



Greening of territories in the system of planning and improvement of the city of Ivano-Frankivsk

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✔ **Abstract.** Compliance with the requirements for landscape and recreational areas in urban planning and development is a prerequisite for ensuring the sanitary well-being and comfortable living of the population. Therefore, the purpose of the presented work was to assess the green and other public landscape and recreational areas within the Ivano-Frankivsk, as well as to provide recommendations for greening the city and its improvement. Theoretical research methods were applied, including the collection and systematisation of regulatory and reporting information on public landscape and recreational areas within the Ivano-Frankivsk; analysis of compliance with the requirements of Ukrainian legislation; and generalisation of problems to provide recommendations for improving the city's amenities. It has been established that as of the beginning of 2024, the total area of existing green spaces is about 126 ha and is represented by five city parks, one dendrological park, and 58 squares. There are 5.3 m² of green space per person, which is almost twice as low as the norm (10 m²/person). In 2021-2023, the city council has planned to build 41 new squares with a total area of 31.46 ha, which will increase the specific area of green spaces to 6.6 m²/person. It was found that the average level of greenery in squares is 72%. There are seven areas and objects of the Nature Reserve Fund of Ukraine in the city, and the coverage of protected areas is less than 1%. The territory of the Emerald Network "Bystrytsia Nadvirna Valley" within the city and adjacent villages has been significantly transformed and urbanised and is used as a recreation area, which may affect protected species. The city's water bodies are only partially equipped with recreation areas. Measures to green the city and improve its amenities are proposed, including the creation of green spaces in residential neighbourhoods and along roads, the use of green elements on the walls of buildings, and the organisation of meadow parks. The practical value of the results is to highlight the current and future state of the public landscape and recreational area network in Ivano-Frankivsk and to provide reasonable recommendations for its improvement

✔ **Keywords:** improvement of settlements; landscape and recreational areas; park; square; protected area

✔ Introduction

The issue of urban landscaping is gaining new importance. In addition to the tasks set out in the current legislation of Ukraine: rational use of the territory, proper maintenance and protection, creation of conditions for the protection

and restoration of a favourable environment for human life, new aspects are being added, including the preservation and improvement of the mental health of the population (Law of Ukraine No. 2807-IV, 2005). Greening the territories of

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Ukrainian cities is one of the directions of the strategy for sustainable urban development and the strategy for planning public spaces. This issue is constantly discussed not only by ordinary residents but also by the authorities and non-governmental organisations. The majority of modern Ukrainian cities are characterised by a high density of multi-story buildings and a low level of green spaces. The main ways to improve the situation with urban greenery are mostly related to the development of the existing network of parks and the arrangement of large green spaces. Insufficient attention is paid to indoor areas in city neighbourhoods and the development of lakes and riverside areas. Another equally important issue is the organisation of care for green plants, which in urban systems require special attention and directly affect the level of greenery. An interesting trend is the use of various elements of landscape design, such as hedges, lawns, curb ribbons, alley plantings, and rhododendrons for urban greening.

The importance of creating green spaces in the context of modern dense development, which is especially important for large cities in Ukraine, was considered by scientists A.V. Kodzhebash & A.P. Kodzhebash (2020), who studied the issues of vertical and modular landscaping and roof gardening. The analysis of the problem of urbanisation and development of large cities and megacities in European countries and China, conducted by V. Loiko *et al.* (2021), showed the negative impact of global urbanism on the quality of life of the population and their mental health, highlighting the main negative features. Considering the issues of urbanism in the modern and post-war space of Ukraine, N. Godz (2023) notes the importance of combining natural and urban landscapes, as well as the use of futurology in the development of urbanism. In order to solve the problem of the lack of places for recreation – green spaces within a 10-minute walk – Yu. Polianskyi & K. Shchuryk (2023) proposed the creation of a Green Line in the Riasne Micro-District of Lviv.

A number of works are devoted to the study of various aspects of green spaces in Ivano-Frankivsk. O. Tkachuk (2023), studying the degradation of vegetation in urbanised ecosystems, concluded that it is important to maintain lawn grasses taking into account climatic and environmental factors, which should improve the quality of lawns in the city. O. Lytvyn & V. Sydorka (2022) note that Ivano-Frankivsk is one of the cities in Ukraine where the greening standards are among the closest to the norms compared to other large cities in Ukraine. At the same time, they propose to create a multifunctional public space using small sensory gardens in different neighbourhoods of the city, which would be accessible and comfortable for different age groups. O. Oleshko & Yu. Petrovska (2020) studied the use of various elements of landscaping, the creation of phytocompositions, and the formation of a subject-spatial urban environment. A. Rykhliivskiy (2019) compared residential neighbourhoods built in 1960-1980 and newly built residential complexes in Ivano-Frankivsk in 2008-2018 with European analogues of urban space creation. The

paper focuses on the significant increase in the building area, number of storeys, and population density, as opposed to the decrease in the area of green spaces. And the share of greenery in residential development in Ivano-Frankivsk decreased from 49.6% in the 60s-80s of the twentieth century to 16.4% in 2008-2018. V. Moroz & N. Moskalchuk (2021) also assessed landscape and recreational areas (LRAs) at the level of the inter-roads space, which covered the Park and partially the BAM and Naberezhna micro-districts. They made a map of the structural elements of the territory, calculated their areas, and calculated the percentage of greenery. I. Kavchuk & N. Riznychuk (2022) studied the species diversity of trees and shrubs in the Taras Shevchenko City Park and the memorial square in Ivano-Frankivsk.

To summarise the reviewed scientific papers, the main studies of the problem of greening urbanised areas have been carried out in the following areas: the negative impact of global urbanism on the quality of life of the population, the lack of places for recreation – green spaces within a 10-minute accessibility, the prospects for the use of vertical and modular landscaping and roof greening in densely built-up cities, assessment of visual impacts in areas with different intensity of greening, reduction of the area of green spaces and determination of the recreational load in parks in Ivano-Frankivsk, assessment of LRAs at the level of the intermunicipal territory at the city level and species diversity of tree and shrub plants in the city park and memorial square in Ivano-Frankivsk. The issue of greening urban areas covers various areas of research and is becoming increasingly relevant in modern urbanism, the formation of urban amenities, and the improvement of the quality of life and health of the population. The purpose of the study was to assess the green and other public LRAs within the Ivano-Frankivsk and to provide recommendations for greening the city and its improvement. The main tasks were to determine the adequacy of existing and projected areas of public landscaping and the level of greening of public gardens; to establish the presence and type of protected areas to organise recreation areas near water bodies; and to recommend measures to improve the city's greenery.

✔ Materials and Methods

Ivano-Frankivsk is a regional centre located in western Ukraine in the Precarpathian Upland Region of the Ukrainian Carpathians. The theoretical research methods used in the study included systematisation of information from regulatory documents on the concept of LRAs, their structure, requirements for their planning and maintenance; collection and systematisation of data on existing and projected public LRAs within Ivano-Frankivsk; and analysis of compliance with the requirements of Ukrainian legislation regarding the size of the specific area, level of greening, etc. The paper uses the definitions of concepts and requirements from such regulatory documents as the state sanitary rules for planning and development (Order of the Ministry of Health of Ukraine No. 176, 1996), state construction norms (Order of the Ministry of Regional Development,

Construction and Housing and Communal Services of Ukraine No. 104, 2019), rules for the maintenance of green spaces in settlements of Ukraine (Order of the Ministry of Construction, Architecture, and Housing and Communal Services of Ukraine No. 105, 2006), and rules for the protection of human life on water bodies of Ukraine (Order of the Ministry of Internal Affairs of Ukraine No. 301, 2017).

The sources of initial information on existing and planned LRAs within the city were open data from the Official website of the Ivano-Frankivsk (n.d.), the database of the Regulatory acts of Ivano-Frankivsk City Council (n.d.), and official websites of the City Development and Recreation Centre Municipal Enterprise (n.d.) and Blahoustrii Municipal Enterprise (n.d.), Landscaping facilities (n.d.), and the State cadastre of territories and objects of the Nature Reserve Fund (n.d.). Some important documents used in the work were: an explanatory note to the city master plan (On the approval of the changes..., 2018); an environmental protection programme for 2021-2025 (Resolution of the Ivano-Frankivsk City Council No. 396-18, 2021); and a number of resolutions of the Ivano-Frankivsk City Council on land issues in 2021-2023, which approved the technical documentation for the construction and maintenance of public gardens in the city.

The following general data about the city were used for the study: the number of available populations is 238,196 according to the Main Department of Statistics in Ivano-Frankivsk Region (Population (estimate)..., 2022). The data is as of 01.01.2022, as no up-to-date demographic information is available due to the war. The indicator was used to calculate the specific area of green space/LRAs and the ratio of the total area of green spaces/LRAs for public use to the population (m^2/person). The area of the territory within the city limits is 37 km^2 according to the city's general plan (On the approval of the changes..., 2018). The indicator was used to determine the percentage of the area of protected areas and objects in relation to the city area – the protected area indicator (%). In analysing and summarising the recommendations, it was also taken into account that since 2020 the city has been the centre of the Ivano-Frankivsk territorial community, whose territory includes 18 suburban villages. The total population of the Ivano-Frankivsk territorial community is 288,243 people, with a total area of 265.5 km^2 (Official website of the Ivano-Frankivsk, n.d.).

✓ Results and Discussion

Planning of settlements in Ukraine is carried out in accordance with the state sanitary rules for planning and development of settlements (Order of the Ministry of Health of Ukraine No. 176, 1996). Settlement planning is based on the principle of functional zoning of the territory. The sanitary rules state that, in accordance with the current building codes and regulations, the territory of a settlement is divided into rural, industrial, and LRAs, taking into account the predominant functional use. The main purpose of the creation of rural areas and LRAs is to create favourable living

conditions for the population, taking into account the quality of the environment and microclimate. The LRAs form the system of greenery and recreational areas of settlements. The main construction standards referred to in the sanitary rules are DBN B.2.2-12:2019 (Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 104, 2019). In accordance with them: "LRAs are a network of green and other open spaces for various purposes located both in the territories of settlements, suburban areas, and inter-settlement areas". When forming the LRAs network of settlements, it is necessary to separately allocate areas of general use, restricted use, and special purpose. Appendix D of the construction norms details the main structural elements of the network and their components depending on the location relative to the boundaries of the settlement and the type of use.

In particular, within the boundaries of settlements, the structural elements are public green spaces, which include multifunctional and specialised parks, gardens, squares, boulevards, urban forest parks, green areas of embankments and beaches, botanical gardens and zoological parks, parks-monuments of landscape art, and other natural and artificially created landscape objects. These state construction norms and sanitary rules define the basic requirements for landscaping in various zones of settlements; in particular, they oblige to comply with the requirements for the proportion of green or other LRAs within the territory of the settlement. The area of green public areas should be at least $10 \text{ m}^2/\text{person}$ for cities and at least $12 \text{ m}^2/\text{person}$ for rural settlements. Areas of the LRAs network may be located differently in relation to the boundaries of the settlement (its administrative boundaries). They also differ in the type of use for recreational purposes: general (access is allowed and available to all), limited (access is allowed or available to certain groups of recreationists, for example, residents of a group of residential buildings, students, or employees of an institution), or not used for recreation but have a special purpose (protected natural areas, greening of security zones, sanitary protection zones, etc.).

The normative indicators of the area vary depending on the size of the city's population, physical and geographical zoning, and the type of LRAs. According to the state building codes for Ivano-Frankivsk, the normative specific area of public LRAs within the city limits should be $11 \text{ m}^2/\text{person}$. According to the state sanitary rules, the specific area of public green spaces (greening norm) should be at least $10 \text{ m}^2/\text{person}$. According to the main type of urban planning documentation intended to substantiate the strategy of planning and development of the city's territory – the general plan (On the approval of the changes..., 2018), the area of public green spaces in the city at the beginning of 2017 was 124.26 ha . The general plan envisages 75.07 ha , which together will make up about $8.0 \text{ m}^2/\text{person}$. Based on the nomenclature of structural elements of the LRAs network, information from the explanatory note to the master plan of Ivano-Frankivsk, decisions of the Ivano-Frankivsk City Council on land issues for 2021-2023, information

from the websites of the municipal enterprises City Development and Recreation Centre and Blahoustrii, as well as information from other sources, a summary of existing public LRAs within the Ivano-Frankivsk was formed. As of the beginning of 2024, the total area of public green spaces in Ivano-Frankivsk was about 126 ha: 5 municipal multifunctional parks with a total area of 96.6 ha; one specialised park, Druzhba Dendrological Park, with a total area of 5.0 ha (+5 ha outside the city); 58 squares with a total area of 24.3 ha. Taking into account the population of the city as of the beginning of 2022, the specific area of green public areas is 5.3 m²/person. The calculated indicator does not meet the greening standard of 10 m²/person and is almost half of it.

It is worth noting that the actual area of the “land” is even smaller, as 41.76 ha is water area (the total area of the water surface in three parks). In addition to public green spaces, there are no other publicly accessible LRAs within the city (urban forests, forest parks, meadow parks, hydro parks), so the specific area of publicly accessible LRAs is also 5.3 m²/person, which does not meet the standard of 11 m²/person.

In 2020, the environmental protection programme of the Ivano-Frankivsk territorial community for 2021-2025 was approved (Resolution of the Ivano-Frankivsk City Council No. 396-18, 2021), one of the expected results of which is to increase the area of green spaces by creating new squares and other landscaping facilities. As a result, since 2021, the number of city council decisions on the construction of new squares has increased. The information on specific objects was systematised, and it was determined that 41 new squares are planned to be arranged within Ivano-Frankivsk with a total area of 31.46 ha (Table 1). If all the squares planned for 2021-2023 are completed, the area of public green spaces could increase to 6.6 m²/person (with the population as of the beginning of 2022). However, this will still fall short of the required amount. It is also worth noting that due to the full-scale invasion by the Russian Federation, the community's territory has become a refuge for tens of thousands of internally displaced persons. As of the end of 2023, 41,039 internally displaced persons were registered in the Ivano-Frankivsk territorial community (Assistance to internally displaced persons, 2023).

Table 1. Land sites within the Ivano-Frankivsk for which technical documentation on the inventory for the creation and maintenance of the square was approved in 2021-2023

Title	Area, ha	Transferred to permanent use
Yevhenii Konovalts Str., next to building No. 93	0.1179	Blahoustrii Municipal Enterprise
Flotska Str., near the Ivano-Frankivsk National Technical University of Oil and Gas	0.1822	Blahoustrii Municipal Enterprise
In the area of Kaluske Hwy. (near the cemetery)	2.8862	Blahoustrii Municipal Enterprise
Sukhomlynskyi Str.	0.4480	Blahoustrii Municipal Enterprise
Heroyi UPA Str.	0.1153	Blahoustrii Municipal Enterprise
Stepan Bandera Str. – Rebeta Str.	0.1321	Blahoustrii Municipal Enterprise
V. Manyukha Str.	0.0653	Blahoustrii Municipal Enterprise
Mlynarska Str.	0.1945	Blahoustrii Municipal Enterprise
O. Dovzhenko Str.	0.8041	Blahoustrii Municipal Enterprise
Hetman Mazepa Str.	0.5673	Blahoustrii Municipal Enterprise
Cardinal Lubomyr Husar Str. (Novhorodska)	0.1936	Blahoustrii Municipal Enterprise
Yevhenii Konovalts Str., in the area of buildings 130A and 136D	0.24	Blahoustrii Municipal Enterprise
Belvedere Str.	0.2830	Blahoustrii Municipal Enterprise
Halytska Str.	0.0934	Blahoustrii Municipal Enterprise
Yevhenii Konovalts Str., next to the building No. 136B	0.1151	Blahoustrii Municipal Enterprise
V. Ivasyuk Str.	0.1004	Blahoustrii Municipal Enterprise
Nearby kindergarten No. 23 “Dudaryk”	0.4903	Blahoustrii Municipal Enterprise
In the Pasichna Micro-District	2.5	Blahoustrii Municipal Enterprise
Tysmenytsia Str.	15.1932	Blahoustrii Municipal Enterprise
O. Dovzhenko Str.	0.1744	Blahoustrii Municipal Enterprise
O. Dovzhenko Str.	0.04	Blahoustrii Municipal Enterprise
V. Stus Str., near the Arsen shopping centre	0.0967	Blahoustrii Municipal Enterprise
Vovchynetska Str., next to building No. 180	0.7025	Blahoustrii Municipal Enterprise
Kakhovska Str.	0.0425	Blahoustrii Municipal Enterprise
V. Symonenko Str., near houses No. 9-13	0.25	–
Parkova Str., near the building No. 18A	0.1	–
29 Pivdennyi Blvd. – 9 Korol Danylo Str.	0.5686	–

Table 1, Continued

Title	Area, ha	Transferred to permanent use
V. Ivasyuk Str.	0.097	–
Yevhenii Konovalets Str., next to building No. 88A	0.05	–
John Paul II Str., next to building No. 18	0.4	–
Parkova Str., near the monastery of St. Joseph the Betrothed	0.3	–
V. Ivasyuk Str., in the area of buildings No. 30-44	0.7936	–
V. Ivasyuk Str., in the area of buildings No. 25-26	0.4581	–
V. Symonenko Str., next to building No. 7	0.17	–
Vovchynetska Str., in the area of buildings No. 192-198	0.5	–
11A Korolya Danyla Str. – 28 Pivdennyi Blvd.	0.2997	–
V. Chornovil Str., in the area of buildings No. 132-136	0.4843	–
Natsionalna Hvardiia Str., in the area of buildings No. 16-22	0.2018	–
V. Stefanyk Embankment Str., next to the building No. 6	0.2521	–
V. Stefanyk Embankment Str., next to the building No. 32	0.6	–
V. Stefanyk Embankment Str., next to the building No. 26	0.1567	–
Total	31.46	

Note: – not transferred to the balance sheet (as of 01.01.2024)

Source: compiled by the authors based on Resolution of the Ivano-Frankivsk City Council No. 184-8 (2021), Resolution of the Ivano-Frankivsk City Council No. 293-13 (2021), Resolution of the Ivano-Frankivsk City Council No. 424-18 (2021), Resolution of the Ivano-Frankivsk City Council No. 469-19 (2021), Resolution of the Ivano-Frankivsk City Council No. 55-20 (2022), Resolution of the Ivano-Frankivsk City Council No. 130-26 (2022), Resolution of the Ivano-Frankivsk City Council No. 254-32 (2022), Resolution of the Ivano-Frankivsk City Council No. 157-37 (2023), Resolution of the Ivano-Frankivsk City Council No. 125-36 (2023)

For green areas, a prerequisite is the presence of green plantings – tree, shrub, flower, and herb vegetation of natural and artificial origin (Order of the Ministry of Construction, Architecture, and Housing and Communal Services of Ukraine No. 105, 2006). According to the city council, at the beginning of 2021, the total area of green plantings in the city was 826 ha, i.e., 22% of the city's area (Resolution of the Ivano-Frankivsk City Council No. 396-18, 2021). The maps of the Global Forest Watch online platform provide a visual understanding of the real share of woody vegetation over 5 m in height (Fig. 1). State construction standards set a minimum level of greenery (percentage of green plantings in the total area of a given territory) that should be adhered to when organising green areas for public and restricted use. This figure is 65% for city parks and 75% for squares. The website of Blahoustrii, among other things, contains information on the Landscaping facilities (n.d.) maintained by the enterprise and their characteristics. It is interesting to note that the areas of the squares listed on the website differ from the areas of the same ones listed in the decisions of the Ivano-Frankivsk City Council on the transfer to the balance sheet of Blahoustrii. The level of greenery in the squares ranged from 39% to 100% (squares with 100% greenery do not have sidewalks). The average level of greenery in squares was 72%. Table 2 presents the results of determining the level of greenery in squares, which was calculated as the ratio of the area of lawns in a square to its total area. The names of the squares, their area, and lawn area are based on the data of Blahoustrii as of January 2024. The LRAs also include nature protection areas, in particular those belonging to the Nature Reserve Fund of Ukraine. The territory of the city is characterised by low coverage of protected areas (less than 1%) and the number of

protected areas and objects – only 7 units (Table 3). The use of these areas and objects of the Nature Reserve Fund may be varied, but it is important to comply with the requirements of the law so that activities do not contradict their purpose and requirements for the protection, restoration, and use of natural complexes. Excursions are allowed in the Druzhba Dendrological Park, and Taras Shevchenko City Park is the main short-term recreation area of the city. Instead, natural monuments declared to preserve unique natural formations in their natural state are special purpose areas.

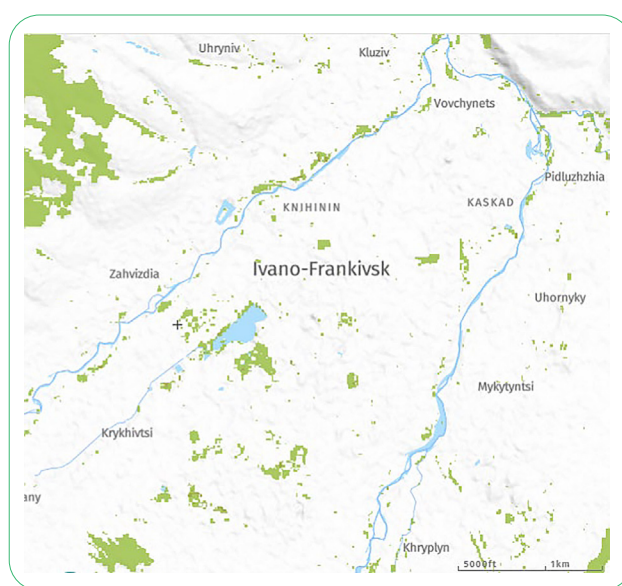


Figure 1. Tree cover (over 5 m high) in 2023

Source: created by the authors based on Global Forest Watch (n.d.)

Table 2. The greening levels of squares of Blahoustrii Municipal Enterprise

Name of the square location	Square area, m ²	Lawn area, m ²	Greening level, %
202-206 Vovchynetska Str.	112,059	10,944	91
On the corner of Vovchynetska Str. and Symonenko Str.	850	710	84
1 Dovzhenko Str.	1,300	900	69
On the corner of Mazepa Str. and Gordynskiy Str.	500	380	76
The area around the Christ the Saviour Rotunda	600	400	67
5 Kryva Str. (Piatnytsia Square)	240	170	71
97A (behind the Cosmos Cinema)	2,710	1,910	70
Knyagynia Square	3,380	1,400	41
170 Vovchynetska Str.	900	500	56
On the corner of Nezalezhnist Str. and Sukhevychi Str.	1,900	1,400	74
On the corner of Konovalts Str. and Viiskova Str.	1,400	850	61
119-121 Chornovol Str.	3,800	3,800	100
Mazepa Str., behind the medical college	1,200	900	75
Square opposite to the airport	7,000	6,200	89
Grunwaldska Str.	2,300	1,000	43
16 Mykolaichuk Str.	150	100	67
11A Korol Danylo Str. (Korol Danylo Square)	750	500	67
89A Depovska Str.	1,150	900	78
67 Halytska Str.	780	330	42
6 Botanichna Str.	600	550	92
On the corner of Petrushevyh Str. and Franko Str.	380	150	39
175, 179 Hetman Mazepa Str. (behind the market)	390	250	64
73-75A/1-75A/2 Khotkevych Str. (Nebesna Sotnia Square)	2,510	2,000	80
126 Halytska Str.	1,575	1,575	100
4 Pavlo Ivan II Str.	857	586	68
30 Ukrainka Peremoha Str.	1,462	1,012	69
22 Snizhna Str.	1,602	1,090	68
13 V. Stus Str.	1,756	1,756	100
24 August, V. Stus Str.	1,868	860	46
45 V. Stus Str.	5,000	4,200	84
96 Chornovol Str.	3,829	1,490	39
2 Slava Stetsko Str.	650	450	69
Shota Rustaveli Str.	4,500	4,500	100
Grunwaldska Str. (next to the Ivano-Frankivsk City Court)	900	900	100
Total	70,848	54,663	2,439

Source: compiled by the authors based on Landscaping facilities (n.d.)

Table 3. Areas and objects of the Nature Reserve Fund of Ukraine in Ivano-Frankivsk

Title	Type of protected area/object	Separation by value	Location	Functional purpose of the LRA
Druzhba (named after Z. Pavlyk)	Dendrological park	National level	Ivano-Frankivsk (partially), Uhryniv Village	General use
Taras Shevchenko City Park of Culture and Recreation	The park is a monument of landscape art	Local	126 Chornovol Str.	General use
Common oak	Botanical natural monument	Local	4 Hnatyuk Str.	Special purpose
Purple beech	Botanical natural monument	Local	44 Knyahynia Str.	Special purpose
Ginkgo double-lobed	Botanical natural monument	Local	54 Vasylianok Str.	Special purpose
Centenary oak	Botanical natural monument	Local	25/1 Malanyuk Str.	Special purpose
Common oak	Botanical natural monument	Local	64 Mateyko Str.	Special purpose

Source: compiled by the authors based on State cadastre of territories and objects of the Nature Reserve Fund (n.d.)

Natural areas subject to special protection are not limited to the Nature Reserve Fund. They also include those protected under international obligations. These include the Emerald Network areas established under the Bern Convention for the conservation of species and habitats that are threatened with extinction across Europe. The site “Bystrytsia Nadvirna Valley”, with a total area of 92.85 km², which was approved by the Bern

Convention Secretariat and included in the Emerald Network in 2019, is important for the conservation of fish species listed in the Ukrainian Red List, and rare insect species found only in the Carpathian Region have been recorded here (Fig. 2). However, part of it within the city and adjacent villages has been significantly transformed and urbanised, used as a recreational area, which may affect protected species.

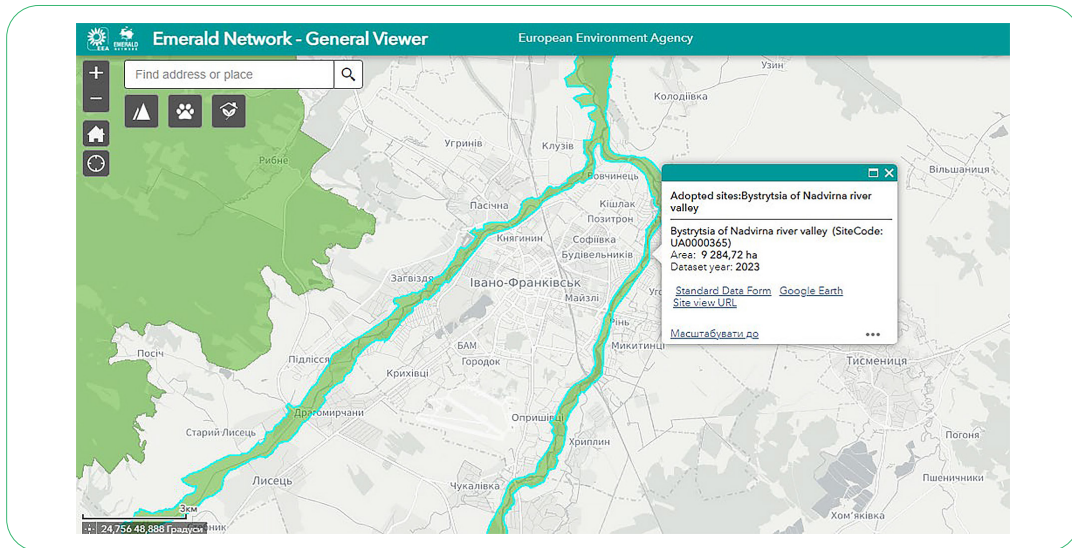


Figure 2. The Emerald Network “Bystrytsia Nadvirna Valley”

Source: created by the authors based on Emerald Network – general viewer (n.d.)

In the structure of the LRAs, water recreation areas are of great importance. According to the rules for the protection of human life on water bodies of Ukraine: “places of mass recreation on water bodies are beaches and water bodies with entertainment facilities and attractions, as well as places for physical fitness and sports activities, recreational and sport fishing” (Order of the Ministry of Internal Affairs of Ukraine No. 301, 2017). State construction standards state that within the coastal strips of rivers and lakes, beaches should be provided with a standard specific area of 8 m²/visitor and a length of river and lake shoreline of at least 0.25 m²/visitor. On the land and water areas adjacent to the beach zone, the coastal and aquatic zones are created. The areas of these zones are also regulated. In Ivano-Frankivsk, the beach of the City Lake, an artificial reservoir that occupies 69% of the City Lake Park with a total area of 47.93 ha, is well-equipped. It provides amenities such as umbrellas, sunbeds, changing rooms, and showers (Fig. 3). The beach is systematically maintained and cleaned. A sports ground for beach volleyball has been created in the coastal zone. However, the water area of the City Lake cannot be used for swimming due to the fact that the depth in the lake area adjacent to the beach is 2 m, not 1.5-1.75 as per safety requirements. Since Ivano-Frankivsk is located in the interfluvium of the Bystrytsia Nadvirna and Bystrytsia Solotvynska rivers, residents actively use these water

bodies for recreation. According to Blahoustrii, there are 9 recreational areas in the city (Table 4), with a total area of over 10 ha. Some areas of the coastal territory are equipped with changing facilities, garbage bins, and sports grounds, but mostly water recreation is unorganised. As mentioned above, this may affect species protected within the Emerald Network.



Figure 3. The beach of the City Lake

Source: compiled by the authors based on City Development and Recreation Centre Municipal Enterprise (n.d.)

Table 4. Recreation areas on the river banks of Ivano-Frankivsk

No.	Location	Total area, ha
Bystrytsia Sotolvynska River		
1	Near the pedestrian bridge from the side of Naberezhna Str. (near Flotska Str.)	0.32
2	From the pedestrian bridge to the V. Stefanyk Embankment Str. ring – Nadrichna Str.	0.18
3	Pasichna Str. near the metal depot	0.28
4	Left side from the bridge to the metal depot	3.5
5	Left side from the metal depot to Pasichnyanske Lake	3.85
6	Halytska Str. area below the bridge to the pipes	1
Bystrytsia Nadvirna River		
7	Khotkevych Str. – Ivasiuk Str.	0.25
8	Mykitynenska Str. – Obzhodova Str.	0.727
9	Glinka Str., Mykityntsi Village	0.101
Total		10.208

Source: compiled by the authors based on Landscaping facilities (n.d.)

A recreation area in the area of Flotska Str. (near the pedestrian bridge) was arranged in 2017 on the banks of the Bystrytsia Sotolvynska River. In addition to basic amenities for holidaymakers, such as trash bins, a dry closet, sun umbrellas, and changing rooms, there was also access to the river and two beach volleyball courts. The summer flood of 2018 partially destroyed it. The recreation area on the banks of the Sotolvynska Bystrytsia River, near the metal depot on Pasichna Str., was developed in 2018. Sunshades, changing rooms, and garbage bins were also installed. Taking into account the current state of landscaping in Ivano-Frankivsk, the following measures are proposed to improve it. As of the beginning of 2024, the total area of green public areas within the city was about 126 ha, i.e., about 5.3 m²/person, which is less than the established norm of 10 m²/person. The planned expansion of the network through the creation of new squares will slightly improve the situation – up to 6.6 m²/person, but this is not enough. This indicator of greenery in Ivano-Frankivsk is low and requires more intensive action. Particular attention should be paid to considering the possibility of organising new parks, botanical gardens, boulevards, etc.

When constructing new facilities, it is necessary to comply with the requirements for their level of greenery (the proportion of green planting to the total area), as the analysis showed that the average level of greenery in squares is 72%, while the norm is 75%, and there are squares where green spaces occupy less than half of the area. The city has 9 recreation areas along the banks of the Bystrytsia Nadvirna and Bystrytsia Sotolvynska rivers with a total area of almost 58 ha, which are not well organised. Turning them into meadow parks would be a significant addition to the city's LRAs network and partially solve the problem of the lack of public areas. It is equally important to study the issue of areas of limited use, in particular the arrangement of green areas within residential neighbourhoods and city districts; study of street and road greenery and its increase, which is likely to improve air quality. Greening of residential neighbourhoods is possible through modifications of landscape design, which will include vertical and flat landscaping of

residential neighbourhoods, the creation of green roofs, green bus stops, and an increase in the number of flower beds. This transformation of urban space will contribute not only to the level of greening, but also to the sustainable development of the city, addressing certain environmental issues, such as reducing air pollution and noise. Thus, it is important to create an urban space that is favourable to human activity as the basis for the improvement of a settlement. Greening of the territory is one of the mandatory components of landscaping (Law of Ukraine No. 2807-IV, 2005; Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 310, 2017). It must comply with the current sanitary rules and building codes and be carried out in accordance with the rules for the maintenance of green plantings in Ukrainian settlements (Order of the Ministry of Construction, Architecture, and Housing and Communal Services of Ukraine No. 105, 2006).

The joint work of J. Song *et al.* (2024) investigated the concept of urban ecological acupuncture and the possibility of applying European experience to its implementation in Korea, where there are many megacities with high population density. M. Stangel (2023) developed a strategy of ecological acupuncture on the example of the cities of Chorzów, Ruda Slenska, and Świętochłowice in Poland, which involves the use of local climate-resistant plants for vertical or roof gardening, which can also contribute to the restoration of biodiversity. Australian researchers M. Buckland & D. Pojani (2022) established the dependence of accessibility to urban greenery in Europe on the level of economic development of cities or the regional location of the city in Europe and found that urban green areas are distributed differently in different regions of Europe and have their own unique layout. The greenest cities in Europe are Prague, Stockholm, Brussels, Birmingham, and Milan. E.P. Barboza *et al.* (2021) studied the correlation between green space and mortality in 1,027 settlements in 31 European countries. It was found that the highest mortality rates due to non-compliance with the World Health Organisation recommendations on access to green spaces

for different age groups in the city were in such EU capitals as Athens, Brussels, Budapest, Copenhagen, and Riga. This fact alone could prevent 20% of deaths per 100,000 inhabitants per year, or 2.3% of total mortality. The study on intensive recreational activity and the level of greenery was conducted by N. Denysyuk & V. Melnyk (2019) for the Rivne. The scientists determined that the provision of city-wide green public areas is below the standard and amounts to 6.6 m²/person. They also found that the provision of recreational areas in different city neighbourhoods is not uniform. T. Nasteka *et al.* (2022) pay attention to the fact that when landscaping urban areas of the Kyiv Region, use evergreen representatives of dendroflora that have resistant properties to adverse environmental factors and have brightly coloured leaves in winter. An interesting area is the study of I. Zapukhliak *et al.* (2023) on the integration of sustainable development ideas into the system of training applicants in educational institutions. One of the elements is the formation of a way of thinking aimed at preserving the environment and greening the educational space.

In many regions of the world, there is a problem of insufficient greening of urban areas, which is confirmed by research by scientists from different countries. For example, D. Aly & B. Dimitrijevic (2022) assessed the level of urban greening, the condition of trees, and studied the reasons for the decline in greening in Cairo. C. Huang *et al.* (2021), having mapped the area of green spaces in 1,039 cities using satellite imagery, concluded that the density of green spaces and accessibility to them is an important element of urbanism for both large and medium-sized cities around the world. The level of urban greenery will directly affect the quality of life of the population and is an integral part of sustainable urban development. F. Tian *et al.* (2021), based on the results of studying the balance of regional ecosystems in northern China and vegetation changes using the GeoDetector method, determined that more than 94% of the region is characterised by an average rate of greening of vegetation, and, in their opinion, this is due to the intensity of urban development. V. Giannico *et al.* (2021), comparing the quality of life of the population in 51 European cities and the level of their greenery, concluded that the social component of city development, the amount of green space, and the perception of the environment are interconnected. The increase in green areas in the city will also affect the quality of the environment, which is confirmed by a number of scientists in their studies. For example, interesting are the studies by T. Iungman *et al.* (2023), which prove that it is possible to regulate the temperature balance in European cities by increasing the area of green areas. L. Xu *et al.* (2021) studied carbon dioxide emissions and the intensity of green innovations. M. Sun & J. Zhang (2020) considered the possibilities of using blockchain technology to create a smart city with low carbon dioxide levels and appropriate greening of the territory. In general, the research of S.M. Atiqul Haq *et al.* (2021) shows that city residents have a positive attitude towards urban green spaces, so this should be taken into account when designing various urban areas.

The problem of greening urban areas and their accessibility is being raised in all countries of the world. New constructive solutions are being sought for the modernisation and transformation of urban space aimed at increasing green areas. The impact of landscaping on life quality and population health is being studied. The issue of greening urban areas for sustainable urban development and the development of a “smart city” is being raised. Alternative ways to increase the area of green spaces are being sought, for example, through vertical gardening. It is also important to find plants for landscaping that are resistant to climate change and pollution. There are many progressive trends that are already being implemented in some cities, especially in the European Union. Thus, the issue of low or insufficient greening of urban areas exists in most countries of the world, so increasing the number of green areas can not only improve the quality and comfort of life but also solve environmental problems, especially in large cities. A promising area is the creation of green areas in residential neighbourhoods and the development of LRAs, which will significantly increase the level of urban greenery. Equally important is the use of landscape design elements in urban areas.

✓ Conclusions

As a result of the assessment of green and other public LRAs in Ivano-Frankivsk, the following main results were obtained: the total area of public green spaces (parks and squares) within the Ivano-Frankivsk is about 126 ha, with 5.3 m²/person, which does not meet the green space standard of 10 m²/person and the public LRAs standard of 11 m²/person. Provided that all the squares planned for 2021-2023 with a total area of 31.46 ha are arranged, the specific area of public green spaces may increase to 6.6 m²/person. The level of greening of squares in Ivano-Frankivsk ranges from 39% to 100%. The average level of greenery was 72%, which is slightly lower than the standard of 75%. Ivano-Frankivsk is characterised by low coverage of protected areas – less than 1%. The public green spaces include the national significance Druzhba Dendrological Park and the Taras Shevchenko City Park.

A part of the Emerald Network “Bystrytsia Nadvirna Valley” within the city and adjacent villages has been significantly transformed and urbanised and is used as a recreational area, which may affect protected species. The City Lake beach with an organised lakeside area is equipped in the city. The water area of the lake cannot be used for swimming, as the depth in the lake area adjacent to the beach is 2 m. Since Ivano-Frankivsk is located in the interfluvium of the Bystrytsia Nadvirna and Bystrytsia Solotvynska rivers, residents actively use these water bodies for recreation. The city has 9 recreation areas with a total area of 10.208 ha, which are mostly unequipped. Thus, promising directions for urban greening require more detailed study in the future. The most effective are vertical gardening, green roofs, the creation of green areas in residential and urban neighbourhoods, the arrangement of public gardens on the territory of educational institutions of the city, the study of the

condition of trees and the city's plant fund, the development of the concept of urban ecological acupuncture, research into the accessibility of urban green spaces for all segments of the population, and the study of the relationships between green spaces and the health of the population.

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✓ Conflict of Interest

None.

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Озеленення територій у системі планування та благоустрою міста Івано-Франківська

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✔ **Анотація.** Під час планування та забудови міст необхідно дотримуватися вимог щодо ландшафтних та рекреаційних територій для забезпечення санітарного благополуччя та комфортного проживання населення. Тому метою представленої роботи була оцінка озелених та інших ландшафтних та рекреаційних територій загального користування у межах Івано-Франківська та надання рекомендацій щодо озеленення території міста та його благоустрою. Було застосовано теоретичні методи дослідження, зокрема збір та систематизацію нормативної та звітної інформації стосовно ландшафтних та рекреаційних територій загального користування у межах Івано-Франківська; аналіз дотримання вимог українського законодавства; узагальнення проблем для надання рекомендацій із покращення благоустрою міста. Встановлено, що на початок 2024 року загальна площа існуючих озелених територій становить близько 126 га і представлена 5 міськими парками, 1 дендропарком і 58 скверами. На одну особу припадає 5,3 м² озеленення, що майже удвічі нижче норми (10 м²/особу). У 2021-2023 роках міською радою запроєктовано облаштування 41 нового скверу зі загальною площею 31,46 га, що збільшить питому площу озелених територій до 6,6 м²/особу. Встановлено, що середній рівень озеленення скверів складає 72 %. На території міста є 7 об'єктів природно-заповідного фонду України, показник заповідності становить менше 1 %. Територія Смарагдової мережі «Долина Бистриці Надвірнянської» у межах міста та прилеглих сіл помітно трансформована та урбанізована, використовується як відпочинкова зона, що може впливати на види, що охороняються. Водні об'єкти міста тільки частково облаштовані зонами для відпочинку. Запропоновано заходи з озеленення території міста та покращення його благоустрою – створення зелених зон у житлових мікрорайонах та вздовж доріг, використання зелених елементів на стінах будинків, організація лугопарків. Практична цінність результатів полягає у висвітленні існуючого та перспективного стану мережі ландшафтних та рекреаційних територій загального користування Івано-Франківська та наданні обґрунтованих рекомендацій щодо його покращення

✔ **Ключові слова:** благоустрій населених пунктів; ландшафтні та рекреаційні території; парк; сквер; природоохоронна територія