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Joint Green Infrastructure Strategy (2026–2036) for the North-East Planning Region (Republic of North Macedonia) and Kyustendil (Republic of Bulgaria)

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Contents

Summary 5
1. Introduction 7
1.1. Objective of the Regional Strategy for Green Infrastructure 7
1.2. Territorial scope and planning period 8
1.3. Policy Framework and Relevance to the EU 8
1.4. Methodological approach 10
2. Legal, political and strategic framework 12
2.1 Policy and strategic framework of the EU 12
2.2 National, regional and local context of planning 13
3. Concept and definition of green infrastructure 16
3.1. Definition of green infrastructure 16
3.2. Green, Blue and Grey Infrastructure 16
3.3. Ecosystem services 17
3.4. Multifunctionality 17
3.5 Connectivity and ecological coherence 18
3.6. Green infrastructure in urban, suburban and rural areas 18
4. Analysis of the current situation in the region 19
4.1. Spatial and territorial characteristics 19
4.2. Land use and land cover 19
4.3. Natural and Semi-natural Areas 20
4.4. Rivers, wetlands and blue infrastructure 21
4.5. Forests and forest systems 22
4.6. Agricultural Landscapes 24
4.7. Urban and suburban green spaces 24
4.8. Biodiversity and habitats 25
4.9. Protected areas and areas of Natura 2000/Emerald 25
4.10. Climatic risks: heat, floods, droughts, erosion and fires 29
4.11. Demographic, Social and Economic Context 29
5. Inventory of green infrastructure 33
5.1. Main natural areas 33
5.2. Ecological corridors 36
5.3. Stepping Stones and Connection Points 37
5.4. Buffer zones 38
5.5. River corridors and blue-green corridors 39
5.6. Urban green infrastructure 41
5.7. Elements of agricultural and semi-natural landscapes 43

5.8. Degraded areas with potential for restoration 45
6. Valuation of ecosystem services 48
6.1. Climate regulation and carbon storage 48
6.2. Reduction of Flood Risk and Water Retention 51
6.3. Soil Protection and Erosion Control 52
6.4. Support for biodiversity and habitats 52
6.5. Improving air quality 53
6.6. Rest, health and well-being 54
6.7. Cultural landscape and tourism value 55
6.8. Economic and social benefits 57
6.9. Overall Score 59
7. Assessment and prioritisation of green infrastructure 65
7.1. Evaluation criteria 65
7.2. Evaluation of Multifunctionality 65
7.3. Connectivity Assessment 66
7.4. Environmental condition and integrity 67
7.5. Climate Resilience Value 68
7.6. Social accessibility and public benefit 69
7.7. Priority areas for protection 70
7.8. Priority areas for restoration 72
7.9. Priority areas for new investments in green infrastructure 73
8. Pressure, risks and challenges 75
8.1. urbanisation and land use change 75
8.2. Fragmentation caused by infrastructure 76
8.3. Intensification of agriculture 78
8.4. Forest degradation and fire risk 79
8.5. River Regulation and Flood Risk 80
8.6. Soil erosion and land degradation 82
8.7. Impact of Climate Change 83
8.8. Institutional and Governance Challenges 85
8.9. Weaknesses in Funding and Implementation 87
9. Analysis 90
9.1. SWOT Analysis 90
9.2. Strategic Implications 91
10. Vision and strategic goals 94
10.1. Regional Vision for Green Infrastructure 94
10.2. Strategic Objectives 96

11. Solutions and guidelines 102
11.1. Nature-based Solutions 102
11.2. Planning and Design Guidelines 104
11.3. Maintenance and Management Guidelines 108
12. Strategic Projects and Project Fiches 113
12.1. Strategic Projects 113
12.2. Project sheets with objectives, location, budget and responsible institutions 118
Annexes 123

Summary

This strategy sets the framework for the development, protection, restoration and management of green infrastructure in the North-East Planning Region in North Macedonia and the Municipality of Kyustendil in Bulgaria. Its main purpose is to establish a connected, climate-resilient and multifunctional green network**,** which will unite the natural, rural, urban and natural and cultural spaces in a single cross-border system.

Green infrastructure in this region is of great importance for biodiversity conservation, improving the quality of life, water management, the reduction of the risks of floods, erosion, droughts and fires, as well as for the development of sustainable tourism, recreation and the local economy. It covers forest and mountain areas, river corridors, aquatic ecosystems, agricultural and rural landscapes, urban green spaces and cultural and natural sites.

The strategy identifies the following areas as the most significant natural cores of the regional green infrastructure: the Osogovo mountain region, the forest areas around Kriva Palanka, Kratovo, Rankovce and Kyustendil, as well as the river systems, including Kriva Reka, Kumanovska Reka, Pchinja, Lipkovsko Lake and the water systems in Kyustendil. These areas represent the basis for ecological connectivity, climate regulation, erosion protection and the development of recreational and tourism functions.

The strategy identifies the main pressures, risks and challenges facing green infrastructure. These include urbanisation and land-use changes, infrastructure fragmentation, agricultural intensification, forest degradation, fire risk, river regulation, flood risk, soil erosion, land degradation, climate change, institutional weaknesses and insufficient financing. These factors reduce the functionality of the green infrastructure network and increase the vulnerability of the region.

The SWOT analysis shows that the region has significant natural and cultural resources, potential for cross-border cooperation, opportunities for ecotourism, rural tourism, cultural tourism, spa tourism and adventure tourism, as well as a good basis for the development of a green economy. At the same time, weaknesses are related to insufficient connectivity of green spaces, limited financial resources, poor technical readiness, insufficient GIS data and insufficient system maintenance.

The regional vision envisages the North-East planning region and Kyustendil municipality to develop as a cross-border green region, in which forest, river, rural, urban and natural and cultural spaces function as a single network of green infrastructure. The vision defines green infrastructure as the foundation for climate resilience, nature conservation, sustainable tourism, health, recreation and a better quality of life.

The strategy defines three main strategic objectives. The first goal is the protection of key natural areas and the restoration of degraded ecosystems. It refers to the protection of natural cores, forest and mountain areas, river corridors and cultural and natural landscapes, as well as the restoration of degraded forests, erosive terrains, riparian zones and abandoned agricultural areas.

The second objective is to improve ecological connectivity and strengthen resilience to climate change. It envisages the creation of green and blue corridors, reducing fragmentation, better water management, flood and erosion protection, as well as increasing resilience to droughts, heat waves and forest fires.

The third objective is to improve the quality of life in urban areas. It focuses on the development of urban greenery, parks, tree-lined streets, boardwalks, neighbourhood green spaces, green schoolyards, and public spaces with shade and recreational function. This goal is directly related to health, recreation, microclimate and social cohesion.

The strategy proposes the implementation of environmentally friendly solutions, such as riparian green belts, wetlands, retention ponds, afforestation with native species, hedgerows, agroforestry, rain gardens, green streets, permeable surfaces, green roofs and naturally landscaped hiking trails. These solutions simultaneously reduce risks, improve biodiversity, create public benefits and increase tourism attractiveness.

A separate section of the strategy refers to strategic projects. They are grouped into seven categories: urban green infrastructure projects, river corridors and wetlands, ecological corridors, afforestation and erosion control, sustainable tourism and recreation, climate change resilience and heat mitigation, and cross-border and inter-municipal projects. A total of 32 projects have been proposed with an indicative total budget of approximately EUR 18.99 million to EUR 37.60 million.

The highest priority projects are the revitalisation of river corridors, the development of urban green infrastructure, the creation of the Osogovo cross-border green corridor, afforestation and erosion control, green tourist routes and the joint GIS database for green infrastructure. These projects have the potential to create visible effects on quality of life, climate change resilience, tourism and cross-border cooperation.

In conclusion, the strategy defines green infrastructure as one of the main tools for sustainable and stable development of the North-East Planning Region and the municipality of Kyustendil. Its implementation will contribute to the protection of natural resources, the reduction of climate risks, the improvement of the urban environment, the development of sustainable tourism, the strengthening of the rural economy and the promotion of cross-border cooperation. With a systemic approach, stable funding and good institutional coordination, the region can develop as a recognizable, green and climate change-resistant cross-border territory.

1. Introduction

1.1. Objective of the Regional Strategy for Green Infrastructure

The EU Green Infrastructure Strategy highlights the importance of green infrastructure, especially in urban areas, as more than 70% of the EU's population currently lives in urban areas. Recognising the important role that green infrastructure plays in protecting the environment and improving quality of life in urban and peri-urban areas, and considering that this type of infrastructure and this way of solving certain municipal service challenges in cities is not yet sufficiently implemented in the North-East Planning Region of North Macedonia and Kyustendil, a green infrastructure strategy has been prepared for this region. Well-designed and integrated green infrastructure increases biodiversity, supports wildlife and improves resilience to climate change. Developing a robust green infrastructure strategy that lays the foundations for appropriate green infrastructure development is critical to addressing climate change.

Joint Green Infrastructure Strategy for the North-East Planning Region in North Macedonia and Kyustendil municipality in the Republic of Bulgaria aims to create a common, long-term and practical framework for planning, protecting, restoring, connecting and sustainably managing green and blue infrastructure in the cross-border region.

The strategy treats green infrastructure not only as a collection of individual green spaces, forests, river corridors, agricultural landscapes and natural areas, but as an integrated and multifunctional blue-green network, which provides environmental, climatic, social and economic benefits for the population, local communities and territorial development.

This strategy provides a basis for improving ecological connectivity between natural and semi-natural areas, strengthening resilience to climate change, reducing the risks of floods, droughts, erosion and urban heat islands, as well as protecting biodiversity, landscape values and ecosystem services. Of particular importance is the integration of river systems, forest complexes, agricultural landscapes, urban green spaces and transboundary natural connections into a unified approach to planning and development.

The strategy also aims to support the integration of green infrastructure priorities in regional and municipal plans, urban development plans, development programmes, sectoral policies and future investments. In this way, it will contribute to more coordinated planning, better use of space, more efficient management of natural resources and increased opportunities to use national, cross-border and European funds.

In a cross-border context, the strategy aims to strengthen cooperation between the North-East Planning Region and Kyustendil Municipality by jointly defining priority green and blue corridors, protection and restoration zones, potential strategic projects and coordination mechanisms. This creates a basis for joint action in the fields of climate resilience, nature conservation, sustainable tourism, improving the quality of life and sustainable local and regional development.

The main aim of the joint strategy is to provide a clear direction for the development of a connected, functional and sustainable network of green infrastructure, which will contribute to a healthier environment, better living conditions, preserved nature and more sustainable development of the North-East Planning Region and Kyustendil Municipality in the next planning period.

1.2. Territorial scope and planning period

The Joint Green Infrastructure Strategy applies to the area of the North-East Planning Region in North Macedonia and the Municipality of Kyustendil in the Republic of Bulgaria, as a common cross-border area with significant natural, water, forest, agricultural and urban potential. The territorial scope is defined in order to ensure an integrated approach to the planning and management of green and blue infrastructure, taking into account natural connections, river basins, ecological corridors, urban and rural spaces, as well as the socio-economic characteristics of both sides of the border.

Within the North-East Planning Region, the strategy considers natural and semi-natural areas, river systems, forests, agricultural landscapes, urban green spaces, conservation and ecologically significant areas, and the infrastructure and development pressures that affect their condition and connectivity. Within the Kyustendil municipality, the strategy covers urban, suburban and rural areas, mountain and forest landscapes, river corridors, agricultural areas, natural resources and potential to connect with the wider regional and cross-border network of green infrastructure.

The strategy treats the transboundary area as a functionally connected space in which natural processes, water systems, climate risks, biodiversity, landscape values and development needs are not limited by administrative boundaries. Special emphasis is therefore placed on the identification and strengthening of common green and blue corridors, areas of high ecological potential, areas suitable for restoration, as well as opportunities for joint planning, management and implementation of strategic projects.

The strategy covers the period 2026–2036. This ten-year period allows the definition of a long-term vision, strategic goals and priority measures, as well as the gradual implementation of activities through short-term, medium-term and long-term phases. Within the planning period, the strategy is intended to serve as a basis for guiding regional and local policies, preparing projects, mobilising financial resources and integrating green infrastructure into planning and investment documents.

The strategy has been developed as a flexible and adaptable document that can be updated in accordance with new data, monitoring results, changes in the legal and strategic framework, climate trends and the needs of local communities. In this way, it provides a stable but flexible basis for the continuous improvement of the green infrastructure in the North-East Planning Region and Kyustendil Municipality in the period 2026–2036.

1.3. Policy Framework and Relevance to the EU

At the European Union level, the strategy is related to the EU Strategy for green infrastructure**,** which aims to preserve, restore and improve green infrastructure to prevent biodiversity loss and enable ecosystems to provide their services to people. In addition, the EU Biodiversity Strategy by 2030 promotes investments in green and blue infrastructure and the integration of healthy ecosystems, green infrastructure and environmentally friendly solutions in urban planning.

The strategy is also aligned with the broader goals of the European Green Deal, climate adaptation policies, disaster risk reduction, water management, ecosystem restoration, soil protection, air quality improvement and sustainable regional development. In this context,

green infrastructure is treated as a practical mechanism by which nature is included in spatial, urban, infrastructural and investment decisions, with the aim of creating a more sustainable, healthier and higher quality living and natural environment.

From the point of view of North Macedonia, the strategy is linked to national policies for long-term development, nature conservation, biodiversity, climate action, spatial and urban planning and regional development. The National Development Strategy 2024–2044 represents a long-term framework for the country's development and emphasizes the need for coordinated, long-term and cross-sectoral implementation of development policies. This is particularly important for green infrastructure, as it requires coordination between regional development, environment, urbanism, agriculture, water, forest, transport and climate policies.

An important basis is also the National Biodiversity Strategy with Action Plan, which defines the framework for the protection of biodiversity, habitats and ecological networks in North Macedonia. For the regional green infrastructure strategy, this is important because the North-East planning region contains natural and semi-natural areas, river systems, forest landscapes, agricultural mosaics and potential ecological corridors, which should be considered as part of a wider network of conservation and connectivity of natural values.

In North Macedonia, the concept of green infrastructure is not yet fully embedded in all national legal and planning processes, but there are clear foundations for its integration through laws and policies in the fields of urban planning, urban greening, nature conservation, water, agriculture, forestry, local government and regional development. Analyses of green infrastructure and spatial planning in North Macedonia show that the concept needs further strengthening in the legal, institutional and planning framework, making this regional strategy a practical tool for its implementation at the territorial level.

From the point of view of the Republic of Bulgaria, the strategy is relevant to national policies related to nature conservation, biodiversity, climate adaptation, spatial planning, water management, forestry, agriculture and local development. As a member state of the European Union, Bulgaria implements the European policies for Natura 2000, conservation and restoring ecosystems, managing climate risks and integrating green infrastructure into the processes of planning and development. National documents and initiatives in Bulgaria, including measures for the protection and restoration of important wetlands, contain elements that are in line with the concept of green infrastructure and functional connectivity of habitats.

Bulgarian climate adaptation policies are particularly relevant for the municipality of Kyustendil, as climate scenarios for Bulgaria show an increased frequency of extreme events, such as heavy rainfall, heat waves, floods, droughts, forest fires and landslides. The same risks are relevant for the cross-border area with North Macedonia, which is why green and blue infrastructure can contribute to reducing risks, improving the water regime, protecting soils, shading, cooling and increasing the resilience of settlements and landscapes.

In a cross-border context, the strategy creates a link between European policies, national development and environmental priorities of North Macedonia and Bulgaria and the specific needs of the North-East Planning Region and the municipality of Kyustendil. Natural systems, river basins, forest belts, agricultural landscapes, ecological corridors and climate risks are not limited by administrative boundaries. Therefore, joint planning and coordinated implementation are necessary to build a functional and sustainable blue-green network.

The strategy also has significant programmatic value for the preparation of future projects and the use of European and national funding sources. It provides a basis for projects under Interreg, IPA, LIFE, Horizon Europe, national programmes for regional development, climate adaptation, nature protection, sustainable tourism, urban greening and ecosystem restoration.

In this way, the strategy represents a bridge between political priorities and practical investments on the ground.

With this political basis, the Regional Green Infrastructure Strategy is a tool for harmonising local and regional needs with the national policies of North Macedonia and Bulgaria, as well as with the European goals for green transition, climate resilience, nature protection and sustainable territorial development. It allows European and national principles to be transformed into concrete measures, priority areas, strategic projects and management mechanisms, applicable in the North-East Planning Region and Kyustendil Municipality.

1.4. Methodological approach

The methodology used to prepare the Joint Green Infrastructure Strategy is based on an integrated, participatory and multidisciplinary process. The methodological approach itself is a combination of several segments, namely: analysis of the current state, review of relevant policies and national, regional and local planning documents, spatial and thematic identification of green and blue infrastructure elements, consultations with stakeholders, public participation and expert assessment of green infrastructure development priorities.

The methodology aims to ensure that the strategy is based on evidence, but also on real needs, experiences and expectations of local communities, institutions, experts and users of the space. Green infrastructure has a marked cross-sectoral nature, which is why its planning requires collaboration between institutions and experts from multiple fields, including spatial and urban planning, nature conservation, water, forestry, agriculture, climate change, tourism, local economic development, risk management and preservation of the cultural and natural landscape.

In the first stage of the preparation of the strategy, an analysis of the relevant documentation was carried out, including European, national, regional and local strategies, laws, plans, programmes and sectoral documents. This analysis identified the political and legal framework, existing development priorities, institutional competencies, as well as opportunities for integrating green infrastructure into planning and investment processes.

In the second phase, an analysis of the basic condition of the territory was carried out. This analysis included an assessment of the most significant natural and semi-natural areas, river systems, forests, agricultural landscapes, urban and suburban green spaces, protected and ecologically significant areas, existing ecological corridors, as well as degraded areas and areas with restoration potential. Special attention was paid to climate risks, such as floods, droughts, erosion, heat waves and forest fires, and their impact on settlements, natural resources and quality of life.

A key part of the methodology is public and stakeholder involvement, to ensure transparency, local relevance and greater acceptance of the strategy by local and regional stakeholders. Representatives of municipalities, regional institutions, public enterprises, sectoral institutions, civil society organisations, educational and scientific institutions, local communities, the private sector, farmers, tourism stakeholders and other interested groups participated in the process.

Public participation was achieved through workshops, advisory meetings, public presentations and collection of written comments and suggestions. This provided an opportunity for local people and stakeholders to identify the most important issues, needs and priorities related to green spaces, access to nature, the quality of public spaces, the state of rivers, forests, agricultural landscapes, urban greenery and climate change risks.

A particularly important role was played by experts from several fields, who provided expert support in the identification, evaluation and prioritisation of green infrastructure elements, as well as expert data interpretation, verification of findings, definition of evaluation criteria and preparation of realistic, actionable and measurable recommendations. Their input was particularly significant in defining the evaluation criteria for green infrastructure, such as ecological value, connectivity, multi-functionality, condition and integrity, climate resilience, social benefit, accessibility and recovery potential. Based on these criteria, priority areas for development were determined, as well as possible green and blue corridors that can enhance the functional connectivity of the territory.

The participatory approach allowed expert analyses to be complemented with local knowledge. Local residents, institutions and users of the space often have practical information on issues that are not always visible in official data, such as flood points, degraded green spaces, under-maintained river corridors, erosion zones, lack of public green spaces, conflict points between infrastructure and nature, and opportunities for greening, recreation and sustainable tourism.

The methodology involved spatial analysis and mapping using available data, field information, planning documentation, satellite and cartographic imagery, and input from stakeholders. Spatial mapping allowed a visual representation of existing elements of green and blue infrastructure, their connectivity, pressures on them, priority areas and potential sites for interventions.

In the last phase, the results of the analyses, expert opinions and public consultations were synthesised into a strategic framework containing a vision, objectives, measures, priority areas, strategic projects, implementation mechanisms and monitoring indicators. The draft strategy was subject to additional consultations with the public and relevant institutions, with the aim of timely incorporating comments and ensuring wider support for its implementation.

The methodology thus ensures that the Joint Green Infrastructure Strategy is expert-based, transparent, inclusive and actionable. The participation of the public and relevant experts is a basic prerequisite for the development of a strategy that reflects real territorial challenges, local needs and European principles for sustainable, adaptive and nature-friendly planning.

2. Legal, political and strategic framework

2.1 Policy and strategic framework of the EU

Joint Green Infrastructure Strategy for North-East Planning Region in North Macedonia and Kyustendil municipality in the Republic of Bulgariais based on modern European and national policies for nature conservation, climate resilience, sustainable territorial development, biodiversity conservation and improvement of ecosystem services. It recognizes green infrastructure as a strategic tool for connecting natural and semi-natural territories, river systems, forests, agricultural landscapes, urban green spaces and ecological corridors in a single, functional and multifunctional blue-green network.

The European Green Infrastructure Policy Framework provides guidance on how natural resources, ecosystems and open spaces can be integrated into development and spatial planning. For this strategy, it is particularly important that the EU does not consider green infrastructure only as a matter of nature protection, but as a practical tool for managing risks, improving the environment, supporting local development and increasing the resilience of territories.

The EU Green Infrastructure Strategy lays the groundwork for planning green and blue spaces as part of a wider system that delivers public benefits. Its importance for the North-East Planning Region and Kyustendil Municipality is seen in the need to consider existing natural areas, river valleys, forests, agricultural areas and urban green spaces as part of a functional network and not as isolated elements. Such an approach allows better targeting of future investments, protecting the space from inappropriate conversion and creating a basis for priority projects.

The EU Biodiversity Strategy by 2030 is relevant as it emphasizes the need to restore degraded ecosystems, expand protected areas and improve the condition of habitats. In the context of this transboundary area, this means identifying areas where there is potential to restore river corridors, improve forest belts, protect agricultural landscapes of high nature value and promote urban green spaces.

The Natura 2000 network, together with the broader concept of ecological connectivity, provides an important guideline for planning the natural connections between habitats. Since Bulgaria is a member state of the EU, the areas related to Natura 2000 on the Bulgarian side are of particular importance for the harmonization of the strategy with European standards. On the North Macedonian side, the existing and potential Emerald Zones, protected areas and ecologically significant zones that can be connected to the Bulgarian natural systems through green and blue corridors are important.

Nature-based solutions play a practical role in this strategy because they enable the use of natural processes to solve specific local problems. Such measures may include managing river corridors to reduce flood risk, reforesting erosive terrain, creating green belts around settlements, restoration of degraded areas, creation of urban parks and use of permeable surfaces in settlements. These solutions are particularly important because they simultaneously contribute to the preservation of nature, the improvement of public space and the reduction of climate risks.

Climate change adaptation and disaster risk reduction are directly related to green infrastructure. In regions at risk of droughts, heavy rains, erosion, heat waves and fires, green and blue systems can have a protective function. The strategy should therefore take into

account areas exposed to climate risks and propose measures that increase the resilience of settlements, agricultural areas, forests, river basins and public spaces.

Cohesion policy and European instruments for financing regional development are important because they allow the strategy to be turned into concrete projects. European programmes can support activities for ecosystem restoration, urban greening, improving access to green spaces, water management, climate adaptation, sustainable tourism and institutional capacity building. The strategy should therefore be drawn up in a way that allows the proposed measures to be easily linked to future calls for funding.

The frameworks for cross-border and transnational cooperation are of particular importance, since the strategy covers the territories of two countries. Through such programmes, joint projects can be developed for river basins, mountain and forest landscapes, tourist and recreational routes, biodiversity conservation, risk management and data exchange. This approach allows the North-East Planning Region and Kyustendil Municipality to coordinate their priorities and come up with joint project initiatives.

In this regard, the European framework represents a basis for practically directing the strategy towards three key results: protecting and connecting natural values, increasing resilience to climatic and spatial pressures and providing a planning framework for future investments in green and blue infrastructure.

2.2 National, regional and local context of planning

For the North-East Planning Region, the national legal and strategic framework is based on the system of laws and policies that regulate regional development, spatial and urban planning, nature conservation, water management, forests, agricultural land, environment and climate change. These policies create a basis for treating green infrastructure as part of wider spatial planning and not just as a matter of landscaping or protecting individual natural areas. The Ministry of Environment and Spatial Planning groups the relevant provisions in the fields of environment, nature conservation, spatial planning and water, which shows that green infrastructure has a direct connection to multiple legal areas.

The context of regional development is defined by the Programme for the development of the North-East planning region 2021–2026, which is the main planning document for directing development priorities in the region. The document states that the region is located in the far north-east of North Macedonia, along the border with Kosovo, Serbia and Bulgaria, and that it encompasses the catchment basin of the rivers Pchinja and Kriva reka. This spatial and hydrological context is particularly important for green infrastructure, as river valleys, forest and agricultural landscapes, hilly and mountainous areas and urban centres should be seen as a connected blue-green network.

Spatial and urban planning tools play a key role in the practical implementation of green infrastructure in the North-East Planning Region. Spatial plans, general town planning plans, detailed town planning plans, urban projects and local development documents can ensure the protection of existing green and blue areas by reserving space for new corridors, buffer zones, urban greenery, recreation areas and regeneration areas. These tools are particularly important in the municipalities of Kumanovo, Kriva Palanka, Kratovo, Lipkovo, Rankovce and Staro Nagorichane, where green infrastructure must be integrated into urban development, land management, erosion protection, river corridor management and the improvement of public spaces.

Sector policies are an important part of the strategic context. Water policies are relevant to the management of Pchinja, Kriva Reka and their tributaries, to reduce flood risk, protect water resources and restore river corridors. Forestry and agricultural policies are related to erosion protection, sustainable land use, conservation of agricultural landscapes with natural value and improvement of landscape connectivity. Transport policies have an impact on spatial fragmentation, but can also enable the creation of green belts along infrastructure corridors. Tourism is relevant through the development of routes based on nature and culture, and energy through the need for new investments to be compatible with the protection of natural and landscape values.

Institutional responsibilities in the North-East Planning Region are distributed between national institutions, the centre for the Development of the North-East Region for Planning, municipalities, public enterprises and sectoral bodies. National institutions define the legal and strategic framework, while the regional and local levels have a key role in setting priorities, preparing projects, coordinating between municipalities and their practical implementation. In the field of climate change, institutions responsible for the environment, agriculture, forestry, water management and hydrometeorology are also relevant, as climate adaptation requires a cross-sectoral approach.

A major shortcoming of the existing planning framework is that green infrastructure is not yet systematically treated as a regional network. Green areas, forests, river corridors, agricultural landscapes and natural areas are often considered sectorally, without sufficient spatial connectivity and without a common methodology for their assessment and prioritisation. Additional challenges are the limited availability of updated spatial data, the different level of planning documentation by municipality, insufficient coordination between sectors and limited financial resources for maintenance, restoration and development of green infrastructure.

For the municipality of Kyustendil, the context of planning and legal context is set within the national policies of the Republic of Bulgaria and the policies of the European Union, since Bulgaria is a member state of the EU. This means that green infrastructure planning must comply with national legislation in the fields of nature conservation, biodiversity, spatial planning, water, forests, agriculture, climate adaptation and regional development, but also with European obligations related to Natura 2000, climate policy, ecosystem restoration and cohesion funding.

The regional development context of Kyustendil is related to the development policies of the South-West region of Bulgaria and the local planning documents of the municipality. Project and programme sources related to cross-border cooperation state that the Integrated Development Plan of the municipality of Kyustendil 2021–2027 is a relevant document for local development, especially in the context of tourism, natural and cultural heritage and cross-border cooperation.

Spatial and urban planning tools in the municipality of Kyustendil are important for the integration of green infrastructure in the development of the city, settlements and rural areas. Municipal spatial and urban development plans can ensure the protection of urban green spaces, river corridors, suburban areas, forest and agricultural landscapes, as well as define conditions for new investments that will not disrupt ecological connectivity. For Kyustendil, the natural connections with the Osogovo mountain region, the river valleys, the mineral and recreational potential, as well as the connections with the border area with North Macedonia are particularly important.

Sectoral policies in the municipality of Kyustendil are directly related to green infrastructure. Water policies are important for managing river corridors, reducing flood risk and improving the quality of aquatic ecosystems. Forestry is important for protecting mountain and hilly

landscapes, preventing erosion and fires, and maintaining ecosystem services. Agriculture is important for the preservation of traditional landscapes, fruit growing and agricultural areas. Tourism is particularly important because Kyustendil has potential for natural, cultural, spa and mountain tourism, and cross-border cooperation projects already recognize the need to improve tourism infrastructure and access to natural heritage.

Bulgaria's climate and energy policy is an important framework for green infrastructure. The national energy and climate context recognizes the role of forests and land use in reducing emissions and climate resilience, while environmental and regional development programmes provide opportunities for investment in green measures, adaptation and nature conservation.

Institutional responsibilities in Kyustendil are distributed among the national authorities of Bulgaria, regional structures, the municipality, sector institutions, public services and the managing bodies of EU-funded programmes. The municipality plays an important role in local planning, project preparation and implementation, maintenance of public spaces, local infrastructure, tourism and cooperation with citizens and the private sector. In a cross-border context, the municipality of Kyustendil has an additional role as a partner in joint initiatives with municipalities and institutions from North Macedonia, in particular within the Interreg VI-A IPA Bulgaria - North Macedonia 2021–2027.

The shortcomings in the existing planning framework of Kyustendil municipality are related to the need for a clearer integration of green infrastructure as a single system in local and regional planning. Although development, tourism, climate, environment and infrastructure policies exist, they are often implemented through individual sectors and projects. Stronger spatial synchronization is needed between nature conservation, urban development, tourism, water, forests, agriculture and climate adaptation. An additional challenge is securing long-term funding to maintain green spaces, restore degraded areas, improve river corridors and establish functional cross-border green links with the North-East Planning Region.

From the point of view of green infrastructure, it can be said that compared to the North-East planning region, the municipality of Kyustendil functions in the planning and institutional context of a member state of the European Union, which means that local planning is more directly related to European policies for Natura 2000, climate adaptation, ecosystem restoration and cohesion funding. The North-East planning region, on the other hand, relies on the national legal and strategic framework of North Macedonia, in which the concept of green infrastructure is still gradually integrated into regional, spatial and urban planning.

At the regional level, the North-East Planning Region has a wider territorial and inter-municipal dimension, as it encompasses multiple municipalities with different development, natural and infrastructural characteristics. Kyustendil, on the other hand, is seen as a single municipal territory, but with a strong connection to the regional policies of South-West Bulgaria and to local planning tools that can be more quickly targeted to specific interventions.

From the point of view of local planning, it is necessary for both territories to treat green infrastructure as a connected blue-green network, and not as a collection of separate green areas, river corridors, forests and agricultural landscapes. A common challenge is better coordination between sectors – water, forests, agriculture, transport, tourism and energy – as well as a clearer inclusion of green infrastructure priorities in planning documents and future investments.

3. Concept and definition of green infrastructure

3.1. Definition of green infrastructure

For the purposes of this Strategy, the working definition of the European Commission is applied, according to which green infrastructure is a strategically planned network of natural and semi-natural territories and other elements of the environment, designed and managed in such a way as to provide a wide range of ecosystem services and at the same time support the protection of biological diversity. It includes green spaces and blue elements when referring to aquatic ecosystems, and covers both urban and rural as well as terrestrial, coastal and marine areas[1].

In the context of this Strategy, green infrastructure is considered as a spatially and functionally connected system including forests, river corridors, wetlands, agricultural landscapes, protected areas and Natura 2000 network areas, urban parks, green belts, buffer forest belts, public green spaces and other natural or man-made elements that support the functioning of ecosystems.

In contrast to the approach where green spaces are seen as separate entities, the concept of green infrastructure treats them as part of a single and interconnected network. A key feature of this network is its multi-functionality—the ability to simultaneously support biodiversity conservation and habitat connectivity, water management, flood and erosion risk reduction, climate change adaptation, air quality improvement, recreation, public health and social well-being[2].

This definition is adopted as a common European conceptual basis and is applied equally in the analysis of the territories in the Republic of Bulgaria and the Republic of North Macedonia, with the specific elements and measures complying with the national legislation of each of the two countries.

3.2. Green, Blue and Grey Infrastructure

Green, blue and grey infrastructure represent three interconnected systems that shape space and influence its ecological, climatic, social and economic function. Addressing them together is important to ensure sustainable planning, better resilience to climate change, more efficient management of natural resources and a higher quality of life.

- The green infrastructure encompasses natural, semi-natural and managed green spaces that perform multiple functions simultaneously. It includes forests, parks, green belts, forest belts, grasslands, agricultural landscapes, protected areas, habitats and ecological corridors. Its role is to support biodiversity, improve ecological connectivity, contribute to cleaner air, create recreational conditions and provide natural protection against heat, erosion and other risks.
- The blue infrastructure encompasses the water-related spatial elements, such as rivers, streams, springs, lakes, wetlands, canals, floodplains and riparian areas. It plays an important role in retaining and purifying water, reducing the risk of flooding, regulating the microclimate, maintaining aquatic ecosystems andcreating natural

[1]European Commission, G*reen infrastructure — increasing Europe's natural capital*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2013) 249 final, Brussels, 6 May 2013

[2]European Commission, T*echnical Information on Green Infrastructure (GI)*, Commission Staff Working Document, SWD(2013) 155 final, Brussels, 6 May 2013; European Commission, E*U Biodiversity Strategy for 2030 — Bringing nature back into our lives*, COM(2020) 380 final.

corridors for the movement of species. In contemporary planning, blue infrastructure is often considered together with green infrastructure as part of a wider blue-green network.

- The grey infrastructure consists of the built and technical systems that enable the functioning of settlements, the economy and everyday life. It includes roads, bridges, streets, sewage and water supply systems, embankments, concrete culverts, parking lots, buildings, industrial zones and energy infrastructure. Although necessary for development, if planned in isolation, grey infrastructure can cause fragmentation of natural spaces, increased surface water runoff, loss of green space and reduced ecological connectivity.

The modern approach does not position green, blue and grey infrastructure as opposing systems, but as parts that need to be integrated. The aim is to supplement technical solutions with natural and semi-natural solutions, which will lead to greater functionality, lower risks and better living conditions. Such an approach allows space to be developed in a way that simultaneously meets infrastructural needs, preserves natural values, and increases resilience to climate and development pressures.

3.3. Ecosystem services

Ecosystem services are the benefits that people, communities and economies derive from nature and well-maintained ecosystems. Within green infrastructure, they provide a basis for understanding the practical value of natural, semi-natural and managed green and blue spaces. These services include air and water purification, temperature regulation, stormwater retention, flood risk reduction, soil erosion protection, carbon storage, biodiversity support, pollination, recreation, health, well-being and preservation of landscape identity.

In the context of planning, ecosystemservices allow green infrastructure to be assessed not only by area, but also by the functions it provides. Green space can simultaneously contribute to cooling space, improving air quality, retaining water, creating habitats and providing space for rest and recreation. Therefore, green infrastructure planning must consider both the environmental and social benefits arising from natural systems.

3.4. Multifunctionality

Multi-functionality is one of the main properties of green infrastructure. This means that a given space, element or corridor does not serve only one purpose, but simultaneously provides multiple functions and benefits. For example, a green space can have an ecological function by providing habitat, a climatic effect by reducing heat, a hydrological function by retaining water, a social function by creating a space for recreation, and an economic function by increasing the attractiveness of the space.

This approach is particularly important for regional and local planning, as it allows for more efficient use of space and better linking of different development objectives. Instead of treating green spaces only as decorative or recreational areas, they should be planned as part of a functional system that contributes to climate resilience, nature conservation, water management, improving health and supporting sustainable development.

3.5 Connectivity and ecological coherence

Connectivity is the ability of green and blue elements in a space to function as a network. Connectivity enables the movement of species, the exchange of genetic material, the maintenance of natural processes and the greater stability of ecosystems. When natural areas are isolated, their ecological value decreases and habitats become more vulnerable to urbanisation, infrastructure fragmentation, climate change and other stresses.

Ecological coherence means that the green infrastructure network is spatially and functionally coherent. This implies the existence of core natural areas, ecological corridors, river and forest connections, buffer zones and smaller connecting elements that together support the functioning of natural systems. In the planning process, this requires identifying key linkages, preventing fragmentation, and providing conditions for long-term preservation and restoration of connectivity.

3.6. Green infrastructure in urban, suburban and rural areas

Green infrastructure plays a different role in urban, suburban and rural areas, but in all cases it is important for the quality of life, the preservation of nature and the resilience of the space to different impacts. In urban areas, green infrastructure is most often associated with parks, tree-lined streets, public green spaces, green roofs, schoolyards, river banks and open spaces. Its role is to reduce the urban heat island effect, improve air quality, provide space for recreation and increase the comfort of life.

In suburban areas, green infrastructure acts as a transition zone between built-up areas and rural or natural areas. These areas are particularly important because they are often under pressure from development, settlement expansion, infrastructure construction and land use changes. Well plannedgreen infrastructure in peri-urban areas can provide buffer zones, recreational areas, ecological corridors and a controlled transition between the urban and natural landscape.

In rural areas, green infrastructure is associated with forests, grasslands, agricultural landscapes, river valleys, hedgerows, semi-natural areas and traditional landscapes. It contributes to biodiversity conservation, soil conservation, water management, support for agriculture, sustainable tourism and preservation of local identity. Connecting urban, suburban and rural green elements is key to creating a complete and functional blue-green network.

4. Analysis of the current situation in the region

4.1. Spatial and territorial characteristics

The spatial scope of the strategy includes the North-East Planning Region in North Macedonia and the Municipality of Kyustendil in the Republic of Bulgaria, as two neighbouring territories with clear cross-border connectivity, common natural characteristics and significant potential for the development of a blue-green infrastructure network.

The northeastern region is characterised by a diverse spatial structure, in which urban centres, rural settlements, agricultural areas, hilly and mountainous landscapes, river valleys and natural areas are intertwined. The territory has an important transit and border position, as it is located in a contact zone with neighbouring countries and is an area through which significant transport and development links pass. Such a situation creates opportunities for economic and territorial cooperation, but also puts pressure on land, natural resources and ecological connectivity.

The municipality of Kyustendil has a distinct urban-rural character, with the city of Kyustendil being the main administrative, economic and service centre, surrounded by rural settlements, agricultural landscapes, forest areas and mountainous areas. The territory of the municipality is significant due to its proximity to the border with North Macedonia, the natural connection with the wider area of Osogovo and the potential for the development of cross-border green and recreational corridors.

4.2. Land use and land cover

Land use and land cover are an important basis for green infrastructure planning, as they show the spatial distribution of urban areas, agricultural lands, forests, grasslands, water areas, natural and semi-natural areas, as well as degraded or underutilized areas. Through their analysis, it is possible to determine which parts of the territory have a high ecological value, where there is a risk of fragmentation, where there is pressure from urbanisation and infrastructure, and where there are opportunities to restore, green or better connect the natural elements.

The North-East Planning Region land use is diverse and reflects the combined urban-rural, agricultural and hilly-mountainous character of the region. Urban and industrial areas are mainly concentrated around larger settlements and transport corridors, while a significant part of the territory is represented by agricultural areas, pastures, forest complexes, river valleys and natural or semi-natural landscapes. These different types of land create the potential for the development of a connected network of green infrastructure, especially through river corridors, forest belts, agricultural mosaics and hilly-mountainous areas.

Agricultural land plays an important role in the spatial structure of the region. In addition to the production function, agricultural landscapes can also contribute to ecological connectivity, the preservation of traditional landscapes, soil conservation and the support of biodiversity, especially if managed in a sustainable manner. The semi-natural agricultural landscapes, pastures, borders, buffer strips, tree rows and green corridors betweenfarmland can have an important function as connecting elements of green infrastructure.

Forests and hilly and mountainous areas represent some of the most important elements of green infrastructure in the North-East Planning Region. They provide habitat, erosion protection, water regime regulation, carbon storage, recreational opportunities and landscape

value. Their connection with river valleys, agricultural landscapes and settlements is important to create a functional blue-green network and to reduce the risks of climate change.

The land cover of Kyustendil Municipality also has a distinct mix of urban, agricultural, forest and natural areas. The urban core of the city of Kyustendil is surrounded by suburban and rural areas, agricultural areas, orchards, river corridors, forest and mountain landscapes. This structure creates favourable conditions for the development of green infrastructure that connects the green areas of the city with the surrounding natural and agricultural landscapes.

Agricultural areas in Kyustendil Municipality play an important role in the local landscape and economy, but at the same time can be part of the wider green infrastructure if their semi-natural elements and spatial connectivity are preserved. Orchards, meadows and agricultural landscapes can provide ecological functions, spatial diversity and support for sustainable tourism and local development.

The forest and mountain areas on the territory of the Kyustendil municipality are of particular importance, as they are important for the protection of biodiversity, water regulation, erosion prevention, recreation and climate resilience. Their connection with urban and rural areas should be preserved and strengthened through green corridors, buffer zones and careful planning of new infrastructure and development activities.

The following table shows the assessment of the strategic importance of the different categories of areas.

Category	Environmental value	Climate function	Social function	Bonding potential	Priority in strategy
Artificial and urbanised areas	Low to medium	Average	High	Average	High for urban landscaping
Agricultural areas	Average	Average	Average	Tall	Medium to high
Forests and semi-natural areas	High	High	Medium to high	Tall	Very tall
Wetlands	Very high	Very high	Average	Tall	Very tall
Water surfaces	Very high	High	High	Very tall	Very tall

4.3. Natural and Semi-natural Areas

On the territory of the North-East Planning Region, natural and semi-natural areas are represented by hilly and mountainous landscapes, river valleys, grasslands, agricultural and natural mosaics and forest areas. The region covers 2 310 km², or approximately 9.3% from the territory of North Macedonia, and includes the municipalities Kratovo, Kriva Palanka, Kumanovo, Lipkovo, Rankovce and Staro Nagorichane**,** comprising 192 settlements in total. Spatially, the region is connected to the watershed of a Pchinja and Kriva Reka rivers.

Natural and semi-natural areas in Kyustendil Municipality occur within mountain, valley, forest, agricultural and riverine landscapes. The municipality has an area of approximately 979.9 km² and is the largest municipality in the Kyustendil region and in the South-West region of Bulgaria. Its territory covers parts of Milevska Planina, Chudinska Planina, Konyavska Planina, Lisets and Osogovska Planina**,** as well as the Kyustendil and Kamenishka basins.

Natural and semi-natural areas in the North-East Planning Region and Kyustendil Municipality are exposed to multiple pressures resulting from land use changes, infrastructure development, urban sprawl, agricultural activities, land degradation and climate change. In the municipality of Kyustendil, the pressure is most pronounced in the suburban areas around the city, along road routes, in agricultural areas and in areas where there is an increased demand for recreational, tourism-related or infrastructural use of the space. An additional challenge is the need to combine local development with the protection of natural and landscape features, especially in areas connected to the Osogovo mountain range and Natura 2000 areas.

4.4. Rivers, wetlands and blue infrastructure

The North-East Planning Region'sblue infrastructure is represented by the river systems of Pchinja**,** Kriva Reka and their tributaries, as well as through springs, thermo-mineral waters and local water resources. The data from the programme indicate that they are registered in the municipality of Kratovo, 74 springs, and most of them are located in mountainous areas, under high peaks and on the slopes of valleys. Thermo-mineral springs are also registered, especially near Proevtse near Kumanovo, Strnovac in Staro Nagorichane and Topolovik in Kratovo.

The territory of Kyustendil Municipality is part of the water basin of the Struma River, which is the largest river in the area. The rivers flowing through the town of Kyustendil include the Banshtitsa and Kolushka rivers, and among the larger rivers in the municipality are Dragovishtitsa, Sovolyanska, Bistritsa, Banshtitsa, Novoselska, Bersinska, Eleshnitsa and Lilyachka. The territory also includes the dams “Bersin", "Drenov dol" and "Bagrentsi**“,** whose waters are used mainly for irrigation and recreation.

The mineral water of Kyustendil Municipality originates from a deep fault-fissure thermal aquifer, thermal circulation, formed in the crystalline rocks of the Osogovo massif.

The deposit occurs in a small thermal zone with a length of 180 m and a width of 60-70 m, located at the foot of the Hisarlukka hill. The mineral waters are formed in the tectonically fractured and cracked gneisses of the Osogovo formation and the embedded granites and granodiorites from the Strum diorite formation and the Osogovo pluton. The waters have a pressure character and by genesis they correspond to deep fracture waterscirculation. They are nourished by surface water infiltration. Thermomineral waters are poured (drained) on the surface along faults. The boreholes were drilled near and parallel to the Kyustendil fault.

The mineral springs, which according to literature are more than 40, were captured already in 1910-1911 year. The water was collected in one common shaft - "Old catchment". Subsequently, two boreholes were also completed. The waters of the three sources are mixed and fed into a common aqueduct network for mineral water. The modern scheme for exploitation of the "Kyustendil" field is:

- Old catchment(capturing the group of about 40 natural springs);
- Drilling BU;
- Borehole No. 5.

According to the official balneological assessment of the Ministry of Health, the operational water sources of the "Kyustendil" field are the captured natural spring "Star catchment", Borehole BU and Borehole No. 5. The document explicitly states that 11 catchments are functioning today, connected to each other and leading the water to a common catchment chamber ("Old Catchment").

The water sources pour their water into a mineral water pipeline, through which it reaches the consumers. The supplied water has a temperature of about 71 °C and a flow rate of 17.54 l/second.

Rivers, streams, springs, dams and riparian zones are exposed to pressures related to river bed regulation, pollution, reduction of natural riparian vegetation, land conversion along watercourses and increased risk of flooding and erosion. In the North-East Planning Region, the river systems of Pchinja, Kriva Reka and their tributaries are influenced by settlements, agricultural activities, infrastructure and local water sources. Erosion processes are also taking place in parts of the region, and the alluvial material affects the riverbeds, the water regime and the quality of the water ecosystems.

In the municipality of Kyustendil, the pressure is related to the urban use of the river corridors, the regulated sections of the water courses, the risk of flooding during intense rainfall, as well as possible impacts from agricultural and urban activities. In regions with thermo-mineral springs, an additional challenge is the sustainable management of water resources and the harmonization of their use with the preservation of the natural water regime.

4.5. Forests and forest systems

The North-East Planning Region'sforest areas are represented especially in the hilly-mountainous parts of the region, including in the area connected to the regions of the Osogovo Mountains, Kratovo and Kriva Palanka area. The development programme states that in 2019 the gross volume of harvested wood in state and private forests in the North-East Region amounted to 71 773 m³, representing 9.45% of the total gross volume of harvested wood at the national level.

Sustainable management of forest territories requires combining economic interests with the need to protect nature, adapt to climate change and ensure benefits for the local population. The total area of forest land in Kyustendil Municipality amounts to 48 054 hectares. Municipal forests cover 6,948.1 ha, comprising 4,091.2 ha (58.9%) of forest, 2,854.8 ha (41.1%) of agricultural land that has acquired forest characteristics, and 2.1 ha of water areas. The forest territories are a strategic natural resource of great importance for the economic, ecological and social development of the municipality. They perform multiple functions – they provide wood and non-wood forest products, preserve biological diversity, protect soils and waters, regulate the local climate, limit erosion processes and create opportunities for tourism, recreation and development of the local economy. On the territory of the municipal forest territories, forests in an old age phase have been identified, as well as a century-old beech forest with a high nature protection value, which has been placed under a special protection regime. These forest territories represent a valuable natural capital and are of particular importance for the preservation of biological diversity, its natural structure of forest ecosystems and the landscape of the municipality. The main goal is to preserve these territories for future generations, preserving their natural structure, biological diversity and ecosystem functions. The numerous forest complexes are located in the Kraishte mountain range, on the southern slopes of Milevska Planina, the southwestern part of Konyavska Planina, part of Zemenska Planina and the northwestern part of Osogovska Planina. The largest share is natural plantations with a total area of 2 008.1 ha, or 29.4 % of the area. By type of forest, conifers predominate - 3,614.9 ha, followed by shoots for conversion - 1,579.9 ha and broad-leaved high-stemmed forests - 1,466.6 ha. Forest territories with protective functions amount to 285.7 ha, with special features 2 501.7 ha, but with economic functions - 4,106.7 ha. Municipal forests can generate income through sustainable use of timber resources. Forests on the territory of Kyustendil municipality as a source of wood and other benefits are of great

importance for the region. Of the secondary uses, animal grazing is the most important. In recent years, the collection of herbs and mushrooms has increased.

The overall health of the municipal forests is good, with 5 083.5 ha or 74.4 % not affected by damage. In recent years, the following types of damage are more common:

- bark beetles-21.7 % - this damage is mainly observed in white pine;
- rot-5.5% - this damage mainly affects beech, winter oak and cera;
- branch cutter 0.9 %- this damage is observed in beech, winter oak and cera;
- snowblower 0.1%- this damage mainly affects white and black pine;
- snow break 0.1%- this damage mainly affects white and black pine;
- dry tops 0.3%- this damage mainly affects beech, winter oak and cera;

The use of forest resources should be consistent with the natural potential of forests for recovery and reproduction. Of great importance to the population in the area are the protective water protection and anti-erosion functions of the forest. The forest complexes are the only water source for the settlements in the area. Significant afforestation and anti-erosion construction in the area in the sixties and the seventies has generally controlled the extensive erosion that has occurred in the area. They are highly valuable from an ecological perspective because they support rich biodiversity, protect water resources, prevent erosion and flooding, purify the air and enrich the soil. They are therefore essential for people and for maintaining healthy living environments under changing climatic conditions. However, for them to continue to provide these vital ecosystem services, urgent measures are needed to protect them.

Forest management needs to be oriented towards increasing their resilience to future climate risks. Fires represent one of the main risks for the sustainability of forest territories. Municipal forests fall into the II class of fire danger (medium) - 47.8 % and into the III class of fire danger (low) - 37.5 %. The main factors for the occurrence of fires in them are negligent or intentional human activity or natural phenomena.

Municipal forest territories represent a significant resource for the development of sustainable tourism, recreation and hunting. The combination of natural features, forest ecosystems, game resources and available infrastructure creates opportunities for increasing the public benefits provided by municipal forests. The development of these activities should be consistent with the capacity of the natural environment, conservation regimes and current legislation. The objective is to use the potential of municipal forest areas for nature-friendly tourism and recreation while protecting natural resources and creating long-term economic benefits for the municipality and the local population. The importance of forests as tourism destinations is increasing. Forest Park "Hisarlaka" is one of the emblems of the town of Kyustendil. This beautiful 100–120-year-old forest has delighted Kyustendil residents and guests of Kyustendil for decades. Of particular interest is the gorge of the Struma river, especially with the Skakavitsa Waterfall and the Zemen Rocks. A number of tourist routes pass through the territory of the municipality. Municipal forest territories are a long-term natural and economic asset, the importance of which goes beyond the immediate income from the use of wood resources. Sustainable management requires combining economic interests with the need to protect nature, adapt to climate change and ensure benefits for the local population. The current strategy creates a framework for consistent and responsible management of municipal forest territories. Its successful implementation requires constant control, adequate funding, professional expertise, participation of interested parties and annual evaluation of the achieved results. The ultimate goal is to create a sustainable model in which municipal forests simultaneously preserve, develop and create long-term social and economic value. In conclusion, it should be emphasized that the forests on the territory of Kyustendil Municipality, with their diverse functions, will have an important share in the economy of the entire Kyustendil region in the future.

4.6. Agricultural Landscapes

The North-East Planning Region'sagricultural areas are significantly represented in the land structure. According to the data provided in the regional rural documents, the district has 172 225 hectares of agricultural land**,** of which 78 828 hectares**,** or 45.7%, are arable land, and 93 391 hectares, or 54.3%, are pastures.

Agricultural holdings are also registered in the region, and according to 2016 data, individual agricultural holdings dominate. The share of individual farms from the North-East Planning Region in the total number at the national level is indicated as 12.41%, while the share of agricultural holdings as economic entities is 6.07%.

Agriculture in Kyustendil Municipality is represented by crop and animal husbandry, with strong traditions in fruit growing. The Integrated Development Plan states that the municipality of Kyustendil and the wider surrounding area are known as “the Orchard of Bulgaria”**,** and agricultural lands amount to 456 454 dka, or 48% of the municipality's territory.

Agricultural landscapes are exposed to pressure from intensive land use, erosion, reduction of traditional landscape elements, abandonment of agricultural areas in some rural areas and fragmentation of semi-natural elements. In the North-East Planning Region, agricultural lands are under various pressures, such as erosion of cultivated land, reduction of vegetation belts and potential pollution from agricultural activities.

In the municipality of Kyustendil, pressure arises through land use change, reduction of traditional agricultural practices, concentration of activities in accessible parts of the municipality and neglect of part of the land in rural and peripheral areas. Agricultural landscapes are also sensitive to climate risks, especially droughts, extreme temperatures and erosion.

4.7. Urban and suburban green spaces

The North-East Planning Region'surban and suburban green areas are connected to larger settlements, especially Kumanovo, Kriva Palanka, Kratovo and other municipal centres. The region has six municipalities and 192 settlements, of which according to the programme document, 189 are rural settlements, indicating a combination of urban cores, suburban areas and rural areas in the regional structure.

Urban and suburban green areas in Kyustendil Municipality are connected to the city of Kyustendil and its surroundings. The municipality includes 72 settlements, of which 1 city and 71 villages, the document states that it is moderately urbanised and that in recent years the city has had almost three times as many residents as the villages and surrounding neighbourhoods combined.

Urban and suburban green spaces are under pressure from urban sprawl, construction, the reduction of public green spaces and insufficient maintenance. In the North-East Planning Region, these pressures are most pronounced in larger settlements and their peri-urban areas, particularly in areas where residential, commercial, industrial and transport functions are concentrated. The lack of continuous green connections between urban centres and the surrounding natural or agricultural landscapes presents an additional challenge for the urban environment.

In the municipality of Kyustendil, the pressure is related to urban development, road infrastructure, parking lots, soil sealing and the need to maintain public spaces. In summer,

urban areas are further exposed to heat stress, especially where hard surfaces predominate and woody vegetation is lacking.

4.8. Biodiversity and habitats

The North-East Planning Region's**biodiversity**and habitats are associated with river valleys, hilly and mountainous landscapes, woodlands, grasslands, agricultural landscapes and semi-natural spaces. At the national level in the ecosystem mapping in North Macedonia are identified 22 types of ecosystems, with broad-leaved forests being the most common, covering 9 933 km², followed by agroecosystems, covering 5 327 km².

The same national analysis states that the Vardar river system with its main tributaries, including Pchinja, shows better condition compared to some of thethe other types of ecosystems. These data are relevant for describing the current situation in the North-Eastern region, since Pchinja is one of the main river axes of the region.

Biodiversity in Kyustendil Municipality is associated with forest, mountain, river and agricultural landscapes. In the documents for the Osogovo Mountains, it is stated that two large areas of the Natura 2000 network have been established on the Bulgarian side:"Osogovo" under the Birds Directive, with an area of 24 125.09 ha**,** and "Osogovska Planina" according to the Habitats Directive, with an area of 34 513.24 hectares.

Biodiversity and habitats in both territories are under pressure from fragmentation, land cover change, intensification or abandonment of traditional agricultural practices, degradation of river corridors, forest fires, infrastructure barriers and climate change. In the North-East Planning Region, the pressure on these habitats is particularly observed in areas where natural and semi-natural spaces are interrupted by settlements, roads, agricultural areas and other forms of land use.

In the municipality of Kyustendil, the pressure is related to the disturbance of the habitats, possible changes in the water regime, fires, erosion, human activity in natural areas and fragmentation of the infrastructure. Areas included in Natura 2000 are subject to special regimes and management requirements, which creates the need to reconcile land use with conservation objectives.

4.9. Protected areas and areas of Natura 2000/Emerald

The North-East Planning Region'sthe protected and ecologically significant territories are connected with mountain, river and forest areas, especially in the parts towards the Osogovo mountains and along the river systems. The national website for Natura 2000 in North Macedonia lists a valuation study with a proposal to declare the Osogovo Mountains a protected area, which refers to an area spatially connected to the eastern part of the North-East Planning Region.

Protected areas in the North-East Planning Region within the sense of the Protected Areas Act

"Osogovsky Mountains" protected area

The protected area covers parts of the municipalities of Kriva Palanka and Kratovo in the North-East Planning Region and continues on the territory of the neighbouring East region. It was declared in 2020 and occupies a total area of 48 807.16 ha, protecting forest, mountain and grassland ecosystems, rare species and traditional rural landscapes.

Natural landmark "Kuklitsa"

"Kuklitsa" is located near the village of Kuklitsa, municipality of Kratovo, and is known for its characteristic stone figures, formed as a result of prolonged volcanic and erosion processes. The locality has a high geological, landscape, educational and tourism value.

Natural monument "Katlanovský pred"

The protected territory covers natural complexes along the lower reaches of the Pchinja River, including gorge, river and riparian habitats. The territory isimportant for the preservation of biological diversity, geomorphological features and ecological connectivity along the Pchinja river corridor.

Natural Monument "Hungarian Oak - Kointse village"

In the area of Kointse village, Staro Nagorichane municipality, a separate old tree of the blagun species is protected. It has natural science, landscape and local cultural value and is a remnant of the older natural oak vegetation in the area

Protected territories in the municipality of Kyustendil in the sense of the Law on Protected Territories
In the municipality of Kyustendil there are 8 protected areas: 1 reserve ("Tsarna Reka"), 4 protected areas and 3 natural attractions, as well as numerous centuries-old forests and parts of the Natura 2000 network.

Main protected areas

I. Category "Reserve"

- **"Tsarna Reka"**
    - **Territorial coverage: Land** in a village Sazhdenik.
    - **Area: 196.43 hectares**.
    - **Purpose: Preservation** of a representative ecosystem of natural centuries-old beech forests in the Osogovo Mountains.

II. Protected area category

- **"A century-old beech forest in the town of Sveta Gora - Monastery of St. Luke"**
    - **Territorial coverage: Land** in a village Granitsa.
    - **Area: 1.3 hectares**.
    - **Purpose: Preservation** of a centuries-old beech forest in the immediate vicinity of the Granichki Monastery.
- **"Green Hill"**
    - **Territorial coverage: t**he lands of the villages Sazhdenik and Tsrvena Yabalka.
    - **Purpose: Preservation** of specific mountain landscapes and habitats in Osogovo.

- **"Rock Cornflower Habitat/Site"**
    - **Territorial coverage: Land** in a village Polska Skakavitsa.
    - **Purpose: C**onservation of the endangered and rare plant species rock cornflower.
- **"Anise-scented Mullein Habitat/Site"**
    - **Territorial coverage: Land** in a village Tsrvenyano.
    - **Purpose: C**onservation of a botanical site of the rare species of anise mullet.

III. Category "Natural landmark"

- **"Group of sequoias in the city of Yuchbunar"**
    - **Territorial coverage: Land** in a village Bogoslov.
    - **Area: 0.2 hectares**.
    - **Purpose: Preservation** of unique three-century-old sequoias of the species giant sequoia and the young forest around them.
- **"Skakavitsa Waterfall"**
    - **Territorial coverage: Land** in a village Polska Skakavitsa.
    - **Area: 0.1 hectares**.
    - **Purpose: Preservation** of the beautiful and unique travertine waterfall in Konyavska Planina.
- **"Zemen Rocks"**
    - **Territorial coverage: Land** in a village Polska Skakavitsa(within the Zemen Gorge),/ the protected natural landmark also extends to the territory of neighbouring municipalities/
    - **Area: 13.00 hectares**.
    - **Purpose: Preservation** of bizarre rock formations located along the Struma River.

Protected areas by Natura 2000

Parts of the territory of the Municipality of Kyustendil fall within six protected areas of the European ecological network Natura 2000. They comprise five sites under the Habitats Directive and one site under the Birds Directive.

A reference in the Information System for Natura 2000 shows the following territorial scope of the zones including lands from the municipality of Kyustendil:

I. Protected areas under the Habitats Directive

- **BG0000293 "Osogovo"**

- Territorial coverage: It covers a huge part of the Osogovo mountain. It includes all or part of the lands of the villages Bogoslov, Bersin, Granitsa, Garlyano, Vrattsa, Zilentsi, Ivanovtsi, Kopilovtsi, Lisetsi, Novo selo, Piperkov chiflik, Radlovtsi, Sajdenik, Slokoshtsita, Tarnovlag, Tsrvena Yabalkaetc.

- **BG0000294 "Kershalevo"**
    - Territorial coverage: It is located in the mountainous and hilly parts of the Geographical Region of Kraishte. It includes the lands of the villages Goranovtsi, Gorno Uyno, Guyeshevo, Dozhdevitsa, Dolno Selo, Dolno Uyno, Dragovishtsita, Kamenichka Skakavitsa, Kutugertsi, Kershalevo, Leska, Mazarachevo, Prekolnitsa, Ranentsi, Razdavitsa, Rusovo, Sovolyano, Stensko, Cerovitsa, Chudintsi.
- **BG0000298 "Konyavska Planina"**
    - Territorial coverage: It extends over the mountain massif to the north and east of the town of Kyustendil. It covers the lands of the villages Konyavo, Gorna Koznitsa, Dolna Koznitsa, Blatets, Lilyach, Bunovo, Dvorishte, Zabokrut, Tsarvenyano, Tavalichevoetc.
- **BG0001012 "Zemen"**
    - Territorial coverage: It covers the picturesque Zemensky Gorge of the Struma River. On the territory of the municipality of Kyustendil, it falls mostly on the land of a village Polska Skakavitsa.
- **BG0000295 "Dolni Koriten"**
- **Location: K**yustendil district (Kyustendil and Trekliano municipalities)
- **Purpose: C**onservation of natural habitats, wild flora and fauna
- **Area: It covers 464.05 hectares**.
    - **Range: T**he territory of the zone falls within the land of the village of Gorno Uyno (for Kyustendil Municipality).

II. Protected areas under the Birds Directive

- BG0002096 "Osogovo"
    - Territorial coverage: It overlaps to a very large extent the boundaries of the habitat zone of the same name in the Osogovo Mountains, but with a focus on the habitats of endangered birds. It includes the same mountain lands of Kyustendil municipality -Sajdenik, Tsrvena Yabalka, Bogoslov, Slokoshchitsa, Glyano, Vratsaetc.

Protected areas and ecologically significant areas are exposed to pressures related to improper land use, forestry activities, recreational pressures, infrastructural interventions, fires, erosion and insufficient connectivity with the surrounding natural spaces.

In the municipality of Kyustendil, the pressure on protected areas is most often related to the way forests are used, agricultural activities, access and recreation, the risk of fires and the need to coordinate development activities with protection regimes.

4.10. Climatic risks: heat, floods, droughts, erosion and fires

The North-East Planning Region'sclimate and natural risks are related to heat waves, reduced summer rainfall, floods, erosion and fires. The development agenda states that national analyses of climate change show that the country will become warmer and moderately drier**,** with a significant decrease in summer rainfall and increasing the number and duration of heat waves.

The same document also lists the risks associated with flooding and erosion and the need for flood protection in the context of water systems. The Pchinja water management area is considered to be the area with the largest amount of eroded sediments in the Republic of Macedonia, with an annual amount of 2 285 278 m³/year. The section on natural hazards also lists fires, mainly in the regions Kratovo and Kriva Palanka**,** as well as in the Kumanovo-Lipkovo region**.**

The climatic characteristics of Kyustendil Municipality and risks are considered within the framework of the natural-geographical analysis of the municipality. Climate resources are a dynamic natural factor and show annual precipitation, maximum and minimum temperatures, sunny, cloudy and rainy days, as well as wind speed by month.

The Struma River Basin has historically been subject to erosion, depositing large amounts of sediment and flooding fertile lands. There are also potential impacts on infrastructure, energy, agriculture, food security and health, as well as the relationship of forests to extreme rainfall, flooding, unstable soils and natural biodiversity.

4.11. Demographic, Social and Economic Context

Demographic data

Demographically, the North-East Planning Region has a distinct urban-rural structure. Kumanovo is the largest urban and economic centre, while the other municipalities have smaller urban centres and a significant number of rural settlements. The spatial distribution of the population is related to the main transport routes, river valleys, agricultural areas and hilly-mountainous areas.

The main demographic problems are the depopulation of rural areas, the ageing of the population and the emigration of young people. These processes lead to loss of labour force, reduced economic activity and changed spatial structure of settlements. Solutions should be directed towards restructuring the rural economy, improving infrastructure and public services, and promoting sustainable models of local development.

Table: Population by Municipality - North-East Planning Region (Census 2021 year)

Municipality	Population	Area (km²)	Density (h/km²)
Kumanovo	98 104	509	193
Lipkovo	28 102	270	104
Kriva Palanka	18 059	480	38
Kratovo	9 837	376	26
Rankovce	3 459	240	14
Staro Nagorichane	3 501	433	8

Total population: 160 062; Total area: ~2 308 km²; Average density: ~69 people/km²

One of the key characteristics of the region is the process of demographic ageing, which is particularly pronounced in smaller and rural municipalities. In these areas, there is a decrease in the young population and an increase in the share of people over 65 years, leading to a decrease in the working-age population and an increased demographic burden. In contrast, in the municipality of Lipkovo the age structure is more favourable, with a higher participation of young categories, which is related to a higher birth rate.

Natural growth in most of the region is negative, as a result of low birth rates and relatively higher death rates, especially in ageing municipalities. This tendency is further strengthened by intensive migration processes. The region faces a continuous emigration of the population, especially the young and able-bodied, who head to Skopje or abroad in search of better economic opportunities. This leads to the emptying of rural areas and further deepening of demographic imbalances.

Demographically, the Municipality of Kyustendil has a clearly defined urban-rural structure, with the city of Kyustendil being the largest urban, administrative, service and economic centre, while the remainder of the municipality consists of rural settlements with a lower population density. The spatial distribution of the population is concentrated in the urban core and its immediate surroundings, while the rural settlements register smaller populations and clearly evident processes of demographic depopulation. According to data for the period 2021–2024, the population of the Municipality of Kyustendil decreased from 51 044 residents in 2021 to 46 856 residents in 2024. In 2024, 34 334 residents lived in the city of Kyustendil, while 12 522 residents lived in the rural settlements.

The main demographic problems are the reduction of the total number of the population, the ageing of the population and the emptying of rural settlements. These processes lead to a decrease in employment. the working population, increased demographic weight and concentration of public services, economic activities and population in the city of Kyustendil.

One of the key characteristics of the municipality of Kyustendil is the high concentration of population in the city of Kyustendil. In 2024 year approximately 73% of the municipality's population lives in the city, while approximately 27% lives in rural settlements. This shows the dominant role of the city as a centre of public services, employment, education, health care and the local economy, but also a gradual decline in rural population.

The ageing of the population is a clearly expressed process both at the municipal and regional level. In the wider Kyustendil region, demographic data show a continuous population decline in recent years: 116 619 residents in 2020, 113 440 in 2021, 108 703 in 2022, 107 673 in 2023 and 106 131 in 2024. This trend is accompanied by negative natural growth and higher proportion of elderly population.

Natural increase is negative, as a result of lower birth rates and higher death rates, which is typical of ageing demographic structures. At the same time, migration processes and the emigration of the young and able-bodied population to larger urban centres or abroad further reduce the demographic potential of the municipality. These processes are most visible in rural settlements wherepopulation decline is associated with reduced local economic activity, poorer land use and greater dependence on the urban centre.

Social context

The social context of the North-East Planning Region is characterised by an uneven distribution of public services between larger urban centres and smaller rural settlements. Most of the administrative, educational, health, cultural and service functions are concentrated in the larger municipal centres, especially in Kumanovo, while smaller and peripheral settlements have more limited access to public services and infrastructure.

The social situation in the region is also related to access to health services. Larger settlements have a better concentration of health facilities and personnel, while rural and peripheral areas face the need for better access to primary health care, specialised services, and mobile or decentralized forms of health support. The regional development documents indicate the need to identify health personnel and measures to retain doctors and health workers in the region.

From the point of view of social protection, the region needs continuous support for vulnerable population groups, including persons with low incomes, the elderly, people with disabilities, families at social risk and residents of remote settlements. Access to social services is related to the local institutional network, public transport, digital accessibility and the capacity of municipalities to provide services close to citizens.

Cultural and entertainment life in the region takes place mainly in the municipal centres, where cultural institutions, sports facilities, public spaces and organised events are concentrated. In smaller settlements, public spaces, sports fields, local cultural centres and green spaces play an important role in social cohesion, but their condition and availability vary by municipality and settlement.

The social context of the municipality of Kyustendil is related to the role of the city of Kyustendil as the main centre for public services, education, health care, culture, administration and local economy. The city provides most of the public functions for the municipality and the wider Kyustendil region, while rural settlements are largely dependent on the urban centre for access to services.

The health infrastructure in Kyustendil district includes 5 hospital **facilities**. The city of Kyustendil plays the role of a major health centre.

The cultural, entertainment and public life in the municipality of Kyustendil is concentrated in the city, where most cultural institutions, public spaces, sports and entertainment facilities are located. In rural settlements, social infrastructure is more related to local facilities, public spaces, traditional events and access to municipal services through the town centre.

Economic context

The economic context of the North-East Planning Region is characterised by a mixed economic structure that includes trade, services, manufacturing, construction, transport, agriculture and small local businesses. Economic activity is most strongly concentrated in Kumanovo, as the largest economic centre in the region, while in other municipalities the economic base is more related to local services, agriculture, small production facilities, trade and tourism with a limited scope.

The North-East Planning Region is one of the regions whose per capita gross domestic product is below the national average. This presents it as economically weaker compared to the most developed planning districts in the country.

The economic structure of the region is closely related to its spatial location. The North-East Planning Region has a transit and border function, with important road connections with Skopje, Serbia and Bulgaria. This creates conditions for the development of transport, trade, logistics and service activities, especially along the main transport corridors. At the same time, hilly-mountainous and rural areas have an economy that relies more on agriculture, animal husbandry, forest resources, local services and potential for rural and nature tourism.

Agriculture remains an important part of the local economy, especially in rural municipalities and settlements. In smaller municipalities, economic activity is more dependent on local resources and public investment, while the private sector is mainly composed of micro and small enterprises.

Tourism in the region has potential related to natural and cultural heritage, mountain and rural landscapes, monasteries, traditional villages, geological and landscape values. However, according to previous regional statistics, the North-East Planning Region has a low share in the total number of tourists and overnight stays at the national level, indicating that the tourism economy still has a limited role in the overall regional development.

The economic context of the municipality of Kyustendil is related to the role of the city of Kyustendil as an administrative, service, commercial, health, tourist and local economic centre. The economic structure includes trade, services, tourism, agriculture, food processing and small-scale manufacturing activities, as well as activities related to mineral waters, spa tourism, cultural heritage and rural resources.

The structure of enterprises is dominated by micro-enterprises, with slightly over 95% of the companies had up to 9 employees.

Agriculture is an important economic segment for the municipality of Kyustendil, especially due to the traditions in fruit growing and agricultural production. The rural areas of the municipality are associated with agricultural lands, orchards, pastures and local production. These activities complement the urban service economy of the city of Kyustendil.

Tourism plays an essential role in the economic picture of the Kyustendil region. Tourism activities are related to mineral waters, spa tourism, natural and mountain landscapes, cultural heritage and recreational facilities.

The economic base of Kyustendil is mainly composed of small and micro-enterprises, which is characteristic of many peripheral and border regions. Local economic development relies on a combination of services, agriculture, tourism, small manufacturing facilities and a cross-border location.

5. Inventory of green infrastructure

5.1. Main natural areas

Core natural areas represent larger, relatively preserved natural and semi-natural formations that form the basic structure of the green infrastructure network. They most often include mountain ranges, forest complexes, river valleys, pastures, protected or ecologically significant territories, as well as other areas with a higher degree of naturalness and spatial continuity.

In spatial terms, the main natural areas serve as the main points of concentration of natural values within the strategy. They are connected by linear corridors, river systems, buffer zones, smaller green areas and agricultural landscapes, thus forming a wider network of green and blue infrastructure on the territory of the North-East Planning Region and Kyustendil Municipality.

In the North-East Planning Region, the main natural areas are the Osogovo Mountains, Kozjak, German, Bilino, Skopska Crna Gora, as well as the river valleys of Pchinja and Kriva Reka. These natural units form the main relief and natural structure of the region, which stretches along the Pchinja and Kriva Reka rivers, along the borders with Kosovo, Serbia and Bulgaria. The area is bounded by Kozjak and German to the north, the Osogovo Mountains to the south and Skopska Crna Gora to the west.

In the northern and northeastern parts of the region, Kozjak, German and Bilino stand out. Kozjak rises between the Pchinja valley to the north and west and Kriva Reka to the south, while German and Bilino are medium-high mountains north of Rankovce and Kriva Palanka, near the border with Serbia.

In the southern and eastern part of the region stands out the region of the Osogovo Mountains, which is connected to the municipalities of Kriva Palanka, Kratovo and the wider cross-border region of Osogovo. Part of the Osogovo Mountains in North Macedonia has been declared a protected area with an area of 48 807.16 hectares.

The following table shows the natural and semi-natural physical entities in the North-East planning region, with the type of physical entity:

Area	Type of natural area/feature
Osogovo mountains	mountain-forest zone
Kozjak	mountainous and hilly area
German	mountainous region
Bilino	mountainous region
Skopska Crna Gora	mountainous region
Pchinja Valley	river and valley unit
The valley of the Kriva Reka	river and valley unit
Kumanovo valley	valley and agricultural-natural area

Kratovo Volcanic Area	hilly-volcanic landscape
Kuklitsa	a geomorphological natural rarity
The Bislim gorge	landscape of the river Defile
Lipkovo district	hilly, mountainous and watery landscape

In the municipality of Kyustendil, the main natural territories are Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina, Milevska mountain, Kyustendil Basin, Kamenishka Basin, as well as the river basins of the rivers Struma, Banshtitsa, Kolushka, Dragovishtitsa, Bistritsa and other local watercourses. In the planning document of the municipality of Kyustendil, it is stated that the territory of the municipality includes parts of the Milevska, Chudinska, Konyavska, Lisetska and Osogovska mountains, as well as the Kyustendil and Kamenishka basins.

On the Bulgarian side of the Osogovo area, the Natura 2000 sites BG0002079 Osogovo and BG0001011 Osogovska Planina stand out. The BG0001011 Osogovska Planina site covers approximately 34 514 hectares, while the BG0002079 Osogovo site is designated for bird protection in the Osogovo region.

The following table shows the natural and semi-natural areas in the municipality of Kyustendil, with the type of natural area/feature:

Area	Type of natural area/feature
Osogovska Planina	mountain-forest zone
Konyavska Planina	mountainous region
Lisets	mountain and forest area
Chudinska Planina	mountainous region
Milevska Planina	mountainous region
Kyustendil basin	valley and agricultural landscape
Kamenishka Basin	valley
Struma River	major river system
Banshtitsa River	city-river corridor
Kolushka River	city-river corridor
Dragovishtitsa River	river valley
Bistrica River	river valley
Skrino Gorge on the Struma River	landscape of the river Defile
Natura 2000 site “Osogovo”	protected area for birds
Natura 2000 site “Osogovska Planina”	protected habitat area

One of the main pressures on key natural areas is spatial fragmentation. Roads, settlements, infrastructure lines, industrial and commercial areas, agricultural areas and other forms of land use can disrupt the natural connections between larger natural units. This pressure is particularly pronounced in the contact zones between natural areas and settlements, along transport corridors and in suburban areas.

Land-use change poses a significant risk to natural and semi-natural areas. The conversion of open areas for construction, infrastructure, intensive agriculture or other development activities can lead to a reduction in the area of natural habitats, loss of green belts and changes in the landscape structure. In rural and peripheral areas, however, the abandonment of traditional land use can lead to overgrowth of pastures and meadows and changes in the natural character of the open landscape.

Forest areas are exposed to risks related to logging, fire, disease, pests, forest cover degradation and climate stress. In hilly and mountainous areas, especially in areas with steep terrain, disruption of forest cover can be associated with erosion, landslides and increased surface runoff. During the summer period, droughts and high temperatures increase the risk of forest and field fires.

Erosion is a significant risk in parts of the core natural areas, especially on steep, degraded or sparsely forested terrain. It can be exacerbated by improper land use, overgrazing, logging, fires, intense rainfall and insufficient maintenance of natural buffer zones. Erosion affects soil stability, riverbeds, agricultural land and downstream infrastructure.

Climate change poses a horizontal risk to all major natural areas. Increased temperatures, more frequent dry spells, erratic rainfall patterns, heat waves and extreme weather events are affecting forests, grasslands, water resources, biodiversity and natural habitats. In mountainous and hilly areas, climate change can lead to changes in vegetation, increased fire risk and reduced ecosystem stability.

Tourism and recreation pressure is present in areas of natural, landscape, cultural or recreational value. Uncontrolled traffic, informal trails, litter, off-road driving, poorly maintained accesses and seasonally increased visitor numbers can affect sensitive natural spaces. This pressure is particularly important in mountainous, defile, geomorphological and protected areas.

Close to settlements, core natural areas are under pressure from illegal dumping, expanding construction, felling of trees for firewood, informal access roads and degradation of riparian green areas. These phenomena are most often found in the contact zones between settlements, agricultural areas and natural landscapes.

In the river and valley natural units, risks are related to pollution, regulation of river beds, reduction of riparian vegetation, flooding and erosion. Since some of the main natural areas are connected to river systems, the state of water courses and their riparian areas directly affects their natural structure and connectivity.

Insufficient data mapping and updating is an additional challenge. For some natural and semi-natural areas, there is a lack of detailed data on habitat condition, degree of degradation, pressure, ownership, use patterns and the real relationship with the surrounding green and blue elements. This makes it difficult to accurately assess the current state and the need for specific interventions.

5.2. Ecological corridors

Ecological corridors are spaces that enable the connection of natural and semi-natural areas in a single functional network. They provide spatial and ecological connections between forests, mountain areas, river valleys, grasslands, agricultural mosaics, protected areas and urban green spaces. Their main role is to ensure the movement of species, the exchange of genetic material, the maintenance of natural processes and the reduction of habitat isolation.

Within the North-East Planning Region, ecological corridors connect to the river systems of Pchinja**,** Kriva Reka**,** Lipkovska Reka and their tributaries, as well as with the mountainous and hilly regions of the Osogovo Mountains**,** Kozjak**,** German**,** Bilino and Skopska Crna Gora. River valleys are particularly important as natural linear corridors, as they connect higher hilly-mountainous areas with valleys, agricultural and urban areas.

In the municipality of Kyustendil, ecological corridors are connected with Osogovska Planina**,** Konyavska Planina**,** Lisets**,** Chudinska Planina**,** Milevska Planina, as well as with the courses of the rivers Struma**,** Banshtitsa**,** Kolushka**,** Dragovishtitsa. and Bistrica. These spaces create natural connections between the mountain, forest, agricultural and urban parts of the municipality.

Osogovo mountainsare particularly important, as they represent a natural connection between the North-East Planning Region and the municipality of Kyustendil. This mountain range acts as a wider transboundary ecological corridor connecting forests, grasslands, rivers and semi-arid areas. natural habitats on both sides of the border. Such natural connections are important for preserving habitat continuity and maintaining the ecological cohesion of the wider region.

They can be grouped into several categories: river corridors**,** forest corridors**,** mountain corridors**,** agro-landscape corridors and urban-suburban green connections**.** River corridors follow watercourses and riparian vegetation. Forest corridors connect larger forest complexes. Mountain corridors provide a link between highland and mid-mountain landscapes. Agrolandscape corridors are formed by pastures, borders, tree rows, hedgerows and agricultural mosaics. Urban-suburban green links connect parks, tree lines, public green spaces and suburban natural spaces.

The key environmental corridors are shown in the following table:

Corridor	Territory	Type
Pchinja Corridor	North-East Planning Region	river and valley corridor
The Kriva Reka corridor	North-East Planning Region	river and valley corridor
Corridor of the Lipkovska Reka	North-East Planning Region	river corridor
Cross-border corridor Osogovo	Northeast - Kyustendil	mountain-forest corridor
Corridor Kozjak – German – Bilino	North-East Planning Region	mountain and semi-natural corridor
Struma Corridor	Kyustendil municipality	river corridor

Corridor of Banshtitsa and Kolushka	Kyustendil municipality	city-river corridor
Corridor Dragovishtitsa	Kyustendil municipality	river and valley corridor
Osogovo – Konyavska Planina	Kyustendil municipality	mountain-forest corridor

Ecological corridors represent one of the main spatial elements through which the green infrastructure is organised as a network and not as a set of separate natural areas. Their identification and mapping allows a better understanding of the relationships between natural, rural and urban spaces in the North-East Planning Region and Kyustendil Municipality.

5.3. Stepping Stones and Connection Points

Stepped areas or connecting points are smaller green, blue or semi-natural objects that do not always form a continuous corridor, but provide gradual connections between larger natural areas. They function as intermediate spaces in the blue-green network and can be particularly important in fragmented landscapes where natural habitats are interrupted by settlements, farmland, roads, industrial areas or other forms of land use.

This category may include smaller forest fragments, groups of trees, rows of trees, hedgerows, borders, grasslands, small wetlands, springs, lakes, protective green belts, local parks, suburban green spaces, derelict or underutilized areas of natural vegetation, and green spaces along river or road corridors. Although individually they may have a limited area, their spatial distribution can contribute to the connection of larger natural units.

In the North-East Planning Region, stepped areas appear in the agricultural and rural areas between Kumanovo, Lipkovo, Staro Nagorichane, Rankovce, Kriva Palanka and Kratovo, as well as along the rivers and valleys connected to Pchinja, Kriva Reka and their tributaries. In the hilly and mountainous parts, such elements are the smaller forest belts, pastures, springs, local ravines and green areas that connect larger natural areas such as the Osogovo Mountains, Kozjak, German, Bilino and Skopje Black Forest.

In the municipality of Kyustendil, connecting points can be identified in the space between the city of Kyustendil, the surrounding villages, agricultural areas, river valleys and mountain areas. These elements are represented by small forest fragments, orchards with semi-natural borders, green belts along watercourses, green suburban areas, local parks, springs, wet microlocations and natural vegetation in the transition zones to Osogovska Planina, Konyavska Planina, Lisets and other natural formations in the municipality.

The following table shows typical stepped areas/connection points:

Element type	*Examples in space*	*Network role*
Small forest fragments	forest belts, groups of trees, hilly green areas	link between larger forest and mountain areas
Hedges and borders	agricultural and orchard landscapes	connecting through an agricultural matrix
Springs and small wetlands	local water sources, small lakes and wet places	supporting blue infrastructure and water-dependent habitats

Urban green spaces	parks, squares, avenues with trees, schoolyards	connecting urban spaces with a suburban green network
Green areas in the suburbs	abandoned or semi-developed green areas around settlements	transition between urban and rural areas
Infrastructure green belts	greenery along roads, canals and local corridors	reducing fragmentation and creating linear connections

The stepped zones allow a more precise recognition of spaces where the network is not completely continuous, but where there are smaller elements that can improve the connectivity of green and blue infrastructure.

5.4. Buffer zones

Buffer zones are spaces that are created around or between sensitive natural areas, river corridors, protected areas, forests, wetlands, agricultural landscapes and urban areas, with the aim of reducing the direct impact of surrounding activities on natural systems. They act as transition zones between intensively used spaces and elements of green and blue infrastructure.

Within green infrastructure, buffer zones can be found as green belts around protected areas, riparian belts along rivers and streams, forest edges, protective belts around springs and water bodies, green areas between settlements and agricultural or industrial areas, as well as transitional spaces between urban and natural areas. Their width and structure depend on the type of the protected natural element, the intensity of the environmental pressure and the spatial possibilities. Buffer zones can be existing if there is already natural or semi-natural vegetation, or potential if there are conditions for greening, afforestation, restoration or improvement of vegetation in the area.

In the North-East Planning Region, buffer zones are defined along the river corridors of Pchinja, Kriva Reka, Lipkovska Reka and their tributaries, around the forest and hilly-mountainous areas of the Osogovo Mountains, Kozyak, German, Bilino and Skopska Tsrna Gora, as well as around natural and semi-natural spaces that are in contact with settlements, agricultural areas and infrastructure corridors. In urban and suburban areas, buffer zones can appear as green belts between residential, industrial, agricultural and recreational functions.

In the municipality of Kyustendil, the buffer zones are connected to the river corridors of Struma, Banshtitsa, Kolushka, Dragovishtitsa, Bistritsa and other local watercourses, with the forest and mountain areas of Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina and Milevska mountain, as well as protected and Natura 2000 areas. In the city and suburban areas of Kyustendil buffer zones can be represented by green belts along rivers, roads, agricultural areas, urban edges and spaces between settlements and natural landscapes.

The following table shows the typical buffer zones with their main function:

Type of buffer zone	Examples in space	Basic function
River buffer zones	green belts along rivers, streams and canals	reducing pressure on waterways and riparian habitats
Zones at the edges of forests	transition between forests, pastures and agricultural lands	mitigating impacts on forest ecosystems
Buffer zones around protected areas	areas around Natura 2000, Emerald and other protected areas	control of activities in the immediate vicinity of sensitive areas
Urban-suburban buffer zones	green belts between settlements, industrial areas and natural spaces	reducing urban pressure and improving spatial transition
Agricultural protective belts	borders, tree rows, lawns and hedges	reducing erosion, surface runoff and fragmentation
Buffer zones around water sources	protective green belts around springs and water basins	protection of water resources and water quality

Buffer zones complement the structure of the main natural territories, ecological corridors and intermediate zones. They provide spatial transitions between different types of land use and enable better management of contact zones between natural, urban, agricultural and infrastructural spaces.

5.5. River corridors and blue-green corridors

River corridors are linear natural and semi-natural spaces that follow river courses, streams, riparian zones, floodplains and associated vegetation. They are one of the most important elements of blue infrastructure, but they also have a green component through riparian vegetation, forest belts, meadows, wetlands and public green spaces along waterways. Therefore, within this strategy, river corridors are seen as part of a wider blue-green infrastructure network.

Blue-green corridors are spaces where water bodies and green spaces function together. These include rivers, streams, canals, springs, wetlands, riparian zones, parks, forest lines, agricultural green belts and natural vegetation. Their structure can be continuous when there is a continuous belt of water and greenery, or fragmented when connectivity is achieved through steps, small green spaces and local water bodies.

In the North-East Planning Region, the basis of the river and blue-green corridors are the rivers Pchinja, Kriva reka, Lipkovska reka and their tributaries. These watercourses connect the hilly-mountainous, agricultural, urban and rural areas and create natural axes in the regional structure. Various forms of riparian vegetation, arable land, settlements, infrastructure and local natural features appear along them, which are part of a single river system.

In the municipality of Kyustendil, the river and blue-green corridors are connected to the Struma River and the local watercourses Banshtitsa, Kolushka, Dragovishtitsa, Bistritsa, Sovolyanska, Novoselska, Bersinska, Eleshnitsa and other smaller rivers and streams. These river systems pass through urban, suburban, agricultural and natural landscapes and

represent an important spatial structure for connecting the city of Kyustendil with the surrounding rural and mountainous areas.

In urban areas, river corridors are often associated with regulated riverbeds, piers, bridges, streets, public green spaces and other built-up features. In such conditions, the blue-green approach allows watercourses to be considered not only as technical water drainage systems, but also as public spaces, natural connections, recreation lines and elements to improve the microclimate. In suburban and rural areas, river corridors often have greater spatial openness and are associated with agricultural areas, pastures, forest belts and natural riparian vegetation.

The following table shows typical river and blue-green corridors and corridor types:

Corridor	Territory	Corridor type
Dogs	North-East Planning Region	main river and valley corridor
Kriva Reka	North-East Planning Region	river and valley corridor
Lipkovska Reka	North-East Planning Region	local river corridor
Tributaries of the rivers Pchinja and Kriva	North-East Planning Region	secondary blue-green corridors
Struma	Kyustendil municipality	major river system
Banshtitsa	Kyustendil municipality	city-river corridor
Kolushka	Kyustendil municipality	city-river corridor
Dragovishtitsa	Kyustendil municipality	river and valley corridor
Bistrica	Kyustendil municipality	mountain-river corridor
Sovolyanska, Novoselska, Bersinska and Eleshnitsa	Kyustendil municipality	local blue-green corridors

One of the main pressures on river corridors is the regulation and channelization of water courses. In urban areas, riverbeds are often narrowed, reinforced, or confined with concrete and stone structures to protect against flooding or improve flow. Such interventions reduce the natural form of the water course, limit riparian vegetation and reduce the ability to naturally retain and absorb water.

Pollution is another significant pressure. It can arise from urban wastewater, inadequately treated wastewater, informal waste disposal, agricultural wastewater, use of fertilizers and pesticides, and industrial or municipal activities. Pollution affects water quality, the condition of aquatic and riparian habitats, and the ability of river corridors to be used as public, recreational, and natural spaces.

In some river corridors there is a reduction or cessation of riparian vegetation. Removal of trees, shrubs, and grass strips along water courses can increase bank erosion, reduce water shading, increase stream warming, and reduce habitat quality. In agricultural areas, riparian strips are often narrowed by tillage all the way to the river bed.

The risk of flooding is a significant challenge, especially in areas where watercourses cross settlements, agricultural areas or infrastructure corridors. The heavy rainfall, the reduced capacity of the soil for infiltration, the impermeableor poorly permeable surfaces in urban areas and narrowing of riverbeds can lead to rapid increases in flow and localized flooding. In rural and mountainous areas, flash floods can carry sediments and cause damage to land and infrastructure.

Erosion is closely related to rivers and blue-green corridors. It occurs on steep terrain, in degraded watersheds, along banks without stable vegetation, and in areas where the land is exposed to intense rainfall or improper use. Erosion can result in water turbidity, deposition of sediments in the river bed, reduction of flow capacity and alteration of natural water flow dynamics.

Fragmentation of river corridors poses an additional risk. Roads, bridges, embankments, fences, industrial areas, buildings and regulated sections of riverbeds can interrupt the natural continuity of the river space. This is especially pronounced in urban and suburban areas where the river is often treated as a technical channel rather than a blue-green space connected to the social and natural system.

In urban areas, limited public access to waterways is also a challenge. In some areas, riverbanks are difficult to access, undeveloped, or separated from surrounding neighbourhoods by roads, fences, or built-up areas. This reduces the ability of river corridors to function as public green and recreational spaces and limits their role in improving the quality of the urban environment.

Climate change further increases risks to rivers and blue-green corridors. More frequent dry spells can lead to reduced flow, drying up of smaller watercourses and deterioration of water quality. On the other hand, intense rainfall can cause flash flooding, erosion, damage to riverbeds, and transport of pollutants from urban and agricultural areas to watercourses.

In agricultural landscapes, river corridors are under pressure from arable land adjacent to watercourses, reduced riparian buffer zones, and surface runoff of nutrients and agrochemicals. When there is not a sufficiently extensive vegetated zone along the water, the risk of pollution, erosion and loss of natural riparian habitats increases.

5.6. Urban green infrastructure

Urban green infrastructure covers all green and blue-green elements in settlements that contribute to improving the quality of the urban environment, public space, microclimate, recreation and everyday life of the population. It includes parks, squares, tree-lined avenues, street green spaces, school yards, sports and recreation areas, green belts, public open spaces, river banks, urban gardens, green roofs and other forms of greenery in the built environment. Urban green infrastructure has multiple functions in settlements. It contributes to reducing summer temperatures, improving air quality, retaining rainwater, reducing surface runoff, creating shade, improving the visual quality of space and providing places for rest, recreation and social activities. In densely built-up areas, even smaller green spaces, avenues with trees and landscaped courtyards can play a significant role in improving the local microclimate and access to green spaces.

In the North-East Planning Region, urban green infrastructure is most pronounced in larger settlements, especially in Kumanovo, Kriva Palanka and Kratovo, as well as in the municipal centres of Lipkovo, Rankovce and Staro Nagorichane. In these settlements, green areas are manifested as city parks, street greenery, public spaces, sports and entertainment areas,

greenery around public buildings and green areas along waterways and road arteries. Their distribution and connectivity depend on the urban structure, the density of development, the availability of public spaces and the state of the local infrastructure.

In the municipality of Kyustendil, the urban green infrastructure is most concentrated in the city of Kyustendil, which is the main urban, administrative and service centre. It is linked to city parks, public green spaces, street greenery, the space around public buildings, recreational areas, river corridors throughout the city and suburban green spaces that connect the urban core with the surrounding agricultural, rural and natural landscapes.

The following table shows the categories of urban green infrastructure and their main function:

Category	Examples	Basic function
City parks and squares	central parks, neighbourhood parks, public green squares	recreation, leisure, social activities and cooling off
Street greenery	streets with trees, green belts, greenery on the sidewalks	shading, improving air quality and visual quality
Greenery around public buildings	schools, kindergartens, health facilities, administrative buildings	daily access to green areas
Green areas for sports and recreation	sports fields, playgrounds, open recreation areas	physical activity and public use
River urban corridors	wharves, green belts along waterways, landscaped shores	blue-green connectivity and public space
Green spaces in the suburbs	green areas on the outskirts of settlements, transitional spaces to rural areas	connection between urban and natural areas
Green roofs and vertical greenery	buildings with green roofs, facade greenery	additional green areas in densely built-up areas
City gardens	common gardens, small productive green areas	local food, social interaction and educational function

One of the main pressures on urban green infrastructure is the increase in built-up and impermeable surfaces (asphalt, concrete, etc.). The construction of buildings, streets, parking lots, sidewalks, industrial and commercial areas can lead to the reduction of green areas, disruption of green connections and increased surface runoff of stormwater. This pressure is particularly pronounced in more densely populated urban areas and in areas where there is a need for new infrastructure or population expansion.

Another important challenge is the uneven distribution of green spaces in urban areas. In some localities there are public parks, tree-lined avenues and recreational areas, while in other parts access to quality greenery is limited. This creates differences in the quality of public spaces, recreational opportunities and exposure to summer temperatures. Smaller settlements and peripheral urban areas often have less developed green space and weaker connections to public recreational areas.

Urban heat islands pose a significant risk, especially in areas with a high proportion of asphalt, concrete, roof surfaces and insufficient tree cover. In summer, such surfaces absorb and retain

heat, which raises the temperature in urban centres. The lack of shade, trees and green spaces further increases heat stress, especially for the elderly, children, people with health problems and people living in densely built-up areas.

Insufficient maintenance of existing green spaces is a common challenge. It can manifest itself through damaged urban equipment, insufficient irrigation, dry or diseased trees, insufficient lawn care, unmaintained public spaces and poor quality pedestrian and recreational walkways. In smaller settlements, support often depends on the limited financial, technical and human resources of local institutions.

Urban river corridors are under particular pressure. In urban areas, watercourses are often regulated, narrowed or surrounded by built-up areas. The reduction of riparian vegetation, the presence of litter, limited access to banks and poor connectivity with public green spaces can reduce their urban and ecological function. At the same time, intense rainfall can cause localized flooding, especially where stormwater drainage and natural water absorption are limited.

Fragmentation is another important risk for urban green infrastructure. Green spaces often appear as separate and disconnected spaces, with no continuity between parks, forest belts, river corridors, schoolyards, sports fields and suburban green areas. This situation reduces their functionality as a network and limits their contribution to movement, recreation, microclimate improvement and connectivity to wider natural areas.

In peri-urban areas, green infrastructure is exposed to pressure from settlement expansion, new building construction, land use change, the emergence of informal or poorly controlled interventions, parking lots, storage facilities and the development of local infrastructure. These spaces often play an important transitional role between the city and the surrounding agricultural or natural landscapes, but are also among the most vulnerable to conversion and gradual loss of green structure.

For street greens, the main risks are insufficient root space, damage from traffic and construction activities, inappropriate selection of species, insufficient maintenance, drying of trees and breaks in the tree line. In streets with a limited profile, greenery is often suppressed by the needs of traffic, parking and underground infrastructure. This reduces the possibility of creating continuous shaded pedestrian corridors.

An additional challenge is the lack of systematic mapping and registration of urban green spaces. In many cases, there is no complete and up-to-date database on the area, type, ownership, condition, availability and quality of green spaces. Without such records, it is more difficult to planthe maintenance, expansion, reconstruction or connection of green spaces in a functional urban network.

5.7. Elements of agricultural and semi-natural landscapes

The elements of agricultural and semi-natural landscapes are part of the wider network of green infrastructure, as they fill the space between the main natural areas, river corridors, urban green spaces and rural settlements, and are an important part of the blue-green infrastructure network, especially in areas where natural areas, rural settlements, pastures, cultivated land, orchards, forest belts and river valleys are intertwined in a mosaic spatial structure. These elements are mostly not completely natural, but have a significant spatial and ecological role due to the presence of vegetation, open spaces, water bodies and traditional forms of land use.

This category includes arable agricultural land, pastures, meadows, orchards, vineyards, agricultural borders, hedgerows, tree rows, buffer strips, small forest fragments, pastures, abandoned or semi-active agricultural plots, as well as transitional spaces between agricultural, forest and natural land. In rural and suburban areas, these elements often represent a link between larger natural areas and settlements.

In the North-East Planning Region, the agricultural and semi-natural landscapes are represented in the Kumanovska hollow, the valleys of Pchinja and Kriva Reka, the rural areas of Lipkovo, Staro Nagorichane, Rankovce, Kriva Palanka and Kratovo, as well as in the transition zones to Kozjak, German, Bilino, Skopje Tsrna Gora and the Osogovo mountains. Cultivated land, grasslands, hilly meadows, mosaic agricultural landscapes, small forest belts, borders and local watercourses are found in these areas.

In the municipality of Kyustendil, the agricultural and semi-natural landscapes are connected to the Kyustendil Basin, rural settlements around the city, orchards, meadows, pastures, river valleys and transition zones to Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina and Milevska Planina. Particularly recognizable are the agricultural and orchard landscapes, which create a mosaic structure between the urban core, villages and natural areas.

The following table shows the typical elements of agricultural and semi-natural landscapes and their main spatial role:

Category	Examples	Main spatial role
Machinable surfaces	fields, grain areas, vegetable areas	part of the rural land matrix
Pastures and meadows	hilly pastures, lawns, seasonally used meadows	open semi-natural areas
Orchards and vineyards	traditional orchards, mosaic plantations, vineyards	the structural diversity of the agricultural landscape
Borders and hedges	borders between plots, shrub belts, naturaledges	linear connecting elements
Tree rows and protective belts	trees along roads, canals, plots and settlements	visual, protective and bonding function
Small forest fragments	groups of trees, forest islands, hilly green belts	connecting agricultural and natural areas
Contact zones between agricultural rivers	agricultural areas along rivers and streams	transition between agriculture and blue infrastructure
Abandoned or semi-active areas	uncultivable plots, naturally vegetated areas	potential semi-natural connecting spaces

Agricultural and semi-natural landscapes are exposed to various pressures resulting from land use patterns, changes in the rural economy, climate change, infrastructure development and demographic processes. These landscapes are particularly sensitive because they are located in the transition zone between natural areas, settlements, agricultural areas and infrastructure corridors.

The following table shows the main stresses, challenges and risks in agricultural and semi-natural landscapes that are characteristic of the North-East Planning Region and Kyustendil Municipality:

Category	Tension, challenge or risk	A possible spatial phenomenon
Intensification of agriculture	Removal of curbs, hedges, grass strips and small natural features	arable land and agricultural valleys
Abandonment of land	Overgrowth of meadows, pastures and arable land	rural and peripheral areas
Erosion	Loss of topsoil and increased surface runoff	hilly, sloping and sparsely wooded terrain
Climate change	Droughts, heat waves, erratic rainfall and fire risk	agricultural, pasture and semi-natural areas
Fragmentation	Breaking the links between natural and agricultural landscapes	roads, settlements, industrial and infrastructure areas
Pollution	Impact of fertilizers, pesticides and improper waste water management	agricultural areas and areas in contact with rivers
Overgrazing	Grass cover degradation and soil compaction	grasslands and hilly grasslands
Underutilization of pastures	Restoration and modification of open semi-natural habitats	abandoned pastures and meadows
Change in land use	Reduction of agricultural and open green areas	suburban areas and outskirts of settlements
Insufficient mapping	Invisibility of small but significant semi-natural elements	borders, forest lines, springs, small wetlands

In the North-East planning region, these loads are found in the agricultural and rural areas of Kumanovo, Lipkovo, Staro Nagorichane, Rankovce, Kriva Palanka and Kratovo, as well as in the transition zones to the hilly and mountainous areas. In the municipality of Kyustendil, they are connected with the Kyustendil Basin, the orchards and agricultural areas, the rural settlements, the suburban areas around the city and the transitional areas to the mountain and forest areas.

5.8. Degraded areas with potential for restoration

Degraded areas with restoration potential include areas where natural, agricultural, aquatic, or urban functions have been disrupted by waste, erosion, mining and other excavations, abandoned or inappropriate land use, regulated river corridors, neglected public spaces, or other anthropogenic stresses.

landfills and waste sites can be designated as priority sites for recovery. Four landfills classified according to risk have been identified: Konopnitsa landfill in Kriva Palanka municipality with high risk, Krasta landfill in Kumanovo municipality with medium risk, as well as Zheleznitsa sites in Kratovo municipality and another low-risk landfill. Also, illegal landfills are reported to occur in rural areas due to insufficient coverage with organised waste collection.

In addition, degraded or sensitive areas with potential for recovery in the North-Eastern region can be considered erosion zones in the basins of Pchinja and Kriva Reka, degraded riparian belts along watercourses, neglected suburban green areas around Kumanovo, Kriva Palanka, Kratovo and Lipkovo, as well as areas around road and infrastructure corridors where natural connectivity is interrupted. In addition, reclamation of degraded areas and municipal solid waste landfills is necessary.

In the municipality of Kyustendil, the degraded areas are associated with landfills, disturbed terrain, mining and other types of excavations, river corridors under urban pressure and places with inappropriate waste disposal.

In the municipality of Kyustendil, the disturbed areas include places related to geological surveys, mining and excavation activities: the open-pit brown coal mine "Katrishte", the Osogovo ore area with polymetallic ores, the Konyavska Planina with limestone, Osogovo with granite and lead-zinc ores, as well as the area near the village of Dragovishtitsa with clays. There are no highly eroded areas on the territory of the municipality, but there are physically disturbed soils and areas from excavation activities.

As an additional place for management and potential development, the area "Reshetka" in the land of the city of Kyustendil, where there is a landfill for construction waste, and expansion of the landfill is being considered.

Table: Indicative degraded areas with restoration potential

Territory	Location / area	Type of degradation	Potential recovery
North-East Planning Region	"Konopnitsa", Kriva Palanka municipality	high risk landfill	closure, rehabilitation, reclamation, landscaping
	"Krasta", Kumanovo Municipality	medium risk landfill	removal, leak control, reclamation
	"Zheleznitsa", municipality of Kratovo	low risk landfill	local restoration and landscaping
	rural settlements in the region	illegal dumps	cleaning, prevention of recurrence, local landscaping
	The basin of the rivers Pchinja and Kriva reka	erosion, sediments, degraded shorelines	riverbank stabilisation, riparian vegetation, blue-green belts
	suburban areas around Kumanovo, Kriva Palanka, Kratovo and Lipkovo	neglected green and open spaces	urban landscaping, public green spaces, connecting corridors
Kyustendil municipality	"Hungry Hill", village of Radlovtsi	closed municipal waste landfill	reclamation, technical rehabilitation, landscaping
	Locality "Reshetka", city of Kyustendil	landfill for construction waste	regulation, control, rehabilitation and reclamation
	"Katrishte"	extraction of disturbed terrain	technical and biological reclamation
	Osogovo mining district	mining and quarrying activities	rehabilitation of disturbed surfaces, erosion control
	Konyavska Planina	limestone quarry	reclamation of excavated areas
	Osogovo	mining of granite and lead-zinc ores	rehabilitation, stabilization, afforestation
	Dragovishtitsa village	clay mining	reclamation and landscaping
	the urban river corridors Banštitsa and Kolushka	regulated/polluted river sections, litter, reduced vegetation	cleaning, riverside landscaping, blue-green landscaping

6. Valuation of ecosystem services

Ecosystem services are the benefits that people receive from nature and the functioning of ecosystems. These include providing clean air and water, food production, climate regulation, stormwater retention, flood and erosion risk reduction, pollination, carbon storage and space for recreation, health and well-being.

In the context of green infrastructure, ecosystem services show that natural and semi-natural areas have not only ecological value, but also practical benefits for the population, economy and local development. Well-preserved forests, river corridors, grasslands, parks and agricultural landscapes can simultaneously provide multiple services, such as protecting the soil, improving the microclimate, supporting biodiversity and creating a better quality living space.

6.1. Climate regulation and carbon storage

Climate regulation and carbon storage are important ecosystem services provided by forests, grasslands, agricultural landscapes, river corridors, urban green spaces and other natural and semi-natural areas. This service refers to the ability of green and blue elements to absorb and store carbon, reduce local temperatures, provide shade, retain soil moisture and contribute to climate change mitigation.

In the North-East planning region, the greatest potential for climate regulation and carbon storage is in the forest and hilly-mountainous areas, especially in the Osogovo, Kozjak, German, Bilino and Skopska Crna Gora mountains. These areas contain forest and semi-natural vegetation that play an important role in carbon absorption, temperature reduction, moisture retention and stabilization of the local microclimate. Grasslands, meadows and mosaic rural landscapes have a lower carbon storage capacity than forests, but contribute to maintaining open green areas and reducing global warming.

In the municipality of Kyustendil, the most significant role in this service is played by the forest and mountain areas of Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina and Milevska Planina. These areas represent larger green areas with the capacity to store carbon in tree mass, soil and natural vegetation. An additional role is played by the Kyustendil and Kamenishka valleys, the agricultural and orchard areas, as well as the green suburban spaces that connect the city of Kyustendil with the surrounding rural and natural areas.

River corridors have an important microclimatic function on both sides of the transboundary zone. In the North-East Planning Region, these are the corridors of Pchinja, Kriva reka, Lipkovska reka and their tributaries, while in Kyustendil municipality these are Struma, Banshtitsa, Kolushka, Dragovishtitsa, Bistritsa and other local watercourses. The presence of water and riparian vegetation contributes to natural cooling, increasing air humidity and reducing heat stress in valley, urban and suburban areas.

Urban green spaces play a particular role in reducing local temperatures and the urban heat island effect. In the North-East planning region, these are the green spaces in Kumanovo, Kriva Palanka, Kratovo and other municipal centres, while in the municipality of Kyustendil, the biggest role is played by the parks, tree stands, public green spaces, greenery around public buildings and river city corridors in the city of Kyustendil. Although urban greenery has a lower carbon storage capacity than forests, its value is high in terms of shading, cooling, improving air quality and reducing temperatures in built-up areas.

The evaluation of this ecosystem service was carried out according to the type of land cover, the area of green areas, the density and condition of the vegetation, the presence of tree cover, the connection with other green elements, the presence of water bodies and the exposure to heat stress. Areas with greater forest cover, continuous vegetation, and less urbanisation received a higher value, while degraded, neglected, and heavily built-up areas had a lower current value.

Table: Assessment of climate regulation and carbon storage

Territory	Element / area	Carbon storage capacity	Microclimate function	Overall indicative score
Northeast planning region	Osogovo mountains	5	5	very high
	Kozjak, German and Bilino	4	4	high
	Skopska Crna Gora	4	4	high
	Pchinja and Kriva Reka	3	4	high
	Lipkovska Reka and its local tributaries	3	3	medium to high
	Grasslands, meadows and mosaic rural landscapes	3	3	the environment
	Urban green spaces	3	5	high
	Degraded and abandoned areas	1	1	low
Kyustendil municipality	Osogovska Planina	5	5	very high
	Konyavska planina, Lisets, Chudinska and Milevska planina	4	4	high
	Struma, Banštitsa, Kolushka, Dragovishtitsa and Bistritsa	3	4	high
	Agricultural and fruit landscapes	2	3	the environment
	Urban green spaces in the city of Kyustendil	3	5	high
	Green spaces in the suburbs	3	4	medium to high
	Degraded and mining/excavated areas	1	1	low

6.2. Reduction of Flood Risk and Water Retention

Flood risk reduction and water retention are important ecosystem services,provided by river corridors, riparian vegetation, forests, grasslands, meadows, wetlands, agricultural green belts and urban green spaces. These elements contribute to slowing surface runoff, absorbing rainwater into the soil, retaining water in the landscape, and reducing the risk of flash floods and flooding.

In the North-East Planning Region, the river corridors of Pchinja, Kriva Reka, Lipkovska Reka and their tributaries, as well as the hilly and mountainous areas that influence the water regime in the basins, play the greatest role in this service. Forest areas, grasslands and natural vegetation in the upper parts of the basins contribute to the retention of water and the reduction of erosion and runoff processes. In urban areas, green spaces are important to reduce surface water runoff. impervious surfaces.

In the municipality of Kyustendil, this service is connected to the basin of the Struma River and the river corridors Banštitsa, Kolushka, Dragovishtitsa, Bistritsa and other local watercourses. The mountain and forest areas of Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina and Milevska Planina play a role in the regulation of runoff and retention of water in the higher parts of the basins. In the city of Kyustendil, urban green spaces and river corridors can contribute to reducing local flooding during intense rainfall events.

Table: Evaluation of risk of flooding and water retention

Territory	Element / area	Water retention	Regulation	Total score
North-East Planning Region	Pchinja and Kriva Reka	5	5	very high
North-East Planning Region	Lipkovska Reka and its local tributaries	4	4	high
North-East Planning Region	Osogovo mountains and hilly-mountainous valleys	4	4	high
North-East Planning Region	Urban green spaces	3	3	the environment
Kyustendil municipality	Stream and its main tributaries	5	5	very high
Kyustendil municipality	Banshtitsa and Kolushka	4	4	high
Kyustendil municipality	Mountain and forest areas	4	4	high
Kyustendil municipality	Urban green spaces	3	3	the environment

6.3. Soil Protection and Erosion Control

Soil protection and erosion control relate to the ability of natural and semi-natural vegetation to stabilize soil, reduce surface runoff, prevent loss of topsoil, and reduce the entry of alluvial material into riverbeds. This service is especially important in hilly, erosive and agricultural areas.

In the North-East Planning Region, the Osogovo Mountains, Kozjak, German, Bilino, Skopje Tsrna Gora, Bislim Gorge and hilly areas in Kratovo and Kriva Palanka area have a higher value for this service. Forests, pastures, meadows and natural vegetation on sloping terrain play an important role in soil stabilization. Agricultural areas on sloping terrain have a lower value if they do not have borders, grass belts, tree rows or protective vegetation.

In the municipality of Kyustendil, soil protection is related to the mountainous and hilly areas of Osogovska Planina, Konyavska Planina, Lisets, Chudinska Planina and Milevska Planina, as well as to the river valleys and agricultural areas in the valley parts. Forested areas have the greatest role in erosion control, while degraded, mined and mined areas have a low current value and a higher risk of soil disturbance.

Table: Evaluation of forsoil protection and erosion control

Territory	Element / area	Soil protection	Erosion control	Total score
North-East Planning Region	Osogovo mountains	5	5	very high
	Kozjak, German, Bilino	4	4	high
	Bislim and hilly areas	4	4	high
	Agricultural landscapes	2	2	low to medium
Kyustendil municipality	Osogovska Planina	5	5	very high
	Konyavska planina, Lisets, Chudinska and Milevska planina	4	4	high
	Agricultural and fruit landscapes	2	3	the environment
	Mining and other excavations	1	1	low

6.4. Support for biodiversity and habitats

Biodiversity and habitat support refers to the ability of green and blue infrastructure to provide conditions for the survival, movement, feeding, reproduction and shelter of plant and animal species. This service is most pronounced in natural and semi-natural environments. natural areas with higherdegree of conservation, in forests, river corridors, grasslands, gorges, wetlands and protected areas.

In the North-East Planning Region, the Osogovo mountains, the Bislim Gorge, the river corridors of Pchinja and Kriva Reka, the volcanic region of Kratovo, Kuklitsa, the pastures,

meadows and mosaic rural landscapes have the greatest value. These areas offer different types of habitats: forest, grassland, riverine, rocky, agricultural - semi-natural and gorge.

In the Municipality of Kyustendil, the highest biodiversity value is found in Osogovo Mountain, the Natura 2000 sites, Konyavska Planina, Lisets, Chudinska Planina, Milevska Mountain, the river valleys of the Struma, Dragovishtitsa, Bistritsa, Banshtitsa and Kolushka, as well as the orchards and mosaic agricultural landscapes. Areas with continuous vegetation and connections to river or mountain systems have a higher value.

Table: Evaluation of Biodiversity and Habitat Maintenance

Territory	Element / area	Habitat diversity	Connectivity	Total score
North-East Planning Region	Osogovo mountains	5	5	very high
	The Bislim gorge	4	4	high
	Pchinja and Kriva Reka	4	4	high
	Mosaic rural landscapes	4	3	high
Kyustendil municipality	Osogovska Planina / Natura 2000	5	5	very high
	Konyavska Planina, Lisets and other mountainous areas	4	4	high
	Struma and local river corridors	4	4	high
	Orchards and rural mosaic landscapes	3	3	the environment

6.5. Improving air quality

Improving air quality is ecosystem service, provided by the ability of vegetation to hold dust, absorb some of the pollutants, produce oxygen, create shade and improve the microclimate. This service is especially important in urban and suburban environment, along transport corridors and in areas with a higher concentration of population and activities.

In the North-East planning region, the most important elements for this service are urban green areas in Kumanovo, Kriva Palanka, Kratovo and other settlements, tree rows, greenery around public buildings, suburban green belts, river city corridors and forest areas around settlements. Kumanovo, likelargest urban centre, has the greatest need for urban greenery due to the concentration of traffic, built-up space and urban activities.

In the municipality of Kyustendil, the biggest role is played by city parks, tree lines, green public areas, river corridors throughout the city, greenery around public buildings andthe suburban onesgreen areas. The forest and mountain areas surrounding the city have an additional role in improving the wider microclimatic conditions and air quality.

Table: Assessment of Air Quality Improvement

Territory	Element / area	Air filtration	Local cooling	Total score
North-East Planning Region	Urban green spaces in Kumanovo	4	5	high
	Urban green spaces in Kriva Palanka and Kratovo	3	4	medium to high
	Green belts in the suburbs	3	4	medium to high
	Forest areas	5	4	high
Kyustendil municipality	Urban green spaces in the city of Kyustendil	4	5	high
	Urban corridors, tree-lined and riverside	4	4	high
	Green spaces in the suburbs	3	4	medium to high
	Mountain and forest areas	5	4	high

6.6. Rest, health and well-being

Recreation, health and well-being are cultural and social ecosystem services, which arise from the population's ability to use green and blue spaces for rest, movement, sports, recreation, social activities, contact with nature and improvement of physical and mental health.

In the North-East Planning Region, this service is connected to the urban green spaces in Kumanovo, Kriva Palanka, Kratovo and other settlements, with the natural and recreational areas such as the Osogovo Mountains, Kuklitsa, the Bislim gorge, the Kratovo volcanic area, the river valleys and rural areas. The accessibility, location and connectivity of these areas affect their recreational value.

In the municipality of Kyustendil, the recreational function is related to the city parks, public green spaces, river corridors, mineral waters, Osogovska Planina, Konyavska Planina, Lisets, the surrounding rural and orchard areas, as well as the cultural and natural locations around the city. The city of Kyustendil has a special role due to the connection of the urban environment with spa, recreational and natural resources.

Table: Evaluation of Recreation, health and well-being

Territory	Element / area	Recreational value	Accessibility	Total score
North-East Planning Region	Urban green spaces	5	4	high
	Osogovo mountains	5	3	high
	Kuklitsa and Kratovsky Volcanic Region	4	3	medium to high

	The Bislim gorge	4	3	medium to high
Kyustendil municipality	Urban green spaces in the city of Kyustendil	5	5	very high
	Osogovska Planina	5	3	high
	Mineral waters and spa areas	5	4	high
	Rural and orchard landscapes	3	3	the environment

6.7. Cultural landscape and tourism value

Cultural landscape and tourism value are related to the natural, historical, agricultural, architectural and traditional characteristics of the space. This service covers the visual, cultural, recreational and identity values provided by landscapes, natural forms, traditional rural spaces, cultural sites and urban green spaces.

In the North-East Planning Region, the tourism-related and cultural-landscape value is associated with Kratovo, Kuklitsa, the Kratovo volcanic region, the Bislim Gorge, the Osogovo Mountains, Kriva Palanka, rural areas, monastic and cultural sites, as well as river and mountain landscapes. These areas create a recognizable regional identity, especially through a combination of natural, geomorphological, cultural and traditional elements.

In the municipality of Kyustendil, the cultural landscape and tourist value are connected with the city of Kyustendil, the mineral waters and established balneological traditions, the Osogovo mountain, the rural and orchard landscapes, the cultural-historical heritage, the river valleys and the mountain areas. The combination of natural, historical, health and recreational resources forms a diverse tourist base and creates conditions for the development of year-round tourism.

Kyustendil is one of the most ancient cities in Bulgaria, with a history stretching back more than 8000 years. Its cultural landscape is formed by the interaction between the rich historical heritage, architectural monuments, mineral springs, natural environment and preserved local traditions. The city is the successor of the ancient Pautalia and the medieval Velbazhd, which confirms it as an important historical and cultural centre in Southwestern Bulgaria.

Among the most significant cultural and historical sights are the Hisarluka fortress, the Roman baths, the medieval churches, the Ahmed Bey mosque, the Vladimir Dimitrov - Master art gallery, the Regional History Museum and the Dimitar Peshev House Museum. These sites represent different stages of the historical development of the city - from antiquity and the Middle Ages to modern times - and have a significant contribution to its characteristic cultural appearance and tourist attraction.

The natural features are an integral part of the cultural landscape of the municipality. Kyustendil is located at the foot of the Osogovo mountain and is known for its mineral springs, parks, forest areas and orchards. Traditional fruit growing and characteristic rural landscapes complement the identity of the area and create opportunities for the development of rural, ecological and gastronomic tourism.

Mineral waters are among the main natural resources of Kyustendil and are important for the historical development, spatial structure and economic profile of the city. Their use since antiquity has contributed to the formation of sustainable balneological and healing traditions. In the modern context, mineral waters provide opportunities for the development of balneotherapy, medical, health, wellness and spa tourism.

The tourist value of Kyustendil is determined by the diversity and complementarity of tourist resources. The city offers cultural and historical routes, visits to museums and art galleries, balneotherapy and spa services, festivals, exhibitions and other cultural events, as well as opportunities for hiking, mountain and nature-based tourism in Osogovo. Of particular importance is the "Vladimir Dimitrov - Master" art gallery, which houses the richest collection of works by the famous Bulgarian artist and is included among the Hundred National Tourist Sites.

Events related to local culture, art, horticulture, traditional foods and customs complement the tourist offer and strengthen the local identity. They create opportunities to attract visitors during different periods of the year and to involve local producers, cultural institutions, the tourism sector and civil organisations in the development of a sustainable tourism product.

Thanks to its strategic location near the borders with the Republic of North Macedonia and the Republic of Serbia, Kyustendil has a significant potential for the development of international and cross-border tourism. It is possible to form joint routes that connect natural sights, mineral springs, cultural and historical sites, monasteries, traditional settlements and protected areas on both sides of the border.

The rich cultural heritage, combined with mineral waters, natural resources and landscape diversity, confirms Kyustendil as an attractivea year-round tourist destination. The sustainable use of this potential requires the preservation of the authentic cultural landscape, the improvement of the tourist infrastructure, the connection of the individual natural and cultural sites in common routes and the integration of the green infrastructure in the development of tourism.

Table: Evaluation of the Cultural Landscape and Tourism Value

Territory	*Element / area*	*Cultural and landscape value*	*Tourist value*	*Total score*
North-East Planning Region	Kratovo and the Kratovsko volcanic region	5	4	high
	Kuklitsa	5	4	high
	Osogovo mountains	4	4	high
	The Bislim gorge	4	3	medium to high
Kyustendil municipality	The city of Kyustendil and its cultural heritage	5	5	very high
	Mineral waters and spa areas	5	5	very high
	Osogovska Planina	4	4	high
	Orchards and rural areas	4	3	medium to high

6.8. Economic and social benefits

The economic and social benefits of green infrastructure relate to its contribution to local development, quality of life, tourism, recreation, agriculture, health, attractiveness of space, risk reduction and improvement of public services. These benefits are not limited to direct economic value, but also include savings from reduced damage from floods, erosion and heat waves, as well as better living and working conditions.

In the North-East Planning Region, economic and social benefits are linked to agriculture, rural development, nature and culture-based tourism, urban greening, improvement of public spaces and reduction of climate and natural risks. Green infrastructure can support the local economy by improving tourism supply, protecting agricultural resources, increasing the quality of urban spaces and improving living conditions.

In the municipality of Kyustendil, the economic and social benefits of green and blue infrastructure are related to the development of spa and health tourism, the use of mineral waters, fruit growing, rural and nature-based tourism, cultural heritage, mountain spaces and urban green areas. Green and blue infrastructure contribute to increasing attractivenessof the city and surrounding settlements, improving recreational opportunities and supporting sustainable local economic activities.

The development of tourism in Kyustendil creates significant economic and social benefits for the local community. The rich cultural and historical heritage, mineral springs, natural resources and the proximity of the Osogovo mountain create conditions for attracting visitors throughout the year. This stimulates the local economy and allows tourism activities to be linked to health, culture, agriculture, food production, trade, transport and various local services.

The main economic benefits include:

- creation of new jobs in hotels, restaurants, balneology, transport, trade and tourist services;
- increasing the income of local businesses through the consumption of tourist goods and services;
- promoting investments in tourist infrastructure, cultural sites, spa and balneology complexes, accommodation and recreational facilities;
- increasing revenues in the municipal budget through tourist tax, local taxes and fees and development of entrepreneurship;
- support for local farmers, fruit growers, processors and artisans by offering traditional products, local foods, drinks and souvenirs;
- creating opportunities for the development of small and medium-sized enterprises, family hotels, guest houses, restaurants and specialised tourist services;
- extension of the tourist season by combining balneological, cultural, mountain, rural, ecological and event tourism.

Green and blue infrastructure have a direct economic impact, as quality parks, river corridors, forest areas, hiking trails and well-maintained public spaces increase the attractiveness of a destination. They create conditions for a longer stay of visitors, diversification of the tourist offer and development of services related to recreation, sports, health and nature-based tourism.

The main social benefits include:

- improving the quality of life through the development and maintenance of green areas, public spaces, tourist infrastructure and transport links;
- expanding opportunities for recreation, sports and outdoor movement for the local population and visitors;
- positive impact on physical and mental health through access to parks, forest areas, mineral waters and natural spaces;
- preservation and promotion of the cultural-historical heritage, traditions, local customs and characteristic cultural landscapes;
- organizing festivals, exhibitions, artistic events and other cultural events that enrich public life and attract visitors;
- strengthening local identity and sense of belonging among residents;
- promotion of intercultural exchange through contacts between the local population and visitors from Bulgaria and other countries;
- creating opportunities for the inclusion of young people, the elderly, local associations and vulnerable groups in public, cultural and tourism initiatives.

The development of tourism also creates opportunities for cooperation between the municipality, cultural institutions, the tourism sector, local producers, educational institutions and civil organisations. Through joint initiatives, integrated tourism products can be developed that combine mineral waters, cultural heritage, natural attractions, local cuisine, traditional crafts and the event calendar.

It is necessary, however, that the tourist development be consistent with the capacity of the natural and urban environment. The increase in the tourist flow must not lead to an excessive load on water resources, waste generation, damage to natural habitats or loss of the authenticity of the cultural landscape. Investments in tourism should therefore be accompanied by measures to protect nature, sustainable resource management, accessible infrastructure and effective waste and wastewater management.

In conclusion, tourism and green infrastructure are important for the sustainable development of the municipality of Kyustendil. They contribute to economic growth, the creation of jobs, the development of local entrepreneurship, the improvement of the living environment and the protection of natural and cultural heritage. The full use of this potential requires an integrated approach, in which economic development is combined with conservation of natural resources, social inclusion and long-term improvement of the quality of life.

Table: Evaluation of Economic and Social Benefits

Territory	*Element / area*	*Economic benefit*	*Social assistance*	*Total score*
North-East Planning Region	Agricultural and rural areas	4	3	medium to high
	Urban green spaces	3	5	high
	Natural and tourist areas	4	4	high
	River corridors	3	4	medium to high

Kyustendil municipality	Mineral waters and spa areas	5	5	very high
	Urban green spaces	3	5	high
	Orchards and rural areas	4	3	medium to high
	Mountain and natural areas	4	4	high

6.9. Overall Score

The assessment of ecosystem services is done by determining the benefits that different elements of green and blue infrastructure provide and how much they contribute to the environment, population and local development. The assessment made is combined (qualitative and quantitative).

First, the evaluated elements are identified, ie. forests, river corridors, grasslands, agricultural landscapes, urban parks, wetlands and protected areas. Each element is then identified as to what ecosystem services it provides, for example climate regulation, water retention, erosion control, biodiversity support, recreation or food production.

The assessment was carried out according to predetermined criteria, such as the area of the area, the degree of naturalness, the condition of the vegetation, the relationship with other natural elements, the presence of water, exposure to risks, accessibility to the population and the role in reducing climate pressure, and each criterion was assessed on a scale from 1 to 5, where 1 means a very low value and 5 means a very high value.

The following table shows the matrix used.

Item	Climate regulation	Water retention	Erosion protection	Biodiversity	Rest
It's burning	5	4	5	5	3
River corridors	3	5	4	4	4
Pastures	3	3	3	4	2
City parks	4	3	2	3	5
Agricultural landscapes	2	2	2	3	2

The assessment of ecosystem services in the North-East Planning Region and Kyustendil Municipality was made as an indicative qualitative assessment, based on the main elements of green and blue infrastructure: forest and mountain areas, river corridors, agricultural landscapes, pastures and meadows, urban green areas, protected and naturally significant areas, as well as degraded areas with restoration potential.

Table: Assessment of ecosystem services in the North-East planning region

An element of green/blue infrastructure	Climate regulation and carbon	Water retention and flood regulation	Erosion protection	Biodiversity and habitats	Air quality	Rest and health	Cultural landscape and tourism	Economic and social benefits	Total score
Osogovo mountains	5	4	5	5	5	4	4	4	36
Kozjak, German and Bilino	4	3	4	4	4	3	3	3	28
Skopska Crna Gora	4	3	4	4	4	3	3	3	28
The Pchinja River Corridor	3	5	4	4	3	3	3	3	28
River corridor of Kriva Reka	3	5	4	4	3	3	3	3	28
Lipkovska Reka and its local tributaries	3	4	3	3	3	3	2	3	24
Pastures and meadows	3	3	3	4	3	2	3	4	25
Mosaic rural landscapes	3	3	3	4	3	3	4	4	27
Agricultural areas in Kumanovsko and Kratovsko	2	2	2	3	2	2	3	5	21
Urban green spaces in Kumanovo, Kriva Palanka and Kratovo	3	3	2	3	4	5	3	5	28
Kuklitsa and Kratovsky Volcanic Region	2	2	3	3	2	4	5	4	25
The Bislim gorge	3	3	4	4	3	4	4	3	28

Degraded areas with potential for restoration	1	2	2	1	1	1	1	1	10
Total	39	42	44	46	40	40	38	42	331

The total score for ecosystem services in the North-East Planning Region is 331 points out of a maximum of 520 points or an average score of about 3.18 on a scale from 1 to 5.

Table: Ecosystem Services Assessmentin the municipality of Kyustendil

An element of green/blue infrastructure	Climate regulation and carbon	Water retention and regulation	Erosion protection	Biodiversity and habitats	Air quality	Rest and health	Cultural landscape and tourism	Economic and social benefits	**Total score**
Osogovska Planina	5	4	5	5	5	4	4	4	**36**
Konyavska planina, Lisets, Chudinska and Milevska planina	4	4	4	4	4	3	3	3	**29**
Natura 2000 site “Osogovo” and "Osogovska" zones. mountain	5	4	5	5	5	4	4	4	**36**
The Struma River Corridor	3	5	4	4	3	4	4	4	**31**
Banštitsa, Kolushka, Dragovishtitsa and Bistritsa	3	4	3	4	3	4	3	3	**27**

Urban green spaces in the city of Kyustendil	3	3	2	3	4	5	4	5	**29**
Green spaces in the suburbs	3	3	3	3	3	4	3	3	**25**
Agricultural and fruit landscapes	2	3	3	3	2	3	4	4	**24**
Mosaic rural landscapes	3	3	3	4	3	3	4	4	**27**
Mineral waters and spa areas	2	3	2	2	3	5	5	5	**27**
Degraded, mining and other excavation activities	1	1	1	1	1	1	1	1	**8**
Total	34	37	35	38	36	40	39	40	**299**

The overall assessment for ecosystem services in Kyustendil municipality is 229 points out of the maximum 520 points, or an average score of about 2.88 on a scale from 1 to 5.

According to the assessment, the highest total value is in the Osogovo Mountains and the Natura 2000 areas associated with the Osogovo area. These areas have high value for carbon storage, climate regulation, erosion protection, biodiversity support, air quality, as well as recreation and tourism. Their role is strongest in services that depend on forest cover, natural vegetation, mountain topography and protected habitats.

The Struma River Corridor has a very high value for water retention and flood prevention, as well as a high value for biodiversity, recreation and cultural-landscape function. The local river corridors Banštitsa, Kolushka, Dragovishtitsa and Bistritsa play an important role in connecting urban, suburban, agricultural and natural spaces. Their value is related in particular to the blue-green connection, the microclimate and the possibilities for organizing public and recreational spaces.

Urban green spaces in the city of Kyustendil have the highest value in terms of recreation, health, well-being and social benefits. They have an important function for daily access to green spaces, cooling the urban environment, improving air quality and creating public spaces for rest, movement and social interaction. Their carbon storage capacity is lower than that of mountain and forest areas, but their local microclimatic and social value is high.

Agricultural and orchard landscapes have a medium to high value, especially in terms of economic benefits, cultural landscape and local identity. In the municipality of Kyustendil, orchards and rural landscapes are a significant part of the spatial and economic character of the municipality. Mosaic rural landscapes, where orchards, meadows, pastures, fens, small forest fragments, villages and watercourses intertwine, have a higher ecological value than uniform agricultural areas.

Mineral waters and spa areas have a very high recreational, health, tourist and economic value. Their ecosystem value derives not only from the natural resource, but also from its relationship with public use, health tourism, cultural identity and the local economy.

Degraded mining areas have a low present value for ecosystem services. However, they can be considered as spaces with potential for improvement if rehabilitation, reclamation, afforestation, soil stabilization, landscaping and connection to the wider green infrastructure network are implemented.

According to this indicative assessment, the highest total value is observed in the Osogovo Mountains, the Pchinja and Kriva Reka river corridors, as well as in the larger hilly-mountainous and mosaic rural landscapes. These areas simultaneously provide multiple ecosystem services, notably climate regulation, erosion protection, biodiversity support, water retention, and recreational opportunities.

The Osogov Mountains have the highest score due to the presence of forest and mountain ecosystems, natural and semi-natural habitats, springs, watercourses, grasslands and landscape values. This area plays an important role in regulating the local climate, retaining water, stabilising soils and supporting biodiversity.

The river corridors of Pchinja and Kriva reka have a very high water retention value, preventing floods and connecting different natural, agricultural and populated areas. They are also important as blue-green corridors, as they connect water courses with riparian vegetation, agricultural areas, valleys and settlements.

Agricultural landscapes have the highest value in the production function, but lower scores in terms of climate regulation, biodiversity and erosion protection, especially where more

intensively used cultivated land dominates. Mosaic rural landscapes, where there is a combination of fields, pastures, borders, tree rows, small forest fragments and local watercourses, have a higher value than uniform agricultural areas.

Urban green spaces have the greatest social and health function. Their value is related in particular to recreation, cooling the urban environment, improving air quality and creating public spaces for the population. However, their ecological value depends on the size, connectivity, maintenance and availability of woody vegetation.

Degraded areas have a low current value for ecosystem services, but can obtain a higher value if measures for rehabilitation, reclamation, greening, soil stabilization and connection to existing green and blue infrastructure are implemented.

7. Assessment and prioritisation of green infrastructure

Assessing and prioritizing green infrastructure is a process by which natural, semi-natural and Natural, urban, agricultural and water features are evaluated according to their ecological, climatic, social, economic and spatial value. The aim is to identify which areas are most important to the functioning of the blue-green network, which areas are most sensitive to pressures and risks, and where interventions can have the greatest impact.

The assessment is based on previously identified elements of green infrastructure: main natural areas, ecological corridors, river and blue-green corridors, stepped areas, buffer zones, urban green areas, agricultural and semi-agricultural areas, etc. natural landscapes, protected areas, Natura 2000 and Emerald areas, as well as degraded areas with restoration potential. Each of these elements is assessed according to its function, condition, connectivity and contribution to ecosystem services.

Main assessment criteria are ecological value, degree of naturalness, relationship with other green and blue elements, role in mitigating climate risks, importance for biodiversity, potential for recreation and public use, exposure to pressures, and opportunity for restoration or improvement. Areas that perform multiple functions at the same time are valued as more valuable because they have a multi-functional character.

7.1. Evaluation criteria

The evaluation criteria provide a basis for evaluating green and blue infrastructure elements and determining their strategic importance. They allow different types of territories, such as forests, river corridors, agricultural landscapes, urban green spaces, protected areas and degraded areas, to be evaluated according to the same logic and to be compared between the North-East Planning Region and Kyustendil Municipality.

The assessment is carried out by combining spatial data, expert assessment, local information and field inspection. For each element, its natural state, functionality, connectivity, contribution to ecosystem services, exposure to risks and opportunity for improvement are assessed. This provides a basis for prioritizing the areas of protection, recovery, connectivity and development.

The rating can be done on a scale from 1 to 5, where 1 means a very low value, 2 a low value, 3 a medium value, 4 a high value, and 5 a very high value. Areas with high scores on multiple criteria are considered priority, especially if they simultaneously provide environmental, climate, social and economic benefits.

7.2. Evaluation of Multifunctionality

The assessment of the multifunctionality of green infrastructure for the North-East Planning Region of North Macedonia and Kyustendil Municipality shows that the region has significant natural, cultural and development potential. Green infrastructure includes forests, mountain landscapes, river corridors, aquatic ecosystems, rural and agricultural landscapes, urban green spaces, and cultural and natural sites.

The highest multifunctionality is observed in forest and mountain areas, especially in the cross-border region of Osogovo, due to their role in biodiversity conservation, climate regulation, erosion protection, recreation and the development of eco- and mountain tourism. River corridors and aquatic ecosystems are also of high value, particularly for water management, flood risk reduction, riparian protection and the creation of recreational green belts.

Cultural and natural tourist sites, such as Kratovo, Kuklitsa and the regions in Kyustendil, play an important role in the development of tourism, the local economy and the preservation of regional identity. Urban green spaces are important for improving the quality of life, the health of the population and the climate resilience of cities. Rural and agricultural landscapes have medium-high multifunctionality, but are important for rural tourism, local foods, traditional landscape and economic development.

Overall, green infrastructure in the region should be treated as a development network that provides environmental, social, economic and tourism benefits. Priority should be given to areas with the highest multifunctionality and cross-border connectivity, as they can contribute the most to sustainable development, climate resilience, better tourism offers and a higher quality of life.

A type of green infrastructure	*Basic functions*	*Level of versatility*	*Priority*
Forest and mountain areas	Biodiversity, climate regulation, erosion protection, recreation, eco and mountain tourism	Very high	Me
River corridors and aquatic ecosystems	Water management, flood risk reduction, riverbank protection, green belts for recreation	High	II
Cultural and natural tourist sites	Tourism, cultural heritage, local economy, education, regional identity	High	III
Urban green spaces	Recreation, health, microclimate, reduction of heat islands, quality of life	High	IV
Rural and agricultural landscapes	Rural tourism, local food, traditional landscape, economic development	Medium high	C

Annex 7.2

7.3. Connectivity Assessment

The assessment of the connectivity of the green infrastructure in the North-East Planning Region and the municipality of Kyustendil shows that the region has a significant basis for the development of a functional and cross-border connected green network. The most strongly connected are the forest and mountain areas, especially the Osogovo mountain region, which is the main natural corridor between the two sides of the border. These areas have a key role in biodiversity conservation, climate regulation, erosion protection, recreation and the development of mountain and ecotourism.

River corridors and aquatic ecosystems have medium to high levels of connectivity and represent important blue-green links between mountain, rural, agricultural and urban areas. However, their functionality is limited by pollution, erosion, insufficiently protected river belts and poor integration with recreational and tourism infrastructure.

Cultural and natural sites, such as Kratovo, Kuklitsa, Rankovce and Kyustendil, have a high potential for connecting nature, cultural heritage, tourism and the local economy. Their connectivity can be greatly enhanced through themed routes, digital maps, QR codes, tourist signage and joint cross-border promotion.

Rural and agricultural landscapes have a medium level of connectivity and play an important role as buffer zones and transition spaces between natural areas and human settlements.

They are important for rural tourism, local foods, traditional landscapes and sustainable local development, but face fragmentation, land abandonment and insufficient infrastructure.

Urban green spaces, which often function as isolated green patches, have the weakest connectivity. They should be linked by tree-lined avenues, green streets, promenades, parks, cycle paths and connections to the surrounding natural and rural landscapes.

A type of green infrastructure	General level of connectivity	Role in the regional green network	A major problem	Priority
Forest and mountain areas	High	Major ecological and cross-border green corridors; protection of biodiversity, climate, erosion and development of ecotourism	Local fragmentation, risk of degradation, insufficiently marked trails	Me
River corridors and aquatic ecosystems	Medium to high	Blue-green connections between natural, rural, agricultural and urban areas	Pollution, erosion, insufficient green belts and poor integration of recreation	II
Cultural and natural sites	Medium to high	Linking tourism, cultural heritage, nature, education and the local economy	Insufficiently integrated routes, limited signaling and digital connectivity	III
Rural and agricultural landscapes	Average	Buffer zones and transition spaces between nature, settlements and tourist sites	Fragmentation, land abandonment, poor infrastructure and insufficient promotion	IV
Urban green spaces	Low to medium	Local recreation, health, microclimate and improving the quality of life	Isolated green areas, lack of green corridors and weak connection with the surrounding nature	C

Most- high priority should be given to the preservation and improvement of forest-mountain and river corridors, as they form the basis of the regional green infrastructure. At the same time, better integration of cultural and natural sites, rural landscapes and urban green spaces is needed into a single network that will support nature conservation, climate resilience, tourism, recreation and local economic development.

7.4. Environmental condition and integrity

The assessment of the ecological condition and integrity of the green infrastructure in the North-East Planning Region and Kyustendil Municipality shows that the region has a significant natural basis for sustainable development, but also certain stresses that require targeted measures for protection, restoration and better management. The green infrastructure in the region is composed of forest and mountain areas, river corridors and aquatic ecosystems, rural and agricultural landscapes, urban green areas and cultural and natural sites.

The best ecological condition and the highest integrity are observed in the forest and mountain areas, especially those connected to the Osogovo mountain range. They represent major ecological cores and cross-border green corridors, with an important role for the protection of biodiversity, climate regulation, erosion protection and the development of eco- and mountain tourism. The main risks are related to logging, fires, fragmentation and degradation of forest areas.

River corridors and water ecosystems are of high ecological importance, but their condition is more sensitive and in some parts disturbed. They are important for the water regime, river

habitats, blue-green connectivity and flood risk reduction, but face pollution, waste, erosion and insufficiently protected river belts.

Natural and cultural sites are in moderate to good condition and represent an important link between natural heritage, cultural landscape, tourism and local identity. Their integrity depends on careful visitor management, preservation of the authentic landscape, erosion control and improved tourism infrastructure.

Rural and agricultural landscapes have average to moderately good ecological status. They are important as buffer zones, spaces for agrobiodiversity, traditional landscapes, local foods and rural tourism. The main challenges are land fragmentation, agricultural abandonment, intensive farming and insufficient infrastructure.

Urban green spaces have the lowest natural integrity, but are extremely important for quality of life, population health, microclimate, recreation and reduction of urban heat islands. They should be expanded, better maintained and connected in a functional urban green network.

A type of green infrastructure	General ecological condition	Level of ecological integrity	Basic environmental value	Key risks/pressures	Priority
Forest and mountain areas	Okay	Tall	Biodiversity, climate regulation, erosion protection, natural corridors	Logging, fires, fragmentation, degradation	Me
River corridors and aquatic ecosystems	Moderately good	Average	Water regime, riparian habitats, blue-green connectivity	Pollution, waste, erosion, unregulated riverbeds	II
Cultural and natural sites	Average to good	Medium to high	Cultural landscape, natural values, tourism, education	Pressure from visitors, erosion, mismanagement	III
Rural and agricultural landscapes	Average to average good	Average	Traditional landscape, agrobiodiversity, buffer zones	Fragmentation, land abandonment, intensive agriculture	IV
Urban green spaces	Average	Low to medium	Microclimate, recreation, health, quality of life	urbanisation, pollution, isolation, insufficient maintenance	C

According to the data presented in the previous table, the highest priority should be given to the protection and sustainable management of forest and mountain areas, as well as to the revitalisation of river corridors. At the same time, it is necessary to integrate cultural and natural objects, rural landscapes and urban green areas into a single green network. With such an approach, green infrastructure can contribute to nature conservation, climate resilience, better quality of life, sustainable tourism and stronger cross-border cooperation.

7.5. Climate Resilience Value

An assessment of the value for climate resilience shows that green infrastructure in the North-East Planning Region and Kyustendil Municipality has significant potential for strengthening climate resilience. Forest and mountain areas have the greatest value as they provide carbon storage, water regime regulation, erosion protection, reduction of temperature extremes and biodiversity protection. These areas should be treated as the main climatic cores of the regional green infrastructure.

River corridors and aquatic ecosystems have great value for climate adaptation, especially by reducing flood risk, retaining water, stabilising river banks and creating blue-green corridors. Their climatic function can be greatly improved by revitalizing riverbeds, creating protective green belts and controlling pollution.

Urban green spaces are of great importance to settlements, as they directly contribute to reducing urban heat islands, improving air quality, creating shade, retaining rainwater and improving recreational conditions. Although their natural integrity is lower than forest and river systems, their benefits to the population are very great.

Cultural and natural sites have a medium to high value for resilience to climate change, especially through landscape conservation, natural shade, green tourism routes, erosion control and sustainable visitor management. Rural and agricultural landscapes have a medium to medium high value that can be improved through agro-ecological measures, agroforestry, green belts, hedgerows and better soil management.

A type of green infrastructure	Total value for climate resilience	A significant contribution to climate adaptation	Major climate risks	Key measures	Priority
Forest and mountain areas	Very high	Carbon storage, water regime regulation, erosion protection, reduction of temperature extremes	Fires, droughts, degradation, erosion	Sustainable forestry, afforestation, fire prevention, monitoring	Me
River corridors and aquatic ecosystems	High	Flood mitigation, water retention, blue-green corridors, space cooling	Floods, pollution, erosion, droughts	revitalisation, green belts, rehabilitation of river banks, water monitoring	II
Urban green spaces	High	Reduction of heat islands, shade, better air, urban drainage	Heat waves, urban flooding, pollution	New parks, tree-lined avenues, green streets, rain gardens	III
Cultural and natural sites	Medium to high	Landscape conservation, green tourist routes, natural shade, education	Erosion, heat waves, visitor pressure	Controlled trails, green routes, erosion protection, visitor management	IV
Rural and agricultural landscapes	Medium to medium high	Water retention, soil conservation, agrobiodiversity, local foods	Droughts, soil degradation, fragmentation, land abandonment	Agroecological measures, hedges, agroforestry, green belts	C

The highest priority should be given to protecting and improving forest, mountain and river systems, as they form the basis of climate-resilient green infrastructure. At the same time, urban green spaces should be expanded and connected, and rural, cultural and natural spaces should be managed sustainably. With such an approach, green infrastructure can significantly contribute to climate change adaptation, reducing the risks of extreme weather events, improving the quality of life and sustainable cross-border development.

7.6. Social accessibility and public benefit

The social accessibility and public benefit analysis carried out shows that green infrastructure in the North-East Planning Region and Kyustendil Municipality has significant public value, especially in terms of recreation, health, tourism, education, local identity and improving the quality of life. However, accessibility and public benefit are not equally developed for all types of green infrastructure.

Urban green spaceshave the greatest direct public benefit, as they are closest to the population and are used daily for rest, recreation, sports, social activities and health improvement. They are of particular importance to children, young people, the elderly, families and people with reduced mobility. The main challenges are the insufficient green space, the isolatedparks, insufficient maintenance and poor connectivity with other public spaces.

Cultural and natural siteshave a very high public benefit due to their role in tourism, education, preserving local identity and supporting the local economy. Kratovo, Kuklitsa, Rankovce and Kyustendil can be developed as connected tourist and educational points, but better signalling, digital tools, access paths and joint promotion are needed.

Forest and mountain areashave a high to very high public benefit, especially for tourism, ecotourism, recreation, sports and nature. Their accessibility is moderately high, as some areas are insufficiently marked, lack sufficient infrastructure and are not fully adapted to different user groups.

River corridors and aquatic ecosystems have a high potential for public use through footpaths, cycleways, recreation areas, educational points and public green belts. However, their public benefit is often limited by pollution, unmaintained shorelines, waste, inadequate safety and poor access.

Rural and agricultural landscapes have medium to high societal benefits through rural tourism, local foods, traditional landscape, agro-education and local products. Their accessibility is average due to limited infrastructure, weak promotion, underdeveloped tourist services and lack of organised routes.

A type of green infrastructure	General social accessibility	Public benefit	A significant contribution to the community	Basic limitations	Priority
Urban green spaces	High	Very high	Daily recreation, health, social cohesion, better quality of life	Insufficient greenery, isolated areas, insufficient maintenance, limited access for vulnerable groups	Me
Cultural and natural sites	Medium to high	Very high	Tourism, education, local identity, cultural value, local economy	Insufficient signalling, poor digitalisation, limited access to infrastructure	II
Forest and mountain areas	Medium high	High to very high	Recreation, tourism, ecotourism, public health and well-being, education	Limited infrastructure, insufficiently marked trails, poor accessibility for vulnerable groups	III
River corridors and aquatic ecosystems	Medium to medium high	High	Recreation, space cooling, public green belts, education, visual value	Pollution, unmaintained shores, poor access, waste, insufficient security	IV
Rural and agricultural landscapes	Average	Medium to high	Rural tourism, local food, traditional landscape, agro-education, local products	Poor infrastructure, insufficient advertising, limited services, lack of organised routes	C

The highest priority should be given to the improvement and expansion of urban green spaces, as they have the most direct benefit for the daily life of the population. At the same time, cultural and natural sites should be developed as carriers of tourism-related and educational value, and forest, river and rural areas should be better connected, marked and popularized. With such an approach, green infrastructure can significantly contribute to a betterhealth, greater leisure provision, sustainable tourism, local economic development and stronger cross-border cooperation.

7.7. Priority areas for protection

The assessment of priority areas for protection shows that the North-East Planning Region and Kyustendil Municipality have significant green infrastructure with high ecological, climatic, social and development value. Protection priorities are determined according to the areas' role in biodiversity conservation, water regime, climate resilience, erosion protection, recreation, tourism, cultural landscape and public benefit.

Forest and mountain areas, especially the Osogovo mountain region, are of the highest priority, as they represent major ecological cores and cross-border green corridors. These spaces provide biodiversity protection, climate regulation, erosion protection and opportunities for eco- and mountain tourism. The main threats are logging, fire, fragmentation and degradation.

River corridors and aquatic ecosystemsare a second key priority as they play an important role in water management, reducing flood risk, protecting riparian habitats and connecting natural, rural and urban spaces. They are particularly sensitive to pollution, waste, erosion and unregulated riverbeds.

Cultural and natural objects, such as Kratovo, Kuklitsa, Rankovce and Kyustendil, are of high priority due to their value for tourism, education, local identity and the local economy. Their protection must combine the preservation of natural and cultural values with controlled use and better tourism infrastructure.

Urban green spacesare important because of their direct benefits to the population, especially health, recreation, microclimate and quality of life. They should be protected from conversion and improved through new parks, tree-lined avenues, green streets and promenades.

Rural and agricultural landscapes play an important role as buffer zones, spaces for traditional landscapes, local foods, agro-biodiversity and rural tourism. Although they have a lower overall priority than forest and river systems, they are important for sustainable local development and the preservation of the authentic character of the region.

In conclusion, the protection of priority areas should be targeted first at forest, mountain and river systems, as they form the basis of the regional green infrastructure. At the same time, cultural and natural sites, urban green areas and rural landscapes should be integrated into a single green network. With such an approach, the protection of green infrastructure will contribute not only to nature conservation, but also to climate resilience, sustainable tourism, local economic development and a better quality of life.

A type of green infrastructure	Main reason for protection	The most important areas	Major threats	Key measures	General priority
Forest and mountain areas	Ecological cores, biodiversity, climate regulation, erosion protection	Osogovo, Kriva Palanka, Kratovo, Rankovce, Kyustendil	Logging, fires, erosion, fragmentation, degradation	Forest protection, afforestation, fire prevention measures, sustainable tourism	Me
River corridors and aquatic ecosystems	Water regime, blue-green connectivity, flood protection, riparian habitats	Kriva Reka, Kumanovska Reka, Pchinja, Lipkovo Lake, water systems in Kyustendil	Pollution, waste, erosion, unregulated riverbeds	revitalisation, green belts, cleaning, water monitoring	II
Cultural and natural sites	Tourism, education, local identity, cultural landscape	Kratovo, Kuklitsa, Rankovce, Kyustendil, cross-border routes	Visitor pressure, erosion, poor signage, inadequate management	Conservation, controlled paths, digital maps, QR codes, promotion	III
Urban green spaces	Health, recreation, microclimate, quality of life	Kumanovo, Kratovo, Kriva Palanka, Kyustendil	urbanisation, pollution, isolation, insufficient maintenance	New parks, avenues with trees, green streets, promenades	IV
Rural and agricultural landscapes	Traditional landscape, agro-biodiversity, local food, rural tourism	Kratovo, Rankovce, Staro Nagorichane, Kumanovo, Kyustendil	Fragmentation, land abandonment, intensive agriculture	Agroecological measures, hedges, green belts, agritourism	C

7.8. Priority areas for restoration

The assessment shows that the priority areas for restoration in the North-East Planning Region and Kyustendil Municipality are those where green infrastructure is degraded, fragmented or insufficiently functional, but has a high potential to re-provide environmental, climate, social and economic benefits.

Highest recovery priority is given toriver corridors and aquatic ecosystems, especially Kriva Reka, Kumanovska Reka, Pchinja, Lipkovsko Lake and the water systems in Kyustendil. These areas are important for the water regime, blue-green connectivity, flood risk reduction, recreation and climate resilience, but face pollution, waste, erosion, degraded shorelines and poor access.

The second priority areurban green spaces, as their restoration has direct benefits for the population through improved microclimate, reduction of heat islands, recreation, health and quality of life. Particularly important are the urban green spaces in Kumanovo, Kratovo, Kriva Palanka and Kyustendil, where expansion, connectivity and better maintenance of greenery are needed.

Forest and mountain areasare of high priority for restoration where there is degraded forest cover, erosion, fragmentation or fire risk. Restoration should focus on reforestation with native species, rehabilitation of erosion points, fire prevention and restoration of natural corridors.

Cultural and natural sitesare prioritised due to their tourism-related, educational and public value. Kratovo, Kuklitsa, Rankovce, Kyustendil and cross-border routes should be improved through controlled paths, signage, digital tools, QR codes, erosion protection and better visitor management.

Rural and agricultural landscapes are of medium-high priority, especially abandoned or degraded agricultural areas. Their restoration can contribute to the preservation of traditional landscapes, reduction of erosion, agro-biodiversity, local foods, rural tourism and improved resilience to climate change.

A type of green infrastructure	Main reason for the restoration	The most important areas	Basic problems	Key recovery measures	General priority
River corridors and aquatic ecosystems	Restoring blue-green connectivity, water regime, public use and flood protection	Kriva Reka, Kumanovska Reka, Pchinja, Lipkovo Lake, water systems in Kyustendil	Pollution, litter, erosion, degraded shorelines, poor access	Cleanup, green belts, riverbank rehabilitation, revitalisation, monitoring	Me
Urban green spaces	Improving the quality of life, microclimate, recreation and public benefit	Kumanovo, Kratovo, Kriva Palanka, Kyustendil	Insufficient greenery, isolated parks, heat islands, insufficient maintenance	New parks, tree-lined avenues, green streets, boardwalks, rain gardens	II
Forest and mountain areas	Restoration of degraded forest areas, erosion zones and climatic functions	Osogovo, Kriva Palanka, Kratovo, Rankovce, Kyustendil	Logging, fires, erosion, fragmentation, degradation	Afforestation, fire prevention measures, erosion control, monitoring	III
Cultural and natural sites	Restoration of the tourism-related, educational and cultural-green function	Kratovo, Kuklitsa, Rankovce, Kyustendil, cross-border routes	Erosion, poor signage, visitor pressure, poor management	Controlled paths, green routes, QR codes, digital maps, interpretation	IV
Rural and agricultural landscapes	Regeneration of abandoned lands, traditional landscape and agro-ecological function	Kratovo, Rankovce, Kumanovo, Staro Nagorichane, Kyustendil	Land abandonment, fragmentation, erosion, intensive agriculture	Agroecological measures, hedges, green belts, agroforestry, agrotourism	C

Restoration should first focus on river corridors and urban green spaces, as they have the greatest potential to rapidly improve ecological status, public benefits and climate resilience. At the same time, forest, cultural, natural and rural spaces should be restored through an integrated approach that links nature, tourism, local economy and cross-border cooperation.

7.9. Priority areas for new investments in green infrastructure

The results of the analysis show that new investments in green infrastructure should be directed to areas where the greatest combined effect on quality of life, climate resilience, recreation, tourism, nature conservation and local economic development can be achieved.

Urban green spacesare of the highest priority, as they provide direct and daily benefits to the population. Investments in new parks, tree-lined streets, greenways, riverwalks and rain gardens will help reduce heat islands, improve air quality, recreation, health and a higher quality of life.

The second priority areriver corridors and aquatic ecosystems, which play an important role in blue-green connectivity, water management, flood protection, recreation and climate adaptation. Investments should include green belts, riverbank rehabilitation, riverside promenades, eco-paths, water monitoring and natural water retention solutions.

Cultural and natural siteshave a high potential for new investment due to their role in tourism, education, local identity and cross-border promotion. Particularly important are Kratovo, Kuklitsa, Rankovce, Kyustendil and the cross-border thematic routes, where investments in digital maps, QR codes, tourist signage, viewpoints and green routes can create a recognizable joint tourist offer.

Forest and mountain areasshould be supported with low-intensity and sustainable infrastructure, such as pedestrian and bicycle lanes, observation decks, educational points, green corridors and safety signage. These investments will improve access to nature, but without compromising ecological integrity.

Rural and agricultural landscapes are important for agritourism, local foods, traditional landscapes and local development. Investments in rural routes, local markets, agri-environmental measures, hedgerows, agroforestry and the revitalisation of abandoned land can contribute to a sustainable local economy and preserve the authentic character of the region.

A type of green infrastructure	*A major reason for new investment*	*The most important areas*	*Key investments*	*Expected effect*	*General priority*
Urban green spaces	Direct public benefit, climate adaptation, health and recreation	Kumanovo, Kratovo, Kriva Palanka, Kyustendil	New parks, tree-lined avenues, green streets, boardwalks, rain gardens	Better quality of life, urban cooling, public recreation	Me
River corridors and aquatic ecosystems	Blue-green connectivity, water regime, flood protection and recreation	Kriva Reka, Kumanovska Reka, Pchinja, Lipkovo Lake, water systems in Kyustendil	Green belts, rehabilitation of river banks, walking paths, eco-paths, monitoring	Better resilience to climate change, recreation, protection of aquatic ecosystems	II
Cultural and natural sites	Tourism, education, local identity and cross-border promotion	Kratovo, Kuklitsa, Rankovce, Kyustendil, cross-border routes	Digital maps, QR codes, signs, green routes, viewpoints	Development of sustainable tourism, local income, better visibility	III
Forest and mountain areas	Ecotourism, recreation, climate resilience and	Osogovo, Kriva Palanka, Kratovo, Rankovce, Kyustendil	Pedestrian and bicycle paths, viewpoints,	Better access to nature, recreation, ecosystem protection	IV

	natural connectivity		educational points, green corridors		
Rural and agricultural landscapes	Agritourism, local food, traditional landscape and local development	Kratovo, Rankovce, Kumanovo, Staro Nagorichane, Kyustendil	Rural routes, local markets, agro-ecological measures, hedgerows, agroforestry	Local economic development, rural tourism, preserved landscape	C

In conclusion, investments should first be directed to urban green spaces and river corridors, as they provide the fastest and most visible benefits for the population and the environment. In parallel, cultural and natural, forest, mountain and rural areas should be developed as part of a single network of green infrastructure that will strengthen climate change resilience, tourism supply and cross-border cooperation.

8. Pressure, risks and challenges

Green infrastructure areas are exposed to various pressures and risks that can reduce their ecological, social and economic value. Pressures most often stem from urbanisation, climate change, land degradation, pollution, poor governance, fragmentation of natural spaces, insufficient infrastructure, and limited financial and institutional capacity.

8.1. urbanisation and land use change

urbanisation and land use changes are some of the most significant pressures on green infrastructure. They most often occur through the expansion of construction zones, the construction of road and utility infrastructure, the conversion of agricultural or natural lands, the reduction of public green spaces and the fragmentation of natural corridors. These processes directly affect ecological connectivity, biodiversity, water regime, air quality, microclimate and the quality of life of the population.

In the North-East Planning Region and Kyustendil Municipality, urbanisation is particularly significant around larger settlements, tourist sites, access roads, industrial and commercial areas, as well as in areas with potential for tourism development. If these processes are not carefully planned, they can lead to loss of green space, land degradation, reduction of natural drainage, increased risk of flooding and erosion, and disruption of cultural and natural landscapes.

Land-use change often disrupts the natural connections between forests, rivers, rural and urban spaces. When agricultural, forest or riverside areas are converted into construction land, green infrastructure loses its function as a connected network. This is particularly risky for river corridors, forest edges, peri-urban green belts and rural landscapes that serve as buffer zones between nature and human settlements.

One of the main risks is the fragmentation of ecosystems. New roads, buildings, parking lots, industrial areas or tourist attractions can divide natural habitats into smaller and more isolated parts. This reduces the ability of plant and animal species to move, disrupts ecological corridors and reduces the resilience of ecosystems to climate change.

urbanisation also increases the risk of flooding and urban heat islands. Increasing paved and concrete surfaces reduces the natural infiltration of rainwater into the soil and increases surface runoff. This can put pressure on river corridors and sewerage infrastructure, especially during periods of intense rainfall. At the same time, the lack of greenery, trees and shaded public spaces contributes to higher temperatures in urban areas and a greater health risk for the population during heat waves.

In rural and agricultural areas, land-use change can lead to loss of traditional landscapes, reduction of agro-biodiversity and land abandonment. On the other hand, the uncontrolled spread of weekend settlements, tourist facilities or inadequate infrastructure can disrupt the natural character of the area and create additional pressure on water resources, waste and access roads.

Cultural and natural sites are also sensitive to inappropriate urbanisation. Construction near sites, inadequate access roads, car parks, commercial facilities or unplanned tourist facilities can reduce the authenticity and landscape value of the area. Therefore, tourism development must be in line with the principles of protection, vehicle capacity, controlled access and sustainable use.

The main challenge is to ensure a balance between development and protection. urbanisation and new investment should not be completely prevented, but should be directed to areas where they will not disturb the green infrastructure. This requires integrating green infrastructure into urban and spatial plans, protecting river and forest corridors, limiting construction in sensitive areas, protecting agricultural and rural landscapes and creating new green public spaces.

Table: Pressure, risks and challenges arising from urbanisation and land use changes

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Expansion of construction zones	Conversion to natural, agricultural orsuburbanland in building land	Loss of green space, reduced ecological connectivity, greater pressure on nature	Spatial development control
Fragmentation of natural corridors	Disconnection between forests, rivers, rural and urban green spaces	Reduced movement of species, weakened biodiversity, lower climate resilience	Preserving a functional green network
Reduction of urban greenery	Diversion or under-maintenance of parks, tree-lined avenues and public green spaces	Urban heat islands, poorer air quality, reduced number of recreational facilities	Provision of sufficient public green spaces
Increaseof the waterproof onessurfaces	Asphalt, concrete, parking lots, industrial and commercial surfaces	Surface runoff, urban flooding, reduced water infiltration	Stormwater management
Pressure on river corridors	Construction, infrastructure or waste near watercourses	Pollution, bank erosion, reduced natural function of rivers	Protection of the blue-green corridors
Unplanned development of tourism	Construction of buildings, parking lots and accesses without clear rules	Degradation of the landscape, pressure on the sites, loss of authenticity	Balance between tourism and protection
Loss of agricultural and rural landscapes	Conversion or abandonment of land	Decline of traditional landscape, agro-biodiversity and local foods	Preserving the function of rural areas
Inadequate planning	Insufficient inclusion of green infrastructure in planning documents	Unrelated interventions, loss of long-term ecological function	Integrated spatial planning

urbanisation and land-use changes have a strong impact on green infrastructure, particularly through loss of green space, fragmentation of natural corridors, increase in impervious surfaces and pressure on rivers, rural, cultural and natural spaces. To reduce these risks, green infrastructure must become an integral part of all spatial and urban plans.

8.2. Fragmentation caused by infrastructure

Infrastructure-induced fragmentation is one of the most significant pressures on green infrastructure, as it disrupts the natural, ecological and spatial connections between forests, rivers, rural and urban green spaces. It most often occurs as a result of the construction or expansion of roads, railways, industrial zones, energy infrastructure, tourist facilities, parking lots, urban settlements and other construction interventions.

In the North-East Planning Region and Kyustendil Municipality, this risk is particularly significant in areas where natural and rural spaces intersect with road infrastructure, tourist approaches, urban extensions and development zones.

The biggest impact of infrastructure fragmentation is the disruption of ecological corridors. Roads and other infrastructure can create physical barriers to the movement of animal species, the distribution of plant species, and the natural exchange between ecosystems. This reduces biodiversity, increases the risk of isolated populations and weakens the resilience of ecosystems to climate change.

River corridors are particularly sensitive to infrastructure interventions. Bridges, regulated riverbeds, roads along watercourses, pipelines and other technical solutions can reduce the natural function of rivers as blue-green corridors. If riparian vegetation is removed or riparian space is narrowed, the risk of erosion, flooding, pollution and loss of riparian habitats increases.

In forest and mountain areas, new roads, forest access paths, tourist routes and energy corridors can lead to fragmentation of forest complexes, degradation of forest edges and increased access to sensitive natural spaces. This can increase the risk of logging, fires, pollution, wildlife disturbance and uncontrolled recreation.

In the city and suburban environment, infrastructure often creates isolated green spaces. Parks, tree-lined avenues, riverbanks and public green spaces can remain unconnected to lanes, car parks, building blocks or industrial spaces. This reduces their recreational, climatic and ecological function, and the population has less access to a continuous green network.

Rural and agricultural landscapes are also affected by infrastructure fragmentation. New roads, utility networks or tourism facilities can divide agricultural areas, disrupt traditional landscape structure and reduce the potential for agro-biodiversity, rural tourism and natural connectivity.

The main challenge is to reconcile infrastructure development with the protection and improvement of green infrastructure. Infrastructure is necessary for economic development, mobility and access to tourist sites, but it must be planned in a way that does not interrupt key greens and bluescorridors. This requires integrated spatial planning, GIS analysis, impact assessment, identification of sensitive areas and implementation of environmentally friendly solutions.

Table: Pressure, risks and challenges arising from infrastructure fragmentation

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Road infrastructure	Construction or widening of roads through natural, rural or riparian areas	Violation of ecological corridors, isolation of habitats, increased access to sensitive areas	Balance between mobility and nature conservation
Fragmentation of forest complexes	Accessible roads, energy routes or hiking trails through forest areas	Loss of forest integrity, degradation of forest edges, disturbance of wildlife	Maintaining forest connectivity
Interventions in river corridors	Bridges, regulated riverbeds, riverside roads, pipelines	Reduction of the natural function of rivers, erosion, loss of riparian vegetation	Protection of the blue-green corridors
City roads and parking lots	Big onesimpervious surfaces and barriers between green public spaces	Isolated parks, urban heat islands, poor pedestrian access	Connecting urban greenery
Tourist infrastructure	Accessible roads, parking lots, facilities and trails near sites	Pressure on the landscape, erosion, waste, loss of authenticity	Sustainable development of tourism
Energy and utility infrastructure	Power lines, pipelines, water and sewage routes	Disruption of natural habitats, visual degradation, technical barriers	Minimize the spatial footprint
Industrial and commercial areas	Construction of large areas with low greenery	Loss of land, increased pollution, disruption of green links	Inclusion of green infrastructure in development areas
Insufficient planning	Infrastructure projects without prior analysis of green corridors	Long-term loss of connectivity and ecological function	Integrated planning

Fragmentation caused by infrastructure can significantly reduce the functionality of green infrastructure, particularly by disrupting ecological corridors, isolating habitats, disrupting river systems and reducing access to connected green spaces. This risk is particularly important in areas where new roads, tourism facilities, urban expansion or infrastructure corridors are planned.

8.3. Intensification of agriculture

Agricultural intensification represents a significant pressure on green infrastructure, especially in rural and agricultural areas, which act as buffer zones, ecological corridors and spaces for the preservation of traditional landscapes. It is most often manifested by the increased use of mechanization, chemical fertilizers and pesticides, the expansion of monocultures, the removal of hedges, tree rows and small natural belts, as well as the excessive use of soil and water resources.

One of the main risks of intensive agriculture is soil degradation. Over-tillage, use of chemicals and removal of natural vegetation can lead to erosion, reduced fertility, soil compaction and loss of organic matter. This reduces land productivity and increases the vulnerability of agricultural landscapes to droughts and intense rainfall.

Intensification can also have a negative impact on water resources. Chemicals from agricultural areas can reach rivers, streams, and groundwater through surface runoff. This can cause water pollution, reduce the quality of aquatic ecosystems and disrupt blue-green corridors. River belts and water courses that pass through agricultural areas are particularly sensitive.

Another important risk is the loss of agrobiodiversity and the traditional mosaic landscape. When diverse agricultural areas are replaced by larger, uniform plots or monocultures, habitats for birds, insects, pollinators and other species are reduced. The removal of hedgerows, borders, meadows, pastures and small woodlands reduces ecological connectivity and weakens the role of agricultural landscapes as part of green infrastructure.

Intensive agriculture can also affect resilience to climate change. Agricultural landscapes with few trees, green belts and native vegetation have a lower ability to retain water, reduce runoff and provide shade and microclimate stability. In the face of climate change, this can lead to greater exposure to drought, erosion, flooding and reduced productivity.

From a social and economic perspective, intensification can create short-term productive benefits, but in the long-term it can reduce the value of rural areas for tourism, recreation and local identity. Traditional landscapes, local foods, small producers and authentic rural atmosphere are important resources for rural and agritourism. If these are lost, the region may reduce its tourist and cultural appeal.

The main challenge is achieving a balance between agricultural production and preserving green infrastructure. Agriculture must remain an important economic activity, but be developed through sustainable and agro-ecological practices. This includes preserving hedgerows, tree rows, pastures and meadows, reducing the excessive use of chemicals, better soil and water management, introducing agroforestry and supporting organic and traditional production.

Table: Pressure, risks and challenges related to agricultural intensification

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Excessive use of chemicals	Use of pesticides, herbicides and mineral fertilizers	Soil, surface and underground water pollution; reducing biodiversity	Reduction of chemical pressure
Monocultures and uniform plots	Reduction of cultural and landscape diversity	Habitat loss, reduced agrobiodiversity, poor ecological connectivity	Preservation of a mosaic landscape
Removal of hedges and green belts	Cleaning of curbs, tree rows, meadows and small forest belts	Violation of ecological corridors, loss of habitats for pollinators and birds	Preserving green links in the agricultural landscape
Soil degradation	Over-tillage, soil compaction and loss of organic matter	Erosion, reduced fertility, greater vulnerability to droughts and floods	Sustainable soil management

Pollution of aquatic ecosystems	Surface runoff of chemicals and sediments to rivers and streams	Disruption of river corridors, reduced water quality, endangered aquatic habitats	Protection of water resources
Excessivewater use	Intensive irrigation and uncontrolled use of water resources	Reduced water supplies, pressureon rivers and groundwater	Effective Water Management
Reduction of pollinators	Chemical treatments and loss of natural habitats	Reduced productivity and biodiversity	Protection of beneficial insects
Loss of the traditional rural landscape	Replacing mosaic landscapes with intensive production areas	Reduced tourist and cultural value	Connecting agriculture with rural tourism

Agricultural intensification can significantly reduce the value and functionality of green infrastructure if not managed sustainably. The biggest risks are related to soil degradation, water pollution, loss of agro-biodiversity, reduced ecological connectivity and the disappearance of traditional rural landscapes.

8.4. Forest degradation and fire risk

Forest degradation and fire risk represent some of the most serious pressures on green infrastructure, especially in forest and mountain areas, which play a key role in biodiversity conservation, climate regulation, erosion protection, water retention and the development of eco- and mountain tourism.

Forest degradation can result from uncontrolled or inappropriate logging, fires, over-exploitation of timber, diseases and pests, mismanagement, erosion, climate change and increased human pressure through tourism, recreation or infrastructural interventions. In the North-East Planning Region and Kyustendil Municipality, this risk is particularly significant in the mountainous and forested areas, such as the Osogovo mountain range, the forest areas around Kriva Palanka, Kratovo, Rankovce and Kyustendil.

Forest fires pose a particularly serious risk because they can destroy large areas in a short time, causing habitat loss, soil degradation, reduced biodiversity and increased erosion. Climate change further increases this risk through longer dry spells, higher temperatures, heat waves and reduced vegetation moisture. In such conditions, even small human errors, such as burning waste, uncontrolled burning of stubble or careless behaviour of visitors, can cause a serious fire.

Degraded forests have a reduced ability to provide ecosystem services. They are less able to hold water, stabilize soil, have a reduced capacity to absorb carbon and contribute less to local climate regulation. This can lead to an increased risk of flash floods, erosion, landslides, reducedspring yieldsand worse conditions for agriculture, tourism and recreation.

From a green infrastructure perspective, forest degradation can also cause fragmentation of natural corridors. When forest areas are damaged or disturbed, the ability of animal species to move is reduced, ecological connectivity is disrupted, and isolated habitats are created. This reduces the resilience of ecosystems and increases their sensitivity to climate change and other external stresses.

Fire risk also has significant social and economic consequences. Fires can threaten the safety of the population, damage tourism infrastructure, access roads, recreational trails, agricultural areas and cultural and natural sites. They can reduce the tourism appeal of the region, create additional rehabilitation costs and weaken the local economy.

The main challenge is the creation of a preventive and integrated forest and fire risk management system. Instead of a reactive approach that is activated after a fire or

degradation occurs, a long-term system of prevention, monitoring, early warning, sustainable forestry, education of the population and coordination between institutions on both sides of the border is needed.

Table: Pressure, risks and challenges related to forest degradation and fire risk

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Uncontrolled or inappropriate logging	Removal of forest vegetation without proper planning and restoration	Reduction of biodiversity, erosion, fragmentation of forest corridors	Sustainable forest management
Forest fires	Fires caused by drought, human factors or mismanagement	Loss of forest areas, habitat destruction, soil degradation	Prevention and rapid response
Climate change	Longer droughts, higher temperatures and heat waves	Increased risk of fires, drying of forests, reduced resilience	Adaptation of forest ecosystems
Erosion after degradation	Loss of vegetation cover on steep terrain	Flash floods, landslides, damage to river corridors	Stabilization of degraded slopes
Diseases and pests	Weakened forest ecosystems susceptible to biological attacks	Deterioration of forest health and productivity	Early detection and control
Fragmentation of forest habitats	Disruptions in forest integrity due to logging, roads or fires	Isolated populations, reduced ecological connectivity	Protection of forest corridors
Uncontrolled recreation and tourism	Moving off-trails, pollution, lighting fires, pressure on sensitive areas	Degradation of objects, increased risk of fires	Sustainable tourism in forest areas
Insufficient institutional coordination	Weak connection between forestry, municipal, fire and environmental services	Slow reaction, poor handling and higher damage	Coordinated management system

Forest degradation and fire risk have a strong impact on the functionality of green infrastructure. They can cause loss of biodiversity, erosion, disruption of the water regime, reduced climate resilience, fragmentation of natural corridors and a decline in the tourism value of the region.

8.5. River Regulation and Flood Risk

River regulation and flood risk place significant pressure on green infrastructure, especially river corridors and aquatic ecosystems. Rivers have a natural role in draining and retaining water, connecting different ecosystems, supporting biodiversity, stabilising the microclimate and creating conditions for recreation and public use. When riverbeds are regulated by concreting, straightening, narrowing or technical canalization, their natural function is significantly reduced.

One of the main risks of excessive or inappropriate river regulation is the loss of natural habitats. River vegetation. Trees, shrubs, and herbaceous vegetation along rivers play an important role in stabilising banks, filtering pollution, creating habitat, shading watercourses, and slowing surface runoff. When this vegetation is removed, the risk of erosion, pollution, water overheating and loss of biodiversity increases.

Regulated riverbeds often reduce the ability of rivers to flow naturally into floodplains. Although technical regulation can reduce the risk of local flooding in certain areas in the short term, it can increase the risk downstream, as water moves faster through the channelized bed and creates higher peak flows. In conditions of intense rainfall, this can lead to rapid flood waves that damage infrastructure, agricultural areas and settlements.

Climate change further increases the risk of flooding. Increasingly frequent intense rainfall, flash floods, changes in the seasonal distribution of rainfall and longer dry periods create greater instability in the water regime. Under such conditions, river corridors must have sufficient space, natural vegetation and floodplains to absorb water. If they are narrowed, concreted or built over, the risk of damage increases significantly.

urbanisation and construction near river corridors further increase vulnerability. Buildings, roads, parking lots and other impermeable surfaces increase surface runoff and reduce the natural infiltration of rainwater into the soil. This puts additional pressure on rivers and sewage systems, especially in urban areas. At the same time, construction along river corridors reduces space for green belts, recreation and natural flood protection.

From the point of view of green infrastructure, the main challenge is the transition from classical technical regulation to integrated and nature-friendly river management. This means that rivers should be treated as blue-green corridors, with enough space for natural dynamics, riverine vegetation, floodplains, pedestrian and bicycle paths, educational points and controlled public use. Instead of complete concreting and reclamation, solutions such as riparian revitalisation, natural stabilization, wetlands, green belts and water retention in the landscape should be implemented.

Table: Pressure, risks and challenges related to river regulation and flood risk

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Concreting and channelization of riverbeds	Technical arrangement of rivers with concrete channels, walls and straight beds	Reduced natural function, habitat loss, faster water flow	Balance between flood protection and preservation of natural functions
Removal of riparian vegetation	Cutting down trees, bushes and grassy areas along watercourses	Riverbank erosion, habitat loss, increased pollution and water overheating	Protection of riparian areas
Narrowing of river corridors	Construction, roads or agricultural activities near river banks	Reduced space for natural runoff, greater risk of flooding	Providing space for the river
Increased surface runoff	Asphalt, concrete and other impervious surfaces in the catchment	Rapid filling of riverbeds, urban flooding, pressure on sewers	Stormwater management
Intense rainfall and torrential currents	Climatic extremes with short-term, heavy rainfall	Floods, erosion, damage to infrastructure and agricultural areas	Climate adaptation
Pollution and waste in river corridors	Municipal waste, unregulated discharges and pollution from agriculture	Reduced water quality, degraded ecosystems, reduced recreational value	Pollutant control
Unplanned construction in flood zones	Construction of facilities in risky riverside areas	Increased exposure of population and property to flooding	Risk-based spatial planning
Insufficient maintenance of river corridors	Abandoned shorelines, debris, invasive vegetation or damaged protective structures	Reduced permeability, increased risk of local flooding and degradation	Regular and environmentally friendly maintenance

River regulation and flood risk are closely related to the state of green infrastructure. Over-engineering, narrowing of river corridors, removal of riparian vegetation and construction in floodplains reduce the natural ability of rivers to hold, slow and safely conduct water. This increases the risk of flooding, erosion, habitat degradation and infrastructure damage.

8.6. Soil erosion and land degradation

Soil erosion and land degradation pose significant risks to green infrastructure, especially in hilly, mountainous, rural, agricultural and riverine areas. These processes occur when soil loses its stability, fertility and natural cover, most often as a result of intense rainfall, steep terrain, removal of vegetation, inappropriate land use, agricultural abandonment, over-tillage, forest degradation and climate change.

In the context of the North-East Planning Region and Kyustendil Municipality, the risk of erosion is particularly important due to the presence of mountainous and hilly areas, river valleys, agricultural areas on sloping terrain and areas with sensitive natural and cultural landscapes. Erosion can cause loss of fertile soil, reduced agricultural productivity, the occurrence of torrential flows, damage to roads and infrastructure, siltation of watercourses and degradation of river ecosystems.

Land degradation is a broader process that refers not only to the physical behaviour of the soil, but also to the reduction of its quality, biological activity, water-holding capacity and productive value. It can result from erosion, pollution, soil compaction, loss of organic matter, overuse, droughts, fires, and inappropriate urbanisation. When land is degraded, green infrastructure loses its ability to provide important ecosystem services such as water retention, flood protection, biodiversity support, food production and climate regulation.

One of the most significant risks is the loss of vegetation cover. Forests, grasslands, hedgerows and riparian vegetation stabilize the soil and reduce surface runoff. When these are removed or degraded, the soil becomes exposed to the direct effects of rainfall, wind and temperature extremes. This is particularly problematic on steep slopes, forest edges, degraded agricultural areas and riparian zones.

Heavy rainfall and flash floods further increase the risk of erosion. With climate change, precipitation increasingly occurs as short-lived but intense events that create rapid surface runoff and transport soil material. This can result in damage to farmland, trails, local roads, riverbeds and tourist approaches. Eventually, the eroded material ends up in rivers and dams, reducing their capacity and degrading water quality.

In agricultural landscapes, erosion and degradation are most often associated with over-tillage, insufficient soil cover, monocultures, removal of borders and green belts, and tillage on sloping terrain without protective facilities. This reduces soil fertility and increases dependence on external factors such as fertilizers and irrigation.

In forest and mountain areas, forest degradation, fires and inadequate access roads can cause severe erosion. After a forest fire, the soil is left without a protective cover and becomes particularly vulnerable to heavy rainfall. This can cause landslides, flash floods and long-term disruption of the natural water regime.

End River basins are also sensitive. If river banks are deprived of natural vegetation or exposed to unregulated interventions, this can lead to increased bank erosion, land loss, water turbidity and damage to blue-green corridors. This reduces both the recreational and ecological value of rivers.

From a social and economic perspective, land erosion and degradation can have long-term consequences for local communities. They affect agriculture, forestry, tourism, infrastructure, safety and quality of life. Degraded landscapes are less attractive to visitors, have reduced productivity and require higher rehabilitation and maintenance costs.

The main challenge is that erosion often develops gradually and becomes visible when the damage is already significant. Therefore, this risk should be seen as a long-term threat to the stability of green infrastructure, especially in areas where steep terrain, degraded vegetation, intense rainfall and improper land use combine.

Table: Pressure, risks and challenges related to soil erosion and land degradation

Pressure / risk	Description	Potential impact on green infrastructure	A key challenge
Loss of vegetation cover	Removal or degradation of forests, grasslands, hedgerows and riparian vegetation	Increased surface runoff, loss of fertile soil, reduced terrain stability	Maintaining the natural protection of the soil
Intense rainfall and torrential currents	Short-term, heavy rainfall that causes rapid movement of water and sediments	Erosion, damage to roads, riverbeds, agricultural areas and hiking trails	Reducing vulnerability to climate extremes
Cultivation of sloping agricultural areas	Agricultural production on steep or erosion-sensitive terrain	Loss of fertile soil, reduced productivity, increased turbidity of water courses	Harmonization of agricultural use with natural conditions
Abandonment of agricultural land	Abandonment of land without proper management or natural regeneration	Landscape degradation, erosion, fire risk and loss of productive function	Preventing the long-term degradation of rural areas
Degradation of forests	Logging, fires, disease, forest roads or forest edge damage	Increased erosion, loss of water retention function, fragmentation of habitats	Maintaining the stability of forest ecosystems
Fires	Destruction of the plant cover and the organic soil layer	Rapid erosion after rainfall, loss of fertility, flash floods, degraded landscape	Reducing vulnerability after fire
Soil compaction	Excessive mechanization, traffic or uncontrolled movement on sensitive terrain	Reduced infiltration, increased runoff, lower biological activity of the soil	soil structure and water holding capacity
Land pollution	Chemicals, waste, industrial or municipal impacts	Reduced fertility, risk to water and biodiversity, limited land use	Long-term pollution control
Erosion of river banks	Loss of bank stability due to lack of vegetation, flash floods or interventions in riverbeds	Loss of land, water pollution, damage to blue-green corridors	Preservation of riparian stability
urbanisation of sensitive terrains	Construction of buildings, roads or infrastructure in erosive or unstable areas	Increased risk of landslides, surface runoff, degradation of green areas	Spatial planning according to natural constraints

Soil erosion and land degradation pose a serious challenge to green infrastructure as they reduce its ability to provide sustainable ecological, climatic, agricultural and recreational functions. These processes affect forests, agricultural landscapes, river corridors, tourist sites and urban fringes.

The biggest risks are related to the loss of fertile soil, reduced water holding capacity, damage to river and road systems, landscape degradation and reduced resilience to climate change. Therefore, land erosion and degradation should be treated as long-term spatial and environmental risks that can significantly weaken the functionality of the green infrastructure and the development potential of the region.

8.7. Impact of Climate Change

Climate change poses one of the most significant long-term risks to green infrastructure, as it directly affects forests, river corridors, agricultural land, urban greenery, water resources, and cultural and natural sites. Its impacts are manifested by rising temperatures, more frequent

and longer dry spells, intense rainfall, floods, erosion, forest fires, depletion of water resources and changes in natural ecosystems.

In the North-East Planning Region and Kyustendil Municipality, climate change may reduce the stability and functionality of green infrastructure. The region has significant mountain, forest, rural and river systems, but these are increasingly vulnerable to extreme weather events. Prolonged droughts and high temperatures reduce soil moisture and vegetation, increasing the risk of fires, drying out forests and reducing agricultural productivity.

One of the most pronounced impacts is the increased risk of heat waves. In urban areas, especially where there is little greenery and many paved surfaces, high temperatures create urban heat islands. This negatively affects the health of the population, especially children, the elderly and people with chronic diseases. Insufficient urban greenery reduces the possibility of natural cooling, shade and improvement of the microclimate.

Climate change also affects the water regime. Intense rainfall can cause rapid surface runoff, flash flooding, erosion and flooding, especially in river valleys and along river basins. On the other hand, longer dry periods can lead to lower river levels, drying up of smaller watercourses and reduced water availability for agriculture, ecosystems and populations. These changes weaken the function of river corridors as blue-green infrastructure.

Forest and mountain areas are particularly sensitive to climate change. Higher temperatures, droughts and extreme weather conditions can cause forest vegetation to dry out, diseases and pests to develop, reduced natural regeneration and a greater risk of forest fires. Degradation of forests further increases erosion and reduces the ability of the landscape to retain water and regulate the local climate.

Agricultural and rural landscapes are also exposed to significant risks. Droughts, altered rainfall patterns and extreme temperatures can lead to reduced yields, soil degradation, increased irrigation needs and increased vulnerability of traditional farming systems. This can have direct economic consequences for the local population and reduce the potential for rural tourism and local foods.

Climate change can also affect cultural and natural sites. Intense rainfall, erosion, droughts and temperature extremes can cause damage to access roads, landscape degradation, terrain instability and reducedsafety for visitors. In sites of high tourist value, these processes can reduce their attractiveness and create additional maintenance costs.

Climate change also has indirect effects on the social and economic function of green infrastructure. Reduced water availability, degraded green spaces, increased fire and flood risk, as well as degraded recreational conditions can affect the quality of life, tourism offers, local economy and public safety.

Table: Impact of climate change on green infrastructure

Impact of climate	Description	Potential impact on green infrastructure	The most affected areas
Rising temperatures	Higher average and extreme temperatures	Drying of vegetation, heat stress, reduced microclimatic function	Urban green spaces, rural landscapes, forest areas
Heat waves	Longer periods of very high temperatures	Urban heat islands, health risks, reduced usability of public spaces	Kumanovo, Kriva Palanka, Kratovo, Kyustendil

Sushi	Reduced rainfall and lack of soil moisture	Reduced water holding capacity, desiccation of plants, reduced yields	Agricultural landscapes, forests, rural areas
Intense rainfall	Short but heavy rains	Flooding, erosion, damage to trails, roads and river corridors	River valleys, riparian areas, steep terrain
Floods	Overflowing watercourses and urban flooding	Degradation of river corridors, damage to infrastructure, loss of land	Kriva Reka, Kumanovska Reka, Pchinja, water supply systems in Kyustendil
Erosion	Loss of soil material due to water, wind and degraded vegetation	Reduced fertility, siltation of watercourses, degradation of the landscape	Mountainous, agricultural and riverine areas
Forest fires	Increased risk due to drought and high temperatures	Loss of forests, habitats, soil stability and tourism value	Osogovo, Kriva Palanka, Kratovo, Rankovce, Kyustendil
Reduced water level	Reduced amount of water in rivers, streams and springs	Weakened blue-green connectivity, pressure on aquatic ecosystems	River corridors, small watercourses, agricultural landscapes
Diseases and pests	Climatic conditions that allow the spread of pests	Deforestation, reducing biodiversity and productivity	Forest and agricultural areas
Degradation of cultural and natural objects	Impact of extreme weather conditions on sensitive sites	Erosion, trail damage, reduced safety and tourism value	Kratovo, Kuklitsa, Kokino, Kyustendil

Climate change is putting serious and long-term pressure on green infrastructure. It increases the vulnerability of forests, rivers, agricultural landscapes, urban greenery and cultural and natural sites. The most significant risks are droughts, heat waves, floods, erosion, forest fires and the reduction of water resources.

These impacts can reduce the ecological stability, climate resilience, recreational value, tourism attractiveness and economic potential of the region. Therefore, climate change followsto be treated as one of the key factors in assessing the condition, risks and future planning of green infrastructure.

8.8. Institutional and Governance Challenges

Institutional and governance challenges are a significant factor affecting the condition, functionality and long-term sustainability of green infrastructure. Although green infrastructure is most often associated with natural, rural and urban spaces, its successful planning and management largely depends on institutional capacity, coordination between different stakeholders, availability of data, financial resources and clarity of responsibilities.

In the North-East Planning Region and Kyustendil Municipality, green infrastructure covers many types of spaces: forest and mountain areas, river corridors, agricultural and rural landscapes, urban green areas and cultural and natural sites. These spaces are managed by various institutions and actors, such as municipalities, regional authorities, public enterprises, institutions for the protection of nature and cultural heritage, water management organisations, forestry enterprises, agricultural users, tourism organisations and the private sector. Therefore, one of the main challenges is to ensure harmonized and coordinated management.

Insufficient institutional coordination can lead to fragmented and disconnected activities. For example, urban planning, water management, forestry, agriculture, tourism and nature conservation are often treated as separate sectors, although in practice they are interrelated. If measures are planned sectorally, without a common spatial vision, the connectivity of green infrastructure may be disrupted and its ecological, climatic and social value may be reduced.

Another important challenge is the limited institutional capacity for long-term planning, monitoring and maintenance. Green infrastructure requires continuous monitoring of the state of forests, rivers, land, urban greenery and tourist sites. Lack of human resources, technical equipment, specialist knowledge and financial resources can lead to irregular maintenance, poor risk control and delayed response to degradation, pollution, erosion, fires or floods.

The lack of up-to-date and integrated spatial data is another significant management problem. Quality green infrastructure planning requires data on land cover, biodiversity, protected areas, river corridors, erosion zones, flood risks, urban greenery, tourist sites and land ownership. If this data is not available, not up-to-date or not used through GIS tools, prioritisation of investment, protection and restoration becomes weaker and less accurate.

Financial constraints are a particular challenge. Green infrastructure often requires investment in protection, restoration, maintenance, monitoring, urban landscaping, riverfronts, trails, signage and public green spaces. In many cases, local budgets are limited and priority is given to core municipal infrastructure, while green infrastructure is treated as additional rather than core infrastructure for development and climate. That canled to insufficient maintenance, delayed interventions and gradual degradation of green spaces.

Unclear division of responsibilities can also be a problem. Some areas, especially river corridors, forest edges, green belts, protected areas and tourist areas, may be under the influence of multiple institutions. When there is no clear division of responsibilities, management gaps occur, decision-making is delayed, and ineffective responses to risks or damages occur.

The cross-border nature of the region brings additional complexity. Natural systems, mountain ranges, river courses, tourist routes and cultural and natural values do not end at the administrative border. However, different legal frameworks, institutional procedures, planning documents and administrative practices can make joint coordination difficult. This is particularly important for the development of green corridors, cross-border tourist routes, risk management of fires, floods and degradation of natural resources.

Involving the local population and stakeholders is another important challenge. Green infrastructure has public value, but its management is often planned institutionally, without sufficient participation of citizens, farmers, tourism workers, NGOs, youth and the private sector. Insufficient participation may lead to low acceptance of measures, insufficient sense of responsibility and low interest in long-term maintenance.

There are also challenges related to combining development interests with nature conservation. Investments in infrastructure, tourism, agriculture, urban development and economic activities can bring benefits, but if not carefully managed, they can cause fragmentation, degradation and pressure on sensitive areas. Therefore, the institutional challenge is to ensure a balance between the needs of development and the preservation of the ecological function of the space.

Table: Institutional and governance challenges for green infrastructure

A challenge	Description	Potential impact on green infrastructure	Affected areas
Insufficient institutional coordination	Different institutions manage different aspects of space without sufficient mutual coordination	Fragmented activities, disconnected green spaces, inefficient management	Urban planning, water, forests, tourism, nature
Sectoral approach to planning	Tourism, agriculture, forestry, water resources and urban planning are considered separately.	Insufficiently integrated green network and weakened multifunctionality	Spatial planning, regional development
Limited institutional capacity	Lack of personnel, technical equipment, specialised knowledge and operational resources	Poor monitoring, delayed response, insufficient support	Municipalities, public enterprises, regional authorities
No updated data	Insufficient or inconsistent data on land, risks, biodiversity and green spaces	Inaccurate planning, poor prioritisation, risk of inappropriate interventions	GIS, monitoring, spatial analyses
Limitedfinancial resources	Insufficient budgets for protection, restoration, maintenance and investments	Gradual degradation of green areas and insufficient implementation of measures	Local budgets, regional programmes, projects
Unclear division of responsibilities	Overlaps or gaps in the management of rivers, forests, urban and tourist spaces	Delayed decisions, ineffective response, poor support	River corridors, urban greenery, protected areas
Insufficient cross-border coordination	Different legal, institutional and planning systems on both sides of the border	Impaired functional connectivity and poor management of shared risks	Mountain landscapes, river systems, tourist routes
Weak involvement of the local community	Insufficient participation of citizens, farmers, NGOs, tourism stakeholders and the private sector	Low adoption, low interest in maintenance, insufficient local ownership	Rural areas, urban spaces, tourist sites
Conflict between development and protection	Infrastructural, tourism or economic activities without sufficient ecological integration	Fragmentation, degradation, loss of natural and cultural values	Infrastructure, tourism, urbanisation
Lack of continuity in policy	Changes in priorities, projects or institutional governance	Discontinued activities, unfinished interventions, poor sustainability	Local and regional strategies

Institutional and governance challenges strongly impact the ability of green infrastructure to be planned, protected, restored and used in a sustainable manner. Insufficient coordination, limited financial and human resources, lack of data, unclear responsibilities and weak cross-border integration can reduce the functionality of the green network, even when significant natural and development potential exists.

These challenges show that green infrastructure is not just an environmental issue, but also a matter of good governance, institutional cooperation and long-term planning. Without clear coordination, robust capacities and an integrated approach, there is a risk that green spaces will remain fragmented, underprotected and underutilized as a resource for climate resilience, tourism, recreation and regional development.

8.9. Weaknesses in Funding and Implementation

Shortfalls in financing and implementation represent a significant challenge for the development, protection and maintenance of green infrastructure in the North-East Planning Region of North Macedonia and Kyustendil Municipality. Although both areas possess significant natural, rural, water, forest, urban and natural and cultural values, their full use as

functional green infrastructure is often limited by insufficient financial resources, limited institutional capacity and incomplete implementation of planned activities.

In the North-East planning region, which includes the municipalities of Kumanovo, Kriva Palanka, Kratovo, Rankovce, Lipkovo and Staro Nagorichane, the need for investment in green infrastructure is great. They are related to the organization and revitalisation of river corridors, erosion protection, afforestation, improvement of urban greenery, development of pedestrian and bicycle paths, organization of tourist sites and improvement of rural infrastructure. However, local budgets are often limited and focus primarily on basic utility, road and social needs, while green infrastructure remains dependent on project funding, donor programmes and occasional investments.

In the municipality of Kyustendil, the situation is similar regarding the need for continued investment in green public spaces, river and water systems, forest and recreation areas, spa and tourist areas, as well as better connectivity of natural and cultural sites. Although the municipality has more experience with European projects and cross-border cooperation, securing long-term funds for maintenance, monitoring and further upgrading of the realized investments remains a challenge.

One of the main problems is the dependence on project funding. European and cross-border programmes provide important investments in tourism, natural heritage, digital tools, urban greening and infrastructure, but they are often of limited duration. After projects are completed, additional funds are often needed to maintain trails, signage, digital maps, recreation equipment, green spaces, and tourism content. If these funds are not provided, there is a risk that the results will gradually deteriorate or not be used to their full capacity.

An additional challenge is the lack of technical readiness for larger investments. Green infrastructure often requires preliminary studies, GIS analyses, technical documentation, property and legal arrangements, impact assessments, permits and coordination between multiple institutions. In the smaller municipalities of the North-East planning region, the limited number of professional staff can delay the preparation and implementation of such projects. Similar administrative and technical challenges can also arise in cross-border activities with Kyustendil, especially when harmonization of different procedures, standards and implementation dynamics is necessary.

Insufficient funding for maintenance is a particularly important problem. Green infrastructure does not stop at building or installing equipment. Parks, tree-lined avenues, boardwalks, trails, tourist signage, digital tools, and recreation areas require regular maintenance, cleaning, repairs, renovations, and monitoring. Without a solid support system, even quality investments can quickly lose their function.

Implementation may also be hampered by property rights issues, particularly in river corridors, agricultural landscapes, tourist routes and suburban green belts. Unclear ownership or complex land use procedures can delay planned activities or reduce their scope.

In a cross-border context, an additional risk is the mismatched dynamics between partners. The North-East Planning Region and Kyustendil share common natural, tourism and development potential, but different administrative systems, procurement procedures, budgetary rules and institutional capacity may complicate joint implementation. This can affect the timeliness, quality and sustainability of collaborative deliverables.

Table: Funding and Implementation Gaps

A challenge	Demonstration in the North-East Planning Region and Kyustendil	Potential impact on green infrastructure	Affected areas
Limited local budgets	Municipalities have several main priorities in the area of infrastructure and utilities.	Delayed investment in green spaces, river corridors and regeneration	Urban greenery, rivers, rural spaces
Dependence on the EU and donor projects	Green infrastructure is often financed through limited-term projects	Lack of continuity after project completion	Tourist routes, digital tools, public green spaces
Insufficient funds for maintenance	Once investments are made, funds are not always provided for regular maintenance.	Degradation of trails, parks, signage, equipment and greenbelts	Parks, trails, observation decks, river walkways
Limited professional staff	Smaller municipalities have limited technical and administrative capacity.	Delayed preparation and implementation of projects	Municipalities, regional bodies, public enterprises
Insufficient technical documentation	Lack of studies, GIS analyses, projects and permits	Postponement of investments and poor prioritisation	Restoration, urban planning, waters, tourism
Complex administrative procedures	Public procurement, permits and coordination between institutions take time.	Risk of delay or incomplete performance	Infrastructure and cross-border projects
Property and legal issues	Unclear ownership or use of the land	Limiting interventions in green corridors and paths	River belts, country lanes, suburban areas
Insufficient cross-border compliance	Different administrative systems and procedures in North Macedonia and Bulgaria	Uneven dynamics and difficulties in co-management	Cross-border green routes, tourism, natural corridors
Limited monitoring	Insufficient resources to monitor the condition and consequences	Poor assessment of outcomes and risks	Waters, forests, urban greenery, biodiversity
Risk of unsustainable investments	Investments without a clear plan for use and maintenance	Reduced public benefit and loss of trust in the local community	Tourism, public spaces, digital solutions

Shortcomings in financing and implementation represent a serious limiting factor for the development of green infrastructure in the North-East Planning Region and Kyustendil Municipality. The main problems are related to limited local budgets, dependence on project funding, insufficient funds for maintenance, complex administrative procedures, limited technical staff and the need for better cross-border coordination.

These challenges show that green infrastructure should be treated as a long-term public and development investment, not just a sporadic project activity. Without stable funding, technical readiness and a clear implementation and maintenance system, there is a risk that green spaces, river corridors, tourist routes and public green spaces will remain underdeveloped or gradually lose their function.

9. Analysis

9.1. SWOT Analysis

The SWOT analysis presents the main strengths and weaknesses, opportunities and threats related to green infrastructure in the North-East Planning Region and Kyustendil Municipality. The analysis covers forest and mountain areas, river corridors, rural and agricultural landscapes, urban green spaces and cultural and natural sites.

Strengths	Weaknesses
Significant natural resources: forests, mountains, rivers, rural landscapes and aquatic ecosystems.	Insufficient integrated green infrastructure planning in local and regional policies.
Osogovo represents an important cross-border green corridor.	Limited connectivity between urban green spaces, river corridors and natural areas.
Rich cultural and natural heritage in Kratovo, Kuklitsa, Kokino, Kriva Palanka, Rankovce and Kyustendil.	Insufficiently developed and maintained river corridors and riparian areas.
Potential for development of eco, mountain, rural, cultural, spa and adventure tourism.	Limited financial resources for restoration, maintenance and new investment in green infrastructure.
Existing rural and agricultural areas with traditional landscape and local products.	Insufficient tourist signage, digitisation and promotion of some of the sites.
Urban green spaces have major public benefits for recreation, health and microclimate.	Weak technical readiness, insufficient GIS data and limited monitoring.
The cross-border nature allows a joint approach to tourism, nature and regional development.	Some of the green spaces are fragmented due to infrastructure, urbanisation and land use changes.

Opportunities	Threats
Development of a joint cross-border network of green infrastructure between the North-East Planning Region and Kyustendil.	Climate change: droughts, heat waves, intense rainfall, floods and fires.
Revival of river corridors as blue-green axes for recreation, flood protection and biodiversity.	Degradation of forests, risk of fires and increased soil erosion.
New investments in urban greenery, parks, tree-lined avenues, green streets and promenades.	urbanisation and land use changes that can lead to loss of green space.
Development of pedestrian, bicycle, cultural and ecotourism routes.	River pollution, waste, unregulated discharges and degradation of aquatic ecosystems.
Use of EU funds and cross-border programmes for green infrastructure, climate adaptation and tourism.	Agricultural intensification, loss of hedgerows, agrobiodiversity and the traditional landscape.
digitisation through interactive maps, QR codes, GIS databases, tourist applications and digital promotion.	Insufficient funding and risk of unsustainable or incomplete investments.

Opportunities	Threats
Involve local people, NGOs, tourism stakeholders and the private sector in management and promotion.	Insufficient institutional coordination and different administrative procedures in a cross-border context.

The SWOT analysis shows that the North-East Planning Region and Kyustendil Municipality have a strong natural and cultural basis for the development of green infrastructure. The greatest advantages are associated with mountain and forest areas, river corridors, traditional rural landscapes and cultural and natural sites. These resources create a good basis for sustainable tourism, recreation, climate resilience and cross-border cooperation.

The main weaknesses are related to insufficient connectivity, limited funding, poor technical readiness, insufficient maintenance and insufficient integration of green infrastructure in planning documents. These weaknesses reduce the functionality of the green network and limit the possibility of long-term development.

The opportunities are significant, especially through the use of EU funds, cross-border programmes, digitalisation, development of tourist routes, revitalisation of river corridors and investment in urban greenery. If these opportunities are used in a coordinated manner, green infrastructure can become an important tool for regional development.

The biggest threats are related to climate change, forest fires, erosion, pollution, urbanisation, fragmentation and insufficient financing. These threats can significantly reduce the environmental and societal value of green infrastructure if not managed promptly and systematically.

9.2. Strategic Implications

The main strategic implication is that green infrastructure should be treated as infrastructure for development and not just as an environmental or protection category. This means that investments in forests, rivers, urban greenery, rural landscapes and tourist green routes must be linked to regional economic development, tourism, health, climate adaptation and cross-border cooperation.

The need for integrated green infrastructure planning

One of the key strategic implications is the need to include green infrastructure in spatial, urban planning, tourism and climate plans. The region has significant natural and cultural resources, but these are often treated separately: forests as a forest resource, rivers as water infrastructure, urban greenery as a common area, and cultural sites as tourist sites.

Such a sectoral approach reduces the functionality of green infrastructure. It is strategically necessary to connect all these elements in a single network consisting of natural cores, green and blue corridors, rural buffer zones, urban green spaces and cultural and natural tourism routes.

Strengthening cross-border cooperation

The North-East Planning Region and Kyustendil Municipality share common natural, rural, mountainous and tourist characteristics. Natural systems do not end at the administrative boundary, therefore strategic planning must be transboundary.

This means that the Osogovo region, river systems, rural areas, tourist routes and cultural and natural sites should be treated as part of a common cross-border green network. Cross-border cooperation can enable joint projects, harmonized signage, digital maps, tourism products, risk monitoring and joint promotion.

Prioritizing resilience to climate change

The SWOT analysis shows that climate change is one of the biggest threats to the region. Droughts, heat waves, floods, erosion and wildfires can significantly reduce the ecological and economic value of green infrastructure.

The strategic implication is that any investment in green infrastructure must have a climate function. Forests should be treated as climate regulators, river corridors as natural flood management systems, urban greenery as protection against heat islands, and agricultural and rural landscapes as water retention and soil protection spaces.

Revival of river corridors as a high priority

River corridors are one of the most vulnerable but also the most important elements of green infrastructure. They play a role in the water regime, flood protection, biodiversity, recreation and connecting urban, rural and natural spaces.

Strategically, river corridors should be treated as blue-green development axes. Their revitalisation can provide multiple benefits: better flood protection, cleaner and more attractive public spaces, recreational paths, green belts and better connectivity between settlements and nature.

Urban greenery as public and health infrastructure

The urban green spaces in Kumanovo, Kriva Palanka, Kratovo and Kyustendil are of great public benefit, but are often poorly connected and poorly maintained. The strategic importance is that urban green spaces should be plannedas basic public infrastructure, just like roads, water supply or public buildings.

More parks, tree-lined streets, green avenues, pedestrian and bicycle links, green belts along rivers and shaded public spaces are needed. This is important not only for aesthetics, but also for health, recreation, climate adaptation and social cohesion.

Tourism as a driver of green infrastructure

Cultural and natural sites such as Kratovo, Kuklitsa, Kokino, Osogovo, Rankovce and Kyustendil represent a solid basis for the development of sustainable tourism. The strategic importance is that tourism develops through green infrastructure, not against it.

This means that tourist routes, trails, digital maps, QR codes, signage and promotional activities must be designed in a way that will increase attendance while preserving the natural and cultural landscape. Ecotourism, rural tourism, mountain tourism, cultural tourism and spa tourism have particular potential in Kyustendil.

Need for stable funding and institutional coordination

One of the most important weaknesses is limited funding and insufficient implementation. Strategically, green infrastructure should not depend only on sporadic projects. Stable budget

lines, prepared technical documentation, GIS database, clear responsibilities and coordination between municipalities, regional institutions and cross-border partners are needed.

Lack of maintenance can reduce the value of even well-executed investments. Therefore, any new investment must have long-term management, maintenance and monitoring.

Inclusion of the local population and the private sector

Green infrastructure has the greatest impact when local people recognize it as their own resource. Greater involvement of citizens, farmers, tourism workers, small businesses, non-governmental organisations and educational institutions is strategically needed.

Local communities can contribute through rural tourism, local products, trail maintenance, educational activities, volunteering and promotion of natural and cultural values. The private sector can be an important partner in the development of tourism services, digital tools, local gastronomy and green investments.

Table: Strategic Implications

Strategic area	Consequence	Expected effect
Integrated planning	Green infrastructure will be included in spatial, urban, tourism and climate policies	A connected and functional green network
Cross-border cooperation	Joint planning of green corridors, tourist routes and natural systems	Stronger regional connectivity and joint promotion
Climate resilience	Investments that will contribute to adaptation to droughts, floods, fires and heat waves	Reduced climate risks
River corridors	Treat rivers like blue-green wasps	Better flood protection, recreation and biodiversity
Urban greenery	Parks, tree-lined avenues and green streets should be treated as public infrastructure	Better quality of life and health
Tourism	Cultural and natural sites will be connected in sustainable tourist routes	Greater tourist attraction and local revenue
Funding and management	Stable funds, technical documentation and clear responsibilities are required.	Better enforcement and sustainability
Local involvement	Participation of the population, business, non-governmental organisations and educational institutions	Greater acceptance and long-term sustainability

The strategic implications of the SWOT analysis show that green infrastructure in the North-East Planning Region and Kyustendil Municipality has the potential to become one of the main tools for sustainable cross-border development. For this purpose, it needs to be planned as a connected network, financed in the long term and integrated into tourism, climate change adaptation, urban development, agriculture and nature conservation policies.

The highest strategic priority should be the connection of forest, river, rural, urban and natural and cultural spaces in a single system. With such an approach, the region can increase its resilience to climate change, improve tourism offers, protect natural resources and create better living conditions and local economic development.

10. Vision and strategic goals

10.1. Regional Vision for Green Infrastructure

The regional vision for green infrastructure is aimed at creating a connected, sustainable and multifunctional green network that will unite natural, rural, urban and natural and cultural spaces in a single system for sustainable development.

The vision is based on the idea that green infrastructure is not only a tool for nature conservation, but also a basis for climate resilience, better quality of life, sustainable tourism, local economy, recreation, public health and well-being and cross-border cooperation.

The regional vision for green infrastructure should guide future policies, investments and cross-border activities. Its essence is to connect nature, people, tourism, climate sustainability, the regional and local development in a single system.

With this approach, the North-East Planning Region and Kyustendil Municipality can position themselves as an example of a cross-border region that uses green infrastructure as a basis for sustainable development, nature conservation and a better standard of living.

Vision

The North-East Planning Region and Kyustendil Municipalityarea transboundary green region with connected forest, river, rural, urban and natural and cultural spaces that ensure a healthy environment, climate resilience, sustainable tourism, conservation of natural and cultural heritage and a better quality of life for the local population.

Main direction of the vision

Development of a network of natural cores, green and blue corridors, urban green spaces, rural buffer zones and cultural and natural tourism sites, which provides connectivity between the Osogovo mountain region, river systems, rural areas, urban centres and cultural and natural attractions such as Kratovo, Kuklitsa, Kokino, Kriva Palanka, Rankovce and Kyustendil.

The cross-border dimension is of particular importance. The natural and tourism-related resources of the region do not end at the administrative border, so green infrastructure should be planned as a general spatial and structural system. This implies joint planning, coordinated priorities, cross-border tourist routes, digital maps, joint risk management and coordinated investments.

Main pillars of the regional vision

Connected green and blue network

The first pillar is the creation of functional connectivity between forests, rivers, rural and urban spaces. The forest and mountain regions, especially the region of Osogovo, should function as the main green cores. River corridors should be developed as blue-green axes connecting natural, agricultural and urban spaces.

Climate resilience

Green infrastructure should be a key tool for adapting to climate change. Forests, rivers, urban greenery and rural landscapes should contribute to reducing the risks of floods, erosion, droughts, fires and heat waves.

Protection and restoration of natural resources

The vision envisages the protection of the most valuable natural territories, but also the active restoration of degraded territories, especially river corridors, erosion zones, degraded forest areas, abandoned agricultural areas and insufficiently developed urban green areas.

Urban greenery for a better quality of life

City centres such as Kumanovo, Kriva Palanka, Kratovo and Kyustendil should develop more parks, avenues with trees, green streets, riverside promenades, shaded footpaths and public green spaces. Urban greenery should be treated as public and health infrastructure.

Sustainable tourism and natural and cultural connectivity

Cultural and natural sites should be connected in a common tourism network that will combine nature, culture, traditions, local food, spa tourism, rural tourism and adventure activities. Such an approach will enable the region to position itself as a recognizable green cross-border destination.

Institutional coordination and long-term management

The vision calls for a robust management system that will link municipalities, regional authorities, institutions for nature, water, forests, tourism, culture and local communities. Green infrastructure should be included in planning documents, budgets and development strategies.

Table: Regional vision for green infrastructure

Pillar of Vision	Strategic direction	Expected effect
Connected green and blue network	Connecting forests, rivers, rural and urban spaces into a single system	Better environmental connectivity and functional green infrastructure
Climate resilience	Using green infrastructure to reduce the risks of floods, droughts, fires, erosion and heat waves	Greater resilience of the region to climate change
Protection and recovery	Protection of valuable territories and restoration of degraded areas	Improved ecological status and greater biodiversity
Urban greenery	Development of parks, avenues with trees, green streetsand boardwalks	Better quality of life, healthand recreation
Sustainable tourism	Connecting cultural and natural sites in cross-border tourist routes	Greater tourist attraction and local economic development
Green economy in rural areas	Support for local foods, agritourism and traditional landscapes	Conservation of rural landscapes and new economic opportunities
Institutional coordination	Joint planning, management, monitoring and financing	Better implementation and long-term sustainability
Cross-border cooperation	Joint projects, digital maps, green corridors and promotion	Stronger regional identity and integrated cross-border network

10.2. Strategic Objectives

Strategic objective 1: Protection of the main natural areas and restoration of degraded ecosystems

Strategic objective 1 is aimed at protecting the most significant natural areas and restoring degraded ecosystems in the North-East Planning Region and Kyustendil Municipality. This goal is the basis for building a functional, connected and climate-resilient green infrastructure that will provide long-term protection of biodiversity, water resources, soils, forests, river corridors and cultural and natural landscapes.

This strategic objective lays the foundations for climate resilience, biodiversity conservation, sustainable tourism, improved quality of life and cross-border cooperation. It should be a leading framework for future policies, investments and projects in the North-East Planning Region and Kyustendil Municipality.

The main natural areas are the core of the regional green infrastructure. Protecting these areas is necessary because they provide important ecosystem services. If the main natural areas are degraded or fragmented, the entire network of green infrastructure loses its functionality.

Along with protection, restoration of degraded ecosystems is also necessary. There are areas in the region where natural functions have been weakened due to erosion, forest degradation, fires, water pollution, unregulated river corridors, abandoned agricultural lands, insufficiently maintained urban green spaces and pressure on cultural and natural sites. Restoration should allow restoration of natural stability, improve connectivity, increase resilience to climate change and create greater public and tourism value.

Priority measures

I. The first priority measure is the identification and mapping of key natural areas and degraded ecosystems. It is necessary to clearly identify natural cores, green and blue corridors, forest complexes, river belts, erosion zones, degraded lands and areas of high biodiversity value. This will provide a basis for planning, protecting, restoring and prioritizing future investments.
II. The second priority measure is the protection of forest and mountain areas, especially those of transboundary importance. The mountain region of Osogovo should be treated as a main natural core and transboundary greencorridor. Forest protection is key to biodiversity, climate regulation, erosion protection, water regime and the development of eco- and mountain tourism.
III. The third priority measure is the restoration of degraded forests, erosive and rural areas. This is particularly important for areas affected by fires, uncontrolled logging, erosion, land abandonment or reduced vegetation cover. Restoration should restore the natural function of these areas and reduce their vulnerability to climatic extremes.
IV. The fourth priority measure is the protection and revitalisation of river corridors and aquatic ecosystems. Rivers should be treated as blue-green axes that provide natural connectivity, flood protection, biodiversity, microclimate and recreation. Degraded riverbanks, polluted waterways and narrowed corridors should be among the top priorities for restoration.
V. The fifth priority measure is prevention of fragmentation of natural areas. Infrastructure development, urbanisation, land use changes and uncontrolled

tourism development can disrupt natural corridors. Protection of green connectivity should therefore be included in all planning documents.

VI. The sixth priority measure is the introduction of integrated management of cultural and natural landscapes. Sites such as Kratovo, Kuklitsa, Kokino, Osogovo andKyustendil combine natural, cultural and tourism value. Their protection and restoration should ensure a balance between visitation, tourism development and the preservation of the authentic landscape.

Table: Strategic Objective 1 – Protection and Recovery

Item	Description
A strategic goal	Protection of key natural areas and restoration of degraded ecosystems
Main goal	To preserve the most valuable natural cores and restore degraded ecosystems as the basis of regional green infrastructure
Key areas	Osogovo, Kriva Palanka, Kratovo, Rankovce, Kumanovo, Staro Nagorichane, Kyustendil, river corridors, riverside areas, forest and rural areas
Basic functions	Biodiversity, climate regulation, water regime, erosion protection, flood protection, recreation, sustainable tourism
Main risks	urbanisation, infrastructure fragmentation, fires, erosion, pollution, intensive agriculture, forest degradation, uncontrolled tourism
Priority measures	Mapping natural cores, protecting forest and river corridors, restoring degraded ecosystems, preventing fragmentation, integrated management
Expected result	Preserved, restored and connected network of green infrastructure with greater ecological stability and climate resilience
Contribution to regional development	Better protection of nature, reduced climate risks, improved tourism offer, greater public benefit and higher quality of life

Expected results

The realization of this strategic goal is expected to lead to better protection of the most significant natural areas and their connection in a functional green network. The risk of fragmentation, degradation, erosion, loss of biodiversity and disruption of the water regime will be reduced.

The restoration of degraded ecosystems will contribute to improving the ecological condition, stabilising soils, restoring riparian vegetation, improving water function, increasing climate resilience and creating more attractive spaces for recreation and sustainable tourism.

Furthermore, this objective will enhance transboundary cooperation, as natural systems and risks do not stop at administrative borders. The protection and restoration of natural areas will create a basis for joint planning, joint tourism products, better promotion and long-term sustainable development.

Strategic objective 2: Improving ecological connectivity and strengthening climate resilience

This goal is aimed at building a connected, functional and climate change-resistant network of green infrastructure in the North-East Planning Region and Kyustendil Municipality. This objective is based on the protection and restoration of natural territories, with an emphasis on their interconnection through green and blue corridors, rural buffer zones, urban green spaces and natural and cultural routes.

Improving ecological connectivity and strengthening resilience to climate change are key conditions for the long-term functioning of green infrastructure. If natural cores remain isolated and riverine, rural and urban spaces are not connected, the region will be more vulnerable to climate risks and environmental degradation.

Ecological connectivity is crucial for the stability of ecosystems, the movement of plant and animal species, the preservation of biodiversity and the maintenance of natural processes. If forests, river corridors, agricultural landscapes and urban green spaces are isolated from each other, green infrastructure loses its functionality. Therefore, the priority is the creation of a continuous network that will connect the natural cores, especially the landscape of the Osogovo Mountains, river systems, rural landscapes and urban centres.

Climate change resilience is the second key aspect of this goal. The region is exposed to risks of droughts, heat waves, intense rainfall, floods, erosion and forest fires. Green infrastructure can significantly contribute to reducing these risks by retaining water, stabilising soils, reducing surface runoff, creating shade, improving the microclimate and protecting water resources.

Priority measures

I. The first priority measure is the creation of green and blue corridors. It is necessary to connect forest, river, rural and urban areas in a continuous network. Of particular importance are the region of Osogovo, Kriva reka, Kumanovska reka, Pchinja, riverside belts, rural areas and urban green areas.
II. The second priority measure is reducing the fragmentation caused by infrastructure and urbanisation. New roads, urban extensions, tourist facilities and industrial areas must be planned so as not to interrupt key ecological corridors.
III. The third priority measure is strengthening the climatic function of forests, rivers and land. Forests must maintain their role in water and climate regulation, rivers must provide space for natural water movement, and agricultural landscapes must contribute to soil protection and moisture retention.
IV. The fourth priority measure is the development of an urban green network. City centres should develop connected parks, green streets, tree-lined avenues, shaded pedestrian walkways, bicycle links and green belts along rivers.
V. The fifth priority measure is linking climate resilience with tourism and public benefit. Green and blue corridors can also be used as routes for recreation, tourism and education if managed carefully and sustainably.
VI. The sixth priority measure is cross-border coordination on climate risks. Fires, floods, droughts and degradation of natural resources are not limited by administrative boundaries, so a joint approach between the North-East Region and Kyustendil is needed.

Table: Strategic objective 2 – Ecological connectivity and climate resilience

Item	Description
A strategic goal	Improving ecological connectivity and strengthening climate resilience
Main goal	To create a connected green and blue network that will increase ecosystem stability and the region's resilience to climate change
Key areas	Osogovo, Kriva Reka, Kumanovska Reka, Pchinja, riverside areas, rural areas, urban green spaces, Kyustendil
Basic functions	Ecological connectivity, species movement, climate regulation, flood protection, erosion reduction, recreation
Main risks	Fragmentation, urbanisation, climate change, droughts, floods, fires, erosion, degradation of river corridors
Priority measures	Creating green and blue corridors, connecting urban greenery, protecting river belts, reducing fragmentation, climate adaptation
Expected result	A connected, sustainable and functional network of green infrastructure
Contribution to regional development	Reduced climate risks, better quality of life, greater recreational value, sustainable tourism and better nature protection

Expected results

The realization of this strategic goal is expected to lead to better connectivity between natural, rural, urban and natural and cultural spaces. Green and blue corridors will strengthen the ecological network, allow better movement of species, reduce fragmentation and increase the stability of ecosystems.

The climate resilience of the region will be improved by reducing the risks of floods, erosion, droughts, heat waves and forest fires. River corridors will play a greater role in water management, forests will provide better climate and soil regulation, and urban greenery will contribute to a better microclimate and population health.

In addition, the connected green infrastructure will create opportunities for the development of recreational and tourist routes, better access to nature, strengthening rural development and greater cross-border cooperation.

This strategic objective provides a framework for creating a connected green and blue network that will protect nature, improve quality of life, increase climate resilience and create new opportunities for sustainable tourism and cross-border development.

Strategic objective 3: Improving the quality of life in urban areas

Strategic objective 3 is aimed at improving the urban environment in the North-East Planning Region and Kyustendil Municipality by developing, protecting and connecting the urban green infrastructure. This goal has a direct impact on the daily life of the population, as green spaces in cities and towns contribute to better health, recreation, social cohesion, resilience to climate change, reduction of pollution and a higher quality of public space.

The quality of life in urban areas depends not only on the amount of greenery, but also on its accessibility, connectivity, maintenance, safety and inclusion. Green spaces should be easily accessible to all population groups, including children, young people, the elderly, people with disabilities, families and visitors. Therefore, urban green infrastructure should be treated as a basic public and health infrastructure, not as an additional element of urban planning.

This strategic objective is particularly important as urban areas face multiple stresses: reduction and fragmentation of green space, insufficient tree rows, air pollution, traffic pressure, urban heat islands, poorly managed river corridors and limited recreational spaces. With systematic investments in urban greenery these risks can be reduced and cities can become healthier, more pleasant and more sustainable.

Priority measures

I. The first priority measure is to increase the area planted with urban greenery. New parks, small neighbourhood green spaces, green public spaces, schoolyards and recreation areas should be created in settlements. This is especially important in more densely populated areas where access to greenery is limited.
II. The second priority measure is the connection of the existing green areas in an urban green network. Parks, tree-lined avenues, river belts, pedestrian walkways and public spaces should be connected by green streets, cycle lanes and shaded pedestrian corridors. In this way, the greenery will function as a system rather than as isolated green patches.
III. The third priority measure is the development of river promenades and blue-green urban corridors. Rivers and streams that flow through or next to settlements should be used as an opportunity to create green public spaces, recreational trails and natural areas for cooling and water retention.
IV. The fourth priority measure is the reduction of urban heat islands. It is necessary to increase the rows of trees, shaded footpaths, green areas, water features, permeable surfaces and green public spaces. This will contribute to a better microclimate and reduce health risks during heat waves.
V. The fifth priority measure is improving the accessibility, safety and inclusion of green spaces. Green areas should be equipped with pedestrian walkways, benches, lighting, children's and sports facilities, access for people with disabilities and clear signage.
VI. The sixth priority measure is the connection of urban greenery with cultural and tourism values. In Kratovo, Kriva Palanka and Kyustendil, green public spaces can be linked to cultural heritage, the old city core, spa and recreational facilities, tourist routes and public events.

Table: Strategic objective 3 - Improving the quality of life in urban areas

Item	Description
A strategic goal	Improving the quality of life in urban areas through the development of urban green infrastructure
Main goal	To create healthier, more welcoming, more inclusive and climate-resilient urban environments
Key areas	Kumanovo, Kriva Palanka, Kratovo, Kyustendil and other settlements in the area
Basic functions	Recreation, health, microclimate, shade, urban drainage, social cohesion, public space

Main risks	urbanisation, insufficient greenery, heat islands, pollution, isolated green spaces, insufficient maintenance
Priority measures	New parks, tree-lined avenues, green streets, promenades, urban green corridors, inclusive public spaces
Expected result	Improved quality of life, greater leisure provision, reduced climate risks and a better urban environment
Contribution to regional development	Healthier settlements, more attractive to live and visit, better social and tourism value

Expected results

The implementation of this strategic objective is expected to increase the availability and quality of urban green spaces. Settlements will get more public spaces for rest, recreation, sports, social activities and outdoor activities. This will contribute to better physical and mental health of the population, especially among vulnerable groups.

Connected green streets, tree-lined avenues, parks and promenades will improve the microclimate, reduce the urban heat island effect and help manage stormwater. At the same time, urban green corridors will improve connectivity for pedestrians and cyclists and encourage active lifestyles.

In tourism-related and culturally significant urban areas, such as Kratovo and Kyustendil, improved urban greenery will contribute to a more attractive atmosphere, a better tourist experience and a higher value of public space. In this way, green infrastructure will have not only an ecological and health function, but also an economic and tourism value.

Improving the quality of life in urban areas is one of the most important the visible and most direct benefits of green infrastructure. Urban greenery should be planned as a basic public infrastructure that provides health, recreation, resilience to climate change, social connectivity and a better urban identity.

This strategic goal creates a framework for the development of green, healthy and attractive settlements in the North-East Planning Region and Kyustendil Municipality. With more parks, green streets, greenways, promenades and inclusive public spaces, the urban environment will become more sustainable, more comfortable and of a higher quality to live, work and visit.

11. Solutions and guidelines

11.1. Nature-based Solutions

Nature-based solutions are an approach to spatial planning and management that uses natural processes, ecosystems and green infrastructure to address environmental, climate, social and economic challenges. Rather than relying solely on technical and building interventions, these solutions use nature as an active tool to protect against floods, erosion, droughts, heat waves, pollution, biodiversity loss and land degradation.

The main value of environmentally friendly solutions is their multifunctionality. A well-planned green intervention can simultaneously reduce the risk of flooding, improve the microclimate, create space for recreation, increase biodiversity and improve the visual and tourism value of the area.

Nature-based Solutions for rivers and waters

River corridors are one of the most important spaces for implementing nature-friendly solutions. Instead of full concreting and technical regulation of riverbeds, rivers should be treated as blue-green corridors with natural vegetation, overflow space, green belts and recreational opportunities.

In the region, similar solutions are particularly relevant for Kriva Reka, Kumanovska Reka, Pchinja, the smaller water courses, Lake Lipkovo and the water systems in Kyustendil. They can help reduce riskfrom floods, stabilising banks, improving water quality and creating public green spaces.

Nature-based solution	Description	Expected effect
Green belts by the rivers	Planting and conservation of native vegetation along rivers and streams	Reduced erosion, better water quality and habitat protection
Restoration of riverbanks	Natural landscaping of degraded banks instead of complete concreting	Better blue-green connectivity and reduced flood risk
Wetlands and water retention areas	Spaces for natural retention of excess water during rainfall	Reduced flooding and improved water regime
Permeable riparian zones	Reduction of concrete and asphalt surfaces along rivers	Greater infiltration of rainwater and less surface runoff
River lanes with greenery	A combination of recreational trails, forest rows and riparian vegetation	Improved public amenities, recreation and microclimate

Nature-friendly solutions for forests and mountains

Forest and mountain areas are natural cores of green infrastructure. They provide erosion protection, carbon storage, water regime regulation, flood risk reduction and create conditions for ecotourism and recreation.

Nature-friendly solutions in these areas should focus on forest conservation, restoration of degraded areas, fire protection and sustainable use of natural resources.

Nature-based solution	Description	Expected effect
Afforestation with native species	Restoration of degraded forests and eroded areas	Reduced erosion, better biodiversity and climate resilience
Protective forest belts	Preserving or creating forest belts on sensitive terrain	Soil stabilization and reduction of storm flows
Natural regeneration of forests	Supporting the natural recovery of forest ecosystems	Higher environmental stability and lower renewal costs
Green fire belts	Managed green areas to reduce the spread of fires	Reduced risk of forest fires
Eco-trails with controlled traffic	Marked paths that guide visitors	Reduced pressure on sensitive areas and improved tourism

Nature-friendly solutions for rural areas and agriculture

Nature-friendly solutions in these areas should reduce erosion, improve soil quality, preserve the traditional landscape and support local production and rural tourism.

These solutions are particularly suitable for Kratovo, Rankovce, Staro Nagorichane, Kumanovo and rural areas in Kyustendil.

Nature-based solution	Description	Expected effect
Hedges and green borders	Planting trees, shrubs and grass strips between agricultural areas	Improved ecological connectivity and protection from wind and water erosion
Agroforestry	Combining crops with trees and shrubs	Better soil stability, shade, biodiversity and productivity
Flower belts for pollinators	Bands of native flower species along fields and paths	Support for pollinators and agrobiodiversity
Restoration of pastures and meadows	Maintaining traditional grassland ecosystems	Preserved rural landscape and biodiversity
Green buffer zones	Vegetation belts between agricultural areas, rivers and settlements	Reduced pollution, erosion and surface runoff

Urban solutions based on nature

In the urban environment, nature-based solutions are particularly important to improve the quality of life. They contribute to reducing urban heat islands, improving air quality, stormwater management, recreation, health and social cohesion.

In Kumanovo, Kriva Palanka, Kratovo and Kyustendil, similar solutions should be aimed at creating more parks, avenues with trees, green streets, urban gardens, rain gardens and riverside promenades.

Nature-based solution	Description	Expected effect
Green streets and avenues with trees	Planting trees and greenery on the streets and pedestrian corridors	Shade, better air and reduced heat islands
Rain gardens	Green areas that collect and absorb rainwater	Reduced urban flooding and better drainage
Permeable surfaces	Replacement of asphalt and concrete with water-permeable materials	Reduced surface runoff
City gardens	Public or shared green spaces for local production and education	Social cohesion, local foods and environmental education
Green roofs and facades	Vegetation around buildings in urban areas	Better thermal insulation, microclimate and visual quality

Nature-friendly solutions for cultural and natural sites

Cultural and natural sites require careful, low-impact interventions that will preserve their authenticity. Nature-friendly solutions can help protect against erosion, manage visitors, improve accessibility and preservation of the value of the landscape.

This is especially important for Kratovo, Kuklitsa, Kokino, Osogovo, Rankovce and Kyustendil.

Nature-based solution	Description	Expected effect
Natural stabilization of paths	Arrangement of paths with natural materials and vegetation	Reduced erosion and better safety
Green observation decks and rest areas	Small landscaped areas with shade, native vegetation and minimal infrastructure	A better tourist experience without disturbing the landscape
Controlled green routes	Guiding visitors along marked paths	Reduced pressure on sensitive areas
Indigenous landscaping	Use of native plant species around the sites	Preserved natural character and better adaptation
Natural barriers	Plant belts to protect sensitive areas	Reduced degradation and better visitor management

Nature-friendly solutions represent an efficient and sustainable approach to the development of green infrastructure in the North-East Planning Region and Kyustendil Municipality. They allow nature to be used as an ally in dealing with floods, droughts, erosion, heat waves, pollution and spatial degradation.

By implementing such solutions, the region can increase its resilience to climate change, improve ecological connectivity, create more pleasant urban and rural spaces and develop a more sustainable tourism model. The greatest value of these solutions is that they simultaneously contribute to nature conservation, better quality of life and local economic development.

11.2. Planning and Design Guidelines

The Green Infrastructure Planning and Design Guidelines aim to provide a practical framework for how natural, rural, urban and natural and cultural spaces can be planned, connected, managed and used in a sustainable way. Green infrastructure should be treated as a functional network and not as a collection of isolated green areas.

In the North-East Planning Region and Kyustendil Municipality, planning should link forest and mountain areas, river corridors, rural landscapes, urban greenery, tourist routes and cultural and natural sites. Design should be adapted to the local landscape, climate risks, population needs and the potential for tourism, recreation and local development.

Integrating green infrastructure into planning documents

Green infrastructure should be included in spatial, urban, structural, tourism, climate and sectoral plans. It should be treated as public and urban infrastructure, with the same meaning as roads, water supply, sewerage and public facilities.

When preparing or revising planning documents, natural cores, green and blue corridors, buffer zones, urban green spaces, recreational areas and cultural and natural sites should be clearly identified. Special attention should be paid to protection against conversion, fragmentation and unplanned urbanisation.

Direction	Description	Expected effect
Inclusion in urban and spatial plans	Green cores, corridors and public green spaces to be identified as planning elements	Long-term protection and clear spatial status
Mapping green infrastructure	GIS mapping of forests, rivers, parks, rural areas and tourist sites	Better planning and prioritisation
Protection against conversion	Restriction on the conversion of important green and rural spaces into building land	Prevented loss of green space
Alignment with sectoral policies	Connecting tourism, agriculture, water, forests, nature and urbanism	Integrated development and less conflict between sectors

Design according to the principle of connectivity

A basic principle in planning should be the connection of green spaces. Forests, river corridors, parks, forest belts, agricultural belts and hiking trails should be designed as parts of a single network.

This is particularly important for connecting the Osogovo region with river systems, rural areas and urban centres such as Kumanovo, Kriva Palanka, Kratovo and Kyustendil. Connectivity enables the movement of species, better resilience to climate change, recreation and population access to nature.

Direction	Description	Expected effect
Green corridors	Connecting forest, rural and urban green spaces	Improved environmental and spatial connectivity
Blue-green corridors	Connectivity through rivers, streams, lakes and riparian areas	Better water regime, recreation and biodiversity
Urban Green Links	Connecting parks, tree-lined avenues, public spaces and boardwalks	Better pedestrian and leisure network
Tourist green routes	Connecting natural and cultural sites through trails and signage	Better tourism supply and accessibility

Climate-sensitive design

The design of green infrastructure must respond to climate risks: heat waves, droughts, intense rainfall, floods, erosion and forest fires. Any green intervention must have a climate function, especially in urban, riverside, forest and agricultural spaces.

must be planned. Shady streets, tree-lined streets, green public spaces, rain gardens and permeable surfaces. Space for water, riparian vegetation and natural drainage should be provided in river corridors. In rural and mountainous areas, the soil, vegetation and water in the landscape must be maintained.

Direction	Description	Expected effect
Shade and cooling	Streets with trees, green areas, parks and shady avenues	Reducing urban heat islands
Stormwater management	Rain gardens, permeable surfaces and green belts	Reduced surface runoff and urban flooding
Erosion protection	Landscaping of sloping and degraded areas	Stable soils and lower risk of flash floods
Natural flood zones	Conservation of space along rivers for natural water retention	Reduced risk of flooding

Designing river corridors as public blue-green spaces

River corridors should be designed as natural and public spaces, not just as technical water drainage channels. They should have riparian vegetation, pedestrian and bicycle paths, rest areas, educational boards and protective green belts.

In Kriva reka, Kumanovska reka, Pchinja, Lipkovsko lake and the water systems in Kyustendil, excessive concreting and narrowing of the river corridors should be avoided. Eco-friendly solutions should be preferred.

Direction	Description	Expected effect
Green belts by the rivers	Protection and planting of native vegetation along watercourses	Bank stabilization and better water quality
River alleys	Walking and cycling paths along the rivers	Greater public benefit and recreation
Natural riverside landscaping	Bioengineering and nature-based solutions instead of complete concreting	Better environmental function
Controlled public use	Resorts, viewpoints and educational points without disturbing the ecosystem	Balance between recreation and protection

Urban green design

Urban green spaces should be planned as a network of parks, avenues with trees, green streets, neighbourhood green spaces, schoolyards, sports areas and promenades. Design should be inclusive, safe, accessible and easy to maintain.

In Kumanovo, Kriva Palanka, Kratovo and Kyustendil, priority should be given to green areas that are close to the population, public institutions, schools, health facilities and tourist areas.

Direction	Description	Expected effect
Rural green spaces	Small parks and green public spaces close to the population	Greater everyday accessibility
Green streets	Streets with trees, shade, pedestrian and bicycle lanes	Better mobility and microclimate
Inclusive design	Benches, lighting, access paths and safe areas	Public benefit for all groups
Landscaping of public institutions	Greenery around schools, health facilities and administrative buildings	Better public environment and education

Rural and agricultural landscape design

Rural and agricultural landscapes should be planned as part of a network of green infrastructure, not just as production areas. The design should preserve the mosaic landscape, hedgerows, pastures, meadows, local paths, traditional architecture and the relationship with natural and cultural sites.

This is important for Kratovo, Rankovce, Staro Nagorichane, Kumanovo and Kyustendil, where rural areas can support local foods, agritourismand recreation.

Direction	Description	Expected effect
Preservation of a mosaic landscape	A combination of fields, meadows, pastures, orchards and forest belts	Preserved rural identity and biodiversity
Hedges and green borders	Vegetation belts between agricultural areas	Connectivity, erosion control and pollinators
Country greensroutes	Pedestrian and bicycle paths throughrural areas	Rural tourism and publicbenefit
Connecting with local food	Spatial relationship between agritourism, markets and traditional products	Local economic development

Design of cultural and natural objects

Cultural and natural sites should be managed with minimal, careful and landscape-friendly interventions. The aim is to improve accessibility and the tourist experience without disturbing the natural and cultural value of the space.

This applies to Kratovo, Kuklitsa, Kokino, Osogovo, Rankovce and Kyustendil. The project should use natural materials, native vegetation, controlled paths, viewpoints, QR codes, information boards and digital maps.

Direction	Description	Expected effect
Controlled roads	Clearly defined visitor movement	Reduced erosion and pressure on objects
Natural materials	Stone, wood and locally adapted materials	Preserved authentic landscape
Digital interpretation	QR codes, interactive maps and digital guides	A better tourist and educational experience
Green views and resorts	Small, well maintained sites with shade and minimal infrastructure	Better accessibility and public benefit

General design principles

All interventions in green infrastructure should be guided by several basic principles: local adaptation, use of native species, minimal disruption of nature, multi-functionality, accessibility, resilience to climate change and easy maintenance.

A principle	Meaning
Local customization	The design must match the topography, climate, culture and landscape
Local species	Use of local plant species resistant to climatic conditions
Multi-functionality	One intervention to provide multiple benefits: nature, climate, recreation, tourism
Minimal disturbance	Avoid heavy construction interventions in sensitive areas
Accessibility	Green spaces should be accessible to different groups of users
Sustainability	The design should be easy to maintain and use in the long term

Planning and design guidelines should ensure that green infrastructure in the North-Eastern Planning District and Kyustendil Municipality is developed as a connected, climate-resilient and multi-functional network. The main focus should be on integrated planning, protection of natural cores, connectivity through green and blue corridors, promotion of urban greenery, the preservation of the rural landscape and the careful management of cultural and natural sites.

By implementing these guidelines, green infrastructure can become the basis for a better quality of life, nature conservation, climate resilience, sustainable tourism and cross-border development.

11.3. Maintenance and Management Guidelines

Maintenance and Management Guidelines aim to ensure the long-term functionality, safety and sustainability of green infrastructure. Green infrastructure does not stop at planning, building or restoring; it requires continuous management, regular maintenance, monitoring, financial support and clear institutional coordination.

In the North-East Planning Region and Kyustendil Municipality, management should cover forest and mountain areas, river corridors, rural and agricultural landscapes, urban green spaces and cultural and natural sites. Each type of green infrastructure has different needs, but they should all be treated as part of a single regional green network.

Institutional coordination and clear division of responsibilities

Effective management requires a clear division of responsibilities between municipalities, regional institutions, public enterprises, forestry and water management, institutions for the protection of nature and cultural heritage, tourism organisations and local communities.

As green infrastructure spans multiple sectors, regular coordination is required between institutions responsible for urban planning, environment, utilities, tourism, agriculture, forestry, water and culture. Cross-border coordination between the North-East Planning Region and Kyustendil is particularly important for areas and activities of common importance.

Direction	Description	Expected effect
Clear responsibilities	Determining who manages parks, rivers, trails, forests, tourist sites and green belts	Reducing institutional gaps and overlaps
Coordinating body	Creation of a working group for green infrastructure at the regional and cross-border level	Better coordination of activities
Sectoral integration	Connecting urbanism, water, forests, tourism, agriculture and nature	More functional management
Cross-border coordination	Coordination of activities between the North-East Planning Region and Kyustendil	Shared access to nature corridors and tourist routes

Regular maintenance of urban green spaces

Urban green spaces require regular and systematic maintenance to maintain their social, climatic and recreational function. This includes mowing, pruning, watering, replacing dead trees, maintaining walkways, benches, lighting, children's facilities, sports elements and community equipment.

In Kumanovo, Kriva Palanka, Kratovo and Kyustendil, urban greenery must be maintained according to annual programmes, with clearly defined budgets and responsible municipal departments.

Direction	Description	Expected effect
Annual maintenance programmes	Plan for mowing, pruning, planting, cleaning and repairs	Better maintained green spaces
Replacement of damaged vegetation	Regular replacement of dead trees and degraded lawns	Preserved quality of urban greenery
Maintenance of public equipment	Repair of benches, lighting, paths and recreation facilities	Greater security and usability
Inclusive support	Pathways and approaches to remain usable for children, the elderly and disabled	Greater public benefit

Management of river corridors and aquatic ecosystems

River corridors require careful maintenance that will not disrupt their natural function. Maintenance should not be limited to technical cleaning of riverbeds, but should include riparian vegetation protection, litter control, erosion monitoring, water monitoring, and maintenance of access and recreation areas.

In Kriva Reka, Kumanovska Reka, Pchinja, Lipkovsko Ezero and Kyustendil water systems, management must ensure a balance between flood protection, biodiversity, recreation and public safety.

Direction	Description	Expected effect
Regular cleaning without destruction	Removal of waste and sludge without destroying natural vegetation	Better quality of river corridors
Water quality monitoring	Periodic monitoring of pollution and risk points	Timely detection of problems
Maintenance of riparian areas	Protection and care of trees, shrubs and herbaceous vegetation along rivers	Reduced erosion and better blue-green function
Control flood risks	Monitoring of critical areas, sediments, erosion and permeability	Better security in populated areas

Management of forests and mountain areas

Forest and mountain areas should be managed with an emphasis on biodiversity conservation, fire prevention, erosion control, sustainable use of forest resources and regulation of recreational pressure.

Special attention should be paid to the Osogovo mountain region as a cross-border natural core. Management should ensure regular forest condition monitoring, logging control, trail maintenance, litter prevention and visitor education.

Direction	Description	Expected effect
Forest condition monitoring	Monitoring of degradation, desiccation, disease, pests and fires	Timely response and preserved forests
Fire management	Fire belts, access points, warning and coordination	Reduced risk of forest fires
Trail maintenance	Regular cleaning, marking and safety checks of mountain trails	Safe and sustainable tourism
Control of use	Control of logging, litter, wild camping and off-trail traffic	Reduced degradation

Management of rural and agricultural landscapes

Rural and agricultural landscapes should be managed as part of green infrastructure, not just as production areas. Hedgerows, buffer zones, pastures, meadows, green belts, local paths and traditional landscapes should be maintained.

In Kratovo, Rankovce, Staro Nagorichane, Kumanovo and Kyustendil, this is important for the preservation of rural identity, agro-biodiversity, local foods and the potential for rural tourism.

Direction	Description	Expected effect
Maintenance of hedges and borders	Preservation of vegetation belts between agricultural areas	Better connectivity and erosion protection
Management of pastures and meadows	Controlled use and prevention of neglect	Preserved traditional landscape
Maintenance of rural paths	Cleaning, marking and connecting with tourist routes	Better accessibility and rural tourism
Degradation monitoring	Identification of eroded and abandoned surfaces	Better recovery planning

Management of cultural and natural objects

Cultural and natural sites require integrated management that takes into account both natural and cultural values. This is especially important for Kratovo, Kuklitsa, Kokino, Osogovo, Rankovce and Kyustendil.

Maintenance should include trails, observation points, information boards, QR codes, digital maps, access areas, rest areas and protection from erosion and uncontrolled visitor movement.

Direction	Description	Expected effect
Visitor Management	Direction of movement on paths, signaling and information	Reduced pressure on settlements
Maintenance of tourist infrastructure	Trails, signs, QR codes, lookouts and resorts	A better travel experience
Protection of authenticity	Control of inappropriate interventions and commercialization	Preserved cultural and natural identity
Damage tracking	Regular inspection of erosion, debris and damaged infrastructure	Timely maintenance and protection

Monitoring, data and digital management

Quality management of green infrastructure requires regular data collection. A GIS database is needed, which will contain information about green areas, river corridors, forests, erosion zones, hiking trails, cultural and natural sites and risk zones.

Digital governance will enable better planning, monitoring of the situation, prioritisation of investments and transparency towards the public.

Direction	Description	Expected effect
GIS database for green infrastructure	Digital mapping of all important elements	Better analysis and planning
Regular monitoring	Monitoring of forests, waters, parks, erosion and tourist sites	Timely detection of risks
Digital registry of interventions	Records of completed and required activities	Better accountability and coordination
Publicly available information	Interactive maps and usage information	Greater transparency and participation

Funding and long-term sustainability

Maintenance and management must have a sound financial basis. Green infrastructure should be part of the regular budgets of municipalities and institutions, not just a project-dependent activity. With each new investment, it must be foreseen in advance who will support it, with what means and according to what plan.

Direction	Description	Expected effect
Budget lines for green infrastructure	Tools for regular maintenance and management	Long-term stability
Post-investment maintenance plans	Every new investment should have a plan for use and maintenance	Avoiding degradation after project completion
Blended financing	Local budgets, EU funds, donors and the private sector	More deployment sources
Estimating maintenance costs	Realistic calculation of annual costs	Better financial planning

Maintenance and management are key to the long-term value of green infrastructure. Without regular care, monitoring, funding and clear responsibilities, even well-planned and implemented green investments can quickly lose their function.

For the North-East Planning Region and Kyustendil Municipality, the priority should be the establishment of a systematic management of the green infrastructure, which will connect municipalities, institutions, local communities and cross-border partners. Only in this way can green infrastructure remain functional, safe, resilient to climate change and beneficial to the population, nature, tourism and local development.

12. Strategic Projects and Project Fiches

12.1. Strategic Projects

Strategic projects for green infrastructure are a key tool for the practical implementation of the regional vision and strategic goals for the North-East Planning Region and Kyustendil Municipality. They should ensure a transition from analysis and planning to concrete interventions on the ground, through which natural values will be protected, degraded ecosystems will be restored, ecological connectivity will be improved and the climate resilience of the region will be increased.

The main objective of the strategic projects is to develop a connected, functional and multifunctional network of green infrastructure that will unite forest and mountain areas, river corridors, rural and agricultural landscapes, urban green spaces and cultural and natural sites. In this way, green infrastructure will contribute not only to nature conservation, but also to a better quality of life, sustainable tourism, local economic development, recreation, public health and well-being and cross-border cooperation.

Projects should be directed to areas with the greatest ecological, climatic, social and development value. Priority should be given to river corridors, urban green spaces, degraded forests and erosion zones, ecological corridors and cultural and natural sites with potential for sustainable tourism. Cross-border and inter-municipal projects are of particular importance, as natural systems, watercourses, mountain areas and tourist routes do not end at administrative borders.

Strategic projects should be planned so that each intervention provides multiple benefits simultaneously. For example, the revitalisation of a river corridor can contribute to reducing the risk of flooding, improving biodiversity, creating recreational trails, improving the microclimate and increasing tourist attractiveness. Similarly, urban landscaping can reduce the heat island effect, improve air quality, provide shade and create better public spaces for the population.

Below are proposed strategic projects grouped by type of intervention.

Table Strategic projects

Project type	Strategic name of the project	Location / Scope	Brief description	Expected effect
Urban green infrastructure projects	Development of urban green corridors in Kumanovo	Kumanovo	Connecting existing parks, tree-lined avenues, public green spaces and river spaces into a single urban green network.	Better microclimate, recreation, pedestrian connectivity and quality of life.
	Green cultural routes in Kratovo	Kratovo	Landscaping and organizing pedestrian connections between the old city centre, towers, bridges, public spaces and the natural environment.	Improved tourist atmosphere, shade, accessibility and public benefit.
	Urban greenery and river green belts in Kriva Palanka	Kriva Palanka	Connecting urban greenery with river corridors and approaches to the Osogovo area.	Better urban connectivity, recreation and resilience to climate change.
	Improvement of public green spaces in Kyustendil	Kyustendil	Improvement of parks, green streets, spa recreation areas and public green areas.	Improved quality of life, health tourism and public recreation.
	Green school and public yards	Kumanovo, Kriva Palanka, Kratovo, Kyustendil	Landscaping of schoolyards, health facilities and public institutions with native species, shade and educational content.	Environmental education, better microclimate and public benefit.
River Corridor and Wetland Projects	Revival of Kriva Reka as a blue-green axis	Kriva Reka	Organization of riverside green belts, rehabilitation of degraded banks, cleaning of waste and creation of recreation areas.	Better flood protection, recreation, biodiversity and water regime.
River Corridor and Wetland Projects	Urban revitalisation of Kumanovska Reka	Kumanovo	Transforming the river into a public blue-green corridor through landscaping, pedestrian walkways, litter control and improved access.	Reduction of urban flooding, better public space and microclimate.
	Protection and management of Pchinja and smaller watercourses	Kumanovo, Staro Nagorichane, rural areas	Preservation of riverside vegetation, rehabilitation of erosion points and development of eco-trails.	Conservation of natural waterways and rural recreation.

	Sustainable development of Lake Lipkovo and its surroundings	Lipkovo	Organization of controlled recreation areas, green belts, approaches and waste management system.	Better use from a tourist point of view and protection of the aquatic ecosystem.
	Blue-green water spaces in Kyustendil	Kyustendil	Connecting water systems to parks, spas, boardwalks and recreation areas.	Improved microclimate, health tourism and public use.
	Cross-border green corridor Osogovo	Osogovo, Kriva Palanka, Kyustendil	Connecting forest, mountain and rural areas in a transboundary ecological network.	Improved ecological connectivity, biodiversity and transboundary cooperation.
	Connection Kratovo – Rankovce – Kriva Palanka	Kratovo, Rankovce, Kriva Palanka	Development of green and rural corridors between natural, cultural and tourist sites.	Better spatial connectivity and sustainable tourism.
	Rural green belts in agricultural landscapes	Kumanovo, Staro Nagorichane, Rankovce, Kyustendil	Planting of hedges, rows of trees and green borders between agricultural areas.	Erosion protection, agrobiodiversity and species movement.
	Connecting urban and suburban green spaces	Kumanovo, Kyustendil, Kriva palanka	Connecting parks, tree-lined avenues, river corridors and green areas on the city's periphery.	Reduced fragmentation and better public accessibility.
Afforestation and erosion control projects	Afforestation of degraded parts of Osogovo	Osogovo region	Afforestation with native species, stabilization of erosive slopes and protection of forest edges.	Reduced erosion, better resilience to climate change and protection of biodiversity.
	Erosion control in Kratovo and Rankovce	Kratovo, Rankovce	Stabilization of degraded and sloping terrain, green belts and restoration of plant cover.	Reduced storm flows, soil protection and improved landscape.
	Protective green belts alongagricultural areas	Kumanovo, Staro Nagorichane, Kyustendil	Creation of hedges, protective tree rows and agroforestry belts.	Reduced erosion, soil protection and improved agrobiodiversity.
	Restoration of forest areas after fires	Forest territories in the North-East Planning Region and Kyustendil	Restoring forest areas affected by fires with erosion control and natural regeneration.	Reduced degradation and faster restoration of forest functions.
	Cross-border green tourist route Osogovo - Kyustendil	Kriva palanka, Osogovo, Kyustendil	Development of walking and cycling routes, viewpoints, signage, resorts and digital map.	Increased tourist attraction and cross-border supply.

Projects for sustainable tourism and recreation	Cultural and natural route Kratovo – Kuklitsa – Rankovce	Kratovo, Kuklitsa, Rankovce	Connecting cultural, natural and rural sites with trails, QR codes and tourist signage.	Better tourism visibility, local income and sustainable use.
	Educational and archeo-natural route Kokino	Staro Nagorichane / Kumanovo	Improving accessibility, interpretation, trails and digital representation of the site.	Site protection and enhanced tourist experience.
	Green paths for recreation around Lake Lipkovo	Lipkovo	Development of pedestrian, cycling and recreational areas with controlled access and green infrastructure.	Improved provision of recreation and protection of the lake landscape.
Projects for sustainable tourism and recreation	Spa, natural and recreational green belt in Kyustendil	Kyustendil	Connecting a spa centre, a park, cultural and natural spaces in an integrated green tourist area.	Enhanced health and recreational tourism.
Climate resilience and heat mitigation projects	Green streets and trees to reduce heat islands	Kumanovo, Kriva Palanka, Kratovo, Kyustendil	Planting rows of trees, creating shaded pedestrian corridors and green streets in the most open urban areas.	Lower temperatures, better air and walking comfort.
	Rain gardens and permeable surfaces in urban areas	Kumanovo, Kyustendil, Kriva palanka	Proposed nature-based solutions include for retaining rainwater in public spaces, streets and parks.	Reduced surface runoff and urban flooding.
	Shaded public spaces and resistant to climate changeparks	Urban centres in the region	Designing parks and public spaces with shade, native vegetation, benches, water and inclusive access.	Better quality of life and protection from heat waves.
	Climate resilient rural landscapes	Kratovo, Rankovce, Staro Nagorichane, Kyustendil	Green belts, agroforestry, hedgerows and water retention measures in the rural landscape.	Reduced vulnerability to drought, erosion and degradation.
Cross-border or inter-municipal projects	A common GIS database for green infrastructure	North-East Planning Region and Kyustendil	Creation of a transboundary digital database with natural cores, corridors, risks, tourist routes and priority interventions.	Better planning, monitoring and coordination.
	Joint strategy for the Osogovo Green Corridor	Kriva palanka, Kratovo, Kyustendil	Joint planning of protection, tourism, climate resilience and monitoring of the Osogovo region.	Stronger cross-border cooperation and protection of natural lakes.

Cross-border or inter-municipal projects	Cross-border network of green tourist routes	SIPR – Kyustendil	Connecting Kratovo, Kuklitsa, Kokino, Osogovo, Kriva Palanka and Kyustendil through a common tourist product.	Greater tourism visibility and local economic development.
	Joint Climate Risk Monitoring System	North-East Planning Region and Kyustendil	Monitoring fires, floods, droughts, erosion and degradation through common indicators and digital tools.	Better prevention, risk management and timely response.
	Regional Public Education and Involvement Program	All municipalities in scope	Campaigns, seminars, volunteer actions and educational programmes for green infrastructure.	Greater public awareness, local participation and long-term sustainability.

The proposed strategic projects lay the foundations for the development of a connected, sustainable and multifunctional green infrastructure in the North-East Planning Region and Kyustendil Municipality. Projects on river corridors, climate resilience, urban greening and cross-border coordination should have the highest priority as they have the most direct impact on quality of life, risk protection and green network functionality.

In parallel, projects for ecological corridors, afforestation, erosion control, sustainable tourism and green economy in rural areas should ensure long-term ecological stability, tourist attraction and local economic development.

12.2. Project sheets with objectives, location, budget and responsible institutions

Project sheets are short project profiles that summarize the most important information about each strategic project: purpose, location, indicative budget and responsible institutions. Budgets are given asindicative ratingsand should be further specified through technical documentation, feasibility studies, project planning and consultations with the competent institutions.

Table: Project sheets

Project type	Project name	Main goal	Location / Scope	Indicative budget	Responsible institutions
Urban green infrastructure projects	Development of urban green corridors in Kumanovo	Connecting parks, tree-lined avenues, public green spaces and river spaces into a functional urban green network	Kumanovo	700 000 – 1 200 000 euro	Municipality of Kumanovo, PP for communal activities, Centre for Development of the North-East Planning Region
	Green cultural routes in Kratovo	Landscaping and organizing pedestrian connections between the old city centre, towers, bridges and the natural environment	Kratovo	300 000 – 600 000 euro	Municipality of Kratovo, cultural institutions, Centre for Development of the North-East Planning Region
	Urban greenery and river green belts in Kriva Palanka	Connecting the urban greenery with the river areas and the approaches to Osogovo	Kriva Palanka	400 000 – 800 000 euro	Municipality of Kriva Palanka, SP Komunalets, centre for Development of SIPR
	Improvement of public green spaces in Kyustendil	Improvement of parks, green streets, spa recreation areas and public green areas	Kyustendil	600 000 – 1 000 000 euro	Kyustendil Municipality, communal services, regional institutions
	Green school and public yards	Landscaping of schoolyards, health facilities and public institutions	Kumanovo, Kriva Palanka, Kratovo, Kyustendil	250 000 – 500 000 euro	Municipalities, schools, public institutions, Centre for Development of the North-East Planning Region, Kyustendil Municipality
River Corridor and Wetland Projects	Revival of Kriva Reka as a blue-green axis	Restoration of riparian green belts, rehabilitation of banks and creation of recreational areas	Kriva Reka	1 000 000 – 2 000 000 euro	Municipalities of Kriva Palanka, Rankovce, Kratovo, water management institutions, Centre for Development of the North-East Planning Region
	Urban revitalisation of Kumanovska Reka	Turning the river into a public blue-green corridor	Kumanovo	1 200 000 – 2 500 000 euro	Kumanovo Municipality, PE "Water Supply/Utility Services", Ministry of Environment, Centre for Development of the North-East Planning Region
	Protection and management of Pchinja	Preservation of riverside vegetation, rehabilitation of erosion points and development of eco-trails	Kumanovo, Staro Nagorichane, rural areas	500 000 – 1 000 000 euro	Municipalities of Kumanovo and Staro Nagorichane, water management organisations, centre for Development of the National

	and smaller watercourses				Water Resources Management System
	Sustainable development of Lake Lipkovo and its surroundings	Organization of controlled recreation areas, green belts, approaches and waste water system	Lipkovo	600 000 – 1 200 000 euro	Lipkovo Municipality, Water and Environment Institutions, Centre for Development of the North-East Planning Region
	Blue-green water spaces in Kyustendil	Connecting water systems to parks, spas and recreation areas	Kyustendil	800 000 – 1 500 000 euro	Kyustendil Municipality, communal and water services, regional institutions
Projects for ecological corridors	Cross-border green corridor Osogovo	Connecting forest, mountain and rural areas in a transboundary ecological network	Osogovo, Kriva Palanka, Kyustendil	1 500 000 – 3 000 000 euro	Municipality of Kriva Palanka, Municipality of Kyustendil, forestry enterprises, environmental protection institutions, Centre for Development of the North-East Planning Region
	Connection Kratovo – Rankovce – Kriva Palanka	Development of green and rural corridors between natural, cultural and tourist sites	Kratovo, Rankovce, Kriva Palanka	700 000 – 1 300 000 euro	Municipalities of Kratovo, Rankovce and Kriva Palanka, Centre for Development of the North-East Planning Region
	Rural green belts in agricultural landscapes	Planting hedges, rows of trees and green borders	Kumanovo, Staro Nagorichane, Rankovce, Kyustendil	400 000 – 800 000 euro	Municipalities, agricultural associations, agricultural agencies, Centre for Development of the North-East Planning Region
	Connecting suburban with urban and green spaces	Connecting parks, tree-lined avenues, river corridors and suburban green spaces	Kumanovo, Kyustendil, Kriva palanka	600 000 – 1 100 000 euro	Municipalities of Kumanovo, Kriva Palanka and Kyustendil, communal services
15.4. Afforestation and Erosion Control Projects	Afforestation of degraded partsfrom Osogovo	Restoration of degraded forests and eroded areas with native species	Osogovo region	800 000 – 1 600 000 euro	Forest farms, Kriva Palanka municipality, Kyustendil municipality, environmental institutions
	Erosion control in Kratovo and Rankovce	Stabilization of sloping and degraded terrain	Kratovo, Rankovce	500 000 – 1 000 000 euro	Municipalities of Kratovo and Rankovce, Centre for Development of the North-East Planning Region, forestry and agricultural institutions

	Protective green belts along agricultural areas	Reducing erosion and improving agrobiodiversity	Kumanovo, Staro Nagorichane, Kyustendil	350 000 – 700 000 euro	Municipalities, farmers, agricultural agencies
	Restoration of forest areas after fires	Restoring forest areas affected by fires and reducing post-fire erosion	Forest territories in the North-East Planning Region and Kyustendil	700 000 – 1 400 000 euro	Forest enterprises, fire services, municipalities, environmental institutions
Projects for sustainable tourism and recreation	Cross-border green tourist route Osogovo - Kyustendil	Development of pedestrian and bicycle routes, viewpoints, signs, rest areas and a digital map	Kriva palanka, Osogovo, Kyustendil	900 000 – 1 800 000 euro	Municipality of Kriva Palanka, Municipality of Kyustendil, tourism organisations, Centre for Development of the North-East Planning Region
	Cultural and natural route Kratovo – Kuklitsa – Rankovce	Connecting cultural, natural and rural sites through paths, QR codes and signs	Kratovo, Kuklitsa, Rankovce	500 000 – 1 000 000 euro	Municipalities of Kratovo and Rankovce, cultural institutions, interested parties in tourism
	Educational and archeo-natural route Kokino	Improving accessibility, interpretation, pathways and digital representation	Staro Nagorichane / Kumanovo	400 000 – 900 000 euro	Staro Nagorichane Municipality, Kumanovo National Museum, Centre for Development of the North-East Planning Region
	Green paths for recreation around Lake Lipkovo	Organization of pedestrian, bicycle and recreational areas with controlled access	Lipkovo	500 000 – 1 000 000 euro	Municipality of Lipkovo, interested parties in tourism, institutions in the field of water and environment
	Spa, natural and recreationalgreen belt in Kyustendil	Connecting spa centre, park, cultural and natural spaces in an integrated tourism area	Kyustendil	700 000 – 1 500 000 euro	Kyustendil Municipality, tourism organisations, spa and healthcare establishments
Climate resilience and heat mitigation projects	Green streets and trees to reduce heat islands	Planting rows of trees, shaded pedestrian corridors and green streets	Kumanovo, Kriva Palanka, Kratovo, Kyustendil	700 000 – 1 300 000 euro	Municipalities, utilities, Centre for Development of the North-East Planning Region
	Rain gardens and permeable surfaces in urban areas	We present natural solutions for rainwater retention	Kumanovo, Kyustendil, Kriva palanka	500 000 – 1 000 000 euro	Municipalities, public enterprises, environmental institutions

	Plannedpublic spaces and climate sustainableparks	Organizing parks and public spaces with shade, native vegetation and accessibility	Urban centres in the region	600 000 – 1 200 000 euro	Municipalities, communal services, public institutions
	Climate resilient rural landscapes	Green belts, agroforestry, hedgerows and water retention measures	Kratovo, Rankovce, Staro Nagorichane, Kyustendil	400 000 – 800 000 euro	Municipalities, agricultural associations, agricultural agencies
Cross-border or inter-municipal projects	A common GIS database for green infrastructure	Creation of a cross-border digital database with natural cores, corridors, risks and tourist routes	North-East Planning Region and Kyustendil	250 000 – 500 000 euro	Centre for Development of the North-East Planning Region, Kyustendil municipality, municipalities from the region, GIS experts
	Joint strategy for the Osogovo Green Corridor	Joint planning of protection, tourism, climate resilience and monitoring of the Osogovo region	Kriva palanka, Kratovo, Kyustendil	300 000 – 600 000 euro	Municipalities of Kriva Palanka, Kratovo and Kyustendil, Centre for Development of the North-East Planning Region, nature protection institutions
	Cross-border network of green tourist routes	Connecting Kratovo, Kuklitsa, Kokino, Osogovo, Kriva Palanka and Kyustendil in a common tourist product	SIPR – Kyustendil	800 000 – 1 600 000 euro	Centre for Development of the North-East Planning Region, Kyustendil Municipality, municipalities, tourism organisations
	Jointclimate risk monitoring system	Monitoring of fires, floods, droughts, erosion and degradation through common indicators	North-East Planning Region and Kyustendil	400 000 – 900 000 euro	Municipalities, fire services, environmental institutions, Centre for Development of the North-East Planning Region
	Regional Public Education and Involvement Program	Campaigns, seminars, volunteer actions and educational programmes for green infrastructure	All municipalities in scope	150 000 – 300 000 euro	Centre for Development of the North-East Planning Region, Kyustendil municipality, schools, non-governmental organisations, tourist and local associations

Annexes

Annex 1 Basic data for the North-East Planning Region and Kyustendil Municipality

Annex 2 Legal framework

Annex 3 Current situation

Annex 4 Green Infrastructure Inventory

Annex 5 Ecosystem Services Valuation Methodology

Annex 6 Ecosystem services - assessment

Annex 7.2 Assessing the multifunctionality of green infrastructure

Annex 7.3 Green Infrastructure Connectivity Assessment

Annex 7.4 Environmental condition and integrity of green infrastructure

Annex 7.5 Assessing the Value of Green Infrastructure for Climate Change Resilience

Annex 7.6 Assessing the Social Accessibility and Public Benefit of Green Infrastructure

Annex 7 Priority areas for green infrastructure protection

Annex 8 Priority areas for green infrastructure restoration

Annex 9 Priority areas for new investments in green infrastructure