



**Interreg**



EUROPEAN UNION

**Danube Transnational Programme**

**URBforDAN**

**URBforDAN Mapping of Ecosystem Services**  
Croatia

## Table of content

Table of content .....	2
1. INTRODUCTION .....	3
2. METHODOLOGY.....	5
3. RESULTS .....	5
3.1. Summary of mapped ES .....	5
3.2. Timber production.....	6
3.3. Local climate mitigation .....	7
3.4. Local Air quality .....	8
3.5. Protection against air pollution .....	9
3.6. Protection against erosion .....	10
3.7. Waste water treatment.....	12
3.8. Nature protection.....	13
3.9. Recreation and tourism .....	14
3.10. Scientific/Educational .....	14
4. DISCUSSION .....	15

# 1. INTRODUCTION

## 1. Short description of the strategic (and focus) area:

Provide a paragraph that includes:

- Surface of the strategic and focus area
- Surface of forests and surface of other land (for the strategic area)
- Importance, ownership, protected categories (for the strategic area)

+ add map of the area (ortofoto + shape of the border) where strategic and focus area are marked

Urban forests in City of Zagreb are situated on 22 separate locations and cover 395,08 ha, distributed mostly over northern parts of the city at the lowest south, southwest and south east slopes of Medvednica mountain. They are surrounded with urban settlements and family houses, making them under pressure to decrease the area which considerably influences their functioning. Also, they are an integral part of Zagreb's green areas and represent attractive places for both citizens and visitors.

According to the CORINE Land Cover, forest is covering cca 38 % of total urban area in the city of Zagreb. The most of the forests are in the private properties, what cause a lot of parcels and low stand quality. Forests in state property are in better conditions and quality. Improvement in forest management in private forest has been recognised as priority in development of the city. The most of the forests are in economic based forest management. The all other areas are protected forests or forests with special purposes. Forest density is higher in western part of the city (Medvednica Mountain). Area around the Sava river has not much forests, but is important for the water supply. Some of the afforestation's are in the plans.

Green infrastructure provide better life quality, human's welfare, biodiversity, climate mitigation and protection from ecological disasters. It also support integral, multifunctional and cross sectoral approach for better development, what include protected areas, Natura2000 network, ecosystems aou of the protected areas, parks, gardens, springs, shrubs..etc.

Forest management involves the decision making related to the organisation, use and conservation of forests. The management decisions are made both for long-term planning and the daily activities. Good forest management requires the solution of the issues related to global problems of energy, raw materials and life quality.

In Grmoščica state forests are 46,81 ha, private forests 10,79 ha (63,60 ha in total). Other land area is 13,30 ha. All together area has 70,90 ha. Growing stock is normal (274,60 m<sup>3</sup>/ha), increment is 7,60 m<sup>3</sup>/ha.



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0 100 200 300 400m

**Map of strategic area**



**Legend**

- Grmošćica border
- Quercus petraea ( 6,30 ha)
- Strategic area- forest surface
- Robinia pseudoacacia (7,27 ha)
- Pinus strobus (2,28 ha)
- Populus euroamericana (1,68 ha)

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## 2. METHODOLOGY

Describe the process of mapping ecosystem services (ES):

- how you selected the main ES
- who was involved (also describe if you used any participatory approach)
- which GIS tools you used

The goals of the General urban plan in Zagreb (GUP) are protection of historic and natural values and continuous registration and restoration of endangered historical and other city identities like morphological diversity and park forests. City park forests could be modified into park areas, with management that preserves their natural forest structure and with equipment in favour of recreational facilities as one of the non-wood forest functions. The plan for the park-forest area management is defined within city bodies' responsible for forest management and protection of specific nature protected areas in city area.

The main ecosystem services in Park forest Grmošćica are recreational, esthetic, erosion protection, tourism, which are defined in the Forest management plans (state and private forests) for the selected area.

Different institutions have influence on decision making process regarding management of urban forests. On the city level there are state forest company Croatian forests which are responsible for implementation of forest management plans. In the city of Zagreb, there is a City department for the agriculture and forestry. On the national level, different ministries are involved in implementation of the development measures, like Ministry of Agriculture (approval of forest management plans for state and private forests) and Ministry of Environment and Energy (implementation of Natura2000 and biodiversity protection and mapping).

Ecosystem services include many different benefits which humans have from the forests. Those benefits are the result of the spontaneous influence from a forest to the social environment or they are the result of interaction of man and nature and the process of production and services. Non-wood forest functions consist of ecological (protected), social (society) and combined socio-ecological functions. However, many environmental functions which humans use directly or indirectly could be divided into three groups: resource supply, waste assimilation, aesthetical and space functions.

Quantum Gis, version 2.8 Vienna + GPS Stonex UT10

GIS tools used: drawing tools – points, lines and polygons, Classifying Vector Data, Vector Spatial Analysis – Buffers, Print Composer tool (GIS experts: Kuzle (expert opinion/validation), Čirko (field mapping/technical part)).

## 3. RESULTS

### 3.1. Summary of mapped ES

According to the Forest Law (Official Gazette 68/18) ecosystem services are defined as:

– protection of soil from erosion by water and wind, – balancing water ratios in the landscape and preventing floods and high water waves, – purification of water through percolation into forest soil and the supply of underground streams and water sources with drinking water, – creation of favourable influence on the climate and agricultural activities, – purification of polluted air, – effect on the landscape beauty, – creation of favourable conditions for human health, – ensuring the space for rest and recreation, – conditioning the development of ecological, hunting and rural tourism, – preservation of the genetic pool of forest trees and other types of forest biocenosis, – preservation of biological diversity of the genetic pool, species, ecosystems and landscapes, – support of the general and special protection of nature of forest landscapes (national parks, etc.), – mitigation of the atmospheric «greenhouse effect» by carbon sequestration and oxygen enrichment of the environment, – general protection and improvement of human environment through the existence of forest ecosystems as a biological capital of great value, and – importance for the defence of the country and the development of local communities.

Authors, Matić, S., Prpić, B., (Šumarski list 5-6, 1997), have ranked ES in park forest Grmošćica with grades of importance. The most important value is established protected area.

1. Ecological functions: Hydrological -4, Anti-erosion – 3, Climatic – 3, Fighting air pollution -3, Windshield-road protective -2, Protected forests - 9

2. Social forest functions: Tourism-3, Aesthetic functions-3, Recreational functions-3, Medical functions-3

According to the applied methodology in the Interreg project, the main ES in this strategic area are recreation and tourism, following air quality and local climate mitigation. Erosion protection and nature protection are also important in whole area (17,53 ha).

**Table 1: Area and proportion of mapped ES given ranks of their importance (for the strategic area)**

Strategic area	Rank	ha	%
Type of ES			
11_Timber production	3	15,85	90,4
11_Timber production	1	1,68	9,6
21_Local climate mitigation	4	17,53	100
22_Local air quality	4	17,53	100
23_Protection against noise pollution	2	6,30	35,9
23_Protection against noise pollution	1	11,23	64,1
25_Protection against erosion	3	7,27	41,5
25_Protection against erosion	2	10,26	58,5
26_Waste-water treatment	3	7,27	41,5
26_Waste-water treatment	2,5	6,30	35,9
26_Waste-water treatment	1,8	2,28	13
26_Waste-water treatment	0,9	1,68	9,6
31_Nature protection	3	17,53	100
41_Recreation and tourism	4	17,53	100

### 3.2. Timber production

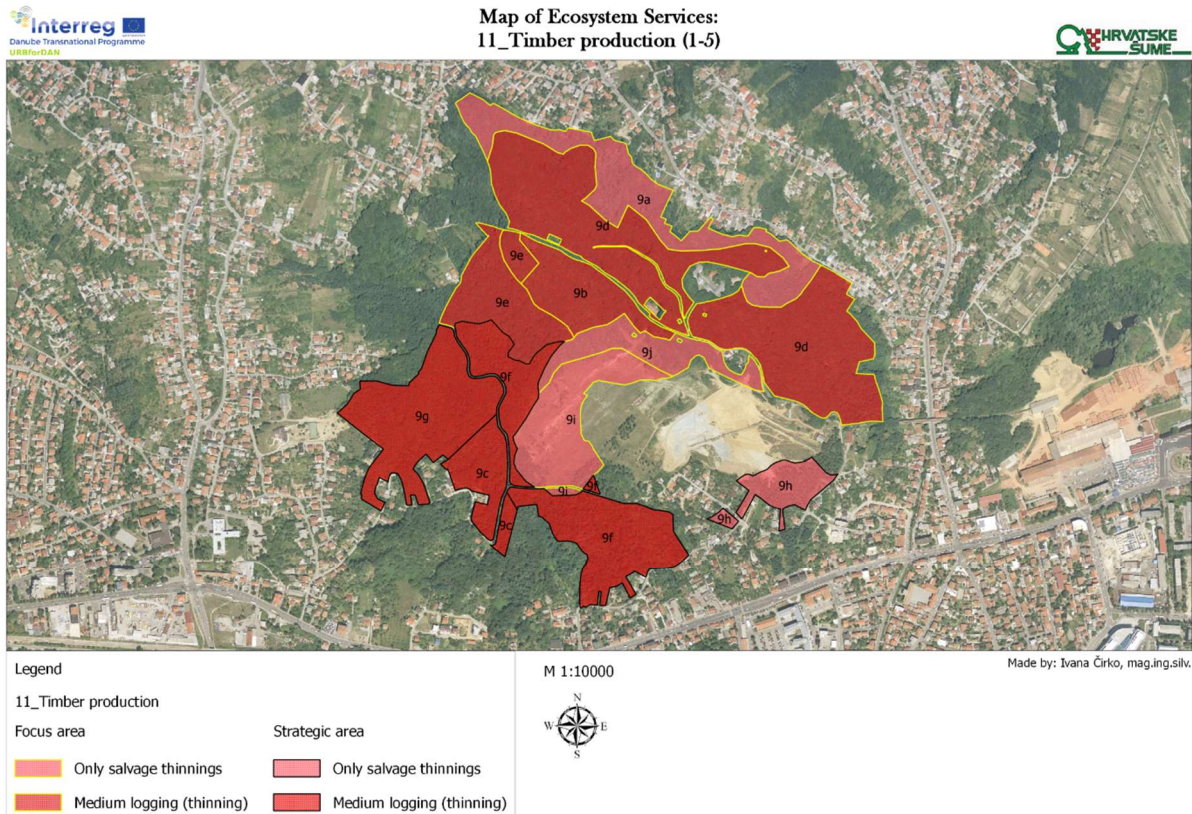
Paragraph 1: Provide short explanation to the map: which criteria you used, the main database

Paragraph 2: Provide explanation on the content of the ES (where in your strategic area is this ES important)

Include the map with the legend (for strategic area)

In the park forests, the aim of the forest management is the improvement of their ecological and social values. The forest management plan forecast the maintenance of the biological diversity by supporting the mixed stands consisting of the trees corresponding to the given habitat. The main timber production is planned according to the growing stock and annual increment in state forest. Timber production has rank 3

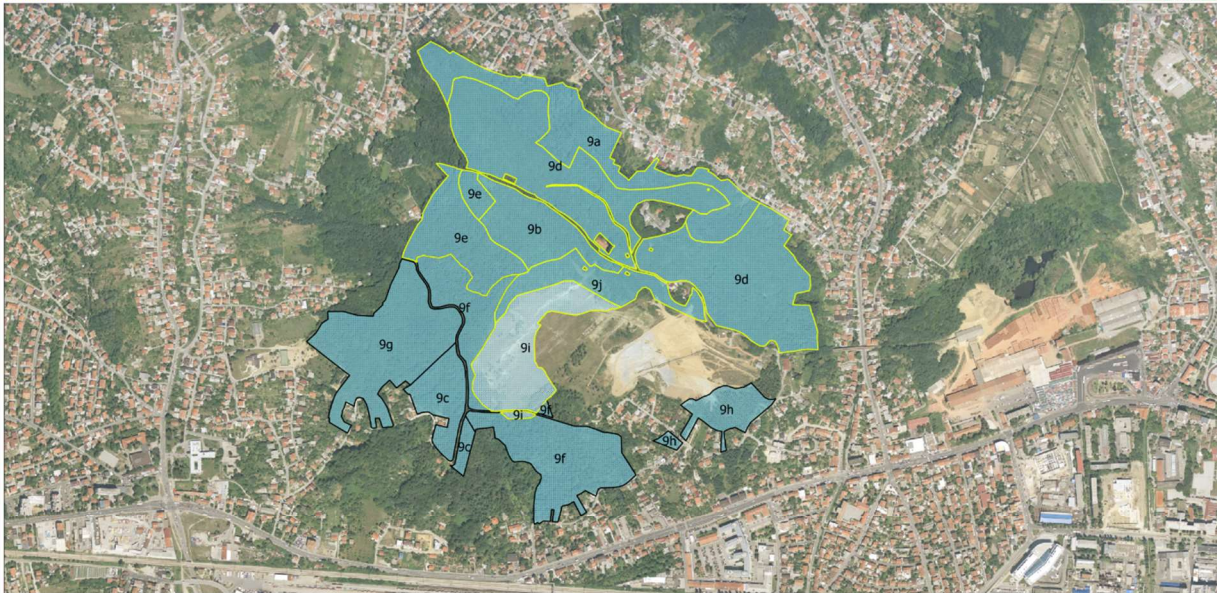
in 90,4% of the area, and rank 1 in 9,6% of the area (in management units 9j, f, and h, due to the erosion protection).



### 3.3. Local climate mitigation

Local climate mitigation has rank 4 in 100% of the area. Urban forest are very good in creation of microclimate conditions (green islands) in urban residential area. Due to the higher and extreme summer temperature green area creat lower temperature and buffer zone in neighbouring area. According to the researchers, even below the small groups of the trees average daily temperature is about 0.7-1.3% lower than in areas without tree canopy vegetation.





Legend

21\_Local climate mitigation

Focus area

- Low effect on local climate mitigation (1)
- Strong effect on local climate mitigation (4)

Strategic area

- Strong effect on local climate mitigation (4)

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### 3.4. Local Air quality

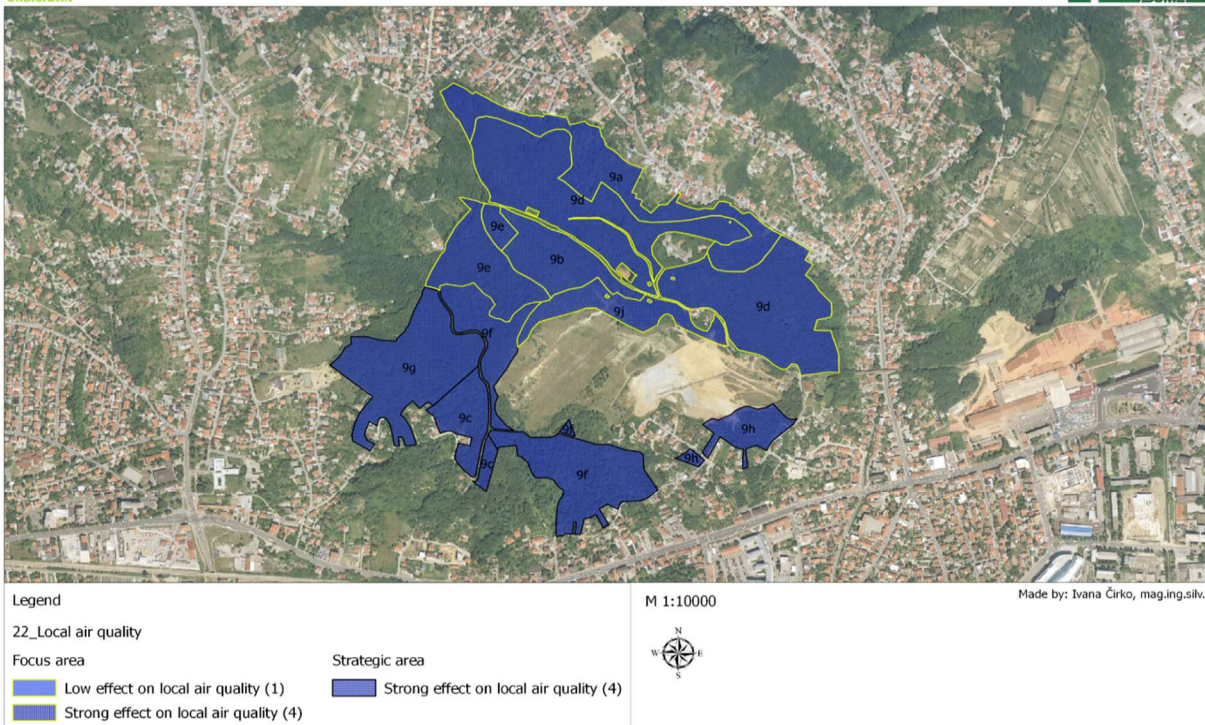
The City of Zagreb doesn't have instruments for measurement local air quality in the park area.

Trees are using CO<sub>2</sub> from the atmosphere and use it in the photosynthesis process. Also, trees in correlation with the species, structure, stand quality and age create big leaves area which could effective hold dust particles.

Air quality in Zagreb has II. Category, i.e. has pollution from NO<sub>2</sub>, flying particles less than 10 micrometer, benzo pyrene, particles lower than 2.5 micrometer, and ozone which could irritate respiratory system together with the city smog. Trees has influence in decreasing of gaseous air pollutants through the absorption of some parts of the pollution through the leaves (phytoremediation). Many citizens in the era of the Grmoščica park, still use fuel wood for the heating, what cause additional pollution during the winter period.

The whole area has rank 4, due to the strong influence on the air quality and absorption of pollution (17,53 ha or 100%).



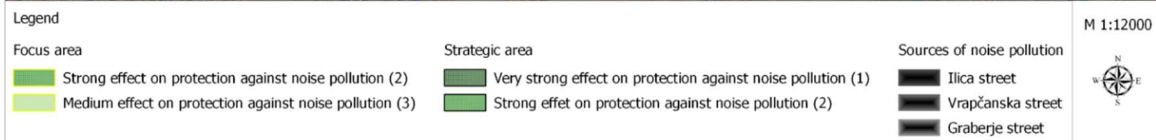
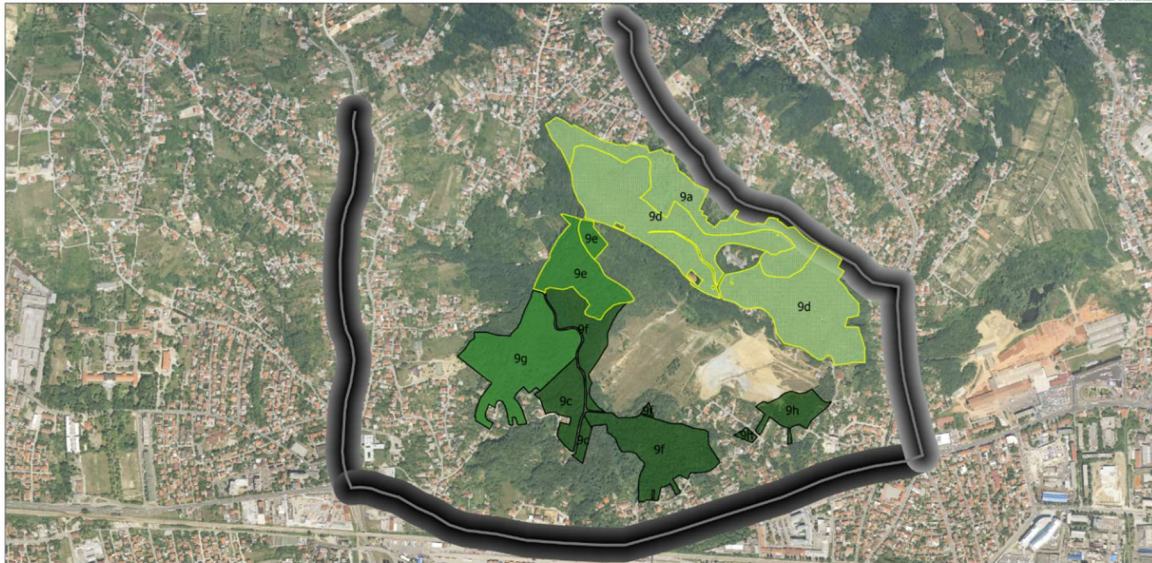


### 3.5. Protection against air pollution

According to the agreement between the City of Zagreb and Institute for medical research and health care, Institute provide annual reports about the levels of air pollution in the city, with number of days with higher concentration of pollution in city measurement stations.

Grmoščica Park Forest has very strong influence on air and noise pollutions because of the three main city roads close to the site, with heavy traffic.

Noise pollution has rank 2, in 6,30 ha (35,9%). Rank 1 is in management units 9f and c, 11,23 ha (64,1%), which are closer to the daily commuting traffic.



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### 3.6. Protection against erosion

According to the national methodology for evaluation of environmental services in Croatia, different levels of erosion influence have:

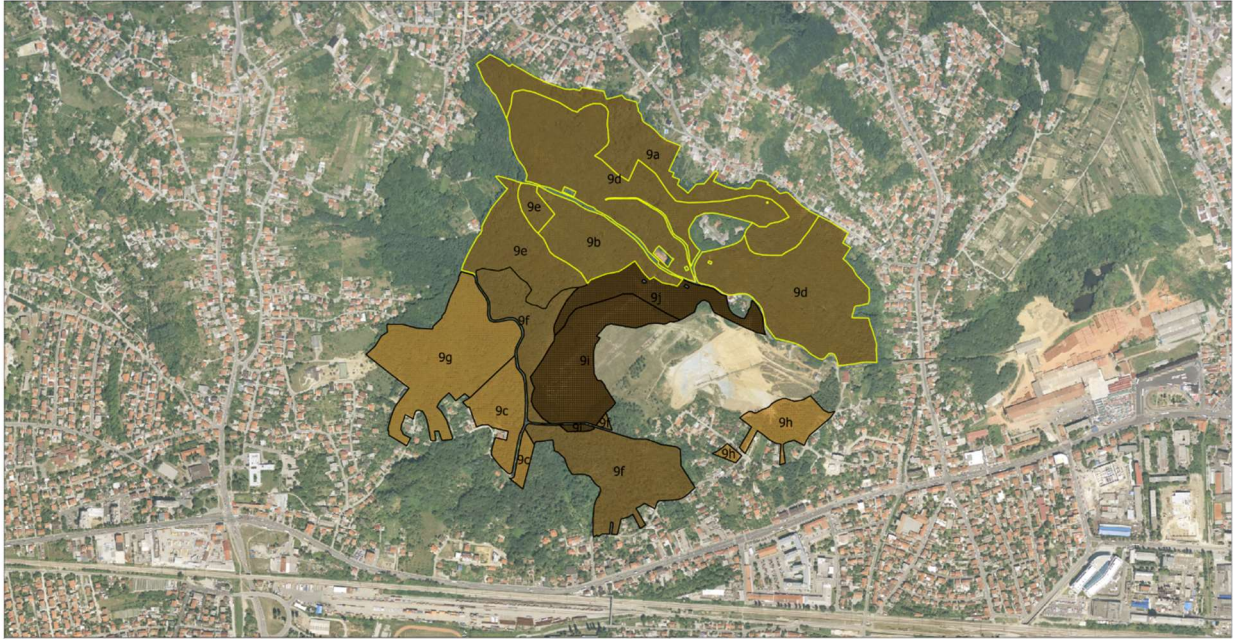
Stands with inclination less than 15° - grade 1

Stands with inclination less from 16° to 29° - grade 2

Stands with inclination more than 30° - grade 3

In this case very strong effect (grade 3) on erosion has management units which covers 7,27 ha or 41,5% of the strategic area, due to the steep slopes with high inclination and less forest cover. Strong protection against erosion have 10,26 ha (58,5%), grade 2.





Legend

25\_Protection against erosion

Strategic area

- Medium protection against erosion (2)
- Strong protection against erosion (3)

Focus area

- Strong protection against erosion (3)
- Very strong protection against erosion (4)

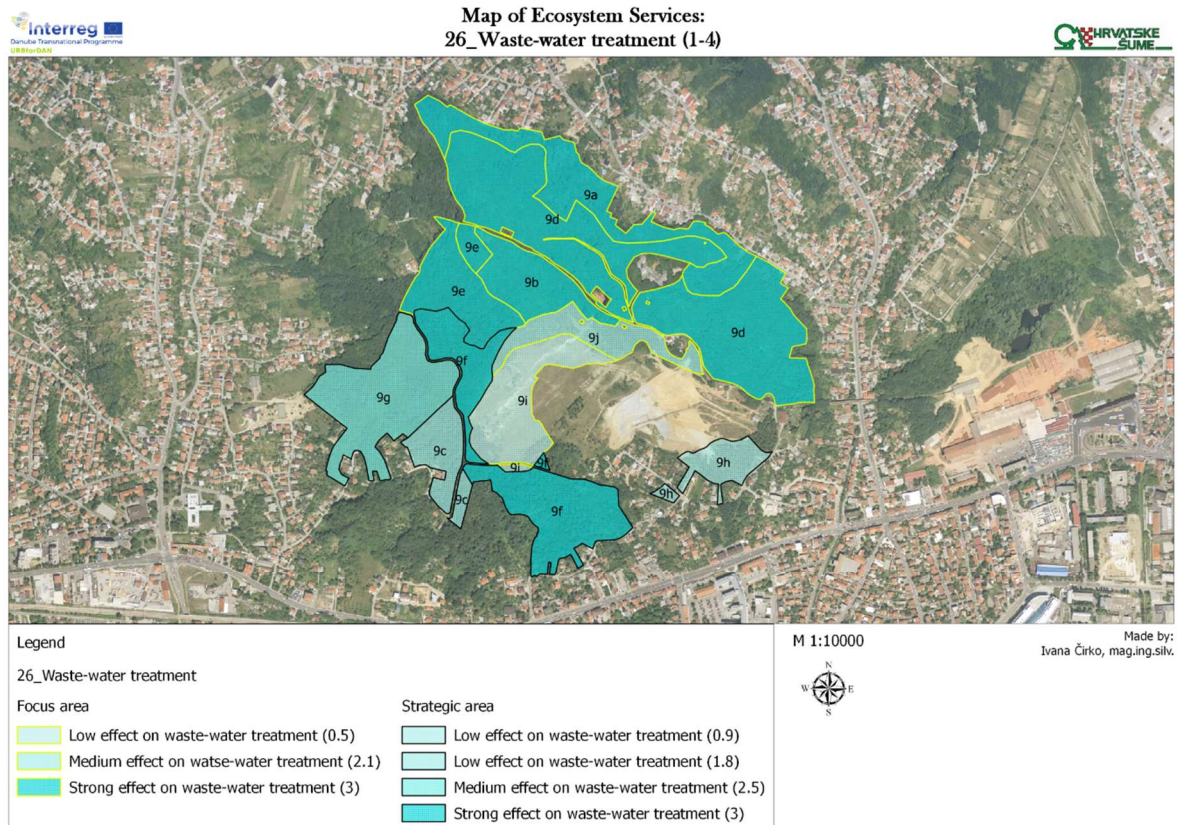
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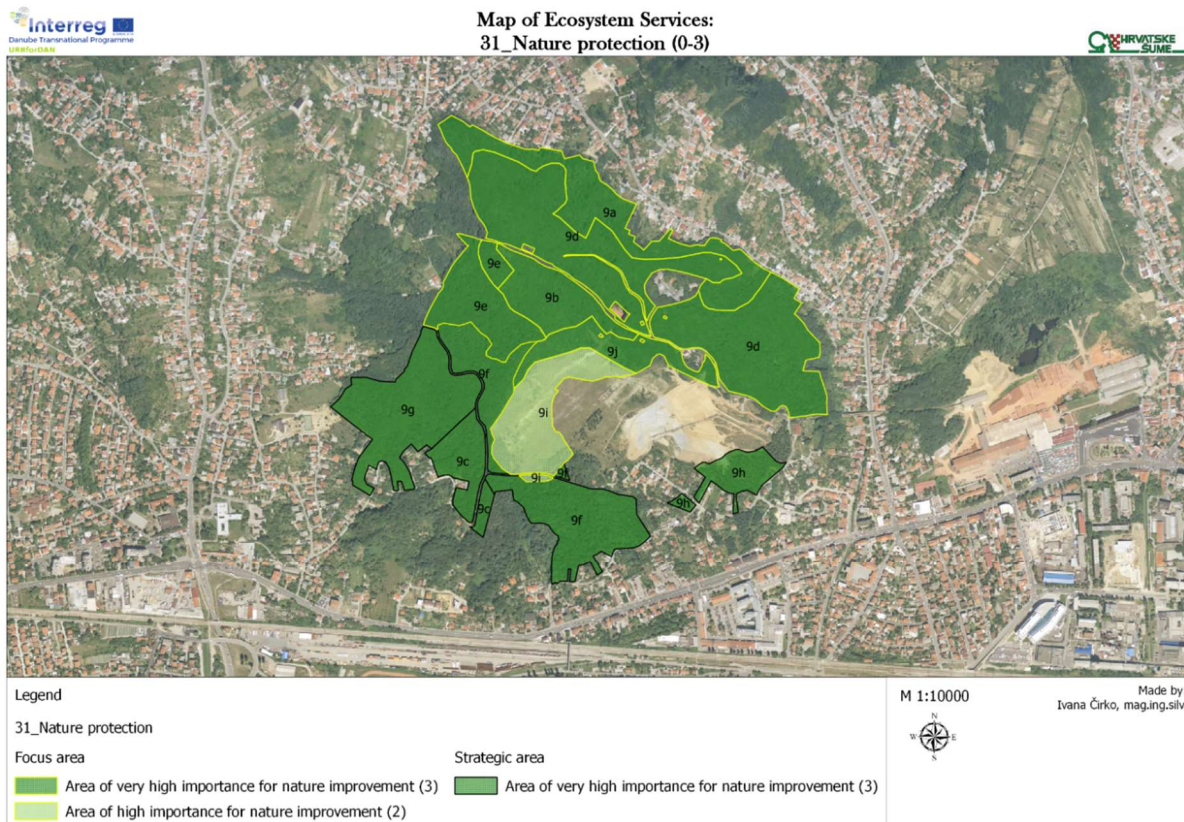


### 3.7. Waste water treatment



Even-aged forests and natural mixed stands with broadleaves and conifers produce strong effect on waste water treatment (grade 3), 7,27 ha (41.5%). Medium effect on waste water treatment has area of 6.3 ha (35.9%) has grade 2,5. Low effect on waste water treatment has area which has erosion influence. Grade 1,8 has 2,28 ha (13%), and grade 0,9 has 1,68 ha (9,6%).

### 3.8. Nature protection

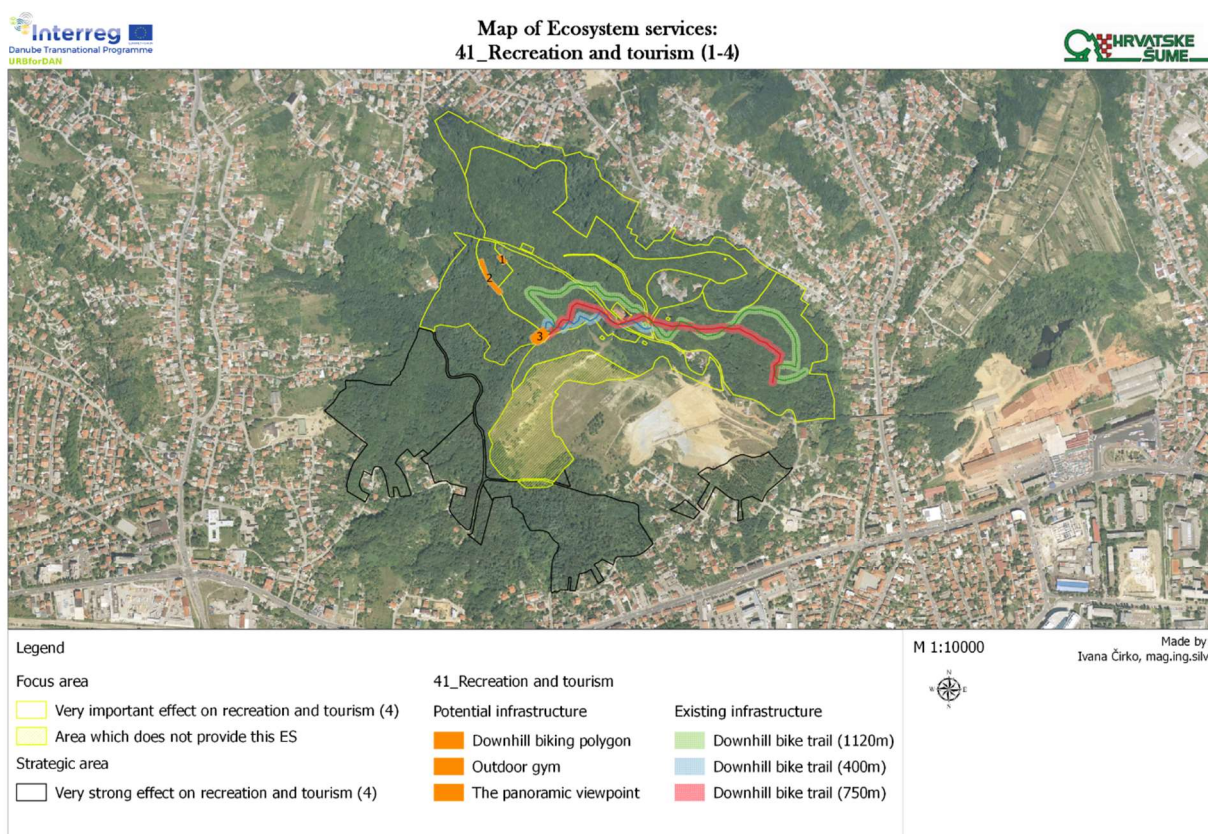


The whole strategic area in park forest Grmoščica is important for the nature protection and has grade 3 17,53 ha.

In Croatia, Nature protection act (OG 80/2013), regulate the system of protection and integrated conservation of nature and its values. The objectives and tasks of nature protection are: to conserve and restore the existing biological and landscape diversity to a state of a natural balance and relations harmonized with human activities; to assess the state of the natural environment and ensure monitoring of that state; to provide a system for the protection of natural values for the purpose of a lasting conservation of the features that form the basis for designating them as protected; to provide a sustainable use of natural resources for the benefit of the present and future generations without substantial degradation of the parts of the natural environment and with the least possible disturbance to the balance of its components; to contribute to conservation of the natural state of the soil, conservation of the quality, quantity and availability of water, maintenance of the atmosphere, generation of oxygen and maintenance of the climate; to prevent harmful human activities and disturbances to nature as a consequence of technological development and activities; to ensure the right of citizens to a healthy environment, rest and recreation in the open.



### 3.9. Recreation and tourism



The whole area, as urban forest is important and has very strong effect on recreation and tourism (grade 4, 17,53 ha). There are several biking trails in the park, and plans are to develop green infrastructure with the outdoor gym, downhill biking polygon and panoramic viewpoint.

The aesthetic contribution to the landscape is the primary reason for the high value placed on the urban forest. In an urban environment, aesthetic benefits include a more pleasant environment, relief from stress, enhanced feelings and moods, increased enjoyment of everyday life and a stronger connection between people and the environment (Dwyer, McPherson, Schroeder, & Rowntree, 1992).

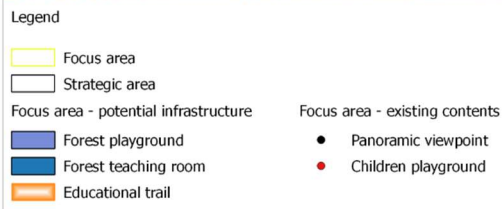
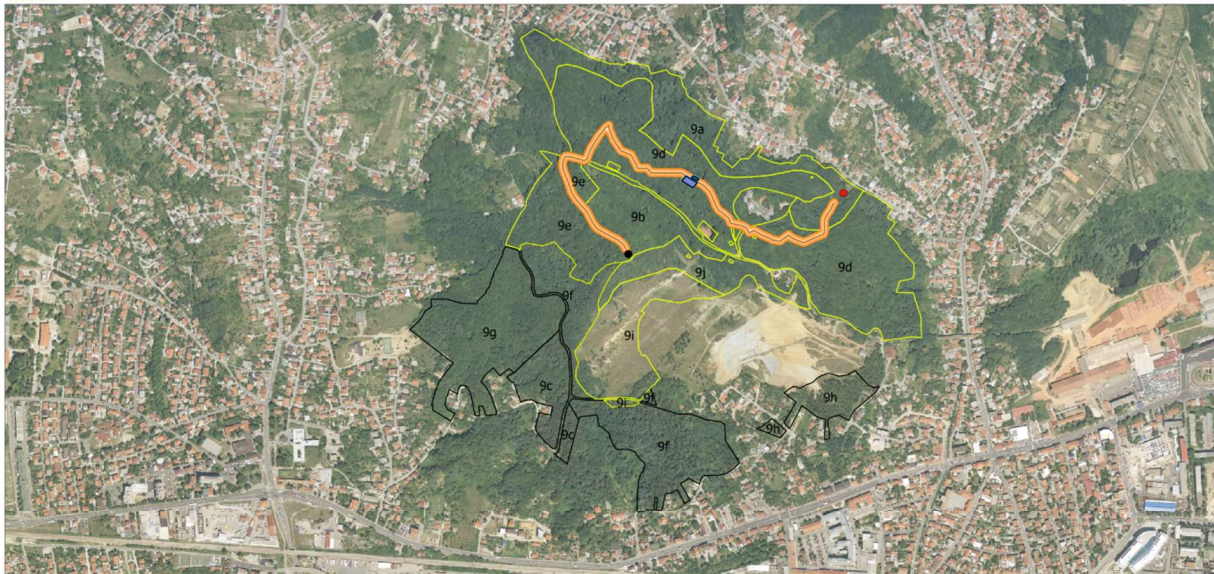
Zagreb could promote image of a “green and sustainable city”, what could be ensured by the existence and development of natural amenities (i.e. gardens and parks), with provision of additional recreation services, thematic parks, infrastructure etc.

#### 3.10. Scientific/Educational

In the focus area, there are only two existing contents like panoramic viewpoint and children playground. Planned potential infrastructure in focus area are forest playground, forest teaching room and educational trail.

According to the national methodology, scientific and educational values for the forests with specific assignment like nature parks, regional parks, park forests, nature heritage have grade 9. This focus area have high potential for development additional scientific and educational information for the visitors and users.





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## 4. DISCUSSION

Point out the main areas where multiple ES overlap (the highest multifunctionality)

Point out possible conflict areas

Add other things you found interesting when mapping

The management methods used for park forests and those for common forests should have different goals, taken in to account multifunctionality of the urban forests. In order to stimulate carbon sequestration and the release of oxygen in the process of photosynthesis, a high productivity of the ecologically balanced forest stand should be sustained and adjusted to the purposes of the Park Forest.

Park forests should be renewed in a different way, cutting the small areas in combination with the regeneration through fringe cuts with relatively long regeneration periods. The reason for regeneration is the physiological age of the trees with the disturbance of the physiological processes, which reduces the ecological forest value (reduced photosynthesis, increased transpiration and breathing).

Non-wood forest products and services should be thoroughly investigated for their quantification in terms of planning forest protection (soil treading, tree damage, etc.). Considering the extremely unfavourable chemical impacts from pollution, the damage degrees on the selected bio-indicative points should be established before deciding about the appropriate measures.

Add comment to the mapping:

- Which problems did you face when mapping

There is a need for integral model of management and protection of urban green areas, what would improve ecological performances of urban areas with direct or indirect influence the quality of living in the cities. According to the strategy of City of Zagreb (Zagrebplan, ciljevi i prioriteti razvoja Grada Zagreba do 2020 godine), the main problems are: insufficient sensibility of public about the ecosystem services, big share of private small forest parcels in total forest area, insufficient defined model of management and possibilities for using the forest. Also, particular implementation of the nature protection measures, non-systematic approach to the environment conditions, inefficient cooperation and overlapping of responsibility from different institutions on city and state level are blocking development of potentially very attractive green urban areas and improvement quality of living for the citizens.