation Park "Bozdoshskiy" (district of Bezdoshka Dorogya St.) (50.0 hectares)



Ground floor square (Narodna Square) (2.0 hectares)



Linden alley (embankment) (1.0 ha)

Fig. 3.1. Green spaces for public use in Uzhhorod

CHAPTER IV. ASSESSMENT OF THE QUANTITY OF GREEN WASTE

As of 2022, in Uzhhorod, statistical accounting data from official sources regarding the volumes of green waste generation, the amount of their treatment and disposal, obtained according to the reliable results of a constantly functioning accounting system (including data on weighing green waste, arriving at the landfill), or data from experimental studies of the volume of waste generated in the city, their composition from different categories of generators, are absent in open sources or are of a fragmentary nature, which does not allow them to be used as a basis for analysis. In the city, there is no separate accounting of the amount of green waste and the parameters of such waste management.

Therefore, the determination of the amount of green waste per unit of measurement requires additional analysis and is carried out through scientific and analytical works.

4.1. DETERMINING THE AMOUNT OF GREEN WASTE ACCUMULATION

The research methodology involves fixing the actual amount of green waste by determining the actual volume of services for the removal of plant waste during the calendar year throughout the city, based on the total area of the city's green areas.

Depending on the method of collecting leaves from green areas, the actual volume of services for their removal is determined by volume and weight.

The amount of green waste is determined by:

- in the case of loading green waste into a special vehicle - based on the volume of the body of the special vehicle;

- in the case of loading green waste together with containers - as the sum of the volumes of loaded containers.

The mass of green waste is determined by:

- in the case of loading green waste into a special vehicle - as the difference in mass of the green waste and the empty special vehicle;

- in the case of loading green waste together with containers - as the total difference between the weights loaded with green waste and empty containers.

The calculation of the volume of green waste generation in an average year for landscaping objects (parks, squares, etc.) is carried out according to the formula:

$$V_C = \frac{V_0}{S}, \quad (4.1)$$

where V_C - the volume of green waste generation per calculation unit for landscaping objects (parks, squares, etc.) on average per year, m^3/m^2 ;

V_0 - volume of green waste, that were removed from the specified sector of the improvement object during the calendar year (m^3);

S - is the total area of the territory with green spaces in the defined sector of the development object.

The calculation of the mass of waste generation from green plantations in an average year is carried out according to the formula:

$$m_c = \frac{m_0}{S}, \quad (4.2)$$

where m_s - the mass of green waste per calculation unit for landscaping objects (parks, squares, etc.) on average per year, kg/m^2 ;

m_0 - the mass of green waste removed from the defined sector of the improvement facility per calendar year (kg);

S - the total area of the territory with green spaces in the defined sector of the development object.

The calculation of the density of green waste on average per year (kg/m^3) is carried out according to the formula:

$$(\text{po}) = \frac{m_c}{V_c}, \quad (4.3)$$

The calculation of the volume of green waste generation in an average year for the residential sector is carried out according to the formula:

$$V_c = \frac{V_h}{m}, \quad (4.4)$$

where V_c - the volume of green waste per calculation unit for the residential sector on average per year, m^3/person ;

m - number of calculation units, people;

V_h - the estimated volume of green waste in the specified residential sector on average per year, m^3 , is determined by the formula:

$$V_h = q \cdot S \cdot n_{av.}, \quad (4.5)$$

where q - the annual rate of green waste for urban planning calculations according to DBN B.2.2-12-2019 "Planning and development of territories", $0.007 \text{ m}^3/\text{m}^2$ is accepted.

S_i - the area of greening, which is determined within the framework of the city's general plan for the i -th sector, m^2 .

The calculation of the density of green waste on average per year (kg/m^3) is carried out according to the formula:

$$(\text{po}) = \frac{m_c}{V_c}, \quad (4.6)$$

4.2. ASSESSMENT OF THE AMOUNT OF GREEN WASTE IN UZHGOROD

The calculation was made on the basis of the provided data, the master plan of the city and own research and assumptions.

The group of bio-waste includes all organic components that are capable of biological decomposition: green waste (flowers, grass, leaves, weeds, etc.), food waste (vegetable and non-vegetable origin - remains of vegetables, fruits, bread, cereals, cheeses, meat, fish, animal feed, etc.) and other waste (bones, feces, etc.).

When calculating the volume of green waste in private households and on improvement sites, a part of the volume of bio-waste generation in the composition of mixed municipal waste (only waste of plant origin), which is planned to be removed from municipal waste by separate collection, was taken into account.

Peak increases in bio-waste content during the year are observed in August, September and January; during the week - on Saturday, Sunday; as well as on holidays (according to the results of research by SE "NDKTI MG" in populated areas of Ukraine).

According to reference data, the moisture content of bio-waste is 70-90% (by mass). The presence of bio-waste in the composition of mixed municipal solid waste leads to the formation of leachate during the transportation and disposal of waste and becomes a source of biogas generation at the municipal waste landfill.

The list of types of generated waste differs depending on the place of their collection (residential sector of multi-apartment buildings, residential sector of manor buildings, objects of non-production sphere (commercial, administrative, etc.)). Fig. 4.1 shows the distribution of volumes of leaf litter formation from green economy objects in the settlements of Ukraine (according to the researches of SE "NDKTI MG").

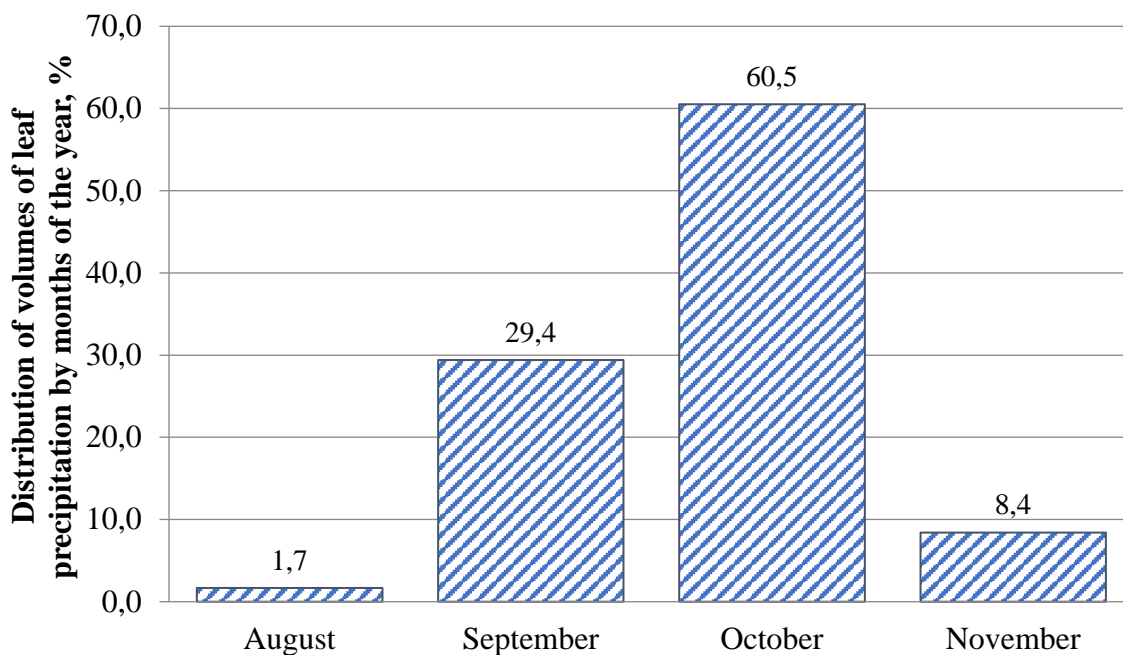


Fig. 4.1. Distribution of volumes of leaf litter formation from green economy objects in the settlements of Ukraine (according to the researches of SE "NDKTI MG")

Also, over the past 10 years, the volume of felling in the city has decreased, and at the same time, the volume of liquid wood is also decreasing. Accordingly, the volume of wood waste also decreases. The unevenness of the volume of fellings over the years is related to the unevenness of their annual funding, as well as the underfunding of programs for the improvement of the city's green spaces.

Currently, liquid wood, which is formed as a result of the economic activity of communal enterprises, is mainly sold to the population in the form of fuel (firewood) or is subject to removal to landfills for disposal. This level of use of wood and wood waste in modern conditions of constant reduction of raw materials and increase in their cost is unacceptable. The list of goods and products that can be produced from wood waste and liquid wood generated and collected on the territory of Uzhhorod by communal enterprises is extensive. First, these are modern types of fuel: fuel briquettes, fuel pellets, biogas, etc. Secondly, it is the product of deep processing of wood and wood waste of plant origin - a wide range of building materials and structures, dozens of names of other consumer goods.

As a result of the calculations, the amount of green waste in Uzhhorod from public improvement facilities (parks, squares, etc.) and the adjacent territories of the multi-apartment sector, the adjacent territories of individual buildings with a plot of land (Table 4.1). The volumes of green waste from the residential areas of the residential sector (apartment and estate buildings) and the territories of non-production objects (commercial, administrative, etc.) are significantly smaller compared to urban landscaping objects, which produce the main amount of green waste in the city. According to the received data, the majority of green waste in Uzhhorod is generated by public improvement facilities (parks, squares, etc.). These norms of formation are not included in the volume of municipal solid waste removal services.

In order to be able to plan the economic activity of the enterprise in the field of waste management in the future, to optimize the work on the removal of green waste in Uzhhorod, it is necessary to take into account the results obtained in the scope of providing services for the transportation of municipal solid waste by establishing the norm of green waste generation.

Table 4.1. Characteristics of volumes of bio-waste generation in Uzhhorod

Year	Number settlement units for 2022, thousand people	Norm formation for green waste, kg/person for a year	Calculated volume of green waste in private houses farms, t/year	Calculated volume of green waste on objects landscaping, t/year	Amount bio-waste as part of mixed municipal waste, t/year
2022	23.2	5.7	132.2	302.4	692.9
2030	33.0	5.7	188.1	699.0	721.9

Notes: The bulk density of leaf litter and clippings is 0.07 t/m³. The rate of green waste generation is 0.007 m³/m². Only waste of vegetable origin is included in the amount of bio-waste generation in the composition of mixed municipal waste, the extraction percentage is taken to be 0.05.

According to the data of the master plan of Uzhhorod, green spaces for public use of the city are represented by parks, squares, boulevards with a total area of about 72 hectares. Based on the fact that the area of such territories is insufficient (the specific value per inhabitant is about 30% of the standard), the general plan provides for the increase of green areas for public use for the city as a whole to 166.4 hectares by the end of 2030 by including them in the city the border of green areas of the forest massif in the north-east of the city (creation of a forest park on its base), green construction in the area of St. Zagorska, residential area "Sady", hydropark. The creation of new green spaces for public use will lead to an increase in the amount of waste received from green spaces.

It was established that green waste is the main generator of unauthorized dumps that are periodically formed on the territory of Uzhhorod (Fig. 4.2). They are promptly and systematically eliminated at the expense of the budget of the Uzhhorod community, but this phenomenon significantly worsens the ecological and sanitary condition of the city and the environment.



Fig. 4.2. Unauthorized dumps of green waste on the territory of Uzhhorod

Processing of collected green waste (fallen leaves and grass) by the method of composting with subsequent use for enrichment and reclamation of park zone lands is not carried out in Uzhhorod. Only 20% of the total volume of this type of waste does not end up at the municipal waste landfill (it is a green waste of a part of the population that composts on their own plots), which is explained by the lack of composting areas and the introduction of modern technologies for treatment green waste.

In the absence of production facilities for the treatment of green waste, it is impossible to process all leaf and grass waste generated in Uzhhorod.

Thus, there is an urgent need to implement modern technologies for the treatment of green waste. One of the priority directions in the development of the field of green waste management is composting. To solve the problem, it is necessary to determine the appropriate territory and create an appropriate enterprise (composting station).

The processes of formation, collection, removal and use of bio-waste constitute a complex socio-economic problem that requires an accelerated solution. The issue of processing and consumption of waste processing products concerns important social, economic and environmental relations that require comprehensive regulation. To successfully solve this problem, it is necessary to take into account all possible national, regional and industrial interests by involving in its development and accompanying representatives of all interested parties.

CHAPTER V. ASSESSMENT OF THE MARKET FOR SALE OF PRODUCTS (COMPOST). RECOMMENDATIONS FOR IMPROVING GREEN WASTE MANAGEMENT AND IMPLEMENTING COMPOSTING

The presence of a large amount of biodegradable waste (green waste, food waste) leads to their excessive accumulation and the need for removal by residents and, as a result, the contamination of other municipal waste (MW) and separated secondary raw materials to which they are added. Further, when it gets into landfills, it worsens the ecological and sanitary condition of the landfill, since the biological decomposition of organic components of municipal solid waste is the main reason for the formation of leachate and biogas, which are harmful migrations into the surrounding natural environment. Therefore, a separate collection of bio-waste is important, which can make up to 50% of the total volume of municipal waste (according to the morphological composition of MSW). This requires the implementation of other methods of handling such types of waste.

5.1 COMPOSTING OF BIO-WASTE

Composting is a biological aerobic process that converts easily degradable bio-waste into carbon dioxide and stable organic matter. During oxygen composting, air reacts under certain conditions with organic materials to form CO₂, water and humus compounds. As a result of the processes of biological decomposition, the material naturally heats up. At the beginning of the process (the main phase), high temperatures occur (up to approximately 65-75°C), which determine the drying of the material and its sanitization. By the end of the process, the temperature slowly decreases. The solid residues of the process are compost and other residues (requiring further processing).

Compostable waste: green waste (leaves, young cuttings, garden waste from households), separately collected food waste.

To obtain commercial compost, waste to be composted must be collected separately. Green waste and food waste must be collected separately from municipal waste and their mixing should be avoided.

Composting technologies

The range of composting technologies is extremely wide, covering simple, open methods (side composting in the open air, in open rolls (sides), which are regularly mixed using special equipment) and closed systems with technical complexity and precise control, where various parameters are regulated, such as temperature, humidity and oxygen supply (tunnel composting). The simplest method is the use of individual composters in private plots of individual buildings in the city (private sector houses).

The technological goal of composting is:

- production of commercial compost;
- reducing the amount of waste that is taken out for disposal at a municipal waste landfill;
- reducing the danger of municipal waste during the operation of the municipal waste landfill.

Technological features of composting

In order to obtain a high-quality composting product, the input material must meet the following quality requirements:

- waste must be collected separately and must not contain components that release harmful substances;
- the structure of the material should provide good aeration, and the ratio of carbon to nitrogen (C/N) should be from 20:1 to 40:1 with adequate humidity;
- optimal humidity 50-60%;

At the same time, a too high concentration of nitrogen in the starting material is not permissible, since in this case almost all nitrogen contained in organic substances will be converted into ammonia under the action of microorganisms. At pH values > 7, a high concentration of ammonia leads to its unwanted release into the atmosphere.

In order to destroy pathogens and weed seeds during composting, it is necessary to expose the material to a temperature of at least 55°C, if possible, continuously for 2 weeks or a temperature of 65°C (in closed installations: 60°C) for 1 week.

Process water, if it is not treated in the process itself, must undergo adequate treatment before discharge into surface water bodies (for example, in accordance with Directive 91/271/EEC⁶⁸ on the treatment of urban wastewater).

Advantages: relative simplicity of the technology and high reliability of the system; the low volume of investments and capital investments; technology has no opponents.

Disadvantages: only waste of vegetable origin is subject to processing by composting; the need to create a separate collection of bio-waste; unpleasant odors near the equipment are possible.

Features of the location of composting facilities: sites and installations for composting can be built throughout the area, but mainly near the places of generation of the corresponding waste. It is desirable to place composting sites and facilities near transport highways in order to organize the removal and sale of composting products. As with the construction of most plants for the treatment of organic waste, it is recommended to maintain a certain distance from residential areas due to unpleasant odors and the presence of vermin.

5.2 RECOMMENDATIONS FOR IMPROVING GREEN WASTE MANAGEMENT AND COMPOSTING

For quality preparation for treatment, any waste should not be mixed with other waste or materials with different properties, that is, collected separately. The introduction of separate collection of waste in Uzhhorod, depending on their type, characteristics and composition, will create conditions for separate collection of bio-waste (green waste and biodegradable waste), which will further facilitate their further processing.

One of the methods of treatment bio-waste is composting, which can be carried out in accordance with the rules established by the central executive body, which ensures the formation of state policy in the field of housing and communal services, as directly in households - on homesteads, summer cottages and garden plots (independently implemented in compost pits or with the use of special composting devices) and centrally (generators on homestead, country and garden plots provide a separate collection of bio-waste, which is then transported to specially equipped sites or to silo towers, where compost is placed). Subsequently, such compost is used for the needs of the green/agricultural sector of the city or, if necessary, for the residents' own households.

Composting technologies in households have become widespread in practically all European countries - in the EU, 20% of private sector residents carry out household composting. Some residents of individual buildings in Uzhhorod (private sector houses) with a plot of land have the opportunity to organize the storage (composting) of waste from green areas (fallen leaves, grass clippings and branches after pruning trees in autumn and spring) in their own yards. Therefore, for residents of individual buildings, it is proposed to introduce a separate collection of bio-waste, which is carried out at the local level, and should include stimulation and encouragement by local self-government bodies of residents to separate collection and composting of the organic component of municipal solid waste in private households by installing individual composters in the yards of households (Fig. 5.1) and parallel implementation of powerful information work with the population. The number and parameters of equipment for individual composting of VBR are determined by household owners, based on their needs. For a household of 2-3 people, an individual composter with a capacity of 1 m³ can be recommended. By encouraging private sector residents, it is possible to involve up to 10% of the population in composting in city households by 2030. This will remove approximately 5% of the

⁶⁸Council Directive 91/271/EEC "On Urban Wastewater Treatment" dated May 21, 1991 (Ukrainian/Russian) // https://zakon.rada.gov.ua/laws/show/994_911#Text

total volume of municipal waste generation. Other bio-waste generated in the private sector will enter the municipal waste collection system in a "grey" container with mixed waste.



Fig. 5.1. Individual composter of industrial production

In the absence of the use of fallen leaves and grass clippings in their own individual composters, the residents of the individual buildings of the city will collect this part of the green waste in separate special bags, and the tree trimmings will be stored on the territory of their own households (on the territory of the house). According to the schedules and routes or by order, a special transport for collecting green waste will pick up bags with a part of green waste (leaves and grass) and on the spot, with the help of installed shredding equipment, shreds branches and tree trimmings, the resulting fragments are taken to composting station plant waste or used for mulching.

Fig. 5.2 presents a machine for shredding green waste (based on a tractor).



Fig. 5.2. Device for shredding green waste (tractor-based)

In order to improve the management of green waste in Uzhhorod, given that they have the property of being subject to anaerobic or aerobic decomposition, it is proposed, after receiving them as a result of mechanized and manual cleaning in the warm period of the city, transportation in accordance with the contract of communal order (or self-removal by transport of residents) to the composting station (separately allocated plot of land for storage and processing of plant waste) on the territory of Uzhhorod for the purpose of obtaining compost and its further sale.

In addition, it is necessary to establish a system of accounting (calculations) of waste that will be composted, for further reporting at the regional level regarding the fulfilment of targets set by the National Waste Management Strategy.

5.3 PROPOSALS FOR THE APPLICATION OF BIO-WASTE COMPOSTING FOR UZHGOROD

The starting materials should be collected separately and should not allow the presence of harmful substances in them. Additional processing of raw materials before composting allows for improved quality but does not ensure the separation of fractions from mixed municipal waste that meets high requirements for compost purity. Preliminary mechanical processing may include the following operations:

- separation of impurities and pollution;
- grinding;
- separation of metals.

For the conditions of Uzhhorod, it is advisable to consider open (side) composting with passive (natural) aeration. The open method of composting has low capital costs compared to others. At the same time, the quality of the compost does not decrease.

The open method of composting involves stacking waste in piles. Forming of sides is carried out by a forklift. The sides have a height of 1.80 to 3.00 m. The shape of the sides is possible: triangular, trapezoidal or flat. The average duration of the composting process is approximately 10-60 weeks. Table 5.1 shows the recommended parameters of the sides and the terms of composting. When stacking in bins with passive aeration, the source material should have an average particle size of about 5 cm. Fig. 5.3 shows an example of stacking bio-waste in bins.

Table 5.1. Recommended side parameters and composting terms

Side size						Term composting, weeks
Height, m	Length, m	Width lower basics, m	Area for lower basis, m ²	Width for upper basis, m	Volume, m ³	
2.5-3.0	10-50	3-4	30-200	2-3	65-525	2.5-7



Fig. 5.3. Example of stacking bio-waste in curbs (Source: <https://city-adm.lviv.ua>)

Based on the volumes of bio-waste generation in Uzhhorod (see Table 4.1), the calculated parameters of the material balance of the composting station in Uzhhorod (Table 5.2) were determined.

Table 5.2. Calculated parameters of the material balance of the composting station

Parameter	Unit	Value
Total population served	person	115,542
Volume of waste generation	t/year	50,396
Design capacity of the composting station (1 shift per day) for 2022	t/year	1,200
	%	100
Obtaining commercial compost	t/year	420
	%	≈ 35
Obtaining screening after composting (disposal at a municipal waste landfill)	t/year	180
Moisture evaporation and gas emissions	t/year	480
	%	40

The capacity of the sorting station in Uzhhorod can be 1,200 t/year, and in 2030 – 1,600 t/year.

It is recommended to accept the area of the land plot for the location of the bio-waste sorting station in accordance with the requirements of GBN B.2.2-35077234-001⁶⁹. In the future, the area of the land plot for the construction of the bio-waste composting station will be 0.18 hectares, excluding administrative and household buildings. The recommended locations of plots (2 options) are given in Annex H.

Functional zoning of the composting site: unloading area (5% of the area), commercial compost storage area (10% of the area), composting area (75%) and other areas (10% of the area).

⁶⁹Municipal waste sorting and processing enterprises. Requirements for technological design // <http://surl.li/cbyrg>

Table 5.3 shows the staff list of the company's employees in accordance with the requirements of GBN B.2.2-35077234-001 for the accepted design capacity of the bio-waste sorting station.

Table 5.3. Approximate staff list of employees of the bio-waste sorting station

No	Profession and position	Estimated number of positions
1	Administrative and managerial employees	1
2	Master technologist	1
3	Mechanic	1
4	Operator	2
5	Total	5

Table 5.4. Investment (capital) costs for the construction of a bio-waste composting station

Expenses	Estimated value, million UAH
Construction of structures, site preparation	3.1
Purchase of machines and mechanisms	6.6
Design and author supervision	0.5
Together	10.2

Notes: the estimated cost of construction works depends significantly on local conditions. The indicators of the collections of resource elemental estimate standards for repair and construction works were used for calculations. The price may be specified when local conditions are established

Table 5.5. Operating costs of the bio-waste composting sorting station

Expenses	Year 1	Year 10
Maintenance, million UAH	0.102	0.123
Operation of machines and mechanisms, million UAH	0.306	0.398
Salary, million UAH	1,125	1,463
Total, million UAH	1,533	1,984

Notes: the salary fund is based on the average salary in the Transcarpathian region, taking into account the number of employees

Thus, composting costs are approximately 1,278 UAH /t (without taking into account the planned profit). For comparison, in the EU countries, composting costs are 1,098-2,562 UAH/t (30-70 EUR/t)⁷⁰. The retail price of compost of KP "Green City" is 0.62 UAH/kg or 620 UAH/t (2021)⁷¹. Composting costs decrease as recycling volumes increase.

There are approximately 915 composting sites in Germany. 40% of them use open composting in piles with passive aeration.

Examples of similar settings:

- Humuswirtschaft Kaditz GmbH, Dresden (www.humuswirtschaft.de);
- Kompostwerk Hellefelder Höhe GmbH, Sundern (www.kompostwerk-online.de);
- Kompostwerk Olpe GmbH, Olpe (www.oez-olpe.de).

5.4 MARKET PRICE OF PRODUCTS OBTAINED FROM COMPOSTING IN UZHGOROD

Despite the relative simplicity of the technology and the high reliability of the system, the low volume of investments and capital investments, the technology of bio-waste processing by composting is not developed in Ukraine. At present, the only practical example of composting of

⁷⁰ <https://www.kompost.de/>

⁷¹ <https://city-adm.lviv.ua/news/city/housing-and-utilities/285358-lkp-zelene-misto-rozpochynaie-prodazh-kompostu-dlia-naseleennia>

municipal waste is its processing at composting sites in Lviv (financed from the city budget), which is implemented by KP "Green City", which carries out the collection of waste in separate containers of 240 l and their removal by separate special transport to composting areas. A practical example of commercial waste composting (pure organic raw materials from the markets) is composting in Lutsk, implemented by the Pasternak-bio company (profitable activity).

The main problem with the application of composting technology – apart from the possibility of using limited types of waste (only waste of plant origin (bio-waste)) and the need to create a separate bio-waste management system (separate collection), is the lack of a market for the resulting compost or compost-like product.

The resulting compost can be used in accordance with SOU ZHKG 10.09-014:2010⁷² in agriculture, forestry and green construction as fertilizer, for land reclamation and as fuel with preliminary briquetting, which must be carried out according to standard technologies, which include preliminary drying of compost to a moisture content of 3 % to 8% and processing on the press.

According to BREF, in some European countries, compost from waste is used as a material for covering (reclamation) landfills and overlapping layers of municipal solid waste.

Scope of commercial compost application (according to agrochemical, microbiological, toxicological and physicochemical indicators):

- 1) mainly in agriculture and horticulture;
- 2) greening of territories, as a substrate for the processing of special crops (fruits, grapes, asparagus), to improve the soil and in homesteads;
- 3) for fertilizing home flowers and plants.

Compost from fallen leaves should be used only in green farming and land reclamation. In this regard, it is advisable to place equipped areas for composting fallen leaves on the territory of communal enterprises for the maintenance of green spaces.

Doses of adding compost to the soil are calculated according to the methods given in the SOU ZhKH 03.09-014⁷³. Control of sanitary and hygienic indicators of fertilizers is carried out in accordance with the Law of Ukraine "On Pesticides and Agrochemicals". The sanitary-epidemiological station must carry out verification control of the sanitary-hygienic indicators of products at least 4 times a year.

Table 5.6 shows the market value of different groups of compost as of 2022 according to expert assessments, depending on the quality assessment according to the criteria of SOU ZhKH 03.09-014, limitations in doses, application frequency and areas of application in agriculture. Table 5.7 shows the same in forestry, green construction and land reclamation.

Table 5.6. Groups of compost according to the quality assessment according to the criteria of SOU ZhKH 03.09-014, restrictions on doses, frequency of application and areas of application in agriculture

Group 1	Group 2	Group 3
Use as fertilizers (or for making compost) in doses adequate to standard fertilizers	Use in a dose of (4-5) t/ha per year based on dry matter or no more than 15 t/ha once every 3 years	Use in a dose of (5-6) t/ha based on dry matter once every 5 years with mandatory control of the background content of elements
Grain, fodder, industrial crops	Grain, fodder, industrial crops	Grain, fodder, industrial crops
The market value of compost is 620 UAH/t	There is no market value	There is no market value

⁷²The technology of processing organic matter contained in household waste // <https://zakon.rada.gov.ua/rada/show/v0078662-10#Text>

⁷³https://www.minregion.gov.ua/wp-content/uploads/2016/01/SOU-ZHKG-03.09-014_2010.pdf

Table 5.7. Groups of compost according to the quality assessment according to the criteria of SOU ZhKH 03.09-014, restrictions on doses, frequency of application and areas of use in forestry, green construction and land reclamation

Group A	Group B	Group B
Use as fertilizers (or for making compost) in doses adequate to standard fertilizers	Use at a dose of (10-15) t/ha per year based on dry matter or no more than 50 t/ha once every 3 years	Use in a dose (10-20) t/ha of dry matter once every 5 years with mandatory control of the background content of elements
Forest crops, green construction	Forest crops, green construction	Forest crops, green construction, land reclamation
The market value of compost is 620 UAH/t	The market value of compost is 450 UAH/t	There is no market value

Taking into account the gradual increase of green areas in Uzhhorod in accordance with the planned expansion of the residential area in the master plan, it is also expected to increase the amount of green waste, obtained in the process of caring for them both in the general territories of the city and in the individual homesteads of residents, and hence the need for more careful attention to the removal and disposal of this type of waste.

Therefore, it is important for Uzhhorod to ensure the complete removal and treatment of green waste and the introduction of modern methods of treatment and organization of the bio-waste management system.

In addition to the use of compost as fertilizer for the city's own needs and for use as roofing material for the city's municipal waste landfill, Uzhhorod has a potential market for selling compost to enterprises in neighbouring territorial communities and, in the long term, for other landfill and quarry reclamation projects such as Transcarpathian Region, as well as Ukraine, in case of their financing and implementation.

GENERAL CONCLUSIONS

1. In recent years, the national legal framework for the management of bio-waste and green waste has been undergoing intensive changes to bring it closer to EU legislation. The regulatory and legislative framework of Ukraine in the field of waste management has a sufficiently extensive number of documents of various levels. Currently, there are regulatory and legal grounds for the creation and implementation of a bio-waste management system in Uzhhorod according to EU standards. At the same time, in Ukraine there are no state standards for determining the quality of compost, and there are no technological regulations on composting.
2. The estimated volume of waste generation from green spaces in private households as of 2022 is 132.2 t/year, and the forecast volume for 2030 is 188.1 t/year. The estimated volume of green waste generation at landscaping objects (parks, squares, etc.) as of 2022 is 302.4 t/year, and the forecast volume of generation for 2030 is 699.0 t/year.
3. The estimated volume of household bio-waste as of 2022, which can be removed by implementing the container collection scheme, is 692.9 t/year, and the forecast volume of generation for 2030 is 721.9 t/year.
4. The generation of green waste, namely green waste in private households and landscaping objects (parks, squares, etc.), is seasonal in nature (warm season) and has the greatest values at the end of summer and autumn. The generation of bio-waste in the composition of municipal waste occurs constantly throughout the year. Characteristic short-term increases in the content of bio-waste in the household in August, September and on holidays.
5. For the conditions of Uzhhorod, it is recommended to implement open (on the sides) composting with passive (natural) aeration. The design capacity of the composting station in the city of Uzhhorod is 1,200 t/year, and in 2030 – 1,600 t/year. The area of the land plot for the construction of the bio-waste composting station will be 0.18 ha.
6. The construction of the composting station requires capital costs of 10.2 million UAH. The number of workers involved in the operation of the station is 5 people. Composting costs will be approximately 1,278 UAH /t.

REFERENCES

1. Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.
2. Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture.
3. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
4. COUNCIL DIRECTIVE of 18 March 1991 on batteries and accumulators containing certain dangerous substances (91/157/EEC)
5. Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC.
6. Council Directive of 16 June 1975 on the disposal of waste oils (75/439/EEC)
7. Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste
8. European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.
9. Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) Directive of the European Parliament "On landfills for waste" (1999/31/EU).
10. Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast).
11. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.
12. Decision (EU) 2018/853 of the European Parliament and of the Council of 30 May 2018 amending Regulation (EU) No 1257/2013 and Directives 94/63/EC and 2009/31/EC of the European Parliament and of the Council and Council Directives 86/278/EEC and 87/217/EEC as regards procedural rules in the field of environmental reporting and repealing Council Directive 91/692/EEC.
13. Convention on long-range transboundary air pollution. Signed on November 13, 1979, ratified on April 29, 1980.
14. Convention on climate change. Signed on June 11, 1992, ratified on October 29, 1996.
15. Convention on environmental impact assessment in a transboundary context. Signed on February 26, 1991, ratified on March 19, 1999.
16. Convention on the Control of Transboundary Transportation of Hazardous Wastes and Their Disposal (Basel Convention). Signed and ratified on July 1, 1999.
17. Convention on access to information, public participation in decision-making and access to justice in environmental matters (Aarhus Convention). Signed on June 25, 1998, ratified on July 6, 1999.
18. "On environmental protection". Law of the Ukrainian SSR dated June 25, 1991 No. 1264-XII.
19. "On ensuring the sanitary and epidemiological well-being of the population." Law of Ukraine dated February 24, 1994 No. 4004-XII.
20. "On the Protection of Atmospheric Air". Law of Ukraine dated October 16, 1992 No. 2707-XII.

21. "On waste". Law of Ukraine dated March 5, 1998 No. 187/98-VR.
22. "On waste management, Law of Ukraine of June 20, 2022 No. 2320-IX (will enter into force on July 6, 2023).
23. "On the national program for the management of toxic waste." Law of Ukraine dated September 14, 2000 No. 1947-14.
24. "On the improvement of settlements". Law of Ukraine dated September 6, 2005 No. 2807-IV.
25. DK-005-96 State waste classifier. State Standard of Ukraine. - K.: 1996.
26. Rules for the provision of municipal waste transportation services. Resolution of the CMU of December 10, 2008 No. 1070.
27. About measures for the collection, processing and utilization of used containers and packaging. Resolution of the Cabinet of Ministers of Ukraine from March 2, 1998 No. 261.
28. About the main directions of the state policy of Ukraine in the field of environmental protection, use of natural resources and ensuring environmental safety. Resolution of the Verkhovna Rada of Ukraine from March 5, 1998 No. 188/98.
29. On the approval of the provision on the state environmental monitoring system. Resolution of the Cabinet of Ministers of Ukraine of March 30, 1998 No. 391.
30. On approval of the procedure for keeping a register of waste disposal sites. Resolution of the Cabinet of Ministers of Ukraine from August 3, 1998 No. 1216.
31. On the approval of the Procedure for identifying and accounting for stray waste. Resolution of the Cabinet of Ministers of Ukraine No. 1217 of August 3, 1998
32. On the approval of the Procedure for submitting a waste declaration and its forms. Resolution of the Cabinet of Ministers of Ukraine from February 18, 2016 No. 118.
33. On the approval of the Procedure for maintaining the register of objects of waste generation, processing and disposal. Resolution of the Cabinet of Ministers of Ukraine from August 31, 1998 No. 1360.
34. On the approval of the Regulation on the control of cross-border transportation of hazardous waste and its utilization/removal and the Yellow and Green lists of waste. Resolution of the Cabinet of Ministers of Ukraine from July 13, 2000 No. 1120.
35. On the approval of the Procedure for keeping state records and certification of waste. Resolution of the Cabinet of Ministers of Ukraine from dated November 1, 1999 No. 2034.
36. On the approval of the Municipal solid Waste Management Program. Resolution of the Cabinet of Ministers from March 4, 2004 No. 265.
37. About the concept of sustainable development of settlements. Resolution of the Verkhovna Rada of Ukraine from December 24, 1999 No. 1359-XIV.
38. Procedure for forming tariffs for municipal waste removal services, Resolution of the Cabinet of Ministers of Ukraine from July 26, 2006 N 1010 .
39. Resolution of the Cabinet of Ministers of Ukraine of October 7, 2009 No. 1048 on the approval of the criteria by which the degree of risk from the implementation of economic activities in the field of improvement of settlements, the field of burial and the field of municipal waste removal and the periodicity of the implementation of planned measures of state supervision (control) are determined.
40. "Reporting form 1-TPV "Report on the management of municipal solid waste", approved by the Order of the Ministry of Construction, Architecture and Housing and Communal Affairs of Ukraine from 19/06/99 No. 308.

41. "On the approval of the List of hazardous properties and instructions on the control of cross-border transportation of hazardous waste and their utilization/removal". Order of the Ministry of Natural Resources of Ukraine from October 16, 2000 No. 165.
42. Decree of the Cabinet of Ministers from November 8, 2017 No. 820-r "On the National Strategy for the Management of Municipal solid Waste in Ukraine."
43. "Methodological recommendations for determining the morphological composition of municipal solid waste" , approved by the Order of the Ministry of Housing and Agriculture of Ukraine from February 16, 2010 No. 39.
44. "SOU of the housing and communal services "Technology of processing organic matter contained in municipal waste" , approved by the Order of the Ministry of Housing and Agriculture of Ukraine from 30.03.10 No. 78.
45. "Methodical recommendations for the organization of collection, transportation, processing and disposal of municipal waste", approved by the Order of the Ministry of Housing and Agriculture of Ukraine from 07.06.10 No. 176.
46. "Rules for determining norms for the provision of services for the removal of municipal waste", approved by the order of the Ministry of Housing and Rural Affairs of Ukraine from 30.07.10 No. 259.
47. "Rules for the operation of municipal waste landfills" , approved by the order of the Ministry of Construction of Ukraine from 01.12.2010 No. 435.
48. "Municipal waste" Biogas from municipal waste landfills, used in cogeneration plants" , approved by the order of the Ministry of Housing and Agriculture of Ukraine from 31.12.10 No. 484.
49. "Municipal waste" The technology of processing waste plastics, paper and cardboard, which is part of municipal solid waste" was approved by the Order of the Ministry of Housing and Agriculture of Ukraine from 31.12.10 No. 485.
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52. "Methodical recommendations for the accounting of green spaces in populated areas of Ukraine" , approved by the Order of the Ministry of Construction of Ukraine from November 22, 2006 No. 386.
53. "Methodology for determining the amount of financing for the maintenance of 1 hectare of green spaces" , approved by the Order of the Ministry of Construction of Ukraine from 09.01.07 No. 2.
54. "Regulations on the monitoring system of green spaces in cities and towns of the urban type of Ukraine , approved by the order of the Ministry of Housing and Rural Affairs of Ukraine from August 4, 2008 No. 240.
55. "Reporting form No. 1 (annual) "Report on green economy" and Instructions for filling out reporting form No. 1 (annual) "Report on green economy", approved by the order of the Ministry of Housing and Agriculture of Ukraine from 24.12.08 No. 401.
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58. DBN V.2.4-2-2005 Municipal solid waste landfills. Basic design provisions (change No.1, change No.2).
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60. DSTU-NB B.2.2-7:2013 Guidelines for arranging container sites.
61. DSTU EN 1501-1:2019 Garbage trucks and their lifting devices. General technical and safety requirements. Part 1. Rear-loading garbage trucks (EN 1501-1:2011 + A1:2015, IDT).
62. DSTU-N B V.1.1-27:2010 Building climatology.
63. DSTU 8727:2017 Sewage sludge. Preparation of organo-mineral mixture from sewage sludge.
64. DSTU 8476:2015 Containers for municipal waste. General technical requirements.
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67. State sanitary rules for the planning and development of settlements. Approved by Order No. 173 of the Ministry of Health of Ukraine from 19.06.96.
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70. On the approval of the Rules for the maintenance of residential buildings and adjacent territories, approved by the State Committee of Ukraine on Housing and Communal Affairs from May 17, 2005 No. 76.
71. Rules for the maintenance of green spaces in populated areas of Ukraine. Approved by Order No. 105 of the Ministry of Construction, Architecture and Housing and Communal Services of Ukraine from April 10, 2006.

ANNEXES

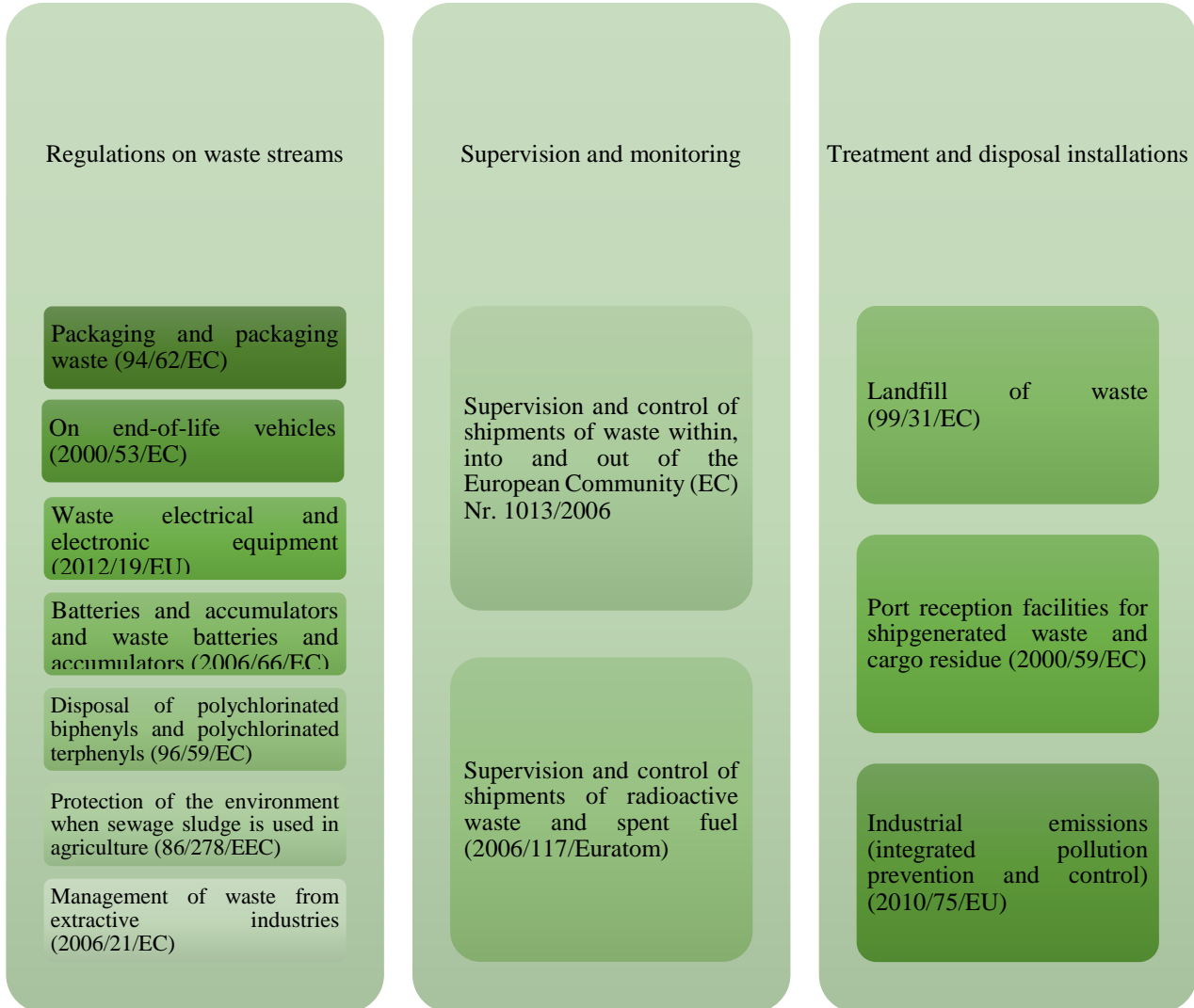
ANNEX A. LEGISLATION ON WASTE MANAGEMENT

Table A.1. Ukrainian legislation in the field of waste management

Law of Ukraine "On Waste" (from March 5, 1998 with subsequent amendments)
<ul style="list-style-type: none">• legal, organizational and economic principles of activities related to waste management/handling in Ukraine
Law of Ukraine "On Environmental Protection" (from June 25, 1991 with subsequent amendments)
<ul style="list-style-type: none">• legal, economic and social principles of environmental protection organization in Ukraine
Law of Ukraine "On Local Self-Government in Ukraine" (from May 21, 1997, with subsequent amendments)
<ul style="list-style-type: none">• general competence and powers (regarding the management of communal property, in the field of housing and communal services, environmental protection) of village, settlement, city councils
Law of Ukraine "On Housing and Communal Services" (from November 9, 2017, with subsequent amendments)
<ul style="list-style-type: none">• regulation of relations arising in the process of provision and consumption of housing and communal services, in particular household waste management services
✓ Law of Ukraine "On Improvement of Settlements" (from September 6, 2005, with subsequent amendments)
<ul style="list-style-type: none">• legal, economic, ecological, social and organizational principles of the development of settlements and aimed at creating conditions favorable for human life. Requirements for waste management
✓ Law of Ukraine "On Ensuring Sanitary and Epidemic Welfare of the Population" (from February 24, 1994 with subsequent amendments)
<ul style="list-style-type: none">• ensuring sanitary and epidemiological well-being, establishes the order of organization of the state sanitary-epidemiological service and implementation of state sanitary-epidemiological supervision
✓ Law of Ukraine "On Environmental Impact Assessment" (from May 23, 2017)
<ul style="list-style-type: none">• carrying out the environmental impact assessment procedure in the decision-making process on the implementation of economic activities that may have a significant impact on the environment, taking into account state, public and private interests
✓ Law of Ukraine "On Strategic Environmental Assessment" (from March 20, 2018)
<ul style="list-style-type: none">• conducting a strategic environmental assessment for state planning documents (applies to state planning documents related to agriculture, forestry, fisheries, energy, industry, transport, waste management, use of water resources, environmental protection, etc.)
✓ National waste management strategy in Ukraine until 2030 (Order of the Cabinet of Ministers of Ukraine from November 8, 2017 No. 820)
<ul style="list-style-type: none">• National document for the development of the waste management
National waste management plan until 2030 (Order of the Cabinet of Ministers of Ukraine from February 20, 2019 No. 117)
<ul style="list-style-type: none">• Detailed implementation plan of the National Waste Management Strategy at the national level.• Development and approval of regional waste management plans for Ukrainian oblasts

Table A.2. Horizontal waste framework of the EU⁷⁴

**EU Waste Framework Directive (2008/98/EC)
 Flagship initiative under the Europe 2020 Strategy COM (2011)0021
 7th EU Environmental Action Program (1386/2013/EU)**



⁷⁴Best Practice Municipal Waste Management. Germany, 2018
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Table A.3. EU regulatory and legal acts, the implementation of which is mandatory for Ukraine, in accordance with the EU-Ukraine Association Agreement⁷⁵

Document	Substantive provisions
<p>Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives</p>	<ul style="list-style-type: none"> ✓ basic definition such as "waste", "waste processing", "waste utilization" and others; ✓ the principle of " priority hierarchy in waste management" ✓ polluter-pays principle ✓ principle of extended producer responsibility ✓ the list of waste and the regulation of the procedure for assigning waste to the hazardous category; ✓ waste management planning requirements.
<p>Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste as amended by Regulation (EC) 1882/2003</p>	<ul style="list-style-type: none"> ✓ gradual reduction of waste disposal, in particular waste suitable for recycling or other recovery operations ✓ prevention or reduction of negative consequences for the environment from waste disposal throughout the entire life cycle of the landfill
<p>Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC</p>	<ul style="list-style-type: none"> ✓ measures, procedures and guidance to prevent or reduce as far as possible any adverse effects on the environment, in particular water, air, soil, fauna and flora and landscape, and any resultant risks to human health, brought about as a result of the management of waste from the extractive industries. ✓ classification system for waste facilities of mining industry waste (O/MRVV); ✓ permit system for waste facilities from the extractive industry (O/MRVV), the procedure for submitting applications for obtaining a permit and the basic requirements for them; ✓ mandatory drawing up of waste management plans by O/MRVV operators; ✓ establishment of requirements for: compliance with the proper condition of mining excavations of the construction and management of O/MRVV; ✓ closure procedures to be carried out after the closure of O/MRVV; ✓ operators regarding the prevention of deterioration of water resources, atmospheric air and soil pollution; ✓ mandatory inspections by authorized bodies at the stage before the start of waste disposal works and at regular intervals after that,

⁷⁵ <https://mepr.gov.ua/news/32693.html>

Document	Substantive provisions
	including the phase after the closure of O/MRVV
Incineration of waste	
Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast)	<ul style="list-style-type: none"> ✓ rules on integrated prevention and control of pollution arising from industrial activities ✓ rules designed to prevent or to reduce emissions into air, water and land and to prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole. ✓ establishment of emission limits from waste incineration plants, requirements for such plants, control and monitoring, etc. ✓ permit system that provides for an integrated environmental permit in exchange for a series of environmental permits from various authorities ✓ introduction of the principle of BAT (best available techniques)
Sectoral legislation of the EU in the field of waste management	
European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste	<ul style="list-style-type: none"> ✓ prevention any impact of packaging and packaging waste on the environment or to reduce such impact, thus providing a high level of environmental protection, and, ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition
Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)	<ul style="list-style-type: none"> ✓ measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste from electrical and electronic equipment (WEEE) and by reducing overall impacts of resource use and improving the efficiency of such use ✓ requirements for separate collection of WEEE
Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC	<ul style="list-style-type: none"> ✓ rules regarding the placing on the market of batteries and accumulators and, in particular, a prohibition on the placing on the market of batteries and accumulators containing hazardous substances; and specific rules for the collection, treatment, recycling and disposal of waste batteries and accumulators to promote a high level of collection and recycling of waste batteries and accumulators in order to reduce their negative impact on the environment; ✓ prohibition of the use of certain hazardous substances in batteries and accumulators;

Document	Substantive provisions
	<ul style="list-style-type: none"> ✓ requirements for separate collection and disposal of batteries and accumulators; ✓ treatment and recycling of waste batteries and accumulators
<p>Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances as amended by Directive 2003/105/EC (Directive 2012/18/EU) and Regulation (EC) 1882/2003</p>	<ul style="list-style-type: none"> ✓ rules for the prevention of major accidents which involve dangerous substances, and the limitation of their consequences for human health and the environment, with a view to ensuring a high level of protection throughout the Union in a consistent and effective manner
<p>Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles</p>	<ul style="list-style-type: none"> ✓ requirements for the disposal of end-of life vehicles ✓ requirements for producers: to use unified standards for labeling polymer components to facilitate identification during disposal, to provide the necessary information regarding the disassembly and composition of materials of components for disposal, the location of hazardous substances and materials in the car, and also to assume all or a significant part of the costs of implementing the collection cars that have served their term
<p>Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)</p>	<ul style="list-style-type: none"> ✓ requirements for the disposal of polychlorinated biphenyls and polychlorinated terphenyls
<p>Council Directive of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (86/278/EEC)</p>	<ul style="list-style-type: none"> ✓ regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil, vegetation, animals and man, thereby encouraging the correct use of such sewage sludge
<p>Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)</p>	<ul style="list-style-type: none"> ✓ restriction of the use of hazardous substances in electrical and electronic equipment. The directive applies to electrical and electronic equipment that operates within the following voltage ranges: with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current
<p>Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (recast)</p>	<ul style="list-style-type: none"> ✓ protecting human health and the environment from POPs by prohibiting, phasing out as soon as possible, or restricting the manufacturing, placing on the market and use of substances subject to the Stockholm Convention on Persistent Organic Pollutants or the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants by minimizing, with a view to eliminating where feasible as soon as possible, releases of such substances, and by establishing provisions regarding waste

Document	Substantive provisions
	consisting of, containing or contaminated by any of those substances.
EU Directives on the environment, the provisions of which are implemented in Ukrainian legislation	
Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment	<ul style="list-style-type: none"> ✓ environmental impact assessment (EIA) should identify, describe and assess the direct and indirect significant effects of a project on the human beings, the surrounding natural environment and its elements, natural territories and objects, material assets and the cultural heritage.
Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment	<ul style="list-style-type: none"> ✓ provide for a high level of protection of the environment and contributes to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.

ANNEX B. COLLECTION OF WASTE AS SECONDARY RAW MATERIALS

Economic entities carrying out collection will collect waste as secondary raw materials

No.	Name	Location	Contact details (web address, phone, email)	Specialization (types of secondary raw materials)
1	"Eco Life" LLC	St. Ogaryova, 25, Uzhhorod	(03122) 2-65-51 eco.life@mail.ru	Collection, provision of waste paper, broken glass, polymer waste, rubber waste, including worn tires, secondary textile materials
2	FOP Povkhan Ya. I.	St. Sadova, 8, village Antalovci, Uzhhorod district, 89471	0507623565 vtorsurovuna@mail.ru	Collection, provision of waste paper, broken glass, polymer waste, secondary textile materials, used metal containers
3	FOP Solyanyk R. M.	St. Verkhovinska, 21, Uzhhorod	(0312) 66-03-63 star04081983@ukr.net	Collection, provision of waste paper, polymer waste, glass
4	FOP Solyanyk D. M.	St. Verkhovinska, 21, Uzhhorod	(0312) 66-03-63	Collection, provision of waste paper
5	"Ekovest" LLC	St. Zankovetska, 1, Uzhhorod	0992922839, 0505596638 ecowest.uz@gmail.com	Collection and provision of waste paper, broken glass, polymer and rubber waste, including worn tires, secondary textile materials, used metal containers
6	"New Ecosvit" LLC	St. Domaninska , 336, Uzhhorod	0664462143 newekosvit@gmail.com	Collection and provision of waste paper, broken glass, polymer and rubber waste, including worn tires, secondary textile materials, used metal containers
7	LLC "Asib"	St. 18/57 Mozhaiskyi Street, Uzhhorod city	0504325277, 0504325277 asib-ltd@yandex.ru	Collection, provision of waste paper, broken glass, polymer waste
8	FOP Schwartz R. K.	St. Peremohy, 159/16, Uzhhorod	–	Collection, provision of waste paper, broken glass, polymer waste
9	Ltd "Eco Karpaty Plus"	St. Voloshina, 16/1, Uzhhorod	0958681359 ecokarpatyplus@ukr.net	Collection, provision of polymer and rubber waste, including worn tires
10	FOP Gubkovich V.M.	St. Dokuchaeva, 6/16, Uzhhorod (25 Hrushevsky St., Uzhhorod; village Dovge Pole, Uzhhorod district)	(0312) 665550 0504326470	Collection, provision of rubber waste, including worn tires
11	FOP Breza O.O.	St. Tsentralna, 149, vil. Baranyntsi, Uzhhorod district	0505127224 zakvtor@gmail.com	Collection, provision of waste paper, glass containers, polyethylene. Collection, provision, disposal of worn tires

No.	Name	Location	Contact details (web address, phone, email)	Specialization (types of secondary raw materials)
12	Ltd "AVE Uzhhorod"	St. L. Tolstogo , 33 a, Uzhhorod	(0312)642852, 0504347700 office.uzhgorod@ave.ua	Collection of waste paper, plastic/polyethylene, glass
13	Storage station for recycled materials "Proektna, 3"	St. Proektna, 3, Uzhhorod	0502821862, shvarts.rr@gmail.com	Collection of polymer waste, waste paper
14	"Eco Chop" LLC	St. Main, 43, Chop	(0312)711239	Collection of polymer waste
15	PJSC "Garant Group"	St. Krylova, 15, Mukachevo, 89600	(03131) 2-35-08 (03131) 3-78-64 garantgroup.m@gmail.com	Collection, provision of polymer waste, waste paper
16	Ltd "AVE Mukachevo"	St. Hrushevsky, 4/7, Mukachevo, 89600	(03131) 3-19-75 (03131) 2-22-69 0507757700 officemukatshewo@ave.ua	Collection of plastic waste, glass, waste paper
17	LLC "Karpaty LTD"	St. Krylova, 65A, Mukachevo, 89600	(03131) 3-78-90 karpaty1@mukachevo.net	Collection, provision of waste paper, broken glass, polymer waste, rubber waste, including worn tires, secondary textile materials
18	Collective enterprise "Vtorma"	St. Ivan Franko, 164, Mukachevo, 89600	(03131) 2-14-21 vtorma_mukachevo@mail.ru	Collection and provision of polymer waste, waste paper, broken glass, rubber waste, including worn tires
19	Private enterprise "Brenner"	St. Slivova, 30-A, Khust, 90400	(03142) 5-53-01 brenner-khust@rambler.ru	Collection, provision of waste paper, broken glass, waste polymer, rubber waste, including worn tires, secondary textile materials, waste . metal container
20	District communal enterprise "Waters of Khustshchyna "	St. Gvardiyska, 122, Khust (Str. 8 Bereznya, 2, Velyatino village, Khustsky district, 90453)	(03142) 5-21-08	Collection, provision of polymer waste, broken glass, waste paper
21	FOP Baburnych I. V.	St. Nova, 9, p. village Iza, Khust district	(03142)5-53-05, 0503722910	Collection, provision of polymer waste, broken glass, waste paper
22	Second export, Ltd	St. Druzhby, 760, village Sokyrnytsia, Khust district	vasil23hotmail.com	Collection, preparation of polymer waste
23	FOP Sivach M. P.	St. Michurina, 10, Irshava (11/1 Zavodska Street, Irshava)	0979051093 sivachsasha@ukr.net	Collection, preparation of broken glass, waste paper
24	DP Svalyavska District Consumer	St. Golovna 6, Svalyava, 89300	(03133) 2-28-50, (03133) 2-36-24	Collection, provision of waste paper, broken glass, polymer waste

No.	Name	Location	Contact details (web address, phone, email)	Specialization (types of secondary raw materials)
	Union " Raikoopzagotprom"			
25	FOP Koshel V. M.	St. Dukhnovycha, 30, Svalyava, 89300	(03133) 2-48-33 koshelia.v@gmail.com	Collection, preparation of polymer waste
26	Ltd "AVE Vynogradovo"	St. Vakarova , 18, Vynohradiv	(03143) 2-31-65 office.vinogradowo@ave.ua	Collection of plastic waste, glass, waste paper
27	Ltd "Vynogradivskiyi plastic plant plumbers"	St. Leizman , 27, Vynohradiv, 90300	(03143) 2-26-61 plastic@vzpsv.com.ua	Collection, disposal of polymer waste
28	Private enterprise "Plastor"	St. Myru, 85, p. Freedom, Berehivskiyi district, 90210	0673423185; 0673423184 0503722024; sytak@ukr.net	Collection, preparation of polymer waste
29	FOP Baksha István - Beylo Andreyovych	St. Shimon Mengerta, 3 A, Batyovo village, Berehiv district	0506983720	Collection, provision of waste paper, broken glass, and plastic waste
30	FOP Tkachuk Volodymyr Vasylovych	St. Prytisyanska, 1, building A, township Veliky Bychkiv, Rakhivskiyi district, 90615	foptkachukvv@gmail.com 0313235680	Collection, provision of waste plastic, glass containers
31	Ecobat Shuravi, Ltd	St. Tsegelna, 17, village Velikiy Bychkiv, Rakhiv district	(03132) 3-56-80 ekobatllc@gmail.com	Collection of waste plastic, glass containers
32	MKP "Rakhiv Commune Service"	St. Shevchenko, 43, Rakhiv	0313222089	Collection of plastic waste, glass, waste paper
33	Kobyletsko - Polyansk VZHKP	St. Shevchenko, 29, village Kobyletska Polyana, Rakhiv district	0677322135	Collection of plastic waste, glass, waste paper
34	Yasinyansk VZHKP	St. Kyivska, 2, Yasinya village, Rakhiv district	Nn@Nn.Nn , 0964581821, 0313242255	Collection of plastic waste, glass, waste paper
35	Chornotisanske VZhKP	St. Tsentralna, 170 A, village Chorna Tysa, Rakhiv district	–	Collection of plastic waste, glass, waste paper
36	Bohdansk VZHKP	St. Shevchenko, 114, p.	0981010208	Collection of plastic waste, glass, waste paper

No.	Name	Location	Contact details (web address, phone, email)	Specialization (types of secondary raw materials)
		Bohdan, Rakhiv district		
37	Kvasivsk VZHKP	village Kvasy, 158, Rakhivskiy district	0962531628	Collection of plastic waste, glass, waste paper
38	FOP Hertz Serhiy Vasylovych	St. Yablunovo, Volovets village	Svsidi@i.ua	Collection, provision of polymer waste, waste paper, broken glass
39	KP "Komunalnik"	St. Uzhhorodska, 68, Perechyn	0502022247 (2-15-33)	Collection of PET bottles
40	FOP Piosa Vasyl Mykhailovych	St. Budivelnikiv, 6, Perechyn	0509494248	Collection of plastic waste, glass, waste paper, scrap metal
41	FOP Mykulanynets Evgeny Evgenovich	St. Lenina, 182, p. Nove Davydkovo, Mukachevo district	–	Collection of waste paper
42	FOP Mykulanynets Yosyp Yosypovych	St. Lenina, 24 A, village Nove, Davidkovo, Mukachevo district (Kolchyno town, Zaliznychna street, 2	0509207879	Collection of glass waste
43	FOP Devitskyi Ihor Mykolayovych	St. Zernovska, 19, village Poroshkovo, Uzhhorod district	0953166124	Collection, treatment and disposal of safe waste
44	FOP Burkush Mykhailo Vasyliovych	St. Zaverlyanska , village Keretsky, Khust district (Molodizhna St., Keretsky village)	–	Collection of waste glass, plastic, waste paper
45	"VBS" Vynohradiv no trash"	St. Leizmana, 27, Vynohradiv	0992379511 Bohdan	Collection of waste glass, plastic, waste paper, small metal containers
46	FOP Matiy Yosyp Yosypovych	St. Vaydy, 42, p. Podvynohradiv, Berehiv district	0981532633	Collection, recycling of waste paper
47	FOP ISimodeyko V. M.	St. Maramoroska , 1 B, Teresva village, Tyachiv district	–	Collection of waste glass, plastic, waste paper
48	KN Consult, LLC	St. Hrushevsky, 82,	097912758	Collection of broken glass and polyethylene waste

No.	Name	Location	Contact details (web address, phone, email)	Specialization (types of secondary raw materials)
		with. Neresnytsia , Tyachiv district		
49	Clean city of Tyachiv, Ltd	St. Golloshi, 5 A, Tyachiv (Bushtyno village, Tereblya village)	0974760814	Collection of waste glass, plastic, waste paper
50	FOP Marchyshinets Sebastian Vasylovych	Vynohradiv, st. Zhukova, 42	–	Collection of waste glass, plastic, waste paper
51	Gringer, LLC	Mukachevo, str. Petefi, 10/17	0506100934	Collection of waste glass, plastic, waste paper

ANNEX C. MANAGMENT OF HAZARDOUS WASTE

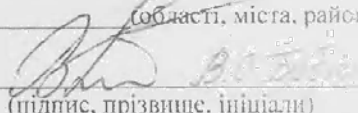
Business entities operating in the field of hazardous waste management in Transcarpathian Region

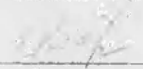
No.	Name	Location	Contacts	Specialization (operations and types of hazardous waste)
1.	Emergency and rescue special squad appointment of the main Administration of the Ministry of Emergency Situations of Ukraine in Transcarpathian Region, 08588688	Uzhhorod, 18b, Vereshchagina, St. (2a, Bolgarska St.)	(0312) 67-30-97 zakarpattya@mns.gov.ua	Collection, transportation: 1. Waste from the production, receive and use of biocides and phytopharmaceuticals, including waste from pesticides and herbicides that do not meet standards, have expired or are not suitable for use as intended
2.	New Ecosvit. LLC, 38629116	Uzhhorod city 336 Domanynska, str.	0664462143 newekosvit@gmail.com	Collection, transportation, storage, treatment, utilization, neutralization: 1. Spent petroleum products that are not suitable for their intended use (including used motor, industrial oils and their mixtures. Waste contaminated with petroleum products - oiled sand, paper, sawdust, soil, rags, used filters (collection, transportation, storage, utilization). 2. Waste oil/water mixtures, hydrocarbons/water, emulsions (collection, transportation, storage). 3. Waste containing as components or pollutants mercury, mercury compounds (including spent fluorescent lamps and devices containing mercury) (collection, transportation, storage). 4. Waste and scrap of electronic and electrical assemblies containing components, such as batteries or other batteries (collection, transportation, storage). 5. Waste from production, receive and use of ink, dyes, pigments, paints, varnishes, oil (collection, transportation, storage, utilization).

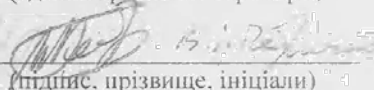
No.	Name	Location	Contacts	Specialization (operations and types of hazardous waste)
				<p>6. Waste solutions of acids or bases (including spent electrolyte) (collection, transportation, storage).</p> <p>7. Waste consisting of or containing chemicals that do not meet specifications or have an expired shelf life (collection, transportation, storage, utilization).</p> <p>8. Waste batteries, unsorted, whole or broken (including used batteries of lead batteries) (collection, transportation, storage).</p> <p>9. Waste from the production, receipt and use of pharmaceuticals, pharmaceuticals that have expired (collection, transportation, storage), processing, disposal).</p> <p>10. Waste containing mainly organic components, which may include metals and inorganic materials (collection, transportation, storage).</p> <p>11. Waste that may contain either inorganic or organic components (collection, transportation, storage).</p> <p>12. Clinical and similar wastes, namely, wastes resulting from medical care, veterinary or similar practices, and wastes generated in hospitals or other institutions during research, patient care or research work (collection, storage, disposal).</p> <p>13. Waste packaging and containers containing compounds listed in Annex 2 to Regulation (3), in an amount sufficient to detect hazardous properties listed in (2) (collection, storage, disposal).</p> <p>14. Spent activated carbon, except for those included in the Green list of waste (collection, storage, disposal).</p> <p>15. Waste from production, production and use of chemicals for wood impregnation (collection, storage, utilization)</p>

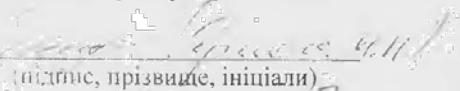
ANNEX D. WASTE DISPOSAL SITE (MSW LANDFILL)

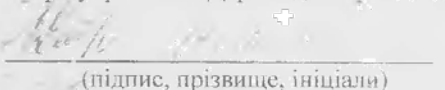
Додаток 1
до інструкції про зміст і складання
паспорта місць видалення відходів

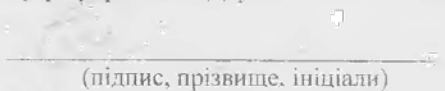
ЗАТВЕРДЖЕНО
Голова комісії державної адміністрації
області, міста, району

(підпис, прізвище, ініціали)
« 16 » 02 2008 р.

ПОГОДЖЕНО
Начальник держу правління екологічної
безпеки в області

(підпис, прізвище, ініціали)
« 16 » 02 2008 р.

ПОГОДЖЕНО
Головний державний санітарний лікар
(адміністративної території)

(підпис, прізвище, ініціали)
« 06 » 02 2008 р.

ПОГОДЖЕНО
Керівник органу Мінпраці
(Держнаглядхоронпраці) в області

(підпис, прізвище, ініціали)
« 06 » 02 2008 р.

ПОГОДЖЕНО
Керівник організації (підприємства)
сфери управління Держводгоспу в області

(підпис, прізвище, ініціали)
« 03 » 02 2008 р.

ПОГОДЖЕНО
Керівник організації (підприємства)
сфери управління Держкомгеології в області

(підпис, прізвище, ініціали)
« 03 » 02 2008 р.

ПАСПОРТ
місця видалення відходів (МВВ)

Ресстраційний номер № _____ Дата ресстрації _____

Назва МВВ: **Полігон твердих побутових відходів (ТПВ) м.Ужгород**

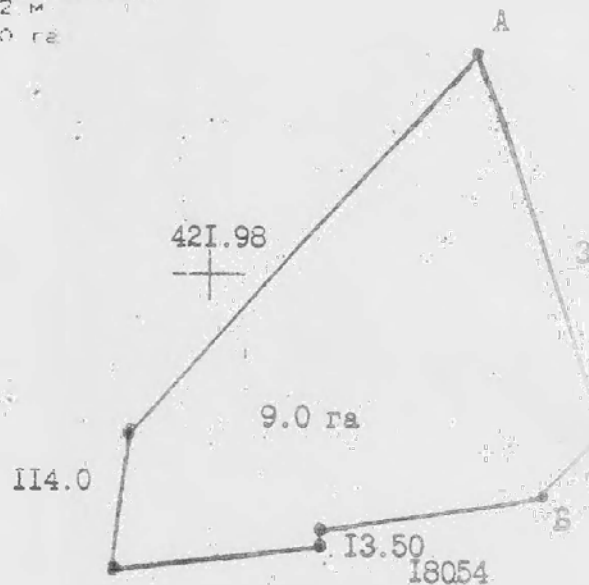
Власник МВВ: **Ужгородське КАТП-072801**

Директор _____ Грамотник В.І. _____ 04 січня 2008 р.
(підпис)

М.П.

Виноска геодалних

Номера пунктів	Кути (праві)	Дирекційні кути	Лінії
1	121 39.0	221 11.2	72.09
2	140 43.2	260 27.9	180.54
3	253 41.1	186 46.8	13.50
4	101 55.6	264 51.2	170.00
5	76 8.5	8 42.7	114.00
6	146 43.0	41 59.6	421.98
7	59 9.5	162 50.2	328.11
Периметр		1300.22 м	
Площа		9.000 га	



ОПИС МЕЖ

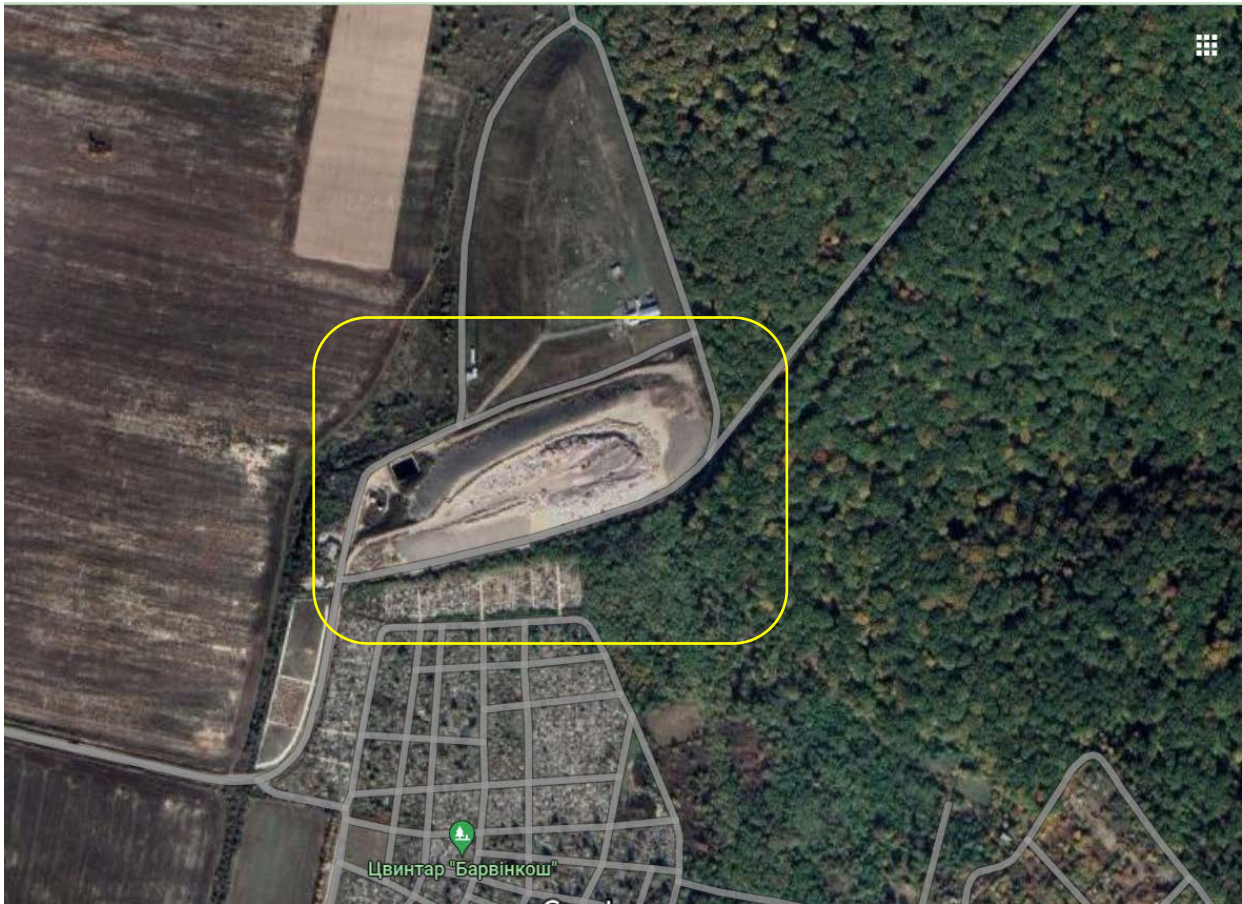
Від А до Б землі Ужгородського державного лісо-господарського підприємства

Від Б до А землі, колективного сільськогосподарського підприємства "Золота нива"

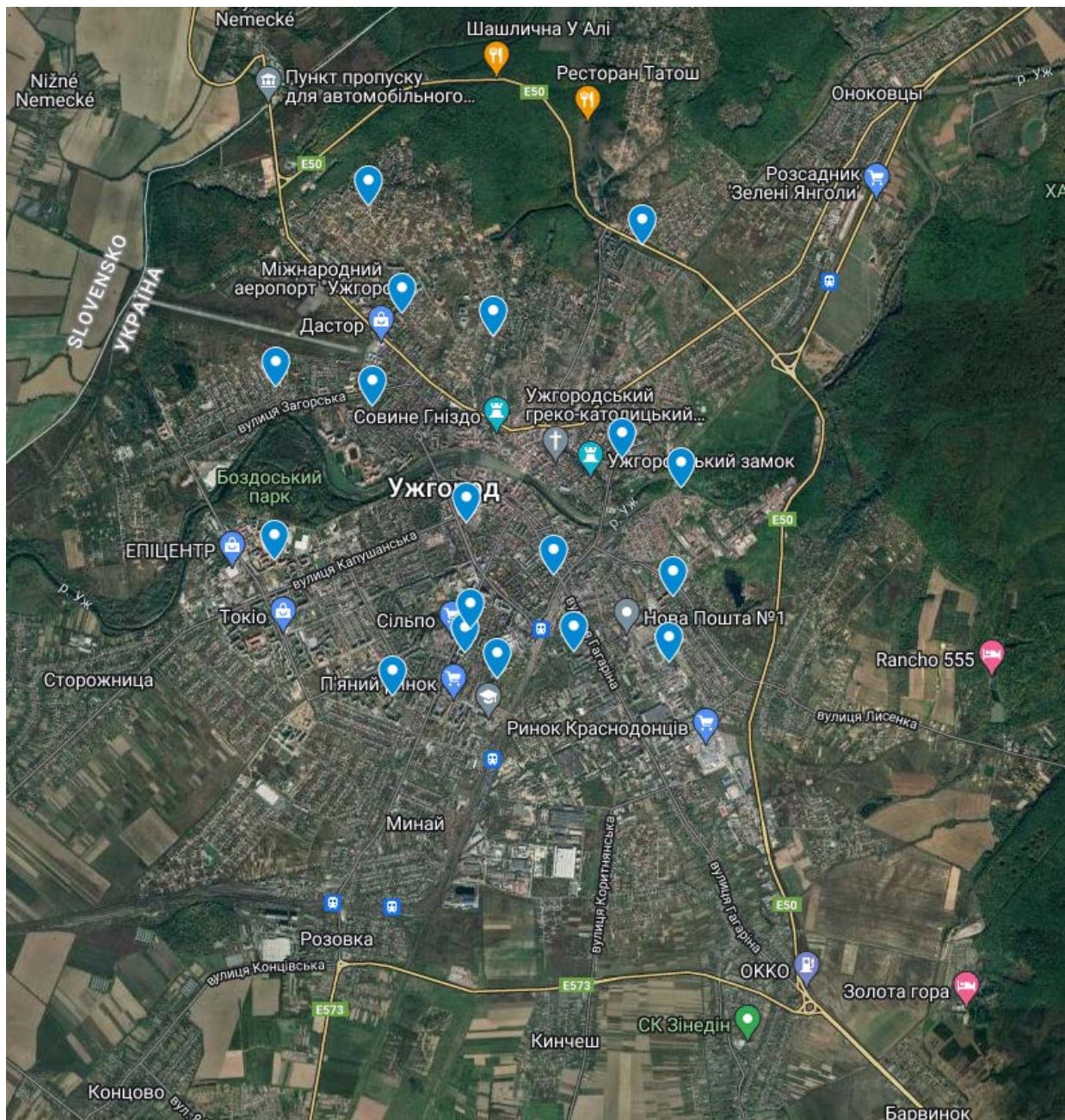
Власник	
Дата, підпис	
Лист №	

Масштаб 1 : 500

Placement of the waste disposal site (municipal solid waste landfill)



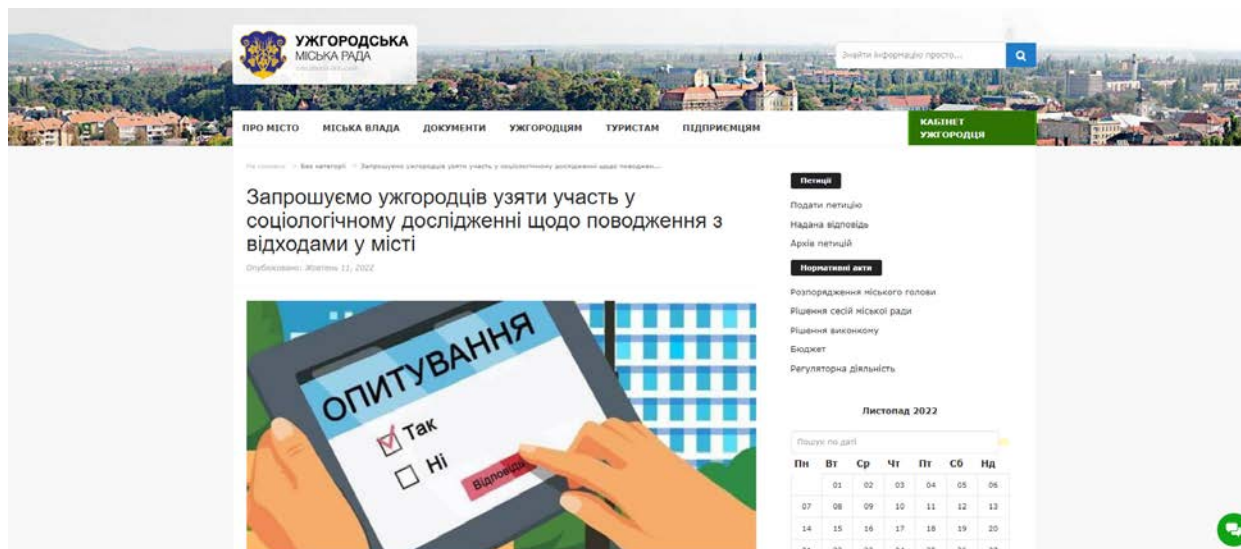
ANNEX E. PLACES OF FORMATION OF SPONTANEOUS DUMPS IN UZHGOROD



Places of formation of spontaneous dumps in Uzhhorod

- | | | | |
|-----|------------------------|-----|-------------------------|
| 1. | 12, Onokivska St. | 11. | V. Dokuchaeva St. |
| 2. | 54, V. Komendarya St. | 12. | Košice St. |
| 3. | 11, Minayska St. | 13. | Brodlakovicha St. |
| 4. | 82, Volodymyrska St. | 14. | Shymna St. |
| 5. | A. Palaia St. | 15. | 38, Shchedrina St. |
| 6. | Uzhanska St. | 16. | 26-28, Zakarpatska, St. |
| 7. | Projectna St. | 17. | Ac . Korolev St. |
| 8. | 28, Yu. Gagarina St. | 18. | Odeska St. |
| 9. | Gulak- Artemovskiy St. | 19. | 31, Svoboda Ave |
| 10. | Sribyasta St. | | |

ANNEX F. RESULTS OF THE SOCIOLOGICAL RESEARCH ON WASTE MANAGEMENT IN UZHGOROD



Methodology

Audience: population of Uzhhorod aged 16 and older

Sample population: 3,256 respondents

Survey method: using Google Forms in social networks and web pages of the city council

The error of representativeness of the study with a confidence probability of 0.95: no more than 2.1%

Dates: from October 11 to November 20, 2022.

Link to main announcement: <https://cutt.ly/YBEjlu3>

Analytical report

According to the results of a sociological survey conducted in Uzhhorod from October 11 to November 20, 2022, 30.8% of men and 69.2% of women took part. The vast majority of respondents, 97.3%, are aged between 18 and 60. The most active age segment from 30 to 40 made up 42.3% of all respondents. 85.6% of the respondents had higher education, and the rest had secondary and incomplete secondary education. The vast majority of respondents, 70.5%, live in apartment buildings, 28.4% live in private houses, and the remaining 1.1% live in dormitories. 81.3% of respondents have from 2 to 4 family members, 8.7% have 5 family members.

The majority of respondents assess the environmental situation in Uzhhorod as "average" - 39.1%, dissatisfied with the environmental situation - 48.5%. In general, there is a manifestation of the tendency to dissatisfaction with the state of the ecological situation.

The majority of respondents have a negative attitude to the situation with waste utilization in Uzhhorod. Thus, 68.5% of respondents are dissatisfied. 76.2% of respondents negatively evaluate the organization of collection of used lamps, batteries and accumulators.

25.9% of respondents are satisfied with the waste transportation service in Uzhhorod, 33.2% rate the performance of the service as "satisfactory", and 41% are dissatisfied with the service.

63% of the respondents believe that the waste transportation service is provided regularly, 34.7% believe that the waste transportation service is not always provided regularly, other respondents could not answer the question.

The most glaring problems noted by more than 45% of respondents are:

- 1) irregular cleaning of the container site;
- 2) waste containers are full;
- 3) bulky waste accumulating near the containers;

4) unpleasant smell from the containers.

16.6% of respondents complain about the problem with the location of container sites. 9.1% of respondents noted that the transportation of waste at night interferes with rest. From the open remarks of respondents, the following problems should be noted: lack of containers for secondary raw materials, presence of informal waste collectors, and residents of nearby villages throwing away waste in Uzhhorod.

96.9% of respondents support the introduction of a separate collections.

83.6% of respondents complain about the lack of a functioning system for separate collection of waste. 71.7% of respondents noted the need for educational materials for proper waste sorting. 44.8% of respondents are ready to compost organic waste centrally or on the territory of their own household. 39.5% are ready for centralized composting, 5.3% on the territory of their own household, 5.7% noted that they are already composting organic waste on the territory of their household. Other respondents were undecided 10.6%.

71.1% of respondents are ready to pay more for the service of removing municipal waste in order to introduce separate collection, sorting and recycling using European experience. More than 15.4% of respondents are categorically not ready to pay. In 2022, the tariff for municipal waste management services in Uzhhorod in the houses of the communal sector is 40.16 UAH, and in the houses of the private sector, it is 35.88 UAH. 57.6% of respondents are ready to pay a tariff in the amount of up to 100 UAH per month, provided that modern municipal waste management practices are implemented. 25.1% are ready to increase the tariff to 150 UAH per month.

Respondents had the opportunity to provide open proposals. 217 open answers were provided. Popular offers include the following:

- 1) installation of underground containers in the historical center of the city;
- 2) creation of a processing plant;
- 3) creation of sites for separate assembly;
- 4) development of the culture of municipal waste management;
- 5) liquidation of spontaneous landfills;
- 6) organize the collection of old equipment, lamps, batteries;
- 7) provide comprehensive information on further processing of collected secondary raw materials and hazardous components;
- 8) implement the processing of branches and leaves;
- 9) move from words to action.

ANNEX G. STATISTICAL DATA REGARDING THE TREATMENT OF DIFFERENT TYPES OF WASTE IN UZHGOROD

Table G.1. Generation and management of waste of I-IV hazard class in Uzhhorod (2012-2021), tons⁷⁶

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 *	2022 *
Formed	3,521.8	4,462.1	4,132.1	4,774.6	4,472.6	5,335.9	4,216.1	4,935.1	2,689.6	...	...
Utilized	70.3	57.0	45.5	7.3	8.6	10.2	8,9	9.4	6.4	...	...
Burned, total, including:	22.5	0.9	7.5	594.4	576.6	926.1	485.5	420.9	245.8	...	...
• obtaining energy	–	–	–	586.6	561.5	688.8	357.1	292.5	123.5	...	...
• thermal processing	–	–	–	7,8	15.1	237.3	128.4	128.4	122.3	...	...
Deleted in specially designated places	176,000.0	–	42,348.0	42,804.2	52,243.9	61,753.9	71,001.8	74,064.9	74,578.0	...	...
Removed to unorganized storage	–	–	–	–	–	–	–	–	–	...	...
Removed waste due to leaks, evaporation, fires, thefts	–	–	0.7	0.1	0.2	0.0	0.0	–	–	...	...
Passed to the side	–	9,861.6	–	–	3,787.4	–	6,229.3	4,505.0	2,432.3	...	...
Received from the side	–	–	–	–	126,611.2	143,107.2	73,443.6	74,832.8	147,483.4	...	...
Accumulated during operation at waste disposal sites	–	–	–	1,091,652.2	1,143,909.5	1,205,664.9	1,276,651.7	1,350,716.6	1,425,294.6	...	...

* Data not available

*Information for 2021 was not provided by the statistical authority due to the effect of martial law on the territory of Ukraine

⁷⁶ Source: Main Department of Statistics in Transcarpathian Region

Table G.2. Management of waste of I-III hazard class in Uzhhorod (2017-2020), ton

Operations/years	2017	2018	2019	2020
Formed	494.7	31.3	40.5	40.9
Utilized	10.2	8,9	9.4	6.4
Burned	237.3	-	-	-
Deleted in specially designated places	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-

Table G.3. Management of waste oils in Uzhhorod (2012-2020), tons

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	35.9	24.1	12.6	14.5	17.2	19.1	13.5	18.9	27.848
Utilized	12.1	13.3	7.4	7.0	8.3	10.2	8,9	9.4	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks	1.1	2,2	0.6	0.1	-	0	0	-	-
Passed to the side	23.8	13.7	-	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	11.9	10.8	5.9	1.5	2.7	2.4	1.9	3.0	2.897
Received waste during the year	35.9	24.1	17.6	498.5	700.2	751.7	15	18.9	27.848
Dropped out waste during the year	37.0	29.2	22.0	497.4	700.6	750.8	14.9	19.9	27.662

Table G.4. Management of industrial waste in Uzhhorod (2012-2020), tons*

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	3,521.8	4,462.1	4,132.1	4,774.6	4,472.6	5,335.9	4,225.4	4,167.2	2,689.592
Utilized	70.3	57.0	45.5	7.3	8.6	10.2	8,9	9.4	-
Burned for obtaining energy	22.5	8.4	7.5	594.4	576.6	926.1	485.5	420.9	245,783
thermal processing	-	-	-	-	-	-	-	-	123,519
Deleted in specially designated places	-	-	42,348	42,804.2	52,243.9	61,753.9	71,001.8	74,064.9	74,577.96
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	0.7	0.1	0.2	-	0.0	-	-
Removed waste for other reasons, including clarification of the hazard class	7.2	2,2	-	-	-	-	-	-	-
Passed to the side	4,249.4	9,861.6	-	-	-	-	-	-	-

*in 2020, wood waste was burned.

Table G.5. Management of mining industry waste in Uzhhorod (2012-2020), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	-	-	-	-	7.6	163.1	2.9	2.5	2.241
Utilized	-	-	-	-	-	1.9	1.9	1.5	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-

* 2020 according to KVED

Mining and quarrying

Extraction of other minerals and development of quarries

Mining of stone, sand and clay

Extraction of sand, gravel, clay and kaolin

Table G.6. Management of electrical and electronic equipment waste in Uzhhorod (2012-2020), tons*

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	2.6	2.4	4.5	1.4	1.1	4.4	2,2	2.9	0.748
Utilized	-	-	2.5	0.3	0.3	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks	-	-	-	-	-	-	-	-	-
Passed to the side	0.1	2.5	-	-	-	-	-	-	-
Received from the side	0.0	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	0.2	0.3	0.0	0.1	0.2	0.2	0.2	0.1	0.102
Received waste during the year	2.7	2.4	40.2	6.3	3.9	4.4	5.5	2.9	0.748
Dropped out waste during the year	2.7	2.5	40.1	6.3	3.9	4.4	5.5	1.8	0.745

*Unsuitable equipment

Table G.7. Management of waste batteries and accumulators in Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	4.2	9.6	8.2	6.5	3.9	5.1	3.0	14.3	2.575
Utilized	-	-	-	-	-	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to detection the class of hazard	1.1	-	-	-	-	0	-	-	-
Passed to the side	9.7	13.2	-	-	-	-	-	-	-
Received from the side	3.1	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	9.6	6.0	2.4	1.0	1,2	1.3	0.9	1.5	0.844
Received waste during the year	7.2	9.6	8.2	6.5	3.9	5.1	5.0	14.3	2.575
Dropped out waste during the year	10.8	13.2	9.6	6.3	3.9	5.4	4.3	5.0	2.575

Table G.8. Management of medical and biological waste in Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	1.0	1.0	-	-	-	1.0	1.1	0.8	19.793
Utilized	-	-	-	-	-	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	-	-	-	-	-	-	-
Passed to the side	1.0	1.0	-	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	-	-	-	-	-	-	-	-	-
Received waste during the year	1.0	1.0	9.0	3.0	3.7	8.1	23.5	0.8	19.793
Dropped out waste during the year	1.0	1.0	9.0	3.0	3.7	8.1	23.5	0.8	19.793

Table G.9. Formation of agricultural waste in Uzhhorod (2012-2022), t

Categories of waste by material	The total volume of waste generation, t								
	Years								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
All categories of waste by material	3,521.8	4,462.1	4,132.1	4,774.6	4,472.6	5,335.9	4,225.4	4,167.2	2,689.592
Animal waste and mixed food waste	-	-	-	-	-	1.3	0.3	0.6	0.651
Waste of plant origin	-	-	-	-	-	-	-	-	-
Animal excrement, urine and manure	-	-	-	-	-	-	-	-	-

Table G.10. Management of wood waste in the city of Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	1,317.3	1,853.5	1,641.4	2039.8	1,944.0	1,586.8	930.7	510.1	537.653
Utilized	-	-	-	-	-	-	-	-	-
Burned:	22.5	8.4	7.5	594.4	576.6	926.1	485.5	420.9	245.783
for the purpose of use as fuel or otherwise to obtain energy	-	-	-	-	-	-	-	-	123.519

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
for the purpose of thermal processing of energy	-	-	-	-	-	-	-	-	122.264
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	-	-	-	-	-	-	-
Passed to the side	1,289.3	1851.2	-	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	5,6	11.0	4.9	666.0	356.1	493.1	463.9	26.9	22.167
Availability of waste on January 1	1,317.3	1,853.5	1,641.4	2,392.1	1,988.3	1,744.0	968.1	510.1	543.753
Received waste during the year	1,311.8	1,859.6	980.3	2702.1	1,851.3	1,773.1	932.6	514.8	541.788

Table G.11. Management of glass waste in Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	7.9	8.0	0.7	0.8	0.2	37.2	17.2	9.5	10.109
Utilized	-	-	-	-	-	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	-	-	-	-	-	-	-
Passed to the side	7.9	8.0	0.7	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	43.2	121.6	26.4	5.3	6.751
Availability of waste on January 1	7.9	8.0	0.7	104.6	81.1	111.2	17.4	9.5	23.509
Received waste during the year	7.9	8.0	0.7	61.6	2.6	187.8	17.6	14.2	21.130

Table G.12. Management of paper and cardboard waste in Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	94.8	76.9	47.9	75.5	125.6	676.0	244.0	244.5	159.183
Utilized	-	-	-	-	-	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	-	-	-	-	-	-	-

Passed to the side	94.4	77.4	-	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	-	0.5	-	-	136.4	148.2	139.0	0.2	62.253
Received waste during the year	94.8	76.9	47.9	490.1	392.7	111.2	268.5	244.5	186.664
Dropped out waste during the year	94.4	77.4	47.9	353.7	380.9	187.8	243.7	244.7	243.765

Table G.13. Management of plastic waste in Uzhhorod (2012-2022), t

Operations/years	2012	2013	2014	2015	2016	2017	2018	2019	2020
Formed	8.4	12.9	7.9	11.1	16.1	152.7	25.4	34.0	29.374
Utilized	-	-	-	-	-	-	-	-	-
Burned	-	-	-	-	-	-	-	-	-
Deleted in specially designated places	-	-	-	-	-	-	-	-	-
Removed to unorganized storage	-	-	-	-	-	-	-	-	-
Removed waste due to leaks, evaporation, fires, thefts	-	-	-	-	-	-	-	-	-
Passed to the side	8.4	13.0	-	-	-	-	-	-	-
Received from the side	-	-	-	-	-	-	-	-	-
Accumulated during operation at waste disposal sites	-	-	-	-	-	-	-	-	-
Availability of waste on January 1	-	1.2	1.1	0.1	59.9	104.6	116.7	0	13.248
Received waste during the year	8.4	12.9	7.9	107.7	104.4	221.1	37.6	34.0	29.852
Dropped out waste during the year	8.4	13.0	9.0	47.9	59.7	185.5	25.5	34.0	40.173

ANNEX H. ANALYSIS OF THE CONDITION OF THE ENVIRONMENT AND THE INFLUENCE OF THE WASTE DISPOSAL SITE

**The results of determining the concentrations of pollutants
in surface waters and atmospheric air
in the area of the location of the municipal waste landfill and the state of their
contamination**

Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzghorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021

ПРОТОКОЛ

відбору проб поверхневих вод

Річка озеро Філариса

Дата та час відбору проби «13» жовтня 2022 р., 11 год. 40 хв. к. ч.

Координати місця відбору проби 48°35'04,5" Пн 22°19'44,9" Сх

Глибина відбору проби: 0,2 м

Температура 13,5 °С

Електропровідність 380 мксм/см

Номери склянок із зафіксованою пробєю на вміст розчиненого кисню 1

Номери склянок для визначення БСК₅ 9 - не розбавлена, 2 - розбав-
лена 1:2, 19 - розбавлена 1:4

Примітка _____

Пробу відібрав:

Завідувач сектору спостережень

за забрудненням поверхневих вод  Петро ВЕРЕШ

Представник Замовника:



Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021

ПРОТОКОЛ № 1

відбору проб забруднювальних речовин в атмосферному повітрі
в районі розташування полігону ТПВ на околиці села Барвінок
Ужгородського району Закарпатської області
від «13» травня 2022 року

Нами, начальником КЛСЗПС Федорішко М. І., завідувачем сектору спостережень за забрудненням атмосферного повітря Борбіль Л. В., на виконання Договору про надання інформації про стан природного середовища, проведено відбір проб атмосферного повітря для аналізу на вміст діоксиду сірки (проба № 54), діоксиду азоту (проба № 56), формальдегіду (проба № 1) в пункті з координатами: 48°35'03,0" Пн, 22°21'10,8" С; відбір проб проводився протягом 20 хв. від 9⁵⁷ до 10¹⁶ київського часу. Температура повітря на час відбору проб складає: 7,0 °С, атмосферний тиск: 760 мм. рт. ст., напрямок та швидкість вітру: ПзСх, 0,5 м/с. Концентрація оксиду вуглецю в атмосферному повітрі на час відбору проби дорівнює 0,54 мг/м³.

Відбір проб проведено відповідно вимогам нормативних документів; при відборі проб застосовувалась установка пневматична УП 1111/5А СРЗ, при вимірюваннях – газоаналізатор «СМ-2-СО».

Виконавці відбору проб:

М. Федорішко Марія ФЕДОРІШКО

Л. Борбіль Ліана БОРБІЛЬ

Представник Замовника:

Е. Пилип

Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021

ПРОТОКОЛ № 2

відбору проб забруднювальних речовин в атмосферному повітрі
в районі розташування полігону ТПВ на околиці села Барвінок
Ужгородського району Закарпатської області
від « 13 » травня 2022 року

Нами, начальником КЛСЗПС Федорішко М. І., завідувачем сектору спостережень за забрудненням атмосферного повітря Борбиль Л. В., на виконання Договору про надання інформації про стан природного середовища, проведено відбір проб атмосферного повітря для аналізу на вміст діоксиду сірки (проба № 76), діоксиду азоту (проба № 67), формальдегіду (проба № 2) в пункті з координатами: 48°34'56,3" Пн, 22°21'06,1" С; відбір проб проводився протягом 20 хв. від 10²⁵ до 10⁴⁴ київського часу. Температура повітря на час відбору проб складає: 8,0°С, атмосферний тиск: 760 мм. рт. ст., напрямок та швидкість вітру: ПзС, 0,8 м/с. Концентрація оксиду вуглецю в атмосферному повітрі на час відбору проби дорівнює 0,99 мг/м³.

Відбір проб проведено відповідно вимогам нормативних документів; при відборі проб застосовувалась установка пневматична УП 1111/5А СРЗ, при вимірюваннях – газоаналізатор «СМ-2-СО».

Виконавці відбору проб:

М. Федорішко Марія ФЕДОРІШКО

Л. Борбиль Ліана БОРБІЛЬ

Представник Замовника:

Е. Паш

Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №1Ф 373 від 24.12.2021

ПРОТОКОЛ № 3

відбору проб забруднювальних речовин в атмосферному повітрі
в районі розташування полігону ТПВ на околиці села Барвінок
Ужгородського району Закарпатської області
від « 13 » листопада 2022 року

Нами, начальником КЛСЗПС Федорішко М. І., завідувачем сектору спостережень за забрудненням атмосферного повітря Борбіль Л. В., на виконання Договору про надання інформації про стан природного середовища, проведено відбір проб атмосферного повітря для аналізу на вміст діоксиду сірки (проба № 79), діоксиду азоту (проба № 75), формальдегіду (проба № 3) в пункті з координатами: 48° 34' 50,2" Пн, 22° 21' 06,1" С; відбір проб проводився протягом 20 хв. від 10⁵⁵ до 11¹⁴ київського часу. Температура повітря на час відбору проб складає: 8,0 °С, атмосферний тиск: 760 мм. рт. ст., напрямок та швидкість вітру: ПдС, 0,5 м/с. Концентрація оксиду вуглецю в атмосферному повітрі на час відбору проби дорівнює 0,95 мг/м³.

Відбір проб проведено відповідно вимогам нормативних документів; при відборі проб застосовувалась установка пневматична УП 1111/5А СРЗ, при вимірюваннях – газоаналізатор «СМ-2-СО».

Виконавці відбору проб:

МФШ Марія ФЕДОРІШКО

ЛВ Ліана БОРБІЛЬ

Представник Замовника:

Е.П.

Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021 р.

ПРОТОКОЛ № 1

вимірювань вмісту забруднювальних речовин в атмосферному повітрі в районі розташування полігону ТПВ, с. Барвінок Ужгородського району Закарпатської області від « 13 » жовтня 2022 року

Відповідно до Протоколу відбору проб забруднювальних речовин в атмосферному повітрі від « 13 » жовтня 2022 року, за № 1, Комплексною лабораторією спостережень за забрудненням природного середовища (КЛСЗПС) Закарпатського ЦГМ проведено вимірювання вмісту діоксиду сірки, діоксиду азоту та формальдегіду в атмосферному повітрі. Вимірювання проведено відповідно вимогам нормативних документів, при вимірюванні вмісту забруднювальних речовин застосовувався фотометр фотоелектричний «КФК-3-01».

Результати вимірювань:

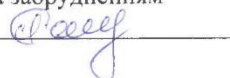
Дата проведення вимірювання	Назва забруднювальної речовини	Номер проби	Концентрація забруднювальної речовини		Гранично допустима концентрація (ГДК _{мр}), мг/м ³	Відомості про методику виконання вимірювань
			мг/м ³	в кратності ГДК		
13.10.2022	Діоксид сірки	74	0,023	0,05	0,5	КНД 09.02-2011
	Діоксид азоту	36	0,084	0,42	0,2	КНД 09.03-2011
	Формальдегід	1	0,010	0,29	0,035	КНД 09.03-2011

Начальник КЛСЗПС



Марія ФЕДОРІШКО

Завідувач сектору спостережень за забрудненням атмосферного повітря КЛСЗПС



Ліана БОРБІЛЬ

Закарпатський ЦГМ

**Комплексна лабораторія спостережень за забрудненням природного середовища
/КЛСЗПС/**

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021 р.

ПРОТОКОЛ № 2

вимірювань вмісту забруднювальних речовин в атмосферному повітрі в районі розташування полігону ТПВ, с. Барвінок Ужгородського району Закарпатської області від « 13 » жовтня 2022 року

Відповідно до Протоколу відбору проб забруднювальних речовин в атмосферному повітрі від « 13 » жовтня 2022 року, за № 2 , Комплексною лабораторією спостережень за забрудненням природного середовища (КЛСЗПС) Закарпатського ЦГМ проведено вимірювання вмісту діоксиду сірки, діоксиду азоту та формальдегіду в атмосферному повітрі. Вимірювання проведено відповідно вимогам нормативних документів, при вимірюванні вмісту забруднювальних речовин застосовувався фотометр фотоелектричний «КФК-3-01».

Результати вимірювань:

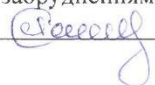
Дата проведення вимірювання	Назва забруднювальної речовини	Номер проби	Концентрація забруднювальної речовини		Гранично допустима концентрація (ГДК _{мр}), мг/м ³	Відомості про методику виконання вимірювань
			мг/м ³	в кратності ГДК		
13.10.2022	Діоксид сірки	76	0,029	0,06	0,5	КНД 09.02-2011
	Діоксид азоту	67	0,098	0,49	0,2	КНД 09.03-2011
	Формальдегід	2	0,011	0,31	0,035	КНД 09.03-2011

Начальник КЛСЗПС



Марія ФЕДОРІШКО

Завідувач сектору спостережень за забрудненням атмосферного повітря КЛСЗПС



Ліана БОРБИЛЬ

Закарпатський ЦГМ

Комплексна лабораторія спостережень за забрудненням природного середовища /КЛСЗПС/

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №ІФ 373 від 24.12.2021 р.

ПРОТОКОЛ № 3

вимірювань вмісту забруднювальних речовин в атмосферному повітрі в районі розташування полігону ТПВ, с. Барвінок Ужгородського району Закарпатської області від «13» жовтня 2022 року

Відповідно до Протоколу відбору проб забруднювальних речовин в атмосферному повітрі від «13» жовтня 2022 року, за № 3, Комплексною лабораторією спостережень за забрудненням природного середовища (КЛСЗПС) Закарпатського ЦГМ проведено вимірювання вмісту діоксиду сірки, діоксиду азоту та формальдегіду в атмосферному повітрі. Вимірювання проведено відповідно вимогам нормативних документів, при вимірюванні вмісту забруднювальних речовин застосовувався фотометр фотоелектричний «КФК-3-01».

Результати вимірювань:

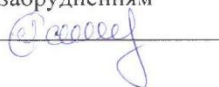
Дата проведення вимірювання	Назва забруднювальної речовини	Номер проби	Концентрація забруднювальної речовини		Гранично допустима концентрація (ГДК _{мр}), мг/м ³	Відомості про методику виконання вимірювань
			мг/м ³	в кратності ГДК		
13.10.2022	Діоксид сірки	79	0,019	0,04	0,5	КНД 09.02-2011
	Діоксид азоту	75	0,089	0,45	0,2	КНД 09.03-2011
	Формальдегід	3	0,009	0,26	0,035	КНД 09.03-2011

Начальник КЛСЗПС



Марія ФЕДОРІШКО

Завідувач сектору спостережень за забрудненням атмосферного повітря КЛСЗПС



Ліана БОРБИЛЬ



ДСНС України

**ЗАКАРПАТСЬКИЙ ОБЛАСНИЙ ЦЕНТР З ГІДРОМЕТЕОРОЛОГІЇ
(Закарпатський ЦГМ)**

Слов'янська Набережна, 5, м.Ужгород, 88018, тел. (0312) 65-70-70 , факс (0312) 61-65-64

www.gmc.uzhgorod.ua

код ЄДРПОУ 20442705

E-mail: pgduzhgorod@meteo.gov.ua

21. 10. 2022 № 998 ст-899/998-12

На № 186 Від 05.10.2022

Т. в. о. директора ДП "НДКТИ МГ"
Марині ГОЛЮК
elena.panchenko.92@gmail.com

Результати вимірювань

Висилаємо Довідки про стан забруднення атмосферного повітря та поверхневої води в районі розташування полігону ТПВ, с. Барвінок Ужгородського району

Додаток: на 2 арк. в 1 прим.

Начальник



Василь МАНІВЧУК

Марія ФЕДОРШКО
0312 65 70 70



ДСНС України

**ЗАКАРПАТСЬКИЙ ОБЛАСНИЙ ЦЕНТР З ГІДРОМЕТЕОРОЛОГІЇ
(Закарпатський ЦГМ)**

Слов'янська Набережна, 5, м.Ужгород, 88018, тел. (0312) 65-70-70, факс (0312) 61-65-64
www.gmc.uzhgorod.ua код ЄДРПОУ 20442705 E-mail: pgduzhgorod@meteo.gov.ua

21.10.2022 № 99801-899/998-12 На № 186 Від 05.10.2022

ДОВІДКА

про стан забруднення атмосферного повітря в районі розташування
полігону твердих побутових відходів,
с. Барвінок Ужгородського району Закарпатської області

№ з/п	Дата відбору проб	Час відбору проб	Координати місця відбору проб	Концентрація, мг/м ³			
				Діоксид сірки	Діоксид азоту	Формальдегід	Оксид вуглецю
1	13.10.22	09 ⁵⁷ - 10 ¹⁶	48°35'03,0'' Пн 22°21'10,8'' Сх	0,023	0,084	0,010	0,57
2		10 ²⁵ - 10 ⁴⁴	48°34'56,3'' Пн 22°21'06,1'' Сх	0,029	0,098	0,011	0,99
3		10 ⁵⁵ - 11 ¹⁴	48°34'50,2'' Пн 22°21'06,1'' Сх	0,019	0,089	0,009	0,95

Начальник



Василь МАНІВЧУК

Марія ФЕДОРІШКО
0312 65 70 70



ДСНС України

**ЗАКАРПАТСЬКИЙ ОБЛАСНИЙ ЦЕНТР З ГІДРОМЕТЕОРОЛОГІЇ
(Закарпатський ЦГМ)**

Слов'янська Набережна, 5, м.Ужгород, 88018, тел. (0312) 65-70-70, факс (0312) 61-65-64
www.gmc.uzhgorod.ua код ЄДРПОУ 20442705 E-mail: pgduzhgorod@meteo.gov.ua

21.10.2022 № 398 01-399/998-12 На № 186 Від 05.10.2022

ДОВІДКА

про стан забруднення поверхневої води в районі розташування
полігону твердих побутових відходів,
заплавне озеро Нілачка, м. Ужгород Закарпатської області

№ з/п	Дата і час відбору	Координати місця відбору	Забруднююча речовина	Концентрація
1	13.10.2022	48°35'04,5'' Пн	Водневий показник рН	8,41
2			Амоній-іон NH_4^+ , мг/дм ³	0,170
3			Нітрит-іон NO_2^- , мг/дм ³	0,008
4			Нітрат-іон NO_3^- , мг/дм ³	0,580
5			Фосфат-іон PO_4^{3-} , мг/дм ³	0,280
6			Фосфор загальний, мг/дм ³	0,412
7	11 ⁴⁰ к. ч.	22°19'44,9'' Сх	Хлорид-іон Cl^- , мг/дм ³	30,13
8			Сульфат-іон SO_4^{2-} , мг/дм ³	32,06
9			Біохімічне споживання кисню БСК ₅ , мгО ₂ /дм ³	7,23
10			Біхроматна окислюваність ХСК, мгО/дм ³	56,0

Начальник

Василь МАНІВЧУК

Марія ФЕДОРШКО
0312 65 70 70

Закарпатський ЦГМ

**Комплексна лабораторія спостережень за забрудненням природного середовища
/КЛСЗПС/**

м. Ужгород, вул. Собранецька, 145 «Б»

Тел./факс.: (0312) 65-70-70,

e-mail: lszauzhgorod@meteo.gov.ua

Свідоцтво про технічну компетентність №1Ф 373 від 24.12.2021 р.

ПРОТОКОЛ

вимірювань вмісту забруднювальних речовин в поверхневій воді
в районі розташування полігону ТПВ, м. Ужгород Закарпатської області,
від « 13 » жовтня 2022 року

Відповідно до Протоколу відбору проб поверхневих вод в заплавному озері Нілачка від « 13 » жовтня 2022 року, Комплексною лабораторією спостережень за забрудненням природного середовища (КЛСЗПС) Закарпатського ЦГМ проведено вимірювання вмісту забруднюючих речовин. При вимірюванні рівню забруднення застосовувались спектрофотометр «Ulab 102», рН-метр «рН-150МА».

Результати вимірювань:

Дата проведення вимірювання	Назва забруднюючої речовини	Концентрація забруднюючої речовини	Відомості про методику виконання вимірювань
13.10.2022	Водневий показник рН	8,41	Інструментально
	Амоній-іон NH_4^+ , мг/дм ³	0,170	Фотометричне визначення з реактивом Несслера
	Нітрит-іон NO_2^- , мг/дм ³	0,008	Фотометричне визначення з реактивом Грісса
	Нітрат-іон NO_3^- , мг/дм ³	0,580	Фотометричне визначення з саліциловою кислотою
	Фосфат-іон PO_4^{3-} , мг/дм ³	0,280	Фотометричне визначення МВВ 081/12-0005-01
	Фосфор загальний, мг/дм ³	0,412	Персульфатне окислення МВВ 081/12-0018-01
	Хлорид-іон Cl^- , мг/дм ³	30,13	Аргентометричний метод МВВ 081/12-0004-01
	Сульфат-іон SO_4^{2-} , мг/дм ³	32,06	Турбідиметричний метод
	Біхроматна окислюваність ХСК, мгО/дм ³	56,0	Біхроматне окислення МВВ 081/12-0019-01
18.10.2022	Біохімічне споживання кисню БСК ₅ , мгО ₂ /дм ³	7,23	Титриметричний метод МВВ 081/12-0014-01

Начальник КЛСЗПС



Марія ФЕДОРІШКО

Завідувач сектору спостережень за забрудненням поверхневих вод КЛСЗПС



Петро ВЕРЕШ

Results of determination of normalized soil indicators in the zone of influence of the municipal waste landfill



ДЕРЖПРОДСПОЖИВСЛУЖБА
УЖГОРОДСЬКА ПРИКОРДОННА ДЕРЖАВНА
КОНТРОЛЬНО-ТОКСИКОЛОГІЧНА ЛАБОРАТОРІЯ

(Ужгородська ПДКТЛ)

вул. Станційна, 56, м. Ужгород, 88000, тел. (0312)-2-58-32
тел/факс (0312)-2-08-09, e-mail: updktl@gmail.com

Акредитована Національним агенством з акредитації України на відповідність вимогам
ДСТУ EN ISO/IEC 17025:2019.

Атестат акредитації №201647 від 18.08.2022р. дійсний до 02.05.2024р.

ЗАТВЕРДЖУЮ

В.о. завідувача Ужгородської ПДКТЛ

Степан ЧУПРКА
"д.б." *Мовшин* 2022 р.



ПРОТОКОЛ ВИПРОБУВАНЬ

26.10.2022 р.

(дата формування)

№ 691

Ужгородська прикордонна державна контрольно-токсикологічна лабораторія
провела випробування:

Грунт. З тіла полігону №1

(назва продукції (об'єкту, матеріалу, речовини і т.п.), код ДКПП(за наявності) та інша інформація)

1. Відомості про замовника випробувань

Державне підприємство "Науково-дослідний та конструкторсько-технологічний інститут міського господарства"

(назва підприємства, установи, іншого суб'єкта господарювання або ПІБ фізичної особи)

м. Київ, вул. Урицького, 35

(адреса замовника - область, район, місто(село,смт), вулиця, будинок)

Запит на проведення випробувань ґрунту від 11.10.2022 р.

(підстава для проведення випробувань)

2. Відомості про відбір зразка

2.1. План та методи відбору зразка ДСТУ 4287:2004

Якість ґрунту. Відбирання проб.

(позначення та назва НД, іншого документу в якому встановлені вимоги та правила відбору)

2.2. Акт ідентифікації (протокол відбору) зразка №35 від 12.10.2022 р.

(номер та дата)

2.3. Дата відбору зразка 12.10.2022 р.

2.4. Відбір зразка здійснено замовником

(замовником, комісією, уповноваженим співробітником лабораторії,
тощо - зазначити необхідне)

Забороняється повне або часткове передруккування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 1 з 6

2.5. Опис та стан зразка придатний (без дефектів)
(придатний (без дефектів), з відхиленнями, опломбований, опечатаний, тощо - зазначити необхідне)

2.6. Зразок отримано та зареєстровано в Ужгородській ПДКТЛ

12.10.2022 р., №691

(дата отримання та реєстраційний номер зразку)

3. Характеристика випробувань

3.1. Дата початку проведення випробувань 14.10.2022 р.

3.2. Дата закінчення проведення випробувань 26.10.2022 р.

3.3. Нормативні документи на методи випробування

№ з/п	Позначення НД	Назва нормативного документу
1	2	3
1	ДСТУ 4405:2005	Якість ґрунту. Визначення рухомих сполук фосфору і калію за методом Кірсанова в модифікації ІНЦ ІГА
2	ДСТУ 4729:2007	Якість ґрунту. Визначення нітратного і амонійного азоту в модифікації ІНЦ ІГА ім. О.Н. Соколовського
3	ДСТУ 7608:2014	Якість ґрунту. Потенціометричний метод визначення активності іонів водню у ґрунтових пастах
4	ГОСТ 26483-85	Приготовление солевой вытяжки и определение ее pH по методу ЦИНАО
5	ГОСТ 26951-86	Почвы. Определение нитратов ионометрическим методом
6	МВ 50-97	Методичні вказівки по визначенню Hg, Zn, Co, Cd, Cu в ґрунті, рослинах, воді методом тонкошарової хроматографії
7	Інструкція №58	Визначення загального азоту в ґрунті розрахунковим методом
8	Інструкція №62	Визначення гігроскопічної вологи ґрунту

3.4. Випробування проводились із залученням зовнішніх постачальників:

не проводились

(види випробувань, назва зовнішнього постачальника, адреса, ідентифікаційний номер зразку)

4. Умови проведення випробувань

Місце проведення випробувань	Температура, °С	Відносна вологість, %	НД
	відповідно до НД/фактичне значення		
1	2	3	4
Аналітична лабораторія	17-23/20,2-19,6	не більше 75/ 71	ДСН 3.3.6.042-99
Вагова	17-23/20,4-19,6	не більше 75/ 71	
Титриметрична лабораторія	17-23/20,2-19,6	не більше 75/ 71	

Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 2 з 6

5. Результати випробувань

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширена невизначеність, (%)	Заява про відповідність НД	Прізвище та ініціали, уповноваженого персоналу, що виконував випробування
			Відповідно до НД ^{2,3}	Фактичне значення				
1	2	3	4	5	6	7	8	9
1	Рухомий фосфор	мг/кг	-	5,48	ДСТУ 4405:2005	±0,00	Відсутня	Дьобба І.Р.
2	Вміст амонійного азоту	мг/кг	-	19,24	ДСТУ 4729:2007	±0,87	Відсутня	Дьобба І.Р.
3	Вміст нітратів	мг/кг	(не більше 130) ²	128,69	ГОСТ 26951-86	±3,01	Вміст нітратів у випробуваному зразку "Грунт. За 100 м від тіла полігону №3" з достовірністю P=0,95 ПЕРЕВИЩУЄ верхню граничну допуску, що встановлена нормативним документом	Крулікевич М.М.
4	Доступні форми азоту (N-NO ₃ ⁻ +N-NH ₄ ⁺)	мг/кг	-	147,93	Інструкція №58	±0,06	Відсутня	Крулікевич М.М.
5	Водневий показник водної витяжки ґрунту (рН)	од.рН	-	7,14	ДСТУ 7608:2014	±0,01	Відсутня	Крулікевич М.М.
6	Водневий показник сольової витяжки ґрунту (рН)	од.рН	-	6,08	ГОСТ 26483-85	±0,00	Відсутня	Крулікевич М.М.

ВИПРОБУВАННЯ ПРОВЕДЕНІ ПОЗА МЕЖАМИ СФЕРИ АКРЕДИТАЦІЇ

7	Вміст цинку	мг/кг	(не більше 23,0) ²	≤0,0004	МВ 50-97	±0,00	Залишкова кількість цинку у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВНЯВЛЕНО	Чубірка Н.П.
8	Вміст нікелю	мг/кг	(не більше 4,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість нікелю у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВНЯВЛЕНО	Чубірка Н.П.

Заборонається повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКЛІ
Протокол поширюється тільки на випробуваний зразок

Фр. 24.00.06 редакція 08 від 10.10.2022р.

Сторінка 3 з 6

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширена невизначеність, (%)	Загва про відповідність НД	Прізвище та ініціали, уповноваженого персоналу, що виконував випробування
			Відповідно до НД ³	Фактичне значення				
1			4	5	6	7	8	9
9	Вміст кобальту	мг/кг	(не більше 5,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість кобальту у випробуваному зразку " Грунт. За 50 м від поверхні №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Чубірка Н.П.
10	Вміст кадмію	мг/кг	(відсутні) ²	≤0,002	МУ 2142-80	±0,00	Залишкова кількість кадмію у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
11	Вміст міді	мг/кг	(не більше 3,0) ²	≤0,004	МУ 2142-80	±0,00	Залишкова кількість міді у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
12	Гігроскопічна волога	%	-	1,53	Інструкція №62	±0,06	Відсутня	Дзьоба І.Р.

Забороняється ловне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКЛЛ
 Протокол поширюється тільки на випробуваній зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

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Примітки. ¹ Розширена невизначеність отримана як добуток стандартної невизначеності і коефіцієнту охолодження $k=2$, який відповідає довірчій ймовірності приблизно рівній 95 % при гіпотезі нормального розподілу. Оцінювання невизначеності проведено відповідно до Процедури системи управління Пр.7.6/03-2022.

² Наказ Міністерства охорони здоров'я України №1595 від 14.07.2020 р. "Гігієнічних регламентів допустимого вмісту хімічних речовин у ґрунті" (зарєєстровано в Міністерстві юстиції України 31 липня 2020 р., за № 722/35005).

(позначення і назва нормативного(-х) документу(-ів) на продукцію (об'єкт, матеріал, речовину і т.п.) відповідно до якого(-их) проводиться оцінка відповідності)

6. Доповнення, відхилення або винятки з методу випробувань

відсутні

(позначення НД на метод випробування та задокументовані доповнення, відхилення або винятки з нього)

7. Тлумачення та інтерпретації

За табл.Б4 ДСТУ 4362:2004 (додаток Б, табл.Б4) за вмістом рухомого фосфору, що визначений методом Кірсанова та вмістом загального азоту (табл.Б3) випробуваний зразок ґрунту належить до ґрунту з **НИЗЬКИМ** вмістом рухомого фосфору та **ДУЖЕ ВИСОКИМ** вмістом загального азоту. За ступенем кислотності та лужності (табл.Б.1) випробуваний зразок ґрунту належить до **БЛИЗЬКИХ НЕЙТРАЛЬНИХ** ґрунтів.

8. Аналізування результатів випробувань (висновок)

Випробуваний зразок "ґрунт. З тіла полігону №1" за показниками (п. 7 - 11) розділу 5 цього протоколу відповідає вимогам наказу МОЗ України №1595

9. Додаткова інформація

відсутня

(зазначається інформація, яка вимагається конкретним методом відбору зразків або випробування, регуляторним органом, замовником або групою замовників)

Заборовається повне або часткове передрукування протоколу випробувань без дозволу У-жгородської ПДКГЛ

Протокол поширюється тільки на випробуваний зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

Сторінка 5 з 6

<p>Особа, що уповноважена на аналізування результатів випробувань (включаючи заяву про відповідність, тлумачення та інтерпретації)</p>	<p>Виконавці обов'язків завідуюча Ужгородської ПДКЛТЛ</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Євген ЧУБІРКА</p> <p>(власне ім'я та прізвище)</p>
	<p>Завідуючий відділу реєстрації зразків та оформлення</p> <p>(посада)</p>	<p>10.10.2022</p> <p>(підпис та дата)</p>	<p>Олександр ПАЛ</p> <p>(власне ім'я та прізвище)</p>
<p>Уповноважений персонал, що виконував випробування</p>	<p>Завідуючий відділу аналізу</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Ірина ДЗЮБА</p> <p>(власне ім'я та прізвище)</p>
	<p>Хімік I-ї категорії відділу аналізу</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Марта КРУЛКЕВИЧ</p> <p>(власне ім'я та прізвище)</p>
	<p>Хімік I-ї категорії відділу аналізу</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Надія ЧУБІРКА</p> <p>(власне ім'я та прізвище)</p>
	<p>Хімік I-ї категорії відділу аналізу</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Борис ШАРГА</p> <p>(власне ім'я та прізвище)</p>
	<p>Хімік I-ї категорії відділу аналізу</p> <p>(посада)</p>	<p><i>[Signature]</i></p> <p>(підпис та дата)</p>	<p>Борис ШАРГА</p> <p>(власне ім'я та прізвище)</p>

Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКЛТЛ
 Протокол поширюється тільки на випробування зразок
 Ф.24.00.06 редакція 08 від 10.10.2022р.



201647
ДСТУ ISO/IEC 17025

ДЕРЖПРОДСПОЖИВСЛУЖБА

УЖГОРОДСЬКА ПРИКОРДОННА ДЕРЖАВНА
КОНТРОЛЬНО-ТОКСИКОЛОГІЧНА ЛАБОРАТОРІЯ

(Ужгородська ПДКТЛ)

вул. Станційна, 56, м. Ужгород, 88000, тел. (0312)-2-58-32

тел/факс (0312)-2-08-09, e-mail: updktl@gmail.com

Акредитована Національним агенством з акредитації України на відповідність вимогам
ДСТУ EN ISO/IEC 17025:2019.

Атестат акредитації №201647 від 18.08.2022р. дієний до 02.05.2024р.

ЗАТВЕРДЖУЮ

В.о. завідувача Ужгородської ПДКТЛ

Синген ІУНІРКА

"16" жовтня 2022р.



ПРОТОКОЛ ВИПРОБУВАНЬ

26.10.2022 р.

(дата формування)

№ 689

Ужгородська прикордонна державна контрольно-токсикологічна лабораторія
провела випробування:

Грунт. За 50 м від тіла полігону №2

(назва продукції (об'єкту, матеріалу, речовини і т.п.), код ДКПП(за наявності) та інша інформація)

1. Відомості про замовника випробувань

Державне підприємство "Науково-дослідний та конструкторсько-технологічний інститут міського господарства"

(назва підприємства, установи, іншого суб'єкта господарювання або ПІБ фізичної особи)

м. Київ, вул.Урицького, 35

(адреса замовника - область, район, місто(село,сmt), вулиця, будинок)

Запит на проведення випробувань ґрунту від 11.10.2022 р.

(підстава для проведення випробувань)

2. Відомості про відбір зразка

2.1. План та методи відбору зразка

ДСТУ 4287:2004

Якість ґрунту. Відбирання проб.

(позначення та назва НД, іншого документу в якому встановлені вимоги та правила відбору)

2.2. Акт ідентифікації (протокол відбору) зразка

№35 від 12.10.2022 р.

(номер та дата)

2.3. Дата відбору зразка

12.10.2022 р.

2.4. Відбір зразка здійснено

замовником

(замовником, комісією, уповноваженим співробітником лабораторії,
тощо - зазначити необхідне)

Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 1 з 6

2.5. Опис та стан зразка _____ придатний (без дефектів)
(придатний (без дефектів), з відхиленнями, опломбований,
опечатаний, тощо - зазначити необхідне)

2.6. Зразок отримано та зареєстровано в Ужгородській ПДКТЛ
_____ 12.10.2022 р., №689
(дата отримання та реєстраційний номер зразку)

3. Характеристика випробувань

3.1. Дата початку проведення випробувань _____ 14.10.2022 р.

3.2. Дата закінчення проведення випробувань _____ 26.10.2022 р.

3.3. Нормативні документи на методи випробування

№ з/п	Позначення НД	Назва нормативного документу
1	2	3
1	ДСТУ 4405:2005	Якість ґрунту. Визначення рухомих сполук фосфору і калію за методом Кірсанова в модифікації ННЦ ІГА
2	ДСТУ 4729:2007	Якість ґрунту. Визначення нітратного і амонійного азоту в модифікації ННЦ ІГА ім. О.Н. Соколовського
3	ДСТУ 7608:2014	Якість ґрунту. Потенціометричний метод визначення активності іонів водню у ґрунтових пастах
4	ГОСТ 26483-85	Приготовление солевой вытяжки и определение ее pH по методу ЦИБЛАО
5	ГОСТ 26951-86	Почвы.Определение нитратов ионометрическим методом
6	МВ 50-97	Методичні вказівки по визначенню Hg, Zn, Co, Cd, Cu в ґрунті, рослинах, воді методом тонкошарової хроматографії
7	Інструкція №58	Визначення загального азоту в ґрунті розрахунковим методом
8	Інструкція №62	Визначення гігроскопічної вологи ґрунту

3.4. Випробування проводились із залученням зовнішніх постачальників:
_____ не проводились
(види випробувань, назва зовнішнього постачальника, адреса, ідентифікаційний номер зразку)

4. Умови проведення випробувань

Місце проведення випробувань	Температура, °С	Відносна вологість, %	НД
	відповідно до НД/фактичне значення		
1	2	3	4
Аналітична лабораторія	17-23/20,2-19,6	не більше 75/ 71	ДСН 3.3.6.042-99
Вагова	17-23/20,4-19,6	не більше 75/ 71	
Титриметрична лабораторія	17-23/20,2-19,6	не більше 75/ 71	

Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

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5. Результати випробувань

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширеність, (%)	Залапа про відповідність НД	Прізвище та ініціали, уповноваженого персоналу, що виконував випробування
			Відповідно до НД ^{2,3}	Фактичне значення				
1	2	3	4	5	6	7	8	9
1	Рухомий фосфор	мг/кг	-	43,57	ДСТУ 4405:2005	±4,78	Відсутня	Дябоба І.Р.
2	Вміст амонійного азоту	мг/кг	-	6,14	ДСТУ 4729:2007	±0,44	Відсутня	Дябоба І.Р.
3	Вміст нітратів	мг/кг	(не більше 130) ²	181,59	ГОСТ 26951-86	±4,48	Відсутня <small>Відсутня у випробуваному зразку</small> Грунт. За 50 м від тіла полігону №2 з достовірністю Р=0,95 ПЕРЕВИЩУЄ верхню граничну допуску, що встановлена нормативним документом	Крулікевич М.М.
4	Доступні форми азоту (N-NO ₃ +N-NH ₄)	мг/кг	-	187,73	Інструкція №58	±0,06	Відсутня	Крулікевич М.М.
5	Водневий показник водної витяжки ґрунту (рН)	од.рН	-	6,80	ДСТУ 7608:2014	±0,00	Відсутня	Крулікевич М.М.
6	Водневий показник сольової витяжки ґрунту (рН)	од.рН	-	6,21	ГОСТ 26483-85	±0,00	Відсутня	Крулікевич М.М.
ВИПРОБУВАННЯ ПРОВЕДЕНІ ЗА МЕЖАМИ СФЕРИ АКРЕДИТАЦІЇ								
7	Вміст цинку	мг/кг	(не більше 23,0) ²	≤0,0004	МВ 50-97	±0,00	Залишкова кількість шлангу у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю Р=0,95 НЕ ВИЯВЛЕНО	Чубірка Н.П.
8	Вміст нікелю	мг/кг	(не більше 4,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість шлангу у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю Р=0,95 НЕ ВИЯВЛЕНО	Чубірка Н.П.

Сторінка 3 з 6

засвідчується повне або часткове передруккування протоколу випробувань без дозволу урядової установи
Протокол поширюється тільки на випробувані зразки

№ 24.00.06 редакція 08 від 10.10.2022р.

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширена невизначеність $\Delta(U)$	Заявка про відповідність НД	Ініціали, уновноваженого персоналу, що виконував випробування
			Відповідно до НД ³	Фактичне значення				
1	2	3	4	5	6	7	8	9
9	Вміст кобальту	мг/кг	(не більше 5,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість кобальту у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Чубірка Н.П.
10	Вміст кадмію	мг/кг	(відсутні) ²	≤0,002	МУ 2142-80	±0,00	Залишкова кількість кадмію у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
11	Вміст міді	мг/кг	(не більше 3,0) ²	≤0,004	МУ 2142-80	±0,00	Залишкова кількість міді у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
12	Гігроскопічна волога	%	-	1,18	Інструкція №62	±0,02	Відсутня	Дзьоба І.Р.

Забороновано повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКПІ

Протокол поширюється тільки на випробування зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 4 з 6

Примітки. ¹ Розширена невизначеність отримана як добуток стандартної невизначеності і коефіцієнту охоплення $k=2$, який відповідає довірчій ймовірності приблизно рівній 95 % при гіпотезі нормального розподілу. Оцінювання невизначеності проведено відповідно до Процедури системи управління Пр.7.6/03-2022.

² Наказ Міністерства охорони здоров'я України №1595 від 14.07.2020 р. "Тітмічних регламентів допустимого вмісту хімічних речовин у ґрунті" (зарєєстровано в Міністерстві юстиції України 31 лютого 2020 р., за № 722/35005).

(позначення і назва нормативного(-х) документу(-ів) на продукцію (об'єкт, матеріал, речовину і т.п.) відповідно до якого(-их) проводиться оцінка відповідності)

6. Доповнення, відхилення або винятки з методу випробувань

відсутні

(позначення ІД на метод випробування та задокументовані доповнення, відхилення або винятки з нього)

7. Тлумачення та інтерпретації

За табл.Б4 ДСТУ 4362:2004 (додаток Б, табл.Б4) за вмістом рухомого фосфору, що визначений методом Кірсапова та вмістом загального азоту (табл.Б3) випробуваній зразок ґрунту належить до ґрунту з **НИЗЬКИМ** вмістом рухомого фосфору та **ДУЖЕ ВИСОКИМ** вмістом загального азоту. За ступенем кислотності та лужності (табл.Б.1) випробуваний зразок ґрунту належить до **НЕЙТРАЛЬНОГО** ґрунту.

8. Аналізування результатів випробувань (висновок)

Випробуваний зразок "ґрунт. За 50 м від тіла полігону №2" за показниками, що визначались (п. 7 - 11) розділу 5 цього протоколу відповідає вимогам наказу МОЗ України №1595

9.Додаткова інформація


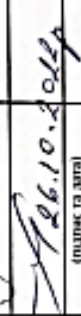
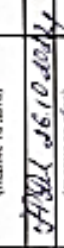




відсутня

(зазначається інформація, яка вимагається конкретним методом відбору зразків або випробування, регуляторним органом, замовником або групою замовників)

Забороняється повне або часткове передруккування протоколу випробувань без дозволу Ужгородської ПДКГП
Протокол поширюється тільки на випробуваній зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 5 з 6

<p>Особа, що уповноважена на аналізування результатів випробувань (включючи зняту про відповідність, тлумачення та інтерпретації)</p>	<p>Виконавці обов'язків завідуюча Ужгородської ПДКТЛ</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Світлана ЧУБРІКА</p> <p>(класифікація та прізвище)</p>
	<p>Завідуюча відділу реєстрації зразків та оформлення</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Олександр ПАЛ</p> <p>(класифікація та прізвище)</p>
<p>Уповноважений персонал, що виконував випробування</p>	<p>Завідуюча відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Ірина ДЗЮБА</p> <p>(класифікація та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Марта КРУЛКЕВИЧ</p> <p>(класифікація та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Надія ЧУБРІКА</p> <p>(класифікація та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Борис ШАРГА</p> <p>(класифікація та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Борис ШАРГА</p> <p>(класифікація та прізвище)</p>

Заборонована людина або часткове перерукування протоколу випробувань без дозволу Ужгородської ПДКТЛ
 Протокол поширюється тільки на випробуванні зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

Сторінка 6 з 6



ДЕРЖПРОДСПОЖИВСЛУЖБА
УЖГОРОДСЬКА ПРИКОРДОННА ДЕРЖАВНА
КОНТРОЛЬНО-ТОКСИКОЛОГІЧНА ЛАБОРАТОРІЯ

(Ужгородська ПДКТЛ)

вул. Станційна, 56, м. Ужгород, 88000, тел. (0312)-2-58-32
тел/факс (0312)-2-08-09, e-mail: updktl@gmail.com

Акредитована Національним агенством з акредитації України на відповідність вимогам
ДСТУ EN ISO/IEC 17025:2019.

Атестат акредитації №201647 від 18.08.2022р. дієний до 02.05.2024р.

ЗАТВЕРДЖУЮ

В.о. завідувача Ужгородської ПДКТЛ

Савен
"26" листопада 2022р.



ПРОТОКОЛ ВИПРОБУВАНЬ

26.10.2022 р.

(дата формування)

№ 690

Ужгородська прикордонна державна контрольно-токсикологічна лабораторія
провела випробування:

Грунт. За 100 м від тіла полігону №3

(назва продукції (об'єкту, матеріалу, речовини і т.п.), код ДКПП(за наявності) та інша інформація)

1. Відомості про замовника випробувань

Державне підприємство "Науково-дослідний та конструкторсько-технологічний інститут міського господарства"

(назва підприємства, установи, іншого суб'єкта господарювання або ПІБ фізичної особи)

м. Київ, вул. Урицького, 35

(адреса замовника - область, район, місто(село,смт), вулиця, будинок)

Запит на проведення випробувань ґрунту від 11.10.2022 р.

(підстава для проведення випробувань)

2. Відомості про відбір зразка

2.1. План та методи відбору зразка ДСТУ 4287:2004

Якість ґрунту. Відбирання проб.

(позначення та назва НД, іншого документу в якому встановлені вимоги та правила відбору)

2.2. Акт ідентифікації (протокол відбору) зразка №35 від 12.10.2022 р.

(номер та дата)

2.3. Дата відбору зразка 12.10.2022 р.

2.4. Відбір зразка здійснено замовником

(замовником, комісією, уповноваженим співробітником лабораторії,
тощо - зазначити необхідне)

Забороняється повне або часткове передруккування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

Сторінка 1 з 6

2.5. Опис та стан зразка придатний (без дефектів)
(придатний (без дефектів), з відхиленнями, опломбований, опечатаний,
тощо - зазначити необхідне)

2.6. Зразок отримано та зареєстровано в Ужгородській ПДКТЛ

12.10.2022 р., №690

(дата отримання та реєстраційний номер зразку)

3. Характеристика випробувань

3.1. Дата початку проведення випробувань 14.10.2022 р.

3.2. Дата закінчення проведення випробувань 26.10.2022 р.

3.3. Нормативні документи на методи випробування

№ з/п	Позначення НД	Назва нормативного документу
1	2	3
1	ДСТУ 4405:2005	Якість ґрунту. Визначення рухомих сполук фосфору і калію за методом Кірсанова в модифікації ННЦ ІГА
2	ДСТУ 4729:2007	Якість ґрунту. Визначення нітратного і амонійного азоту в модифікації ННЦ ІГА ім. О.Н. Соколовського
3	ДСТУ 7608:2014	Якість ґрунту. Потенціометричний метод визначення активності іонів водню у ґрунтових пастах
4	ГОСТ 26483-85	Приготовление солевой вытяжки и определение ее pH по методу ЦВИАО
5	ГОСТ 26951-86	Почвы. Определение нитратов ионометрическим методом
6	МВ 50-97	Методичні вказівки по визначенню Hg, Zn, Co, Cd, Cu в ґрунті, рослинах, воді методом тонкошарової хроматографії
7	Інструкція №58	Визначення загального азоту в ґрунті розрахунковим методом
8	Інструкція №62	Визначення гігроскопічної вологи ґрунту

3.4. Випробування проводились із залученням зовнішніх постачальників:

не проводились

(види випробувань, назва зовнішнього постачальника, адреса, ідентифікаційний номер зразку)

4. Умови проведення випробувань

Місце проведення випробувань	Температура, °С	Відносна вологість, %	НД
	відповідно до НД/фактичне значення		
1	2	3	4
Аналітична лабораторія	17-23/20,2-19,6	не більше 75/ 71	ДСН 3.3.6.042-99
Вагова	17-23/20,4-19,6	не більше 75/ 71	
Титриметрична лабораторія	17-23/20,2-19,6	не більше 75/ 71	

Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКТЛ

Протокол поширюється тільки на випробуваний зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 2 з 6

5. Результати випробувань

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширена невизначеність, (%)	Заява про відповідність НД	Прізвище та ініціали, уповноваженого персоналу, що виконував випробування
			Відповідно до НД ^{2,3}	Фактичне значення				
1	2	3	4	5	6	7	8	9
1	Рухомий фосфор	мг/кг	-	35,24	ДСТУ 4405:2005	±2,39	Відсутня	Дзьоба І.Р.
2	Вміст амонійного азоту	мг/кг	-	4,18	ДСТУ 4729:2007	±0,87	Відсутня	Дзьоба І.Р.
3	Вміст нітратів	мг/кг	(не більше 130) ²	167,45	ГОСТ 26951-86	±4,39	Вміст нітратів у випробуваному зразку "Грунт. За 100 м від тіла полігону №3" з достовірністю $P=0,95$ ПЕРЕВИЩУЄ верхню границю допуску, що встановлена нормативним документом	Круликевич М.М.
4	Доступні форми азоту (N-NO ₃ +N-NH ₄)	мг/кг	-	171,63	Інструкція №58	±0,06	Відсутня	Круликевич М.М.
5	Водневий показник водної витяжки ґрунту (рН)	од.рН	-	6,64	ДСТУ 7608:2014	±0,01	Відсутня	Круликевич М.М.
6	Водневий показник сольової витяжки ґрунту (рН)	од.рН	-	5,66	ГОСТ 26483-85	±0,00	Відсутня	Круликевич М.М.

ВИПРОБУВАННЯ ПРОВЕДЕНІ ПОЗА МЕЖАМИ СФЕРИ АКРЕДИТАЦІЇ

7	Вміст цинку	мг/кг	(не більше 23,0) ²	≤0,0004	МВ 50-97	±0,00	Залишкова кількість цинку у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю $P=0,95$ НЕ ВИЯВЛЕНО	Чубірка Н.П.
8	Вміст нікелю	мг/кг	(не більше 4,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість нікелю у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю $P=0,95$ НЕ ВИЯВЛЕНО	Чубірка Н.П.

Забороняється повне або часткове передруккування протоколу випробувань без дозволу Ужгородської ПДКЛТ
Протокол поширюється тільки на випробуваний зразок

№ п/п	Назва випробувань та (або) характеристик (параметрів), що визначаються	Одиниці вимірювань	Значення показників		Позначення НД на метод випробувань	Розширена невизначеність (U)	Завна про відповідність НД	Прізвище та ініціали, уповноваженого персоналу, що виконував випробування
			Відповідно до НД ^{2,3}	Фактичне значення				
1	2	3	4	5	6	7	8	9
9	Вміст кобальту	мг/кг	(не більше 5,0) ²	≤0,001	МВ 50-97	±0,00	Залишкова кількість кобальту у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Чубірка Н.П.
10	Вміст кадмію	мг/кг	(відсутні) ²	≤0,002	МУ 2142-80	±0,00	Залишкова кількість кадмію у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
11	Вміст міді	мг/кг	(не більше 3,0) ²	≤0,004	МУ 2142-80	±0,00	Залишкова кількість міді у випробуваному зразку " Грунт. За 50 м від тіла полігону №2" з достовірністю P=0,95 НЕ ВИЯВЛЕНО	Шарга Б.М.
12	Гігроскопічна волога	%	-	1,13	Інструкція №62	±0,02	Відсутня	Дзьоба І.Р.

Забороняється повне або часткове перерукування протоколу випробувань без дозволу Ужгородської ПДКСТЛ
 Протокол поширюється тільки на випробуваній зразок

Ф.24.00.06 редакція 08 від 10.10.2022р.

Сторінка 4 з 6

Примітка. ¹ Розширена невизначеність отримана як добуток стандартної невизначеності і коефіцієнту охоплення $k=2$, який відповідає довірчій ймовірності приблизно рівній 95 % при гіпотезі нормального розподілу. Оцінювання невизначеності проведено відповідно до Процедури системи управління Пр.7.6/03-2022.

² Наказ Міністерства охорони здоров'я України №1595 від 14.07.2020 р. "Тієїсничих регламентів допустимого вмісту хімічних речовин у ґрунті" (заресстровано в Міністерстві юстиції України 31 липня 2020 р., за № 722/35005).

(позначення і назва нормативного(-х) документу(-ів) на продукцію (об'єкт, матеріал, речовину і т.п.) відповідно до якого(-их) проводиться оцінка відповідності)

6. Довищення, відхилення або винятки з методу випробувань

відсутні

(позначення НД на метод випробування та задокументовані доповнення, відхилення або винятки з нього)

7. Тлумачення та інтерпретації

За табл.Б4 ДСТУ 4362:2004 (додаток Б, табл.Б4) за вмістом рухомого фосфору, що визначений методом Кірсанова та вмістом загального азоту (табл.Б3) випробуваній зразок ґрунту належить до ґрунту з **НИЗЬКИМ** вмістом рухомого фосфору та **ДУЖЕ ВИСОКИМ** вмістом загального азоту. За ступенем кислотності та лужності (табл.Б.1) випробуваній зразок ґрунту належить до **БЛИЗЬКИХ НЕЙТРАЛЬНИХ** ґрунтів.

8. Аналізування результатів випробувань (висновок)

Випробуваній зразок "ґрунт. За 100 м від тіла полігону №3" за показниками, що визначались (п. 7 - 11) розділу 5 цього протоколу відповідає вимогам наказу МОЗ України №1595

9. Додаткова інформація


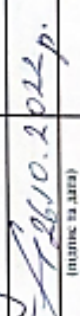





відсутня

(азначачастя інформація, яка вимагається конкретним методом відбору зразків або випробування, регуляторним органом, замовником або групою замовників)

Заборонається повне або часткове пересудкування протоколу випробувань без дозволу Ужгородської ПДКТЛ
Протокол поширюється тільки на випробуваній зразок

Ф. 24.00.06 редакція 08 від 10.10.2022р.

Сторінка 5 з 6

<p>Особа, що уповноважена на аналізування результатів випробувань (включаючи запис про відповідність, тлумачення та інтерпретації)</p>	<p>Випробувач обов'язків завідуюча Ужгородської ПДКСТЛ</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Світлана ЧУБІРКА</p> <p>(вказати ім'я та прізвище)</p>
	<p>Завідуюча відділу реєстрації зразків та оформлення</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Олександр ПАЛ</p> <p>(вказати ім'я та прізвище)</p>
<p>Уповноважений персонал, що виконував випробування</p>	<p>Завідуюча відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Ірина ДЗЬОБЛА</p> <p>(вказати ім'я та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Марія КРУЛКЕВИЧ</p> <p>(вказати ім'я та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Наталія ЧУБІРКА</p> <p>(вказати ім'я та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	<p>Борис ШАРГА</p> <p>(вказати ім'я та прізвище)</p>
	<p>Хімік І-ї категорії відділу аналізу</p> <p>(посада)</p>	 <p>(підпис та дата)</p>	

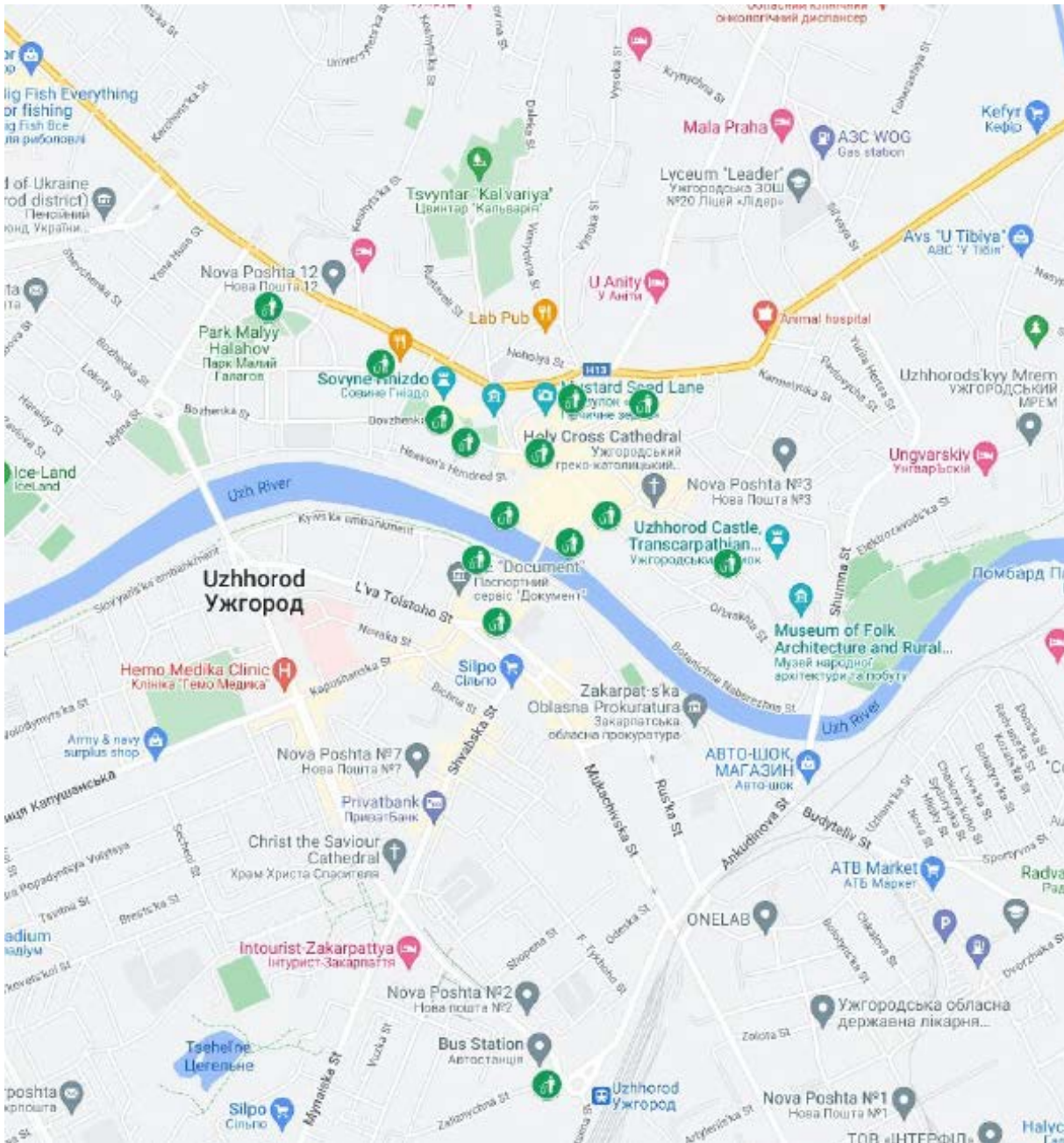
Забороняється повне або часткове передрукування протоколу випробувань без дозволу Ужгородської ПДКСТЛ
Протокол поширюється тільки на випробування зразок

Ф. 24.00.06, редакція 08 від 10.10.2022р.

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ANNEX I. UNDERGROUND CONTAINER SYSTEMS FOR MUNICIPAL WASTE COLLECTION

Recommended locations for installation the underground containers on the territory of Uzhhorod⁷⁷



— the place of installation of the underground container

⁷⁷ <http://surl.li/dwefn>

Examples of installation and maintenance of underground containers on the territory of the settlement



An example of the use of underground containers in Khmelnytsky⁷⁸



⁷⁸[https://ye.ua/syspilstvo/36216 U Hmelnickomu za pivmilyona griven vstanovili dva pidzemni smittyevi konteyneri.html](https://ye.ua/syspilstvo/36216-U-Hmelnickomu-za-pivmilyona-griven-vstanovili-dva-pidzemni-smittyevi-konteyneri.html)

An example of the use of underground containers in Kyiv



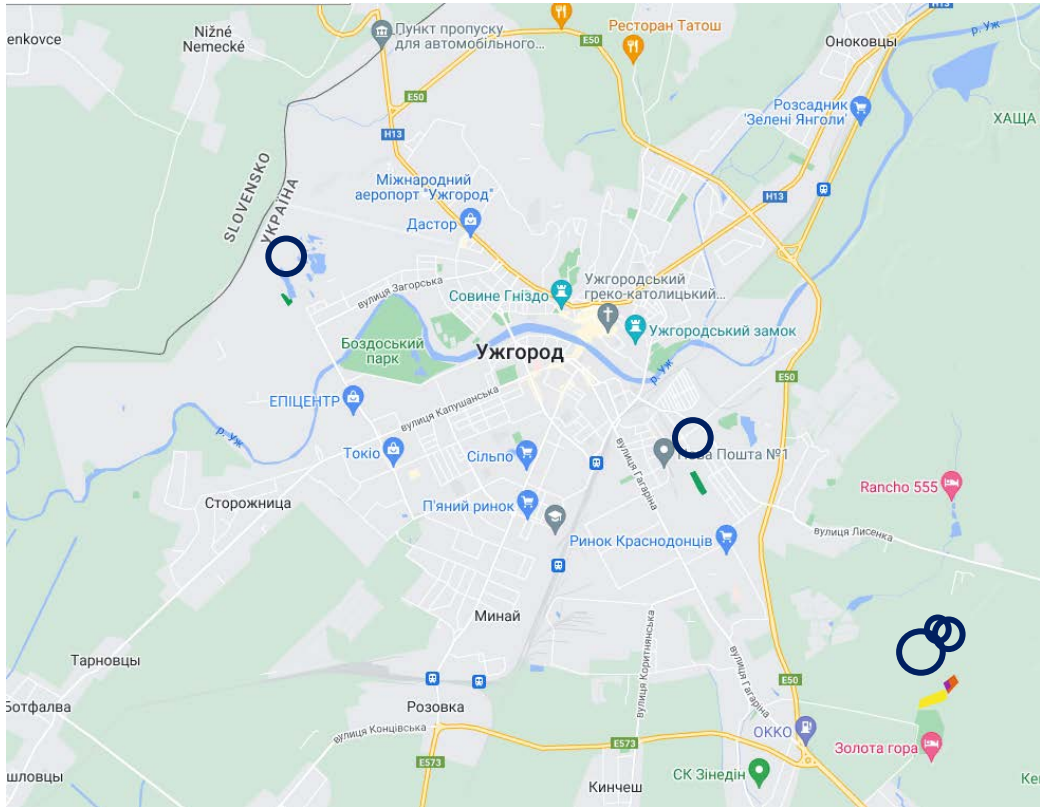
in the central part of the city



on the territory of the residential complex

ANNEX J. LOCATION OF WASTE TREATMENT FACILITIES IN UZHGOROD

Locations of waste treatment facilities in Uzhgorod⁷⁹



The location of the existing waste treatment facility



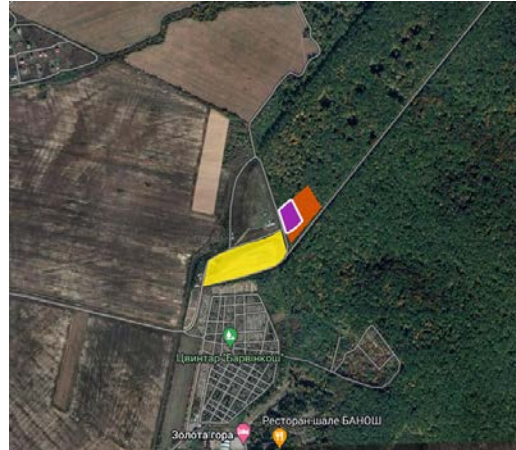
■ - municipal waste landfill

⁷⁹ <http://surl.li/dwefk>

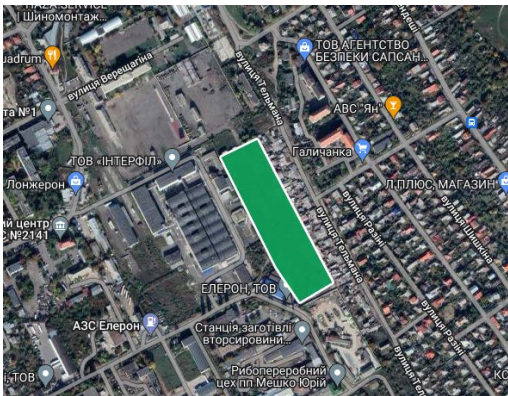
Recommended locations for planned waste treatment facilities



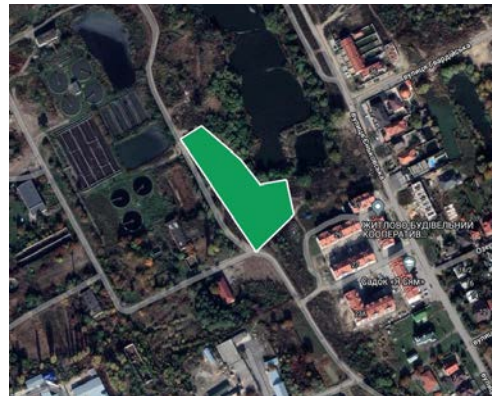
Orange square – MBT complex



Purple square – sorting station for recycled materials



Green rectangle – composting station for bio-waste (site option 1)



Green rectangle – composting station for bio-waste (site option 2)

ANNEX K. COST OF SECONDARY RAW MATERIALS

Table R.1. Average sales prices of secondary raw materials (as of October 2022)

No.	Product type	Price, UAH, per ton
1	PET bottle transparent	19,580.00
2	PET bottle blue	13,700.00
3	PET bottle green	12,000.00
4	PET bottle brown	10,540.00
5	PETF oil	7,670.00
6	PET bottle mixed	16,290.00
7	Glass transparent	3,000.00
8	Glass green	1,800.00
9	Low pressure film	7,000.00
10	Aluminum scrap	37,000.00
11	MS-7B	3,000.00
12	MS-5B	3,000.00
13	Colored HDPE	18,000.00
14	PVD 2 grade + stretch	19,000.00