SMART POST INDUSTRIAL REGENERATIVE ECOSYSTEM

METROPOLITAN BIO-BASED STRATEGY & MASTERPLAN 2050 FOR THE REMEDIATION OF HEAVY METAL POLLUTED SOIL – BAIA MARE FUNCTIONAL URBAN AREA

!!! Disclaimer !!!
The original SPIRE Metropolitan Bio-based Strategy and Masterplan was elaborated in Romanian language, and TAUs member signed according to the Romanian version.

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ARIES Transylvania

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University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca

Green Energy Cluster

IDENTIFICATION DATA OF THE PROJECT

Funded by the Urban Innovative Actions Programme, EUR 2 611 840.4 total ERDF budget granted
https://spire.city/
https://www.uia-initiative.eu/en/uia-cities/baia-mare

GLOSSARY OF TERMS

Term	Definition
Metropolitan Area (ZM)	Urban centre, consisting of a metropolis and its adjacent area of influence.
Urban Functional Area (FUA)	Area consisting of one or more urban centres with a polarizing character from a socio-economic point of view and the surrounding localities. In the current case: Baia Mare, Baia Sprie, Tăuții Măgherăuș, Recea, Groși.
Phytoremediation	Soil remediation method involving the use of plants to extract and remove pollutants or reduce their bioavailability in soil
Value chain	The process by which a product or service reaches from the supplier to the customer, which also takes into account the added value along the chain, both for the product/service and for the actors involved
Biomass	The biodegradable part of products, wastes and residues from agriculture, including plant and animal matter, forestry and related industries, as well as the biodegradable part of industrial and urban waste
Historical pollution	Form of pollution generated by past human actions, which refers to the long-term or delayed-onset effects of negative actions on the environment, such as groundwater or soil pollution
Green infrastructure	Vegetative infrastructure system that improves the natural environment by direct or indirect means
Green – blue corridor	Sustainable design solution that uses a river and adjacent green areas to establish a network between natural habitats
Circular economy	Economic system based on the reuse and regeneration of materials or products, especially as a means of continuing production in a sustainable or environmentally friendly way
Nature – based solutions	Actions to protect, sustainably manage or restore natural ecosystems that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, while delivering benefits for human well-being and biodiversity.
Ecosystem services	Outcomes, conditions, or processes of natural systems that directly or indirectly benefit people or enhance social well-being
Urban regeneration	Action to restore profitability and/or repopulate areas of the city considered to be in decline
Pilot project	Small-scale implementation of a project idea, which is used to prove its viability.
Co-creation	It is the process by which a finished product is developed collaboratively by multiple entities
Replicate	Process by which an initiative is developed and applied on a larger scale (in the context of the document, territorially)
TAU	Administrative-territorial unit
SIDU	Integrated Urban Development Strategy
PMUD	Sustainable Urban Mobility Plan

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INTRODUCTION

CONTEXT: SPIRE PROJECT AND THE METROPOLITAN BIO-BASED STRATEGY & MASTERPLAN 2050

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SPIRE PROJECT

SPIRE Baia Mare is a project financed by the Urban Innovative Actions program, within the 4th call, with the theme "Sustainable use of land and nature - based solutions". The initial challenges of the project were:

- Recovering contaminated land and experimenting with a process of phytoremediation and long-term re-use of formerly polluted land;
- Co-creation of new development models based on eco value chains;
- Supporting citizen participation and behavior change, leveraging new digital solutions to reward eco-friendly actions.

Partners:

Municipiul Baia Mare

Naia Mare City Hall

Urbasofia

indeco soft

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ARIES TRANSILVANIA

ARIES Transilvania

Zona Metropolitana Baia Mare

Baia Mare Metropolitan Area Association

University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca

GREEN ENERGY Romanian Innovative Biomass CLUSTER

Green Energy Cluster

Project indicators:

- 7.15 hectares of contaminated land included in a process of phytoremediation to regain its natural state
- 250 young beneficiaries and 3000 citizens involved
- 3 biomass-based start-ups using biomass for innovative applications in the construction industry
- 10 citizen-led eco-initiatives
- EUR 2,611,840.4 – total ERDF budget granted

At the level of the Baia Mare Metropolitan Area, the former activities of the mining and metallurgical sector have left a "legacy" of approximately 627 ha of land polluted with heavy metals. This pollution is considered a challenge that must be addressed strategically, in the long term, through adaptive, flexible, and accessible solutions for local communities. In addition to lands characterized as severely polluted areas and still considered polluting, such as tailings dumps and

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cyanide ponds, several lands in the metropolitan area are also believed to contain varying amounts of heavy metal soil pollution.

The precise identification of the level of pollution of the territory of the metropolitan area is difficult to achieve because the set of soil samples taken within the SPIRE Baia Mare project does not reveal a specific pattern of pollutant concentrations (Pb, Cu, Cd, Zn): the samples of soil one close to the other having different levels of pollution. Nevertheless, the set of soil samples taken at the level of the Urban Functional Area (FUA: Baia Mare, Baia Sprie, Recea, Groși, Tăuții Măgherăuș), demonstrates the fact that pollution with heavy metals is a factor to be considered in the management of the territory/use land and the development of local green infrastructure, to reduce the risk of population exposure, as well as to protect natural ecosystems.

In this context, the SPIRE Baia Mare project (Smart Post-Industrial Regenerative Ecosystem) proposed an innovative approach to reuse the land contaminated with heavy metals in the Baia Mare Municipality, through adaptive phytoremediation and the creation of new value chains at the local level, to trigger a regeneration of the neighbourhood and residential areas landscape, economic development, improvement of environmental conditions and reduction of the risk of exposure of the population to pollution. The solutions tested within the SPIRE project focused on the area of Baia Mare Municipality and on the remediation of 5 pilot plots. The SPIRE initiative is characterized by 3 pillars of intervention:

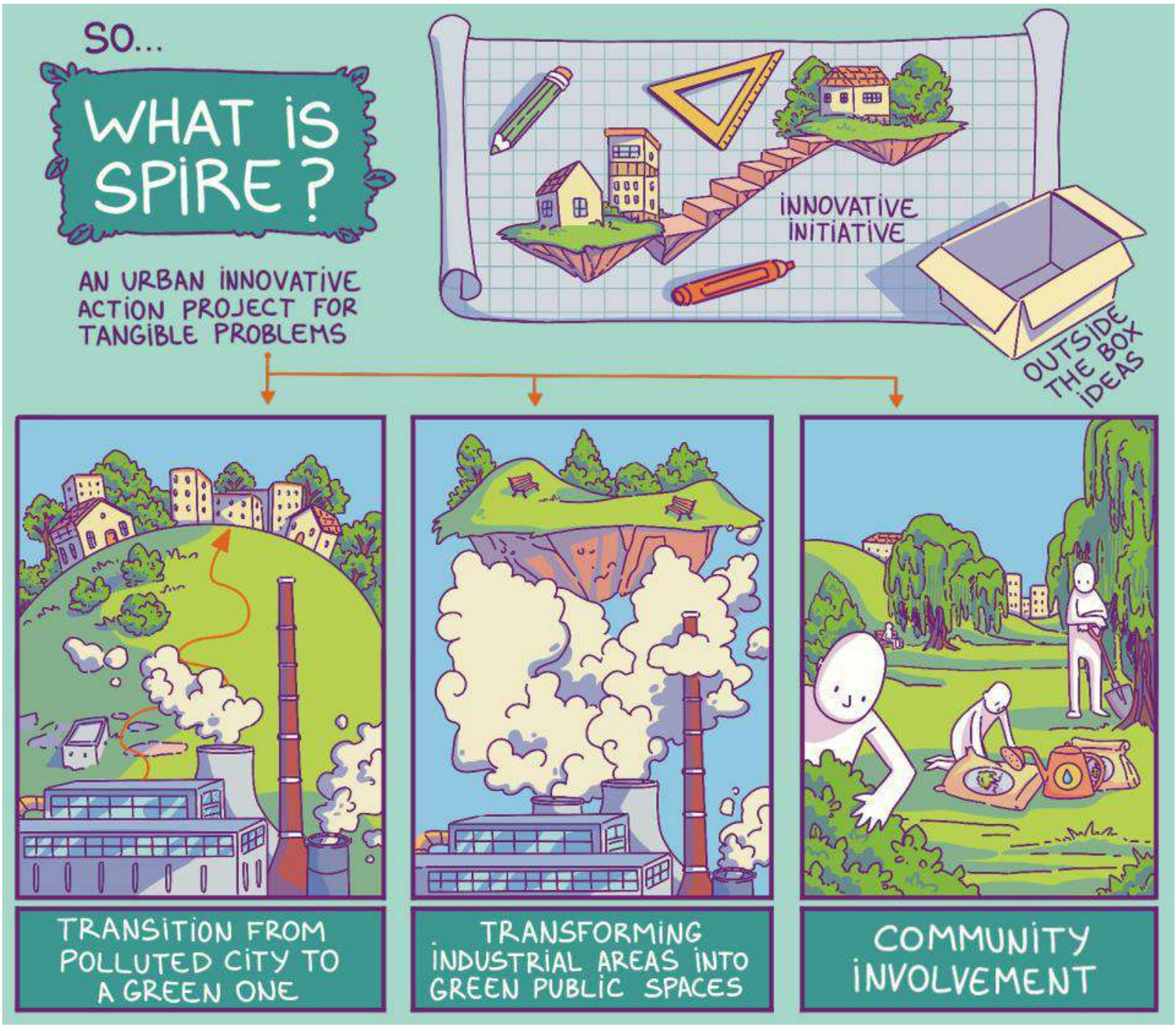
- **PILLAR 1: PHYTOREMEDIATION OF POLLUTED LANDS.** The project experimented with a wide range of plant species capable of phytoremediation and monitored the capacity and speed with which these plants can clean the soil of pollutants, as well as which species lend themselves to one or more of the identified heavy metals. Thus, the 5 pilot plots (totaling approximately 7ha) were planted for the purpose of experimental remediation. The process was a participatory one, with the local community developing together with the project experts the landscaping plans (related to the identified needs and requirements), being further involved in the implementation process (through civic planting events). To consult the species capable of phytoremediation - see Annex 2.

- **PILLAR 2: SUSTAINABLE USE OF THE RESULTING BIOMASS.** Phytoremediation plantations as well as green waste represent a valuable but often overlooked resource that can be used to generate thermal energy in a sustainable way. As part of the SPIRE project, such a biomass-based power plant was installed in the gymnasium of the "C.D Nenițescu" Technical College, which will use plant material resulting from phytoremediation plantations to create energy, thus creating an effective and ecological local value chain.

- **PILLAR 3: DIGITAL TOOLS: iLEU and IGIS.** iLEU is a digital platform for rewarding the ecological behavior of citizens and supporting new green initiatives. IGIS is a tool for monitoring project progress and publicly displaying data related to pilot projects and results of the phytoremediation process. Both tools are considered valuable to be transferred at the metropolitan level within the localities/communities concerned.

RELEVANT RESOURCES

- UIA website: https://www.uia-initiative.eu/en/uia-cities/baia-mare
- UIA SPIRE BAIA MARE website: https://spire.city/
- iGIS: Integrates the spatial components of the project along with the soil sample results: https://spire.city/index.php/igis/
- Phytoremediation Calculator: Pollution Remediation Period Estimation Calculator. https://spire.city/index.php/tabel/
- Relevant project deliverables: https://spire.city/index.php/project-deliverables/



REPLICATING SOLUTIONS AT METROPOLITAN LEVEL

The final objective of the SPIRE project is to develop a series of measures for the replication and scaling at the metropolitan level of solutions that have been tested and considered feasible. Thus, the present strategy is the result of an intensive process of participatory and interdisciplinary work during a three-year period in which possibilities for solving the major problem were explored: soil pollution of heavy metals. The aim is to expand the SPIRE methodology/approach and the impact of the project to increasingly extensive territorial levels, by building **the GREEN METROPOLITAN STRATEGY AND THE 2050 MASTERPLAN FOR THE REMEDY OF POLLUTED LAND.** The strategy combines the evaluation and monitoring of the experiments carried out on the pilot sites with the development of a master plan and a strategy for the Baia Mare Metropolitan Area, with an emphasis on the Urban Functional Area, as well as with the definition of a set of measures, projects and recommendations for the 2050-time horizon.

The strategy followed a gradual and intensive process of co-creation, by organizing 3 thematic workshops with relevant local actors at the level of the Metropolitan Area and especially at the level of the Urban Functional Area.

WORKSHOP 1: OPPORTUNITY ANALYSIS. The first workshop aimed to open the dialogue with relevant actors, especially public authorities - town halls and local action groups. Participation in the workshop was preceded by a questionnaire sent to all administrative units at the metropolitan level to analyse the level of interest and awareness of the issues. After the first workshop, it was decided to take soil samples from the lands in the Urban Functional Area (Baia Sprie, Groși, Recea, Tăuții Măgherăuș), and based on the results of the tests, to develop specific projects.

WORKSHOP 2: DEVELOPMENT SCENARIOS. Based on the analysis of soil taken at the level of the Urban Functional Area and the specific characteristics of the identified key lands, options and scenarios for adapting SPIRE solutions were discussed. Various financing opportunities were also discussed, which would facilitate the transformation of the innovative phytoremediation initiative into a standard practice at the level of the FUA and the metropolitan area.

WORKSHOP 3: DESIGN/PROJECTS. In the last workshop, the matrix of measures, projects and solutions was presented, to determine methods of adopting phytoremediation at local level for the time horizon 2050, considering key sites, future expansions/developments, infrastructure projects already planned and priorities for the regeneration/restoral of green areas and natural landscapes.

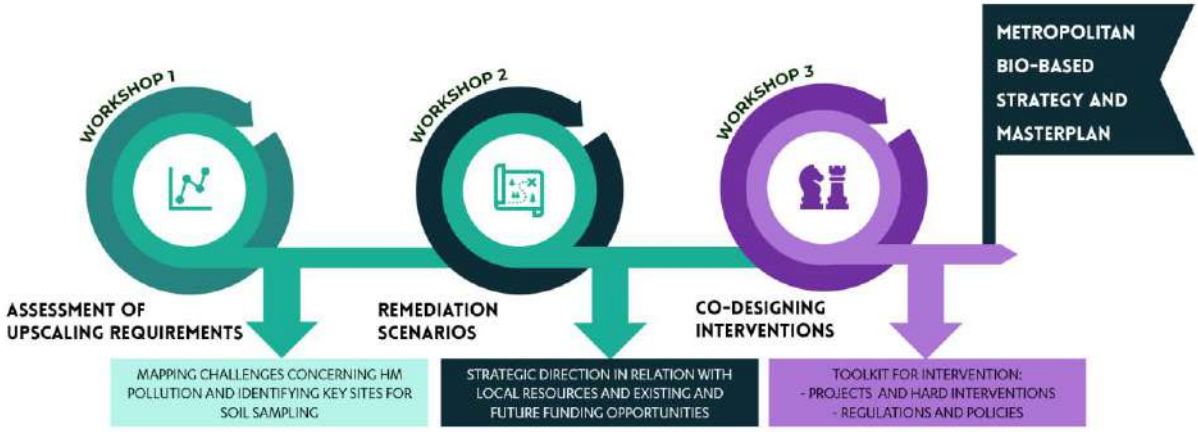


Fig. 1 – Bio-based Metropolitan Strategy and Masterplan Co-creation methodology

CONTENT OF THE STRATEGY

METROPOLITAN BIO-BASED STRATEGY & MASTERPLAN 2050 FOR THE REMEDIATION OF HEAVY METAL POLLUTED SOIL – BAIA MARE FUNCTIONAL URBAN AREA, is a reference document for the TAUs that are part of the Baia Mare Metropolitan Area and especially the TAUs that make up the Baia Mare FUA, which aims at " directing" the development of the territory to lessen the negative effects resulting from the mining and metallurgical industry, from a social, economic, and environmental point of view. This strategy is intended to be used as a strategic guidance and direction document for:

- Piloting key interventions to combat heavy metal pollution
- Modelling/adapting future investments (planned through SIDU and PMUD) to recover polluted land and build a coherent and sustainable green infrastructure at the territorial level
- Adapting and integrating of phytoremediation solutions as a standard practice at the metropolitan level, regarding the management of land resources and green spaces, the development of new functional areas, and re-shaping existing functional areas.

This document is composed of 2 parts:

PART 1 – BASELINE STUDY AND DEVELOPMENT PRIORITIES for long-term ecological remediation. Within this chapter, governance components and socio-economic challenges were analysed, as well as environmental factors and the territorial profile, to establish strategic development options.

PART 2 – THE METROPOLITAN AREA BIO-BASED STRATEGY AND MASTERPLAN 2050 represents an adaptive tool of a strategic nature, which ensures the long-term transfer and adaptation of the solutions experienced within the SPIRE project: phytoremediation, green energy, and circular economy of biomass resources, as well as civic eco – friendly initiatives.

The strategy was developed in a participatory manner by involving stakeholders at metropolitan level, with a focus on actors at the FUA level: public administration and local action groups, as well as area residents (involved through online consultation questionnaires). The strategy contains 4 main components:

VISION	It contains 2 components: Citizens' Vision and Public Authorities' Vision. The resulting objectives seek an integration of the 2 perspectives. It is necessary that the Vision to be assumed by all local actors
ADAPTIVE INSTRUMENT	It represents the methodology of using and applying the current strategy. Given the extended time horizon, it is important that administrative units and local actors adapt to the context and use the tools developed through the SPIRE project.
REMEDY STRATEGY 2050	I. PROJECTS Projects related to SIDU and PMUD planned investments; Priority pilot projects and proposals for regulations and long-term strategic measures for land related to soil samples; Additional strategic interventions at FUA level; II. RECOMMENDATIONS FOR LAND USE III. PUBLIC POLICIES AND CIVIC INITIATIVES
MASTERPLAN 2050	Represents the spatial component of the strategy. The aim was to consolidate a territorial green system, at FUA level.

STUDY AREA – URBAN FUNCTIONAL AREA (FUA)

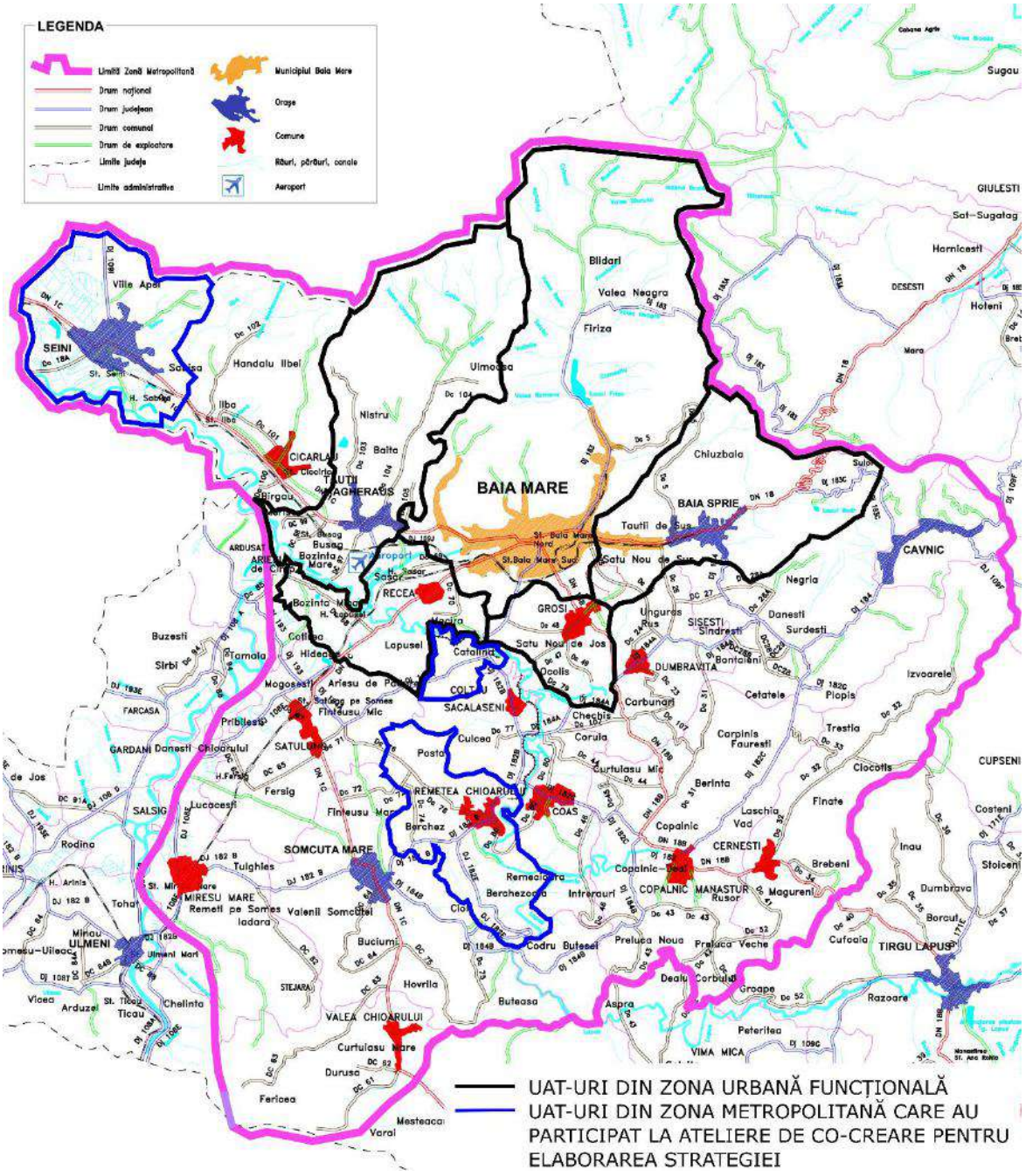


Fig. 2 – The TAUs involved in the Strategy development process

After the first workshop, the project team decided to focus the effort in the process of developing the strategy for replication at the level of the Urban Functional Area (FUA): Baia Mare, Baia Sprie, Recea, Groși, Tăuții Măgherăuș. The study area has a high concentration of polluted land and unproductive areas occupied by tailings dumps and cyanide ponds, a risk to the population and the environment. The decision to focus the strategy was also facilitated by SIDU Baia Mare 2030, and PMUD Baia Mare that developed projects and interventions on the same study area. In the workshops for the elaboration of the strategy, the TAUs Seini, Remetea Chioarului, Coaș have actively participated, being particularly interested in solutions oriented towards the use of biomass for energy.

PART 1

BASELINE STUDY AND DEVELOPMENT OPPORTUNITIES

1. GOVERNANCE STRUCTURE AND OPPORTUNITIES FOR REGENERATION OF POST-INDUSTRIAL AREAS

1.1 REMEDIATION OF CONTAMINATED SITES – NATIONAL PRIORITY

The issue of contaminated sites is extremely relevant for Romania, being addressed in a series of strategic documents at the national level (and not only). The National Agency for Environmental Protection (ANPM) defines, by appealing to the provisions of the specific environmental legislation and to the information from the inventory it carried out in the period 2007-2008, two categories.

- **Potentially contaminated sites** (those for which there is information about the previous activities carried out on the site, but there is no developed level II environmental balance report and/or risk assessment report)
- **Contaminated sites** (those for which the mid-level balance report and/or the risk assessment report was developed).

According to the updated inventory carried out by ANPM in November 2013, a number of 1183 potentially contaminated sites were identified at the national level, the most affected counties being Giurgiu (223), Argeș (111) and Maramureș (109). Regarding the contaminated sites, a total number of 210 such sites were registered, with the most affected counties being Hunedoara and Caraș-Severin. A considerable number of sites are in the metropolitan area of Baia Mare Municipality. According to the environmental report of Maramureș county (2016), the main sources of soil pollution in the county are S.C. Romplumb SA Baia Mare and S.C. Cuprom Bucharest - Baia Mare Branch (formerly Phoenix S.A.), but in the metropolitan area there are a series of settling ponds of non-ferrous ore preparation plants, tailings resulting from mining activities (an important source of air pollution due to suspended particles) and mine waters discharging from existing galleries.

Considering the critical situation of historical pollution at the national level, the National Strategy and the National Plan for the Management of Contaminated Sites have been developed, aiming to reduce the area of contaminated sites and reach an acceptable level of risk to human health and the environment for each site until the year 2050. The target is the improvement of the environmental factors (soil, water, air) as a result of the remediation of the sites and, subsequently, their reintroduction of the sites into the economic circuit. In addition, the strategy aims to increase the capacity of institutions to manage the remediation and exploitation of these sites in the future in an

integrated and sustainable manner, through the development and application of qualitative and cost-effective techniques.

Considering the critical situation in Maramureș county, the Regional Operational Plan for the North-West Region defines a series of strategic objectives relevant to the current strategy within the P3 priority. A region with environmentally friendly localities, namely: SO b (vii) Increasing the protection and conservation of nature, biodiversity and green infrastructure, including in urban areas, as well as reducing all forms of pollution and SO b (i) Promoting energy efficiency and reducing greenhouse gas emissions. In addition, under Priority P7. An attractive region, the objective, SO e (i) proposes integrated and inclusive development in social, economic, and environmental terms, with an emphasis on increasing security in urban areas. The issue is better addressed within the Maramureș County Strategy 2014-2020, emphasizing the fact that heavy metal pollution is one of the biggest problems in the county, namely land pollution with heavy metals, especially in mining areas (17 settling ponds and over 300 tailings dumps, to which are added dozens of contaminated or potentially contaminated sites, including in inhabited areas such as Baia Mare - CUPROM, ROMPLUMB, etc.).

1.2 MANAGEMENT OF CONTAMINATED SITES – GOVERNANCE STRUCTURE AND METHODOLOGY AT THE NATIONAL LEVEL

In Romania, the competent authorities responsible for the management of contaminated sites are the Ministry of the Environment, Waters and Forests, the Environmental Protection Authority at territorial and national level, the National Administration "Romanian Waters" and the National Environmental Guard, which cooperate to meet the requirements of the Strategy for Contaminated Sites. The responsibility for implementing the actual requirements of the strategy rests with local and territorial authorities, who have a crucial role in the management and rehabilitation of contaminated industrial sites, having a good knowledge of the context and being responsible for the effective implementation of the strategy's requirements.

The entire process is coordinated by the Ministry of Environment, Water and Forests, together with the specialized bodies under its supervision, with the role of control and supervision of the entire process. Their responsibilities and tasks include the development and modernization of the national integrated soil and groundwater monitoring sub-system related to contaminated sites, the development and implementation of programs through awareness, information and education campaigns on contaminated sites, the formulation of proposals for financial incentive mechanisms and economic (including reductions or exemptions from duties and taxes), as well as the application of taxation charges in case of non-compliance, the promotion of programs of measures for the restoration of contaminated sites and the provision of tools and mechanisms for their

implementation. The Ministry is supported in this process by the Government of Romania and the ministries responsible for implementing this strategy.

Local public authorities also have several relevant responsibilities regarding the regeneration of former contaminated industrial sites under their management. These include **updating land use plans and imposing the necessary restrictions for the use of these sites affected by contamination, completing, and submitting the inventory questionnaire of potentially contaminated/contaminated sites, as well as impact assessments and risk assessments to the Protection Agency Environment (ANPM).** Additionally, authorities must **allocate funds for the planning and implementation of site decontamination actions** (prioritizing those subjects to a corrective action notification/emergency remediation) to the Ministry of the Environment, Water and Forests, but also for planning the development of these sites after decontamination. They are also responsible for drawing up and submitting to ANPM the Statement of Validation of the corrective or remedial action, when they receive the notification of completion of the works from the MMSC.

From the point of view of the property regime, within the National Strategy for the Management of Contaminated Sites, 3 situation are distinguished at the national level:

- **Contaminated sites owned by the central public administration**
- **Privately owned contaminated sites**
- **Orphan/abandoned contaminated sites - those formerly owned by the state, which do not currently have a legal owner and where industrial activity, which generally was polluting, no longer takes place.**

Regardless of the ownership regime, the steps to be followed for the management of this particular category of land (contaminated or potentially contaminated) are similar, namely:

- **Priority: securing funding sources for the depollution of the site and the reintroduction of new socio-economic activities (only for those owned by the state)**
- **Sectoral approach to common types of industrial sites/activities**
- **Technical and contractual supervision (investigative/remedial actions);**
- **Implementation of remedial activities;**
- **Monitoring soil and water environmental factors**

The methodology proposed by the contaminated sites strategy, which will be applied at the national level, involves 2 **phases:**

1. **Inventory and investigation** (creating a database that classifies and ranks sites according to the degree of site contamination)
2. **Remedial actions** (establishing the set of necessary measures)

The Metropolitan Strategy for ZMBM aims to support this approach at the national level, by carrying out a first investigation/inventory (the lands where soil samples were taken), as well as by proposing a set of concrete measures both for these and for other areas considered with contamination potential from the localities belonging to the Baia Mare metropolitan area.

1.3. MANAGEMENT OF CONTAMINATED SITES AT THE LEVEL OF ZMBM – GOVERNANCE STRUCTURE, ACTORS INVOLVED

Contaminated sites in the Baia Mare Metropolitan Area are located on former industrial platforms or are polluted lands as a result of production for heavy industry. They are in various stages of degradation, having a negative impact both on the environment and on the health and well-being of the population.

Considering the economic activity with an industrial mining profile carried out on the territory of Maramureș county, we consider the following areas "critical" in terms of soil pollution with heavy metals (Cu, Pb, Zn, Cd, Mn, As, etc.):

- Baia Mare Municipality- pollution with heavy metals and cyanides as a result of the activity of S.C. "Transgold" S.A., the surface of the former Meda tailings dump - pollution with industrial emissions of sulfur compounds and heavy metals due to the processing of non-ferrous ores by S.C. "Phoenix" S.A. (ALIED DEALS) and S.C. "Romplumb" S.A.;
- Tăuții Măgherăuș City, Bozânta Mare commune, Recea commune (Săsar village and Bozânta Mică village), as a result of the activity of the "AURUL" Mining Exploitation (with associated tailings dumps) and the Baia Mare "Remin" company;
- Baia Sprie mining area- with tailings dump and associated settling pond;
- ILBA HANDAL mining area;
- Cavnic mining exploitation with tailings dump and associated settling ponds;
- Băiuț mining area with tailings dump and associated settling ponds;
- Herja mining area with associated tailings dumps;
- Nistru and Băița mining areas;
- Baia Borșa mining area with tailings dump and associated settling ponds.

These industrial facilities (and related lands) are in both public and private regime, a fact that can significantly affect the decontamination and reintroduction into the economic circuit of huge areas affected by historical pollution (627 ha) in the metropolitan area. Regarding the governance structure envisaged for a significant progress in terms of the decontamination and valorisation of industrial sites in the Baia Mare Metropolitan Area, it was considered as necessary to map the key actors who can positively influence/will be influenced by this approach, such as and their role.

Table 1 - Identification of relevant actors at the metropolitan level for the problem of soil pollution with heavy metals

Actors	Role	Impact
Ministry of Environment, Waters and Forests	Defining a coherent policy and program for the remediation of contaminated sites at national level, supported by the allocation of structural funds in this regard	High
Environmental Protection Agency	Continuation of the investigation/inventory process of contaminated/potentially contaminated sites at the ZMBM level	High
North-West Regional Development Agency	Management authority of the Regional Operational Plan of the North-West region; responsible for investments related to the strategic objectives of interest for this strategy (OS b (vii), OS b (i), OS e (i))	High
Public authorities at county/local level (Maramureș County Council and town halls related to TAUs in ZMBM)	Defining a program for remediation and reintroduction into the economic circuit of contaminated sites in the territory it manages, by allocating funds from the local budget and coordinating the necessary steps; supporting the investigation process of potentially contaminated land by mediating the dialogue between specialists and their owners (if they are privately owned); carrying out campaigns to raise awareness among the population regarding the importance of the decontamination approach; carrying out planting campaigns of species with a phytoremediation role	High
Baia Mare Metropolitan Area Intercommunity Development Association (ADI ZMBM)	Coordination and support role of the TAUs of ZMBM, but also of other interested stakeholders (Local Action Groups, NGOs), in order to develop and implement policies, programs and projects aligned with this metropolitan strategy	High
Private owners of industrial areas (e.g. CUPROM, C.N.M.P.N "REMIN" S.A., etc.)	Investments in decontamination solutions (hard/soft) or the realization of loan agreements with public authorities for a sufficiently long period, which allow the decontamination and reintroduction into the socio-economic circuit of the industrial areas they own	High
Universities/research centres	Supporting the process of investigation and inventory of contaminated/potentially contaminated sites at the ZMBM level	Medium
Local Action Groups (Baia Mare, Mara-Natur,	Financing projects of local interest (possibility of including the priorities of the Metropolitan Strategy within the	Medium

Maramureș West)	projects targeted in the local development strategies, or of adapting the current projects in accordance with this: e.g. Baia Mare LAG - insertion of phytoremediation plants in the Multifunctional Centre "Craica")	
NGOs (e.g. Concordia)	Carrying out campaigns to raise awareness among the population regarding the importance of the decontamination approach; carrying out planting campaigns of species with a phytoremediation role, in cooperation with local/county authorities)	Medium
Local community/ municipal civic council/neighbourhood civic councils	Supporting the approach to decontamination of sites polluted with heavy metals, through the active participation of citizens in the decision-making process of community interest, participation in planting actions	Medium

Some of the key actors listed above were directly involved in the consultation process started within the SPIRE project, in co-creation workshops addressed to interested parties in the Metropolitan Area.

During these workshops, the main challenges that MA faces from a social, economic and environmental point of view were discussed, correlated with a series of strategic priorities for their solution.

The main challenges were considered to be those created by degraded lands, cyanide ponds and tailings dumps, as they continue to indirectly contribute to air, soil and water pollution through the dispersal of contaminants and dust through wind and precipitation. A priority in this sense consists in securing these areas by implementing dense protective plantations, with the aim of reducing the potential for the transport of pollutants, but also to rebuild the metropolitan green infrastructure and remediate the ecological components (being considered relevant aspects in the long term).

Another challenge related to the presence of degraded lands is the restoration to optimal and ecological conditions of the lands, more precisely the implementation of the necessary investments and measures to restore these lands to optimal conditions.

Although there is consensus that these areas will not regain full productivity or support extended social and economic functions, there are still (limited) opportunities for alternative uses. In this regard, workshop participants discussed at length the prospect of allowing a third party, whether a company or even the state, to extract metals or other valuable compounds from cyanide pools or tailings without associated costs. However, this proposal depends on a number of specific criteria:

- **Implementation of activities in the short term (max. 5 years);**
- **Avoiding any direct or indirect harm to the environment and local communities;**

- Providing safe work opportunities for local people during the process;
- Complete removal of pollution until the end of the process;

The last relevant stage in the process of remediation and reintroduction of these lands into the socio-economic circuit is the post-restoration phase. Once restoration efforts have successfully removed pollution from the area, it is considered optimal for municipalities to collaborate and invest in solar panel fields on these deemed unproductive lands. This strategic investment can generate green energy, with benefits for the rural environment.

All the recommendations mentioned above are the result of intensive discussions with local actors regarding the complexity of remediating heavily polluted areas. It emphasizes the importance of prompt and environmentally responsible action to address the persistent problems created by degraded land, cyanide ponds, and tailings dumps, while providing a glimpse of the land's future potential for sustainable energy initiatives.

The resources of the SPIRE project and the solutions developed do not allow the ecological remediation of all these highly polluted lands. They represent the artefacts of a complex operating infrastructure, whose restoration/remediation to optimal conditions is a costly and complex investment. Therefore, a sustained, long-term effort, but also an intense collaboration between the interested parties, are needed to bring this endeavour to fruition.

The Metropolitan Strategy for the Long-Term Remediation of Polluted Lands takes into account the presence of these lands and elaborates, in the second part, dedicated projects on the identified polluted lands and synergistic recommendations/solutions with other investments planned in other strategic documents to improve environmental conditions and to build a coherent green system at the metropolitan level.

2. TERRITORIAL CONTEXT / ENTRY DATA

2.1 SOCIO-ECONOMIC CHALLENGES

2.1.1 SOCIAL CONTEXT

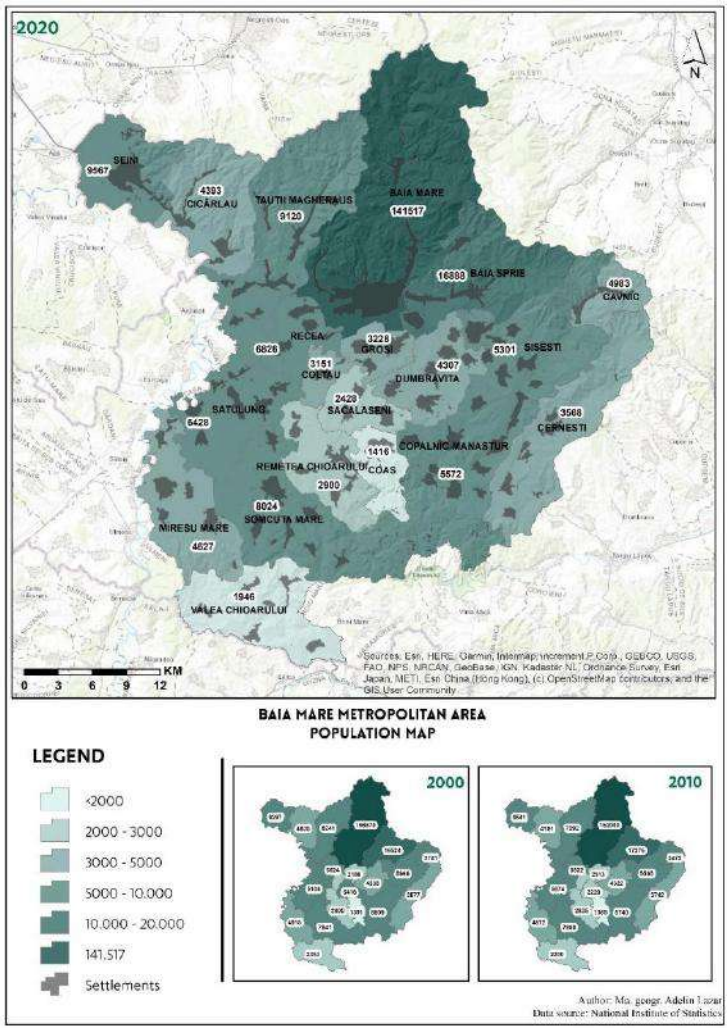


Fig. 3 Population evolution in ZMBM - source Urbasofia, with data from the National Center for Statistics

The North-West region ranks third nationally in terms of the number of inhabitants, with approximately 2,547,429 residents at the time of reference year 2020 (according to INS) and representing approximately 13% of the national total. According to the information provided by SIDU, the Baia Mare Metropolitan Area occupies approximately 22% of the territory of Maramureș County, with an area of approximately 141.7 km2 and a population of 243,000 inhabitants (2020).

The presence of contaminated sites in the territory had significant socio-economic repercussions

at the national level, and especially at the level of the area of interest, generating a negative impact on the health and well-being of the population. Even if there is a general trend of decreasing atmospheric pollutants in the North-West Region, their impact on human health is demonstrated by the data recorded by the Health Departments of the counties. The most relevant data in this regard come from Maramureș county, where there are heavily polluted areas. Given the alarming presence of contaminated industrial areas in the metropolitan area, heavy metals present in the soil, air and water can be inhaled or ingested, causing serious and chronic conditions such as cancer, respiratory

diseases or neurological disorders and contributing to increasing the rate of morbidity and decreasing the quality of life of the affected communities. According to the reports made by the National Centre for Statistics and Informatics in Public Health, diseases of the respiratory system were the main cause of death in Maramureș County in the period 2016-2021, followed by diseases of the digestive system. In addition, a comparative study between the municipality of Baia Mare and the rest of the county regarding the morbidity caused by respiratory diseases reveals that it is higher in the municipality than in the rest of the county.

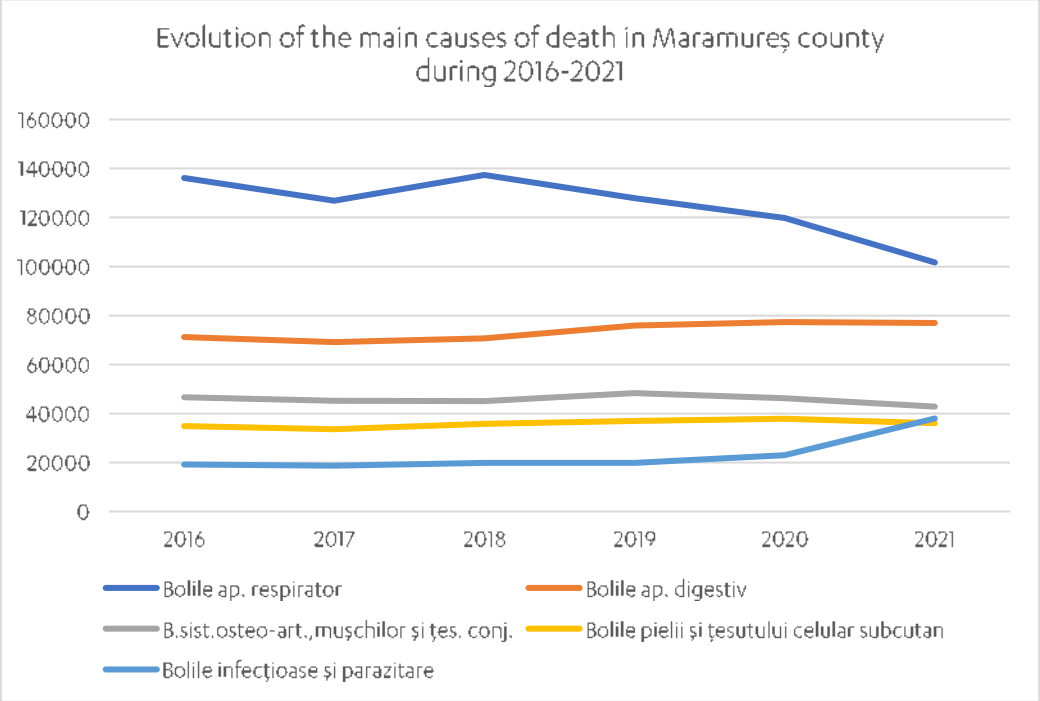


Fig. 4 - The evolution of the main causes of death in Maramureș County (2016-2021) – source Urbasofia, with data from the National Centre for Statistics and Informatics in Public Health. **Blue line (top) is representing respiratory diseases.**

2.1.2 ECONOMIC CONTEXT

The presence of contaminated sites affects local economic development in several ways, the first being the costs involved in remediating and cleaning up these sites. These decontamination processes generally involve significant investment and can take decades, which can inhibit economic development and investment in other sectors.

In the case of ZMBM, this process of decontamination and re-introduction of land and industrial facilities into the economic circuit has not yet been started, which leaves the territory of the metropolitan area with a colossal surface of unproductive and polluted land that is in principle easily accessible due to its positioning in relation with major roads and railways.

In this context, the present strategy aims to support the decontamination approach and contribute to reducing the costs of remediation of the affected areas, by proposing the phytoremediation technique as a simple and cheap solution with a significant impact in the medium and long term.

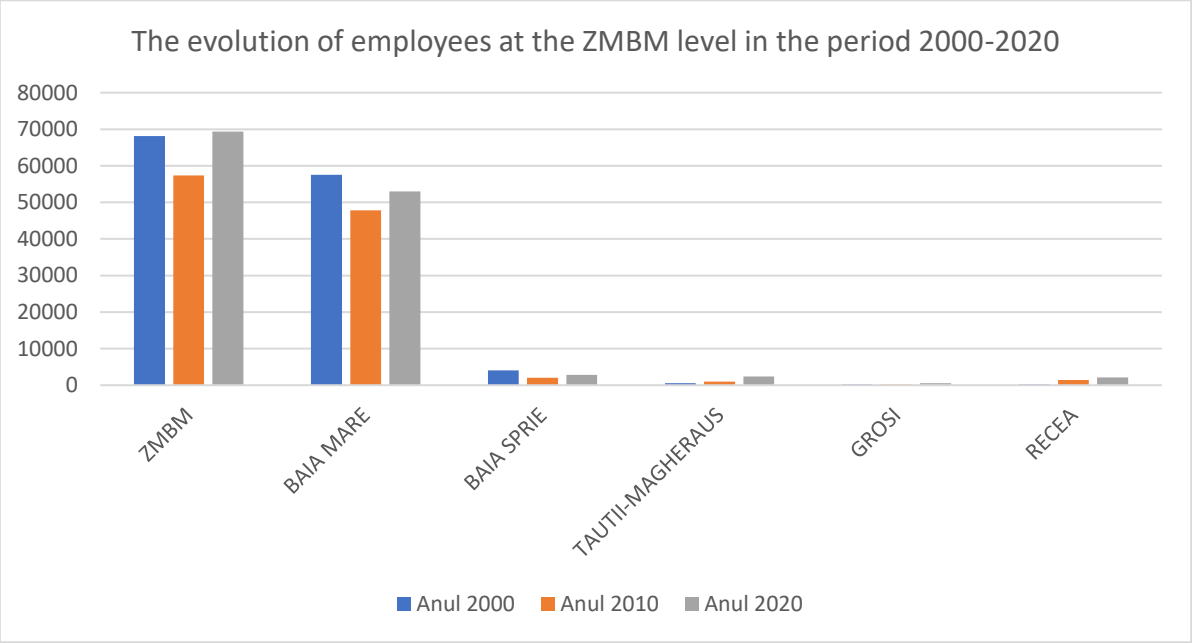


Fig. 5 - The evolution of employees at the ZMBM level (2000-2020) – source Urbasofia, with data from the NCS

Another important aspect regarding the economic context is the negative impact of restructuring on workplaces, as the shutdown of industrial activity led to a drastic decrease in the number of jobs and an increase in unemployment. Although both at the level of Maramureș County and at the level of the Baia Mare Metropolitan Area there was an increase in the number of salaried persons (by 8.29% and 1.77%, respectively), some of its component localities, such as Baia Mare or Baia Sprie, followed an alarming downward trend, registering a decrease of 7.86%, respectively 30.1% in the period 2000-2020, according to data provided by the National Institute of Statistics.

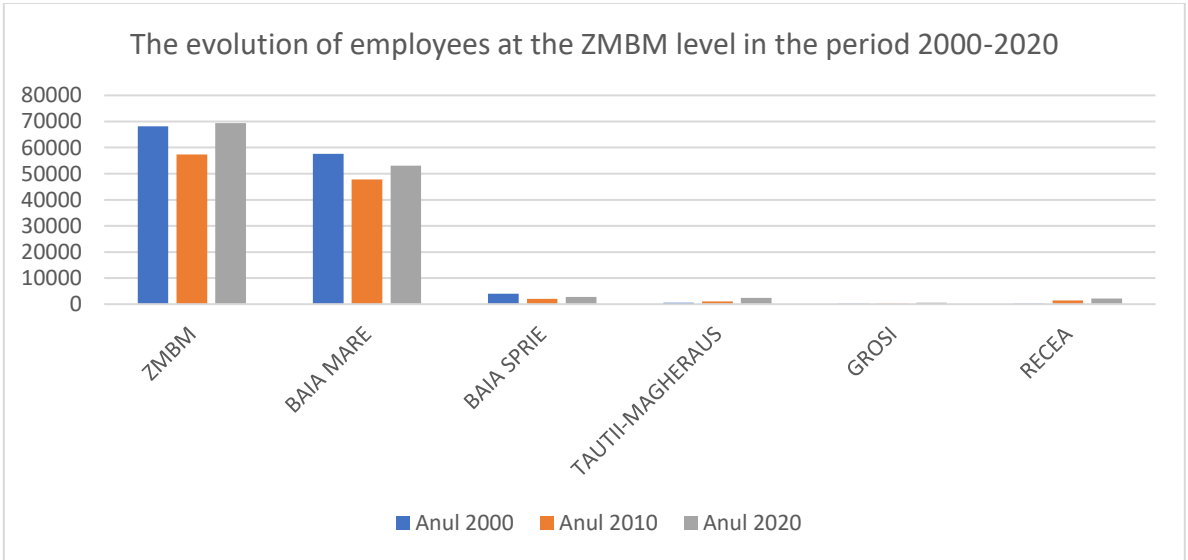


Fig. 6 - The evolution of employees at the ZMBM level (2000-2020) – source Urbasofia, with data from the NCS

The decline of industrial activity further led to negative social consequences such as poverty, marginalization, and the formation of a critical number of disadvantaged areas. According to the Atlas of Marginalized Urban Areas, the North-West Region ranks 2nd in terms of the percentage of disadvantaged areas in housing (5.7%), 7th in terms of the percentage of disadvantaged areas in employment (4.9 %), 3rd in human capital disadvantaged areas (13.3%) and 5th in marginalized urban areas (3.1%). As for Maramureș County, comparing the four dimensions at the regional level, it can be observed that it has the highest percentages of the population in disadvantaged areas in terms of human capital and employment, a fact that can be correlated with the difficulties in the process of economic restructuring after the end of the mining activity.

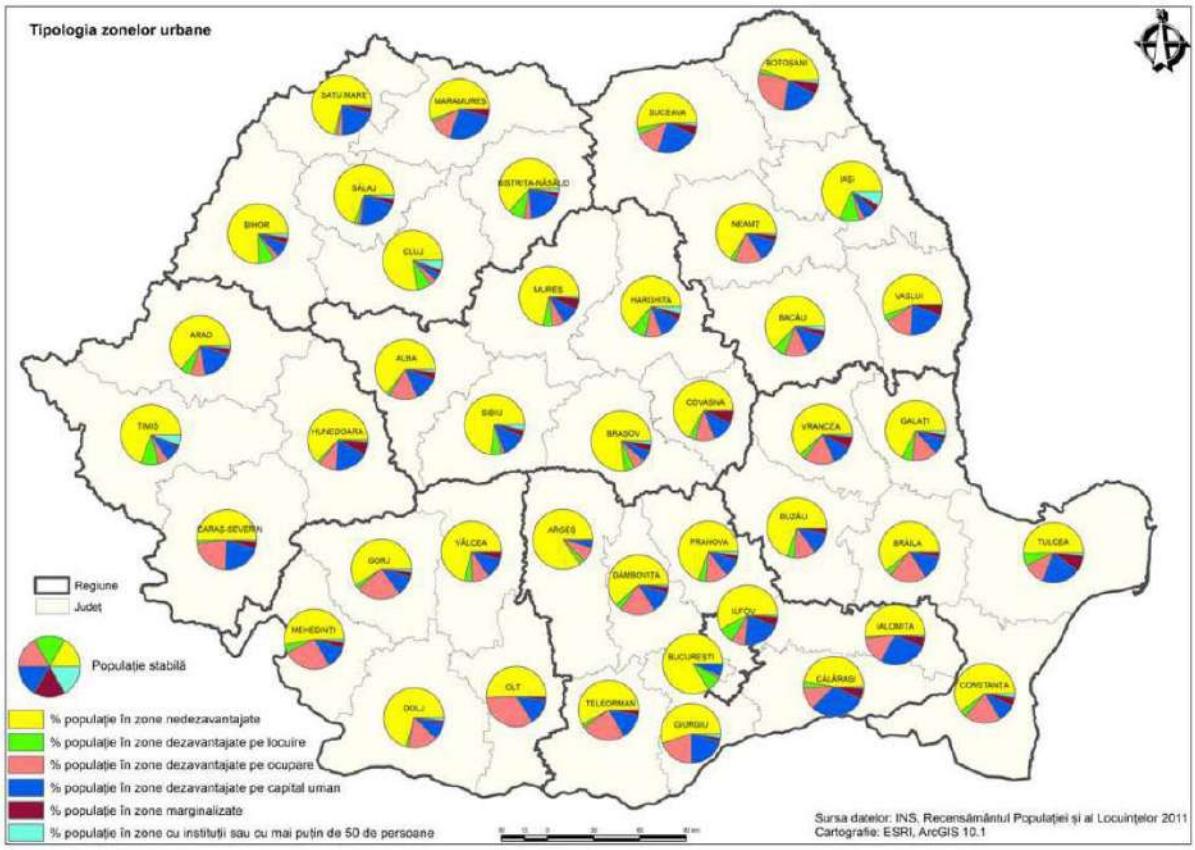


Fig. 7 - Typology of urban areas - source Atlas of Marginalized Urban Areas

According to SIDU FUA 2030, other major challenges that the Urban Functional Zone faces in socio-economic terms are the precarious state of the economy, the lack of investors, the absence of an adequate business infrastructure, unemployment, or poor social services. Economic development in the area faces problems mainly related to the vulnerability of the existing economic profile to shocks and the long process of restructuring previous economic activities, requiring costs for the remediation and reuse of industrial land.

There is an investment dynamic in the field of production (light industry, food, wood) and in transport and distribution services, especially in Baia Mare, Recea, Tăuții Măgherăuș and Seini. Baia Mare Municipality plays an important role in the supra-territorial economic context, being an urban pole with mixed services that concentrates a large number of workplaces and positively influences the neighbouring TAUs. It has a major contribution to the GDP of the NW region (13.83% in 2018).

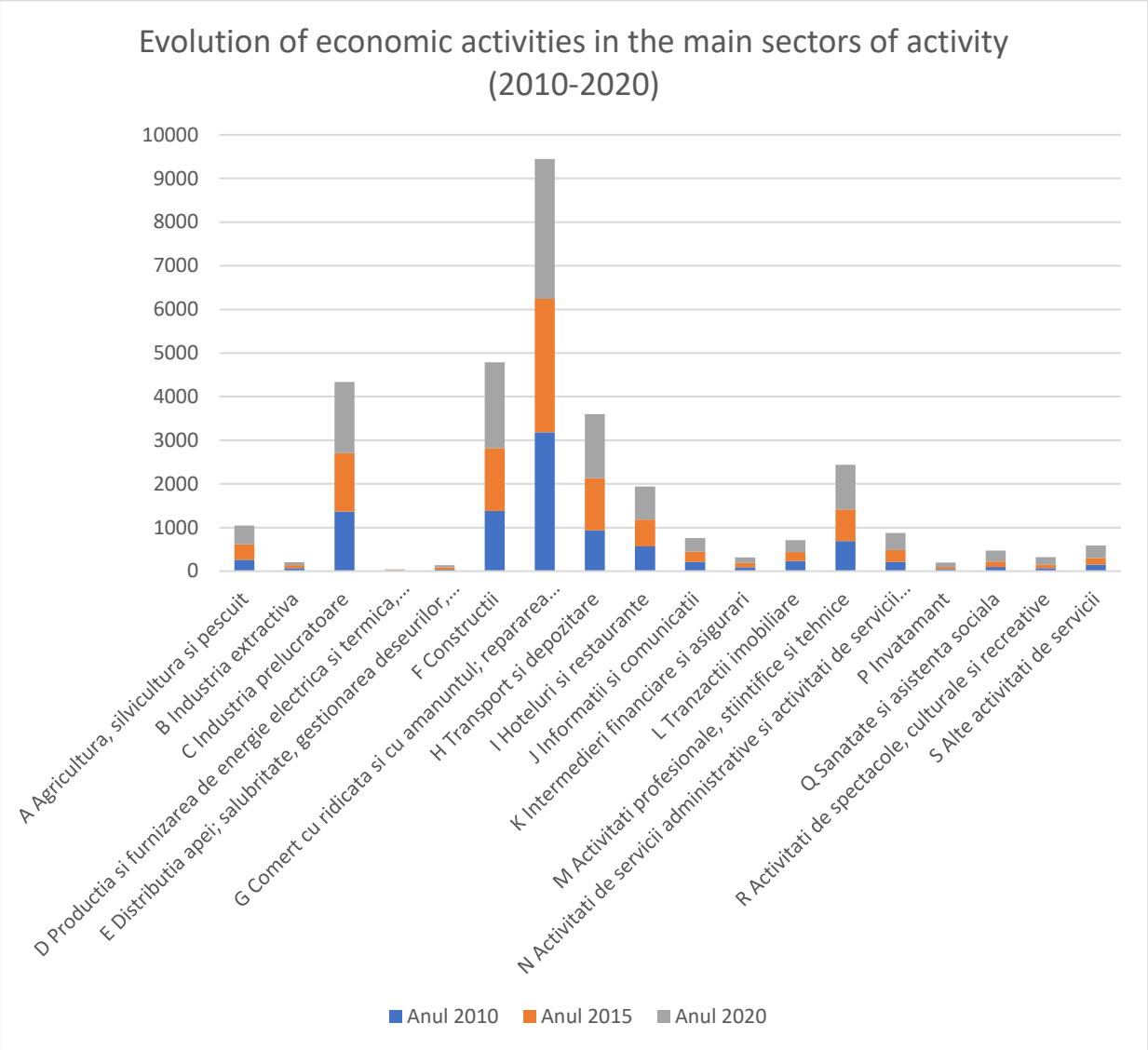


Fig. 8 - Evolution of economic activities in the main sectors of activity (2010-2020) – source: Urbasofia, with data from NCS

Of the 6 county seats, Baia Mare Municipality ranks in 3rd place, with 7.72% of the total number of employees just after Oradea (with 13.16% of the total) and Cluj-Napoca (with 26.45% of the total). This ranking is also preserved if we consider the active population, where at the regional level Maramureș county (43.7% of the total population) is in 3rd place after Cluj (52%) and Sălaj (49%) counties, with an active population of 200,000 people in 2019. The percentage of active population compared to the total population at the regional level is higher than the county one by 3.9%.

The unemployment rate decreased by 2.1% at the national level, by 1.4% at the regional level and by 1.8% in Maramureș county, in the period 2015-2019, compared to the average for the country (2.9%).

In the case of ZMBM, in terms of the labour force, the general trend has been a decrease in the working age population and an increase in the number of elderly people. The same trend is also observed in the Baia Mare Municipality, where the largest decrease was recorded among young people in the 25-29 age category (4700 people), and the largest decrease among the elderly is observed in the category aged 65-69 (2200 people).

In conclusion, historical pollution due to mining activity has major socio-economic repercussions to this day. Although Baia Mare Municipality is a relevant development pole at the level of the West Region, occupying local 3 in terms of the number of employees, both the presence of contaminated soils and the economic restructuring have greatly affected the economic and territorial development of the Baia Mare Metropolitan Area.

The costs associated with the remediation and reintegration of the significant number of contaminated areas in the ZMBM in the economic circuit, which require significant and long-term investments, but also the slowing down/blocking of investments in other sectors, prevented any approach in this regard. Because of this, the presence of heavy metals in soil, air and water has led to significant health problems associated with their ingestion/inhalation, having a major negative impact on the health and well-being of the population.

In addition, the quality of environmental factors affects the economic vitality and willingness of companies to invest in the area, and this fact combined with economic restructuring has led to massive job losses and a high rate of unemployment, poverty, marginalization and a critical number of disadvantaged areas. In this context, the present strategy aims to support the approach of contamination and conversion of "brownfield" type lands into green, productive lands, contributing to the reduction of remediation costs by experimenting with the phytoremediation technique as a simple and cheap solution with a significant long-term impact medium and long, both for increasing the quality of environmental factors and for improving the urban image and reputation of these disadvantaged areas.

2.2 ENVIRONMENTAL FACTORS AND CLIMATE CHALLENGE

2.2.1 GEOGRAPHICAL FRAMEWORK

Baia Mare Municipality and its FUA have a temperate climate, with certain specific characteristics, due to the presence of the Carpathian chain, protecting the settlements from the cold wind from the northeast. The air temperature in Baia Mare Municipality reaches an annual average of 9.6 degrees Celsius, with an average winter temperature of -2.4 degrees Celsius and an average summer temperature of 19.9 degrees Celsius. In terms of precipitation, the study area has an annual average of 975 mm, higher than the national average of 637 mm.

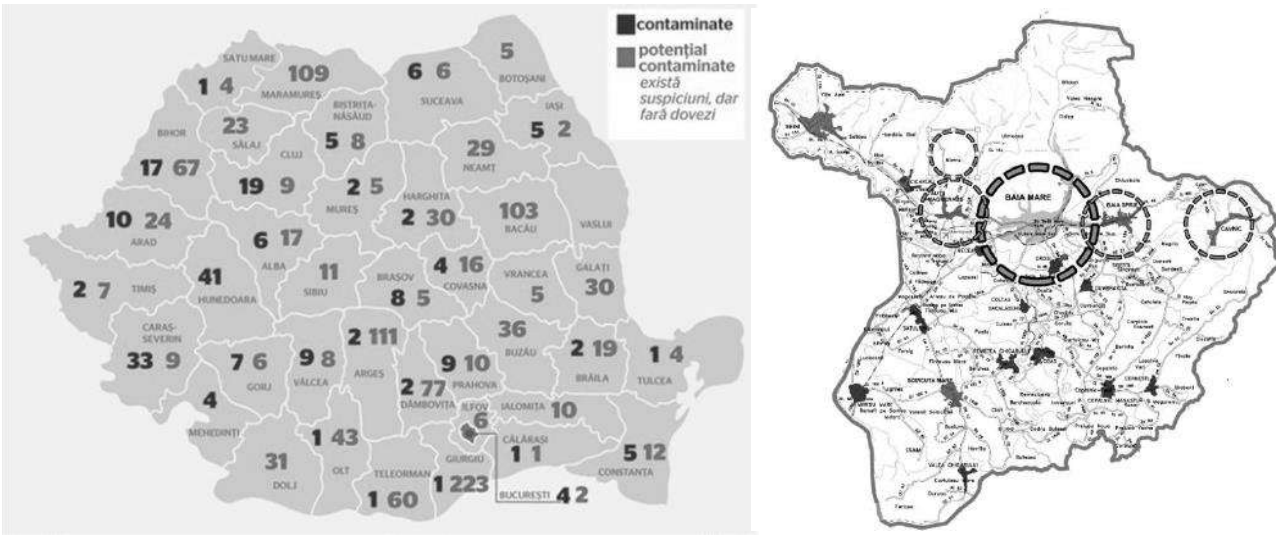


Fig. 10 - Source: ANPM/ National Strategy and Action Plan for the management of contaminated sites in Romania

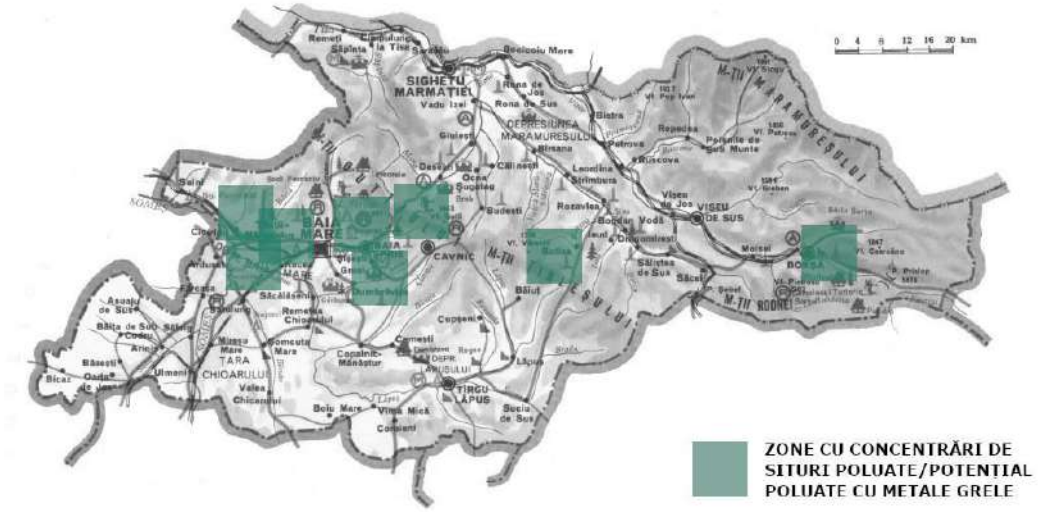


Fig. 9 - Areas with concentrations of polluted/potentially polluted sites with heavy metals – source: Data interpretation and territorial analyses URBASOFIA

2.2.2 ENVIRONMENTAL FACTORS

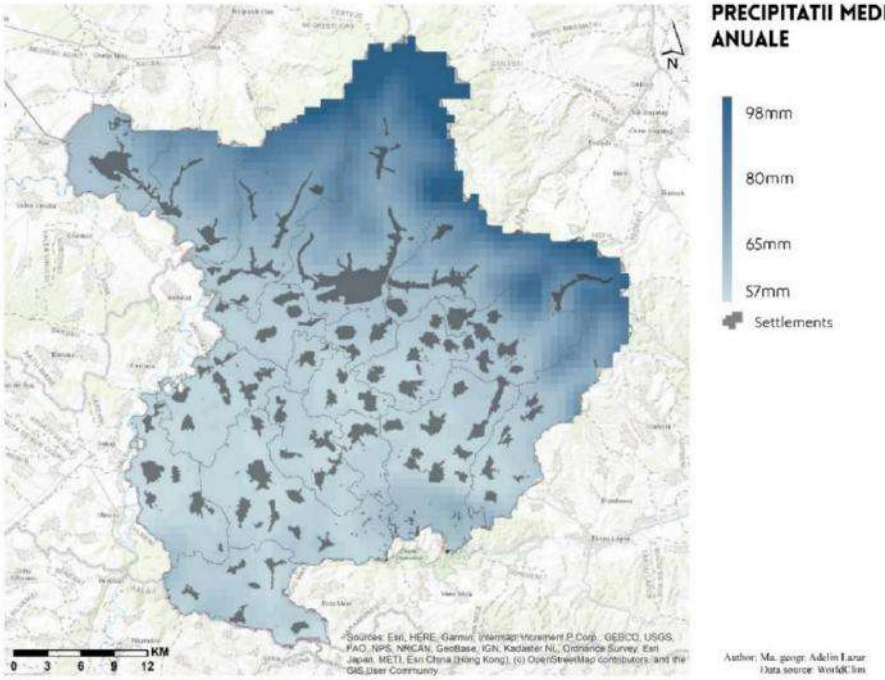


Fig. 11 - Average annual precipitation – source Urbasofia, with data from WorldClimate

Being a mountainous area, the N and N-E parts of the ZMBM experience heavy rainfall, which can lead to deeper infiltration of heavy metals into the soil and water table, and lead to pollution in other non-source areas as well of pollution.

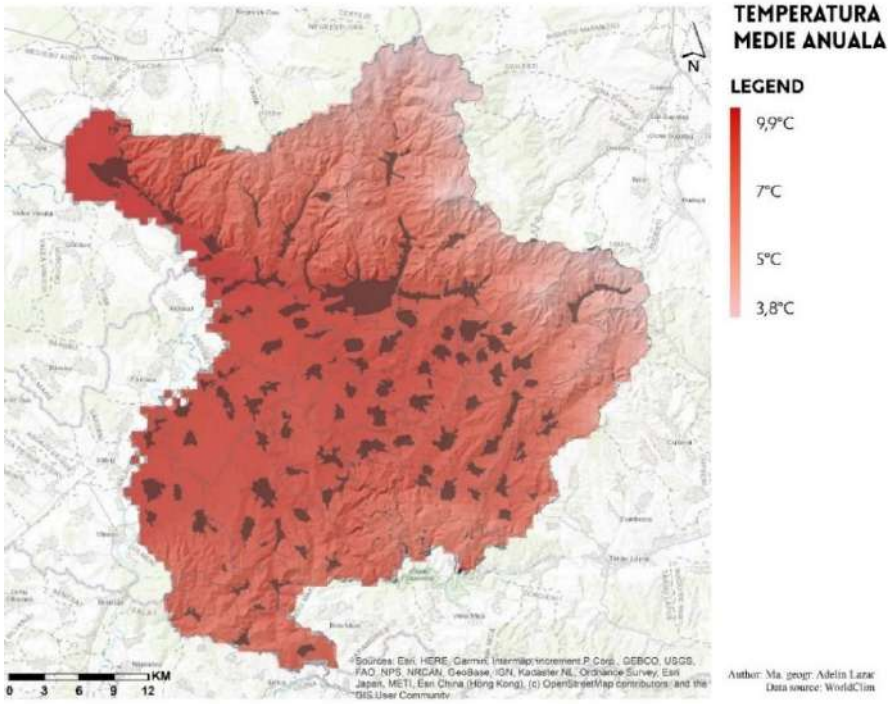


Fig. 12 - Average annual temperature - source Urbasofia, with data from WorldClimate

At the FUA level, the average annual temperature oscillates between 3.8 °C (in the mountainous area – in the N-E-S direction) and 9.9 °C in the centre and west. In the ZMBM localities it has an approximate value of 9.9 °C (the highest in FUA, despite the presence of mountains in the vicinity.

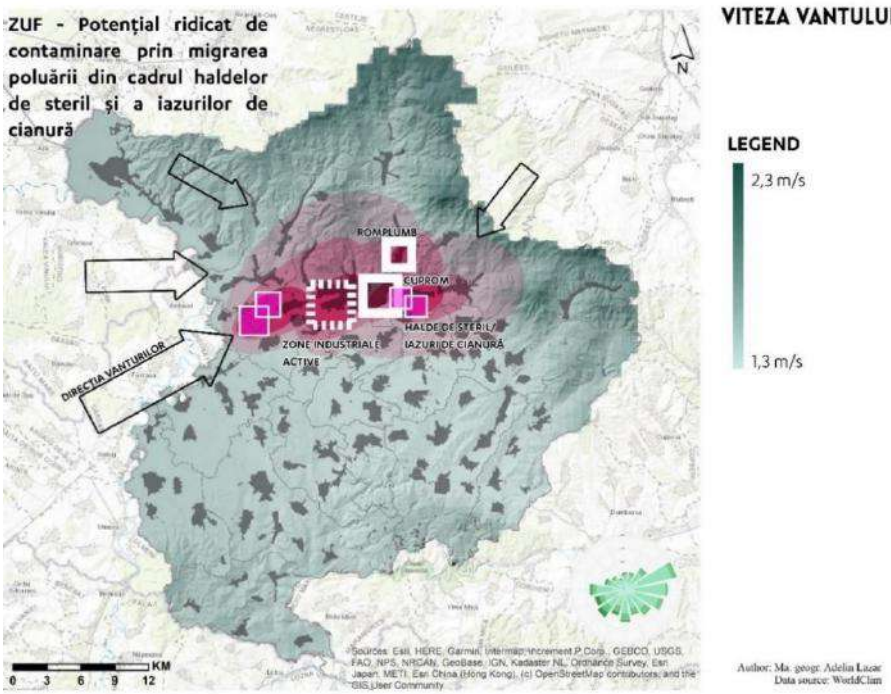


Fig. 13 Wind speed in ZMBM – source Urbasofia, with data from WorldClimate

It can be seen that both the wind speed and its direction can amplify the movement of suspended heavy metal particles generated by active industrial areas and tailings dumps in its direction, amplifying air pollution and severely harming human health, both by direct contact and inhalation, as well as by deposition on food (e.g. apples and tomatoes from crops downstream of Romplumb).

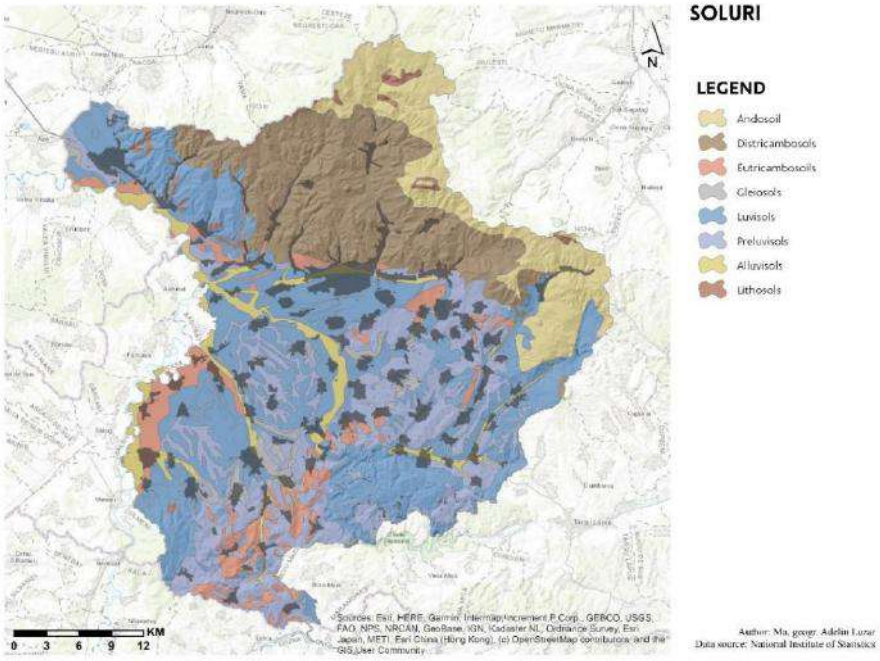


Fig. 14 - Distribution of soils - source Urbasofia, with data provided by NCS

Soils present in ZMBM consist mainly in luvisol, alluvisol and lithosol. Both alluvisol and luvisol are fertile soils, which could be exploited for agriculture in the future, if the pollution problem were solved. Currently, the risk of soil pollution must be taken into account for the entire ZMBM.

2.2.3 LAND USE

Table 1 – Land use at FUA level, source National Institute for Statistics

ha	Baia Mare	Baia Sprie	Tăuții Măgherăuș	Groși	Recea
Total	23347	9602	12065	2353	4388
Non agricultural land	21550	6081	9670	240	1057
Agricultural	1797	3521	2395	2113	3331
Arable	310	525	790	563	1773
Grassland	726	1474	984	448	652
Rough land	604	1464	574	947	777
Vineyards and wine nurseries	7	/	15	/	7
Fruit orchards and nurseries	150	58	32	155	122
Forests and other forest vegetation	17821	5371	8713	44	146
Waters, puddles	361	45	118	22	198
Degraded and unproductive land	418	208	209	30	234

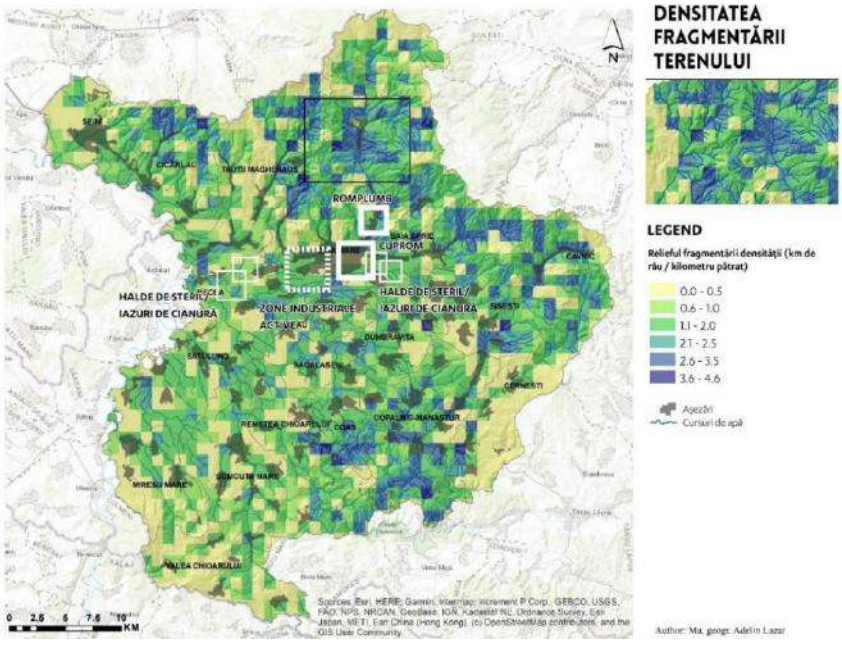


Fig. 15 - Land fragmentation density in ZMBM - source Urbasofia

It is observed that ZMBM water courses play an important role. At the same time, the presence of heavy metals and cyanide spills, including in watercourses, have in the past and continue to have a devastating effect on natural ecosystems, so the development of green-blue infrastructure using plants capable of phytoremediation can have a significant impact to reduce this risk.

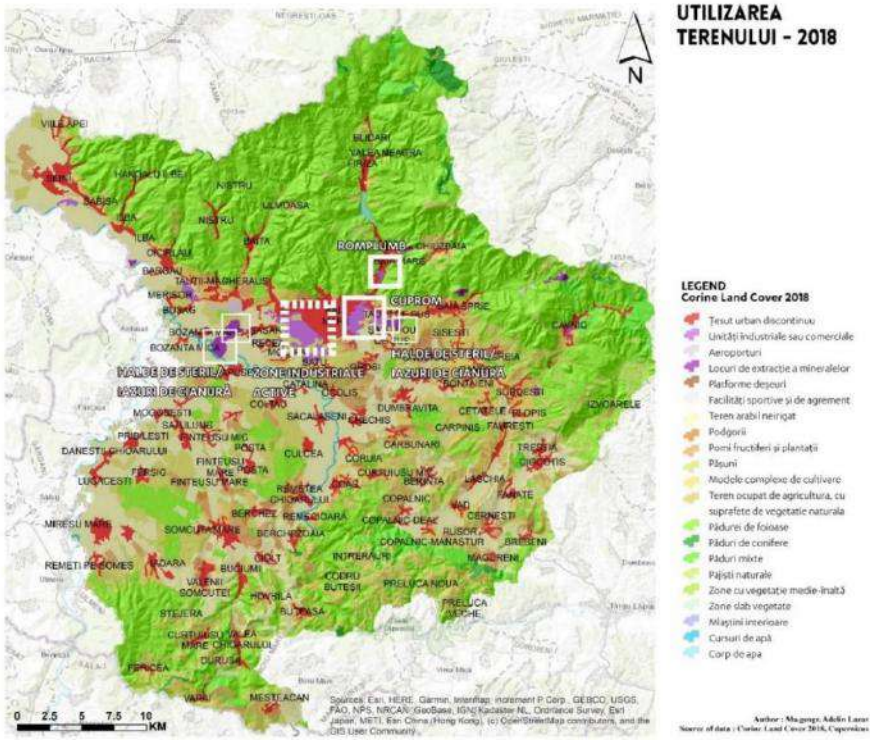


Fig. 16 - Land use at metropolitan level - source Urbasofia, data Corine 2018

In terms of land use, the presence of industrial and mineral extraction units in the vicinity of residential areas and productive areas (pastures, agricultural areas) represents a real danger for the population, as ingested or inhaled pollutants can lead to severe health problems. health that was detailed in the previous chapter, within the social analysis.

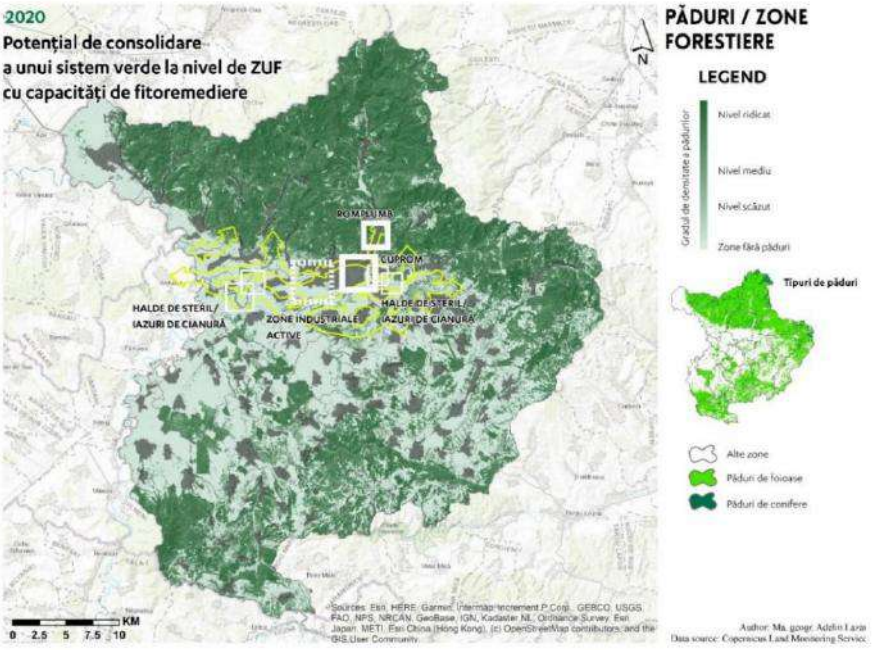


Fig. 17 - Forests/Forest areas in ZMBM – source Urbasofia, with data provided by Copernicus Land Monitoring Service

There is a relevant potential to strengthen a green system capable of phytoremediation at the level of the whole FUA, by connecting the existing forest areas with the green-blue infrastructure developed along the rivers and with other green spaces within the localities.

2.2.4 THE GREEN SYSTEM AND THE RELATIONSHIP WITH THE NATURAL FRAMEWORK

The green system and landscaped planted spaces have an important role for the quality of the environment at the local level, being determining factors in certain cases for the local microclimate, air quality, pollution level, quality of housing, health of the inhabitants.

From the point of view of the green system at the level of Baia Mare Municipality in relation to FUA, a high diversity of types of green spaces and natural areas is observed. The favourable geographical position of the settlements provides easy access to the forested mountain areas in the northern area. The southern area is dominated by an alternating landscape of meadow areas and agricultural areas. Wooded areas are rare.

The former industrial activity is presented in the form of an axis from east to west - the activity had a strong impact on the natural environment (the harmful effects are still present).

Waste deposits resulting from industrial activity represent areas with a high degree of contamination with heavy metals, having a direct impact on the development of vegetation and on the quality of the environment. The management of these lands represents a long-term challenge (detailed aspect in the Soil and Water Pollution chapter).

2.2.5 GREEN SYSTEM AT FUA LEVEL

Fig. 18 - Parcul Municipal Regina Maria, sursa foto: Codrut Papina

At the level of Baia Mare Municipality, there is a need to increase the number of planted public spaces through a diversification of types (important being the lack of a large planted public space - urban park), but also by improving the distribution at the level of the urban system (and the creation of new public spaces planted in disadvantaged areas). Regarding the major green axes at the municipality level, the following are distinguished:

- The blue-green axis related to the Săsar river and the branch of the Firiza river. The axis represents a structuring element at the urban level and at the FUA level, crossing the settlements from east to west (the Firiza river crossing from north to south, flowing into the Săsar river). The axis concentrates an important series of planted spaces, but currently without the specific qualities of a landscaped public space.
- Part of the areas related to the water course are regulated by the PUZ Săsar, elaborated in March 2017, as landscaped public spaces, with a series of pedestrian routes, leisure functions and areas to complement/densify the vegetation planned. The zonal urban plan aims to transform the current axis into a binding element, in terms of pedestrian flows and the system of planted public spaces.
- The major green axis related to Bucuresti Boulevard – major transversal axis at the level of Baia Mare Municipality which concentrates a series of linear and alveolar green spaces, in relation to a dense built-up area (mixed collective housing area, services, commerce)
- The major green axis related to Vasile Alecsandri Street. The axis is represented by a large linear planted space, approximately 720m long, with a specific morphology (circular and fusiform planted alveoli), contained between the traffic arteries related to Vasile Alecsandri Street.
- The major green axis Unirii Boulevard –– presents linear green spaces and connects a series of important landscaped spaces at the city level: Central Park – Mara Park – Săsar Green Axis.
- Secondary green axes, represented by major alignment vegetation (Republicii Boulevard, which presents a fragmented green alignment), Mihai Eminescu street (presents alignment plantation and linear planted areas.

At the FUA level, respectively the TAUs of Baia Sprie, Tăuții Măgherăuș, Groși, Recea, the situation of planted public spaces and the level of structuring and development of the green system is unfavourable with a low density and diversity of planted public spaces. However, given the specific character of the settlements, important planted areas related to the courtyards of individual homes are identified, together with a strong presence of the natural framework at the level of the functional areas and the local landscape:

- BAIA SPRIE: At the level of the TAU, a series of public planted spaces related to the Săsar river watercourse (predominantly spontaneous vegetation) and a series of pocket-type green spaces in collective housing areas are identified. Related to the circulation artery DN18, a series of linear spaces are identified, but without continuous alignment vegetation, being occasionally present

curtains of spontaneous vegetation. The presence of a square located in the central area (behind the Lidl supermarket) can be identified as landscaped planted spaces. At the level of the TAU, the forest area related to the mountainous area represents a dominant area and an important resource for the related settlements.

- **TĂUȚII MĂGHERĂUȘ:** The morphological characteristics of a rural settlement characterize the component settlements of the Tăuții Măgherăuș TAU, the degree of occupation of the land with constructions being quite low, and the planted area and impermeable areas (represented by individual gardens or spontaneous vegetation) being predominant. The TAU is tangent to the forested mountain area and is an important element for the specific landscape. The Someș blue - green axis (represented by wetlands and related vegetation) represents a major natural framework element and an important resource for the related agricultural lands. The TAU presents a deficit of landscaped planted spaces.
- **GROȘI:** The Groși TAU is composed of rural settlements, which, due to the conditions of the hilly terrain, present a specific morphology, the built areas being strongly integrated with the elements of the natural environment: wooded areas, meadows, wetlands and related vegetation. The built density is low, so planted areas (related to individual gardens and spontaneous, natural vegetation) are very present. However, the TAU presents a deficit of planted areas.
- **RECEA:** The TAU Recea is characterized by a rural landscape with a strong agricultural profile. The built-up areas are concentrated along the circulation arteries, and the rest of the surface is occupied by agricultural areas and elements of the natural framework – wooded patches and the blue green axis represented by the Lăpuș river.

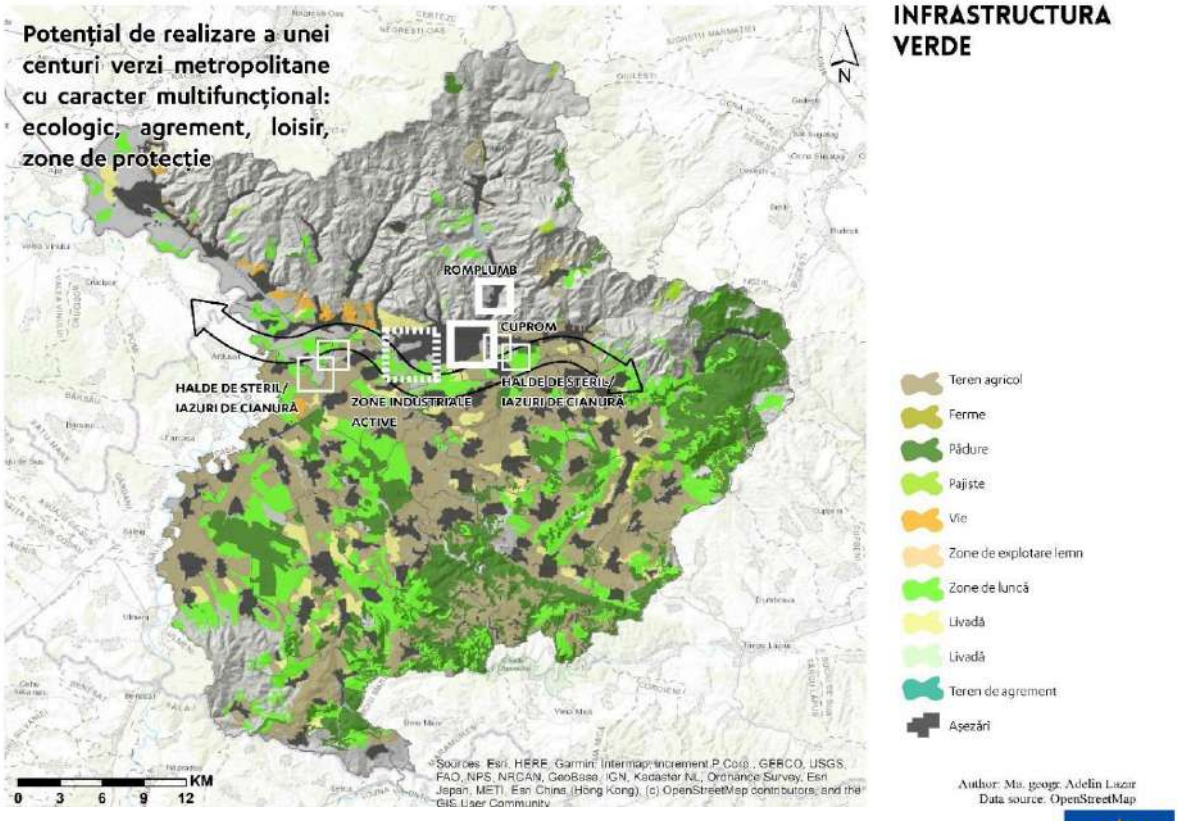


Fig. 19 - Green infrastructure in the MA - source Urbasofia, with data provided by OpenStreetMap

2.2.6 Air Quality

The mining and industrial activities in the Baia Mare area had a considerable negative impact on the city, by virtue of the typology of the extractive and processing processes. The cessation, in recent years, of these polluting activities has also led to a mitigation of the harmful effects on the quality of air, soils and watercourses. Air quality is influenced by several factors, such as socio-economic activities, car traffic, and the surface of planted spaces. To evaluate development priorities and potential measures regarding the environment and air quality, the 2019 Environmental Report produced by the Maramureș Environmental Protection Agency was consulted. The environmental report was carried out through the measurements placed in the Baia Mare urban area, as follows:

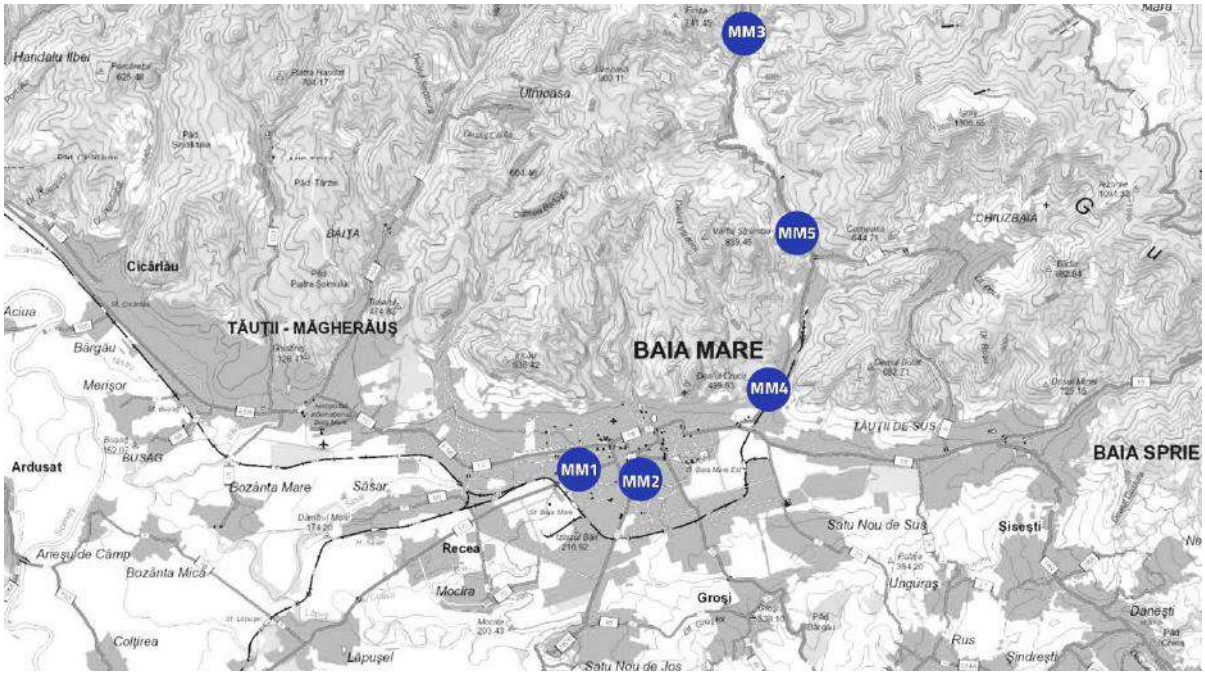


Fig. 20 - Location of automatic air quality monitoring stations in the Baia Mare agglomeration, source: ANMP average report 2019

Table 3 - Location of air quality monitoring stations

Station code	Location	Station type
MM1	Bvd. București nr.28	traffic
MM2	Bvd. Unirii nr.9-11, Mara Park	urban
MM3	Str. Firiza nr. 65, Primary School nr.13	suburban
MM4	Str. Colonia Topitorilor, pressure node SGAMM	industrial
MM5	Str. Lunci nr. 22, Primary School nr.9 Ferneziu	industrial

An uneven distribution in the territory (at the level of Baia Mare Municipality and FUA) of air quality monitoring stations is observed.

Between 2010-2019, in terms of annual average concentrations, there was a decrease noticed for the following monitored substances: SO2, PM10 (small decreases), Pb (significant decreases), Cd. Conversely, at the Baia Mare urban area, there were increases in the average annual concentrations for C6H6, O3, NO2.

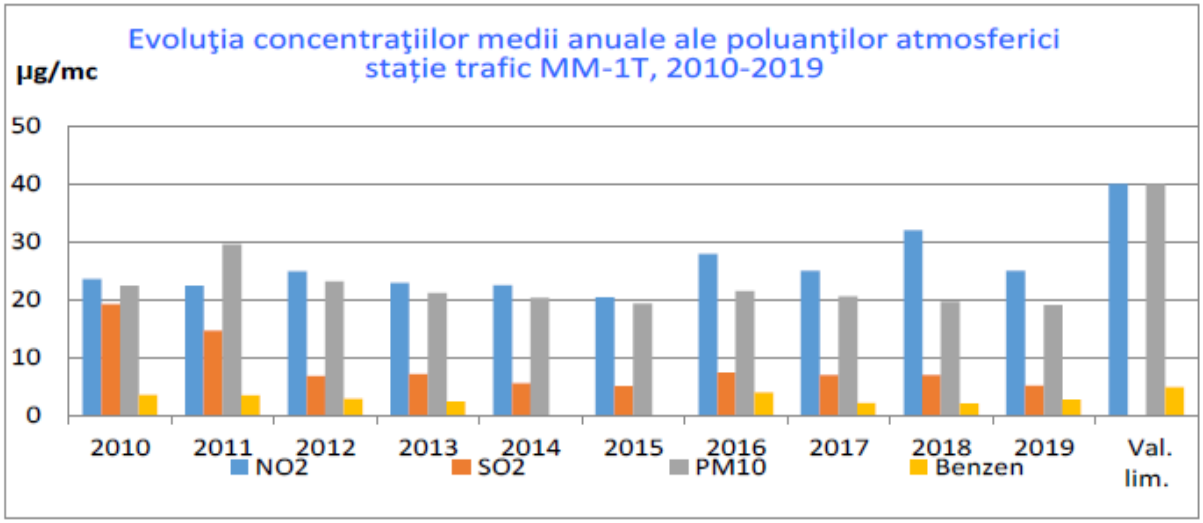


Fig. 21 - Evolution of annual average concentrations of atmospheric pollutants 2010-2019 - source ANPM Environmental Study 2020

Regarding air quality, the general index is used, which is established for each of the automatic stations within the national air quality monitoring network.

During 2019, the overall air quality indices recorded for each automatic monitoring station fell within thresholds 1-6 (1-very good, 5-bad, the highest threshold being 6-very bad). It was observed that in 2019, there were days when the air quality was bad, due to the concentrations of PM10 in the ambient air, when 24-hour average concentrations of suspended dust were recorded.

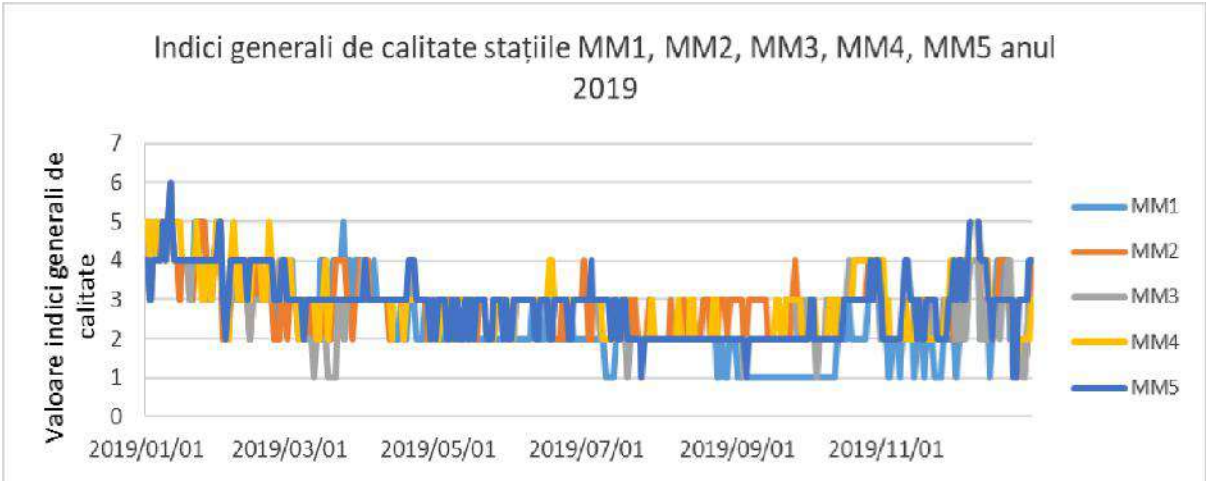
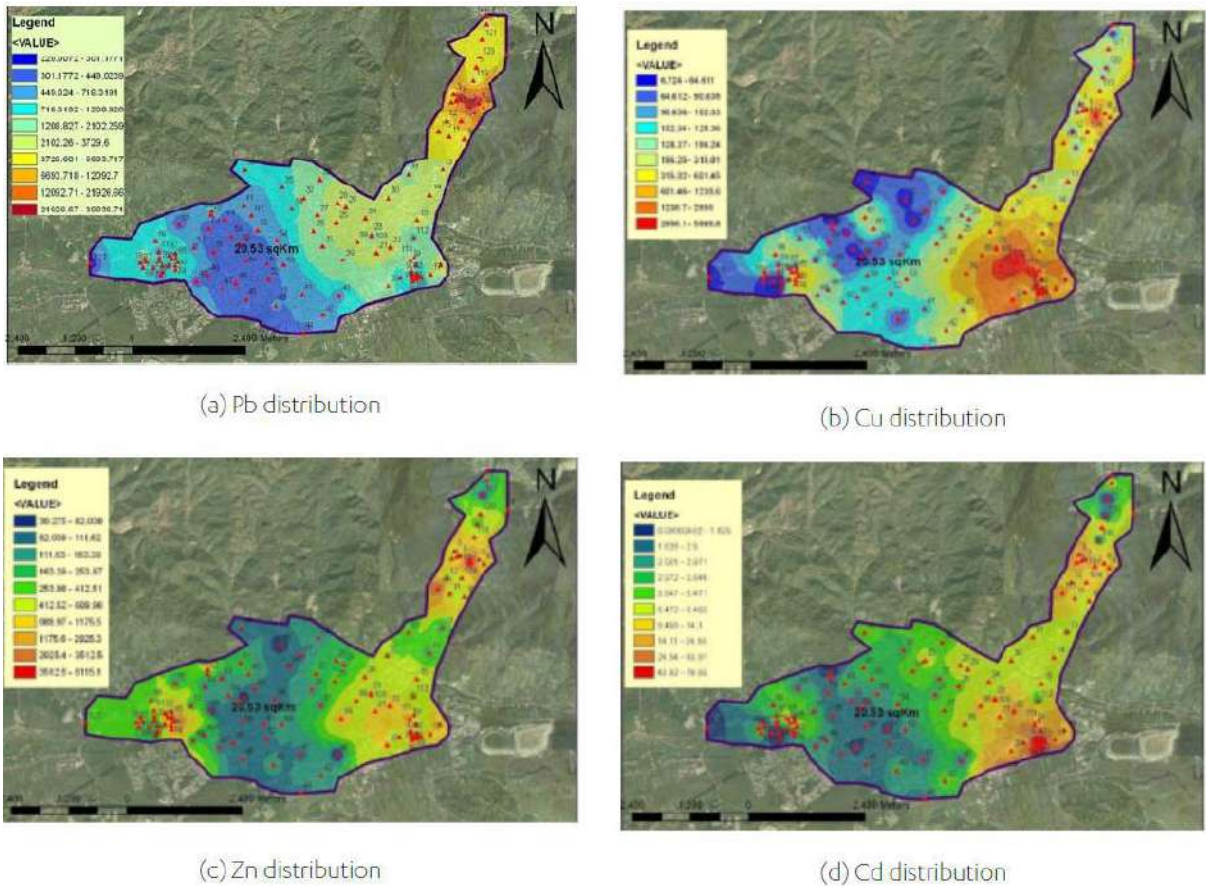


Fig. 22 - Evolution of annual average concentrations of atmospheric pollutants 2010-2019 - source ANPM Environmental Study 2020

2.2.7 SOIL AND WATER POLLUTION

Soil is an environmental factor with a particular influence on health, because the formation and protection of water sources, both surface and underground, depend on its quality. The hydrographic network is represented at the level of Baia Mare Municipality and FUA, mainly by the river Săsar, which crosses the territory from east to west, collecting the tributaries Firiza and Chiuzbaia and the streams Sf. Ion, Roșu and Borcut. Baia Mare Municipality and the related FUA are recognized for the industrial activity they focus on, especially regarding the metallurgical sector, mining activities and related chemical processes. The environment and especially the soil is polluted due to acid rain and heavy metal emissions from former industrial activity. The area became an international concern in January 2000 when a dam failure led to the release of 100,000 m3 of cyanides that affected the natural ecosystems of the Tisza and Danube rivers. Although the lead smelter closed in 2012, an improvement in quality was reported air, the area is still highly polluted and has a high level of soil contamination with heavy metals.



(a) Pb distribution

(b) Cu distribution

(c) Zn distribution

(d) Cd distribution

Fig. 23 – Map of HM distribution in the Baia Mare area at a depth of 0 - 10 cm, source Damian et al, 2008

The term contaminated site refers to a well-defined area where the presence of soil contamination has been confirmed. The gravity of the possible consequences on ecosystems and human health is so high that a remedial process is necessary, especially regarding the current or planned use of the site (ANPM Environmental Report 2019). Remediation or cleanup of contaminated sites may result

in complete elimination or reduction of these effects. According to the 2019 Environmental Report, carried out by the Maramureș Environmental Protection Agency, the main sources of soil pollution in Maramureș County (and mainly for Baia Mare Municipality and FUA) are: S.C Romplumb SA Baia Mare, S.C Cuprom Bucharest – Baia Mare Branch (the former Phoenix S.A.), the tailings ponds of the non-ferrous ore preparation plants, the ore waste heaps resulting from mining activities, the mine waters that are discharged from the existing galleries.

Table 4 - The sitTAUion of the contaminated surfaces related to the SIDU Baia Mare study area (extracted from the ANPM Environmental Report 2019):

No	Site Owner/Administrator	Location	Type of activity	Pollution source	Nature of pollutant	Surface (ha)
1	CNMPN Remin SA Baia Mare – Lake Bozânta	Tăuții Măgheră uș Bozânta	Mining industry	Decantation pool	Wastewater loaded with metals and non-metals	105
2	SC ROMALTYN MINING SRL - Baia Mare – Central lake (old) Tăuții de Sus	Tăuții de Sus	Mining industry	Decantation pool	Wastewater loaded with metals and non-metals	49
3	SC ROMALTYN MINING SRL - Baia Mare – Central lake (old) Tăuții de Sus	Tăuții de Sus	Mining industry	Decantation pool	Wastewater loaded with metals and non-metals	48,6
4	CNMPN Remin SA Baia Mare – lazul Săsar - old	Săsar	Mining industry	Decantation pool	Waste mine waters from mining operations loaded with metals and non-metals	36,5
5	CNMPN Remin SA Baia Mare - Deposit no. 1 - Dept. near the headquarters of the central concentrate warehouse (grabber 3) - UP Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	0,03
6	CNMPN Remin SA Baia Mare - Deposit no. 2 - The warehouse next to the grapple platform no. 4 and 5 - UP Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	2
7	CNMPN Remin SA Baia Mare - Deposit no. 3 - The deposit on the platform next to the raw Turț ore reception - UP Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	0.3
8	CNMPN Remin SA Baia Mare - Deposit no. 4 - The warehouse on the platform near the C.F.N headquarters - U.P. Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	0.3
9	CNMPN Remin SA Baia Mare - Deposit no. 5 - The warehouse on the platform near the Șuior reception - U.P. Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	0,1

10	CNMPN Remin SA Baia Mare - Deposit no. 6 - Gold pyrite transfer deposit - slag pond - U.P. Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	1,5
11	CNMPN Remin SA Baia Mare - Deposit no. 7 - SC Transgold custody deposit - Iaz Tăuții de Sus - UP Central Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	8
12	CNMPN Remin SA Baia Mare - Deposit no. 8 - Lime Station Warehouse - Șuior reception - UP Flotația Centrală	Tăuții de Sus	Mining industry	Tailings deposit from mining activities	Heavy metals, gold pyrite concentrate	0,6
13	Slag deposit SC Romplumb SA Baia Mare	Baia Mare	metallurgical industry obtaining cut lead	agglomerated roasting installations of concentrates	heavy metals (especially Pb and Cd)	1,2
14	SC Romplumb SA Baia Mare	Baia Mare	metallurgical industry obtaining cut lead	agglomerated roasting installations of concentrates	heavy metals (especially Pb and Cd)	5,54
15	Cuprom SA București- Baia Mare branch-	Baia Mare	obtaining cut lead	plants for smelting in suspension of copper concentrates	heavy metals, waste water, sludge, acid solutions, petroleum products	58
16	CNMPN Remin SA Baia Mare – UP Flotația Centrală Baia Mare	Baia Mare	Mining industry	Waste from mining activities	Heavy metals	2,79
17	SC ROMALTYN MINING SRL - Baia Mare tailings reprocessing plant	Baia Mare	hydrometallurgy of precious metals	Waste from mining activities	heavy metals, water, sludge, acid solutions	1,08

At the level of Baia Mare Municipality and the related FUA, according to the Environmental Report, the surfaces of contaminated land add up to a total of 320.5 ha. Although the mining activity and related industrial activity is no longer current, the impact on the environment is very high - it is estimated that the pollution present in this area has led to a decrease in life expectancy by 2.2 years compared to the national average, the index of mortality being increased by 10-15% (see Coman 2006). In a study by Damian et al (2006), soil pollution with heavy metals (Pb, Cu, Zn, Cd) was analysed on an area of over 20.53 km2 in Baia Mare. The obtained results highlighted the fact that the analysed soils (by composition and physical properties) influence the level of concentration and mobility of heavy metals.

Through the SPIRE project, a series of plots were selected at the level of the metropolitan area (in the localities of Baia Sprie, Tăuții Măgherăuș, Recea and Groși) for which soil analyses were conducted. The analysis revealed that all these lands have heavy metal pollution at an alarming level, as can be seen in the images below. The present strategy offers, in the second part, a suite of possible scenarios for the phytoremediation and utilization of the biomass resulting from the planting process for all these lands.

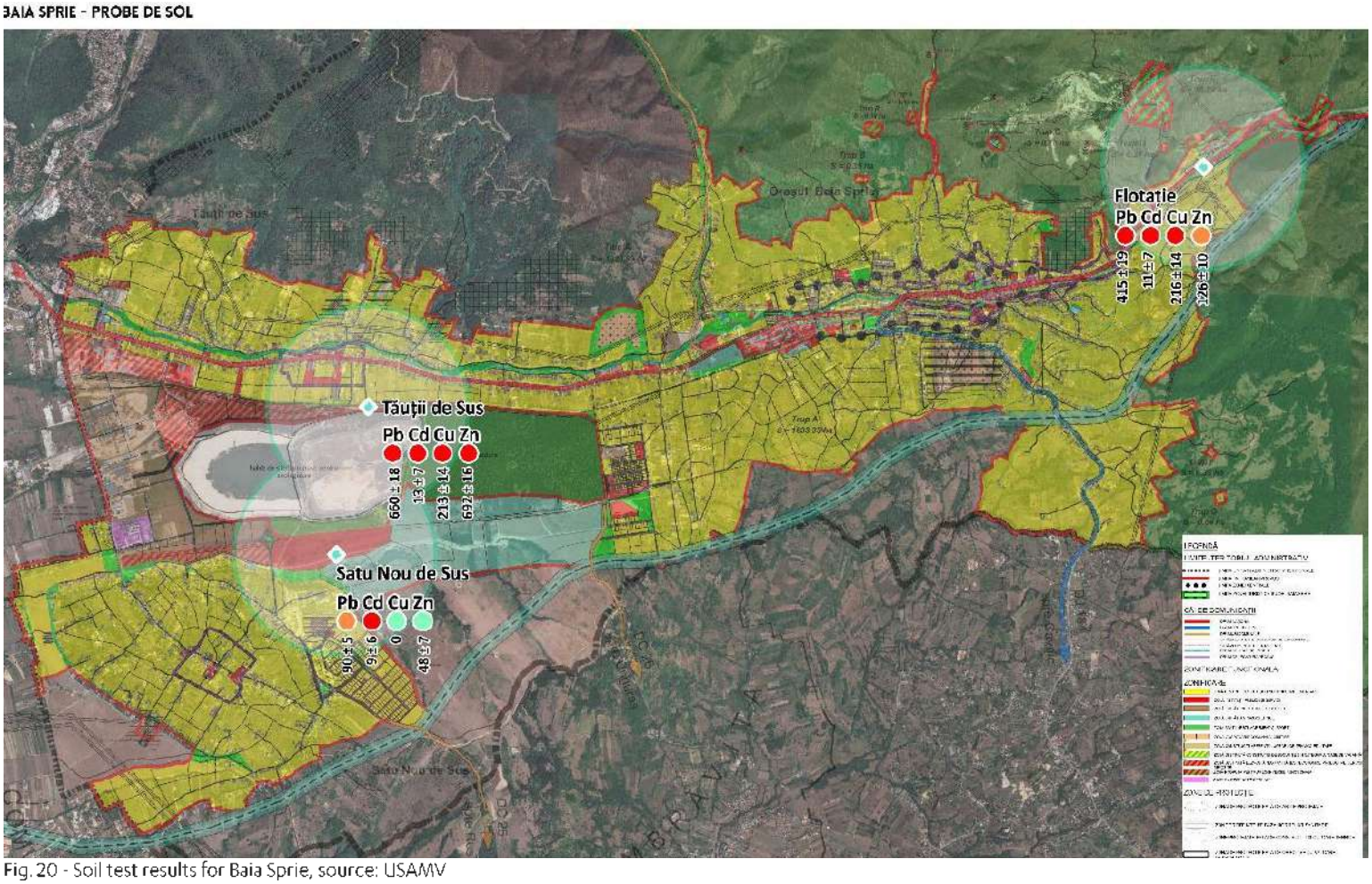


Fig. 20 - Soil test results for Baia Sprie, source: USAMV

RECEA - PROBE DE SOL

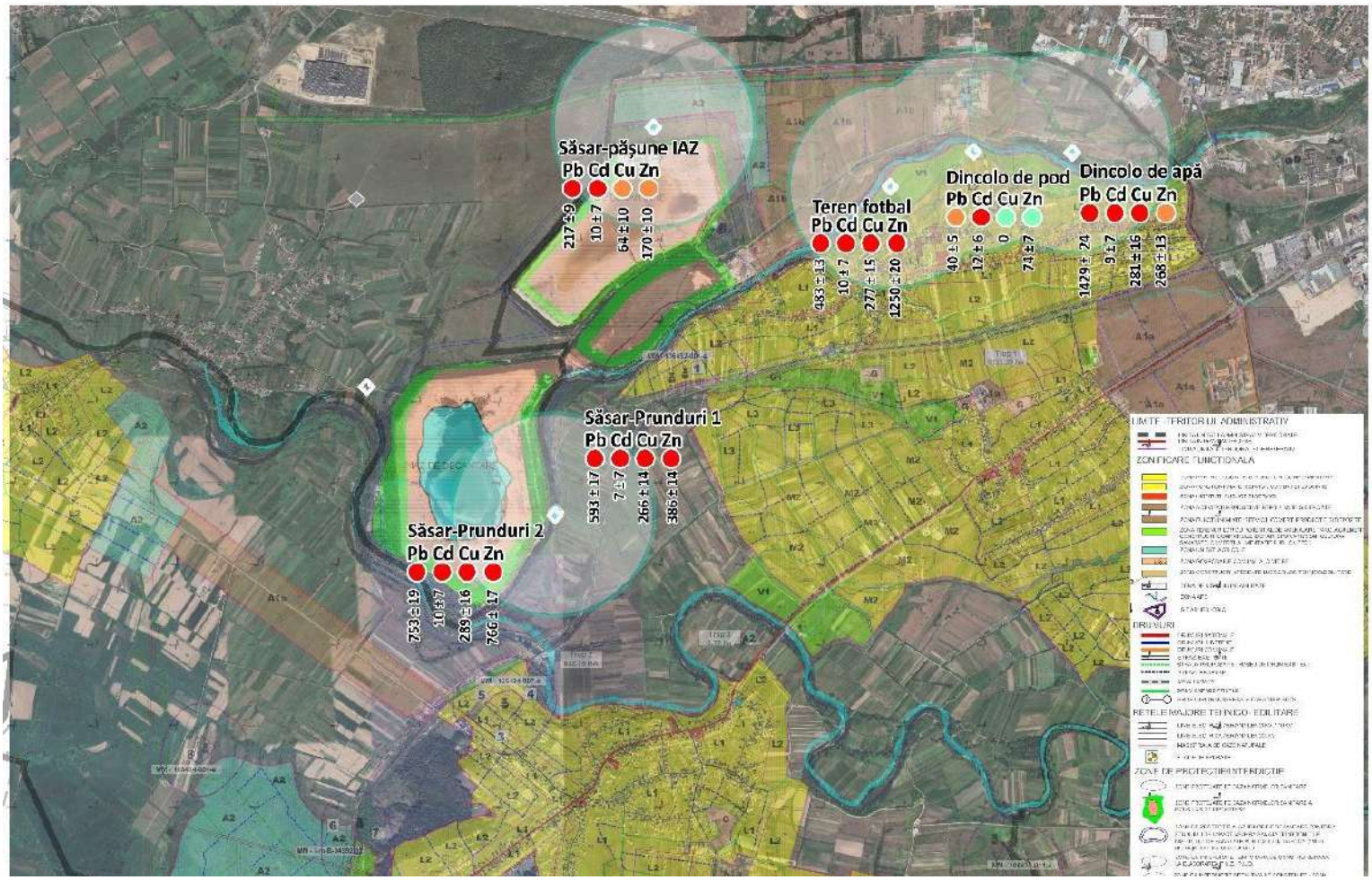


Fig. 22 - Soil test results for Tăuții Magherăuș, source: USAMV

GROSI - PROBE DE SOL

Fig. 21 - Soil test results for Recea, source: USAMV

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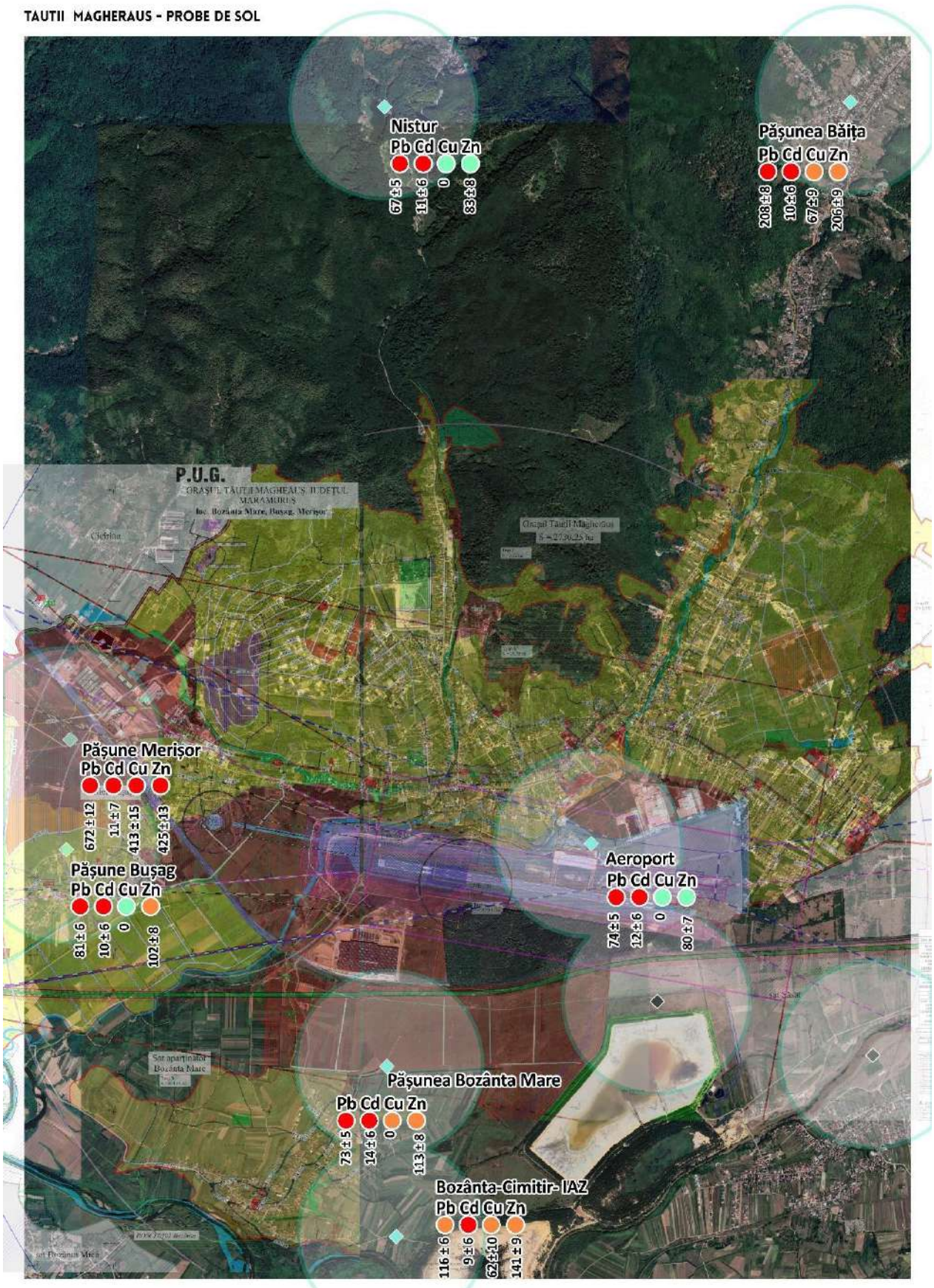


Fig.25 - Soil test results for Tăuții Măgheraș, source: USAMV

PART 2

METROPOLITAN BIO-BASED STRATEGY & MASTERPLAN 2050 FOR THE REMEDIATION OF HEAVY METAL POLLUTED SOIL – BAIA MARE FUNCTIONAL URBAN AREA

1. VISION

The vision of regeneration at the level of the Functional Urban Area and the Metropolitan Area was realized through co-design workshops with representatives of public authorities and relevant organizations (GALs - Local Action Groups), and through questionnaires aimed at the public to identify priorities and needs&opportunities.

1.1 GREEN TRANSFORMATION VISION – PLANNING WITH NATURE

CITIZEN'S VIEWPOINT	PUBLIC AUTHORITIES 'VIEWPOINT
• A green Metropolitan Area with several green spaces and major tree planting interventions. • Localities developed in harmony with Nature - protecting the environment and increasing the quality of green infrastructure and the degree of accessibility. • Ecological green spaces in the courtyards of schools and kindergartens. • Civic activities with an ecological character: planting actions, waste collection, educating the population. • Green / forest barriers around tailings dumps and cyanide ponds. • Conversion of cyanide ponds and tailings dumps into productive areas: solar panels	• The inclusion of plantations with a phytoremediation role in future local investments: roads, mobility corridors, new residential areas, new green spaces, and the rehabilitation of abandoned land and inclusion in the urban circuit. • A strategic plan to support pollution-free environment and projects focused on green/ecological development. •More green spaces and projects/measures to support cycling

VISION OF REGENERATION 2050

In 2050, the inhabitants of Baia Mare Metropolitan Area will benefit from a green territory, in harmony with nature. The green infrastructure at local level is rehabilitated and directly connected to the major elements of the natural setting: blue green corridors, forest areas and valuable meadow areas. Sources of pollution (cyanide ponds and tail dumps) have been secured and the terrain is reintegrated in the economic circuit (used as a solar field). By integrating phytoremediation solutions at local level, critical areas of heavy metal pollution have been remedied, and the green infrastructure created has protected local communities from pollution transported by various ecological phenomena. In 2050, these plantations represent a valuable source of natural landscape, being accessible for leisure and leisure activities. Public areas, green spaces (parks, gardens) as well as planted areas related to public institutions (schools, kindergartens) are arranged with plant species capable of phytoremediation, ensuring the protection of the environment and long-term use. The new developments included within the space a relevant percentage of green spaces arranged with species capable of phytoremediation.

1.2 OBJECTIVES

1.2.1 GENERAL OBJECTIVE

THE TRANSFORMATION OF BAIA MARE AREA INTO A GREEN, NATURE-ORIENTED AND ECOLOGICALLY REMEDIATED TERRITORY.

Reducing the risk of pollution regarding heavy metals in the soil (but also pollution carried by air and water, through meteorological events) for the population of the metropolitan area and ensuring the remediation of the relevant lands, generating local savings by adapting nature based solutions.

1.2.2 SPECIFIC OBJECTIVE OF THE 2050 STRATEGY

DEPLOYMENT OF FLEXIBLE, ADAPTABLE AND EASILY REPLICABLE TOOLKIT OF PHYTOREMEDIATION-BASED INTERVENTIONS RELEVANT TO THE LOCAL CONTEXT: GREEN INFRASTRUCTURE, FUNCTIONAL AREAS AND FUTURE INVESTMENTS.

The aim is to develop solutions, measures and recommendations for adapting/replicating the results of the SPIRE project from the Baia Mare Municipality level to the Urban Functional Area level.

1.2.3 STRATEGIC DEVELOPMENT OBJECTIVES

OS1: CONSOLIDATING AN INTERCOMMUNAL GREEN INFRASTRUCTURE.

The development of major green infrastructure at the level of the FUA represents an important first step for improving the quality of the environment, repurposing unused degraded areas following industrial/exploitation activities and reducing the risk of (indirect) contamination triggered by meteorological conditions on tailings dumps and cyanide deposits.

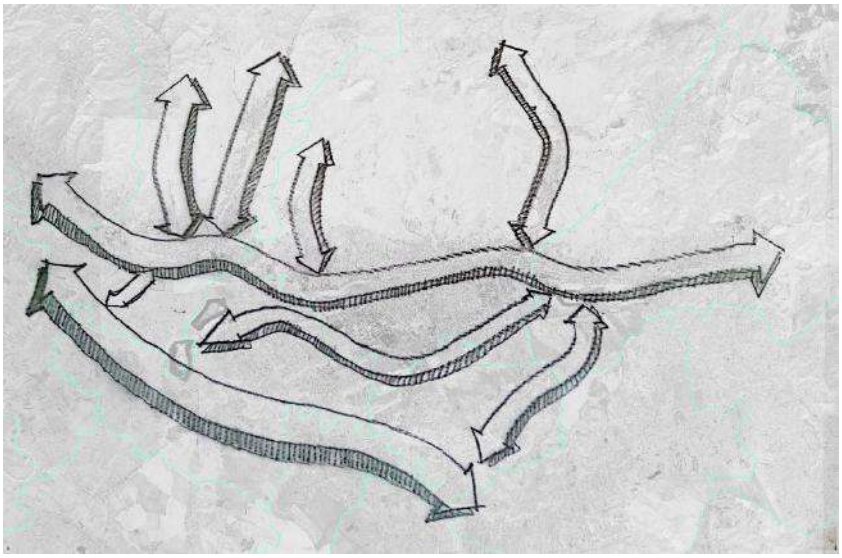


Fig. 23 – Green corridors and phytoremediation capacity at ZUF level - source: Urbasofia

OS2: FUA-LEVEL INTEGRATED MANAGEMENT OF POLLUTED AREAS.

The conversion of pollution-generating lands (tailing dumps and cyanide ponds) is aimed at, and the securing of pollution already existing in the soil through phytoremediation plantations, in relation to functional areas and land use priorities.

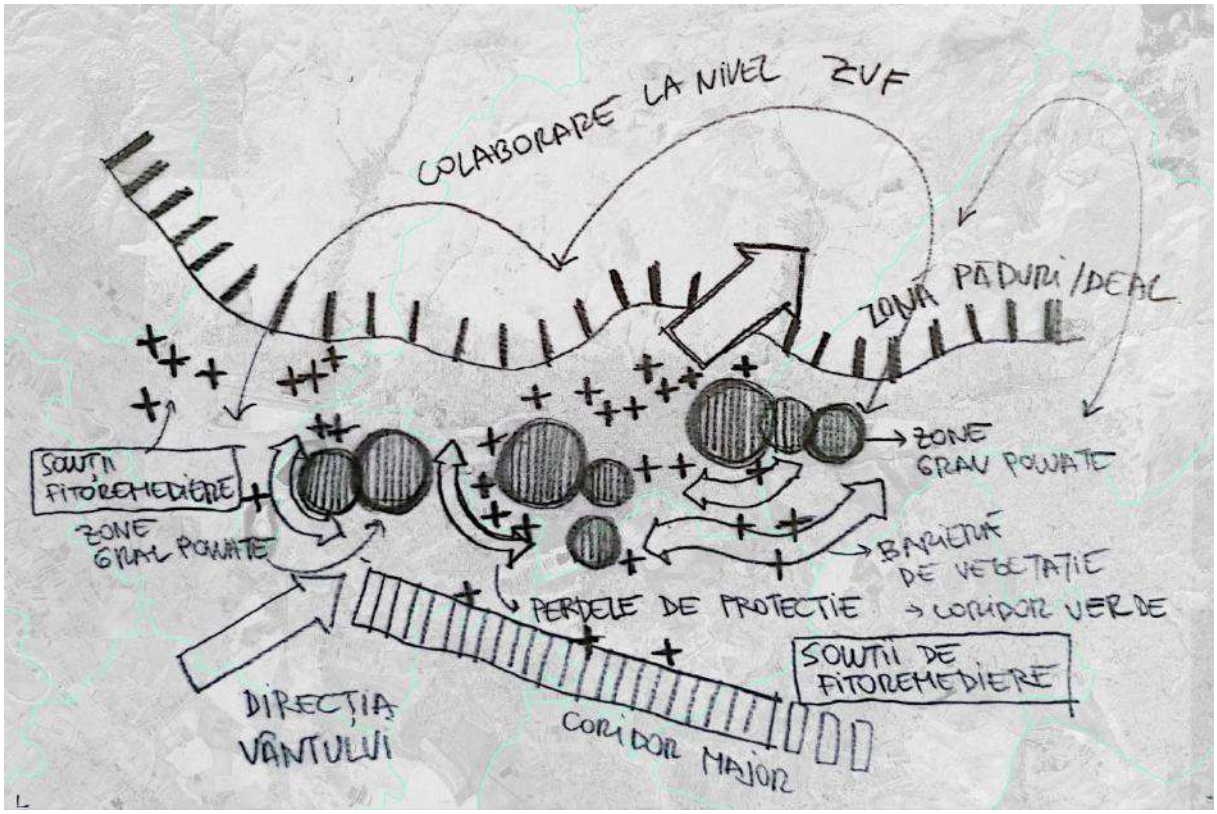


Fig. 24 - Concept for the development of projects and strategic interventions related to the identified vulnerable areas - source: Urbasofia

OS3: NATURE-ORIENTED METROPOLITAN AREA.

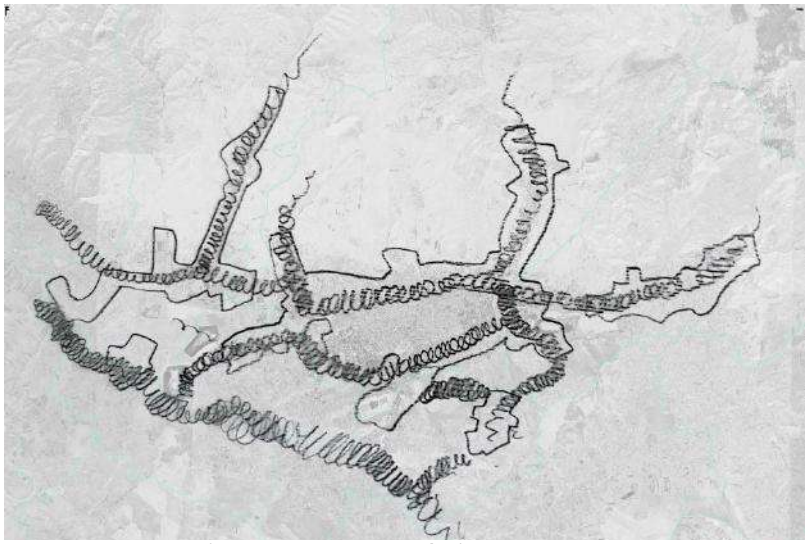


Fig. 25 – Restoring and reintegrating concept for built versus unbuilt natural areas – source: Urbasofia

The integration of phytoremediation solutions (together with the related biomass-based value chains) as a standard practice at the TAUs level is aimed at. Phytoremediation techniques are adopted integrated into the development and management of localities, through a collaboration between departments and between public and private.

2. ADAPTIVE LONG-TERM REGENERATION TOOL

2.1 LONG-TERM REMEDY METHODOLOGY

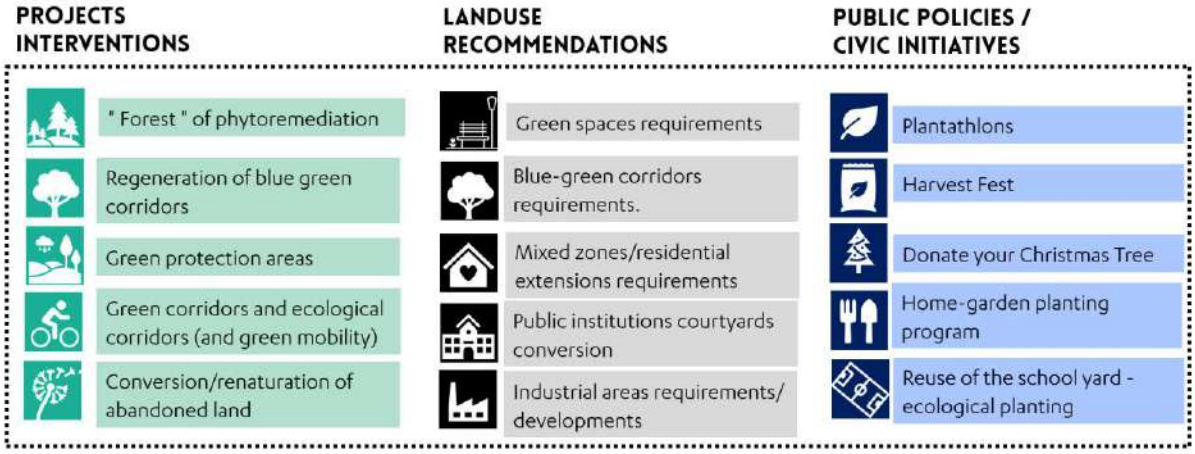


Fig. 26 – 2050 Strategy as an adaptive instrument for the long-term remediation and development – source: Urbasofia

The problem of heavy metal pollution at the metropolitan level and at the FUA level is actually the subject of a territorial regeneration process, in which rural TAUs (or those with a rural or suburban character) play an equal or even more important role than the urban centre Baia Mare Municipality. Thus, it is important to understand and assume (at the investment and collaboration level), both by local authorities and decision-makers, as well as by local private actors, the fact that: **(i) securing pollution, (ii) recovering degraded lands , (iii) ensuring optimal environmental conditions and restoring local ecosystems, creates the optimal context for:** (1) the establishment of a new green economy, (2) a healthier living environment, (3) a competitive territory. The intention behind the development of the current strategy is to function as an adaptive tool (valid both for the next programming periods and for materializing other opportunities). **The integrated strategy approach, represented by the long-term regeneration adaptive tool, considers 3 strategic directions, which can work together and which compose (replicable) Solution Matrix, having a flexible, adaptable, evolutionary character, with the aim of integrating SPIRE solutions at the metropolitan level and at the FUA level:**

1 Development and implementation of projects of a strategic nature, related to the identified lands or synergic/related projects to the investments already planned.

2 Adaptation of phytoremediation practices as standard local practice, by including the solution in land use regulations.

3 Increasing the level of awareness and commitment of local actors through public policies.

3. BIO-BASED METROPOLITAN STRATEGY – 2050

Fig. 31 - Aerial photo looking towards Tăuții Măgherăuș and the Baia Mare area. The proximity of cyanide ponds to productive lands and residential areas is noticeable - photo source Codruț Papina

3.1 PROJECTS

3.1.1 METHODOLOGY

The proposed projects represent specific interventions at the level of localities in the Baia Mare Metropolitan Area, but with relevant impact both at the local level and at the level of the Baia Mare functional urban area. These represent projects of great relevance for the respective TAU - for example, the phytoremediation of neglected and polluted land for the purpose of consolidating green infrastructure (to reduce the risk of "migration" of pollution). In some situations, collaboration between TAUs is necessary, with proposed projects annexed to future interventions planned in SIDU 2030 and PMUD for FUA Baia Mare. Thus, 3 types of projects are proposed:

Projects related/synergistic to the planned SIDU and PMUD interventions (with the indicator "S")

Pilot projects (with priority), within the land related to soil samples (with the indicator "P")

Additional interventions, relevant for the consolidation of the green system at the FUA level (with the indicator "I")

Fig. 27 - Example of land preparation for willow planting. In optimal cases, it does not require expensive equipment, and planting can be done by volunteering. - photo source: Codrut Papina

RELEVANT RESOURCES:

1.FINANCIAL. The added value of the Nature-based Solutions in the SPIRE project is that they are accessible (in terms of implementation cost) and profitable in the medium and long term: from the point of view of low cost compared to a classic soil greening, but also from the point of view of potential value chains based on biomass (energy and materials).

Pilot projects and additional interventions represent dedicated projects for the development of phytoremediation plantations and/or for the remediation of priority sites of local or metropolitan importance. The assumption of these interventions by local public authorities to open the way to a greener, more ecological future. Therefore, political and decision-makers' support is extremely relevant.

The financing of these projects: **(i) requires a dedicated budget**, by accessing the various funding sources available for the green transition (structural funds or funds of the Local Action Groups), or **(ii) it can be achieved through own funds already allocated to the maintenance / maintenance of the premises public greens**. Thus, in the medium-long term, the land owned by the municipality and with the potential of planted public spaces can receive local interventions annually, gradually adopting phytoremediation techniques at the level of the locality and priority areas).

In the case of projects related to the planned SIDU/PMUD interventions, the realization of phytoremediation plantations is considered much more appropriate for the period 2023-2027 (period in which funds are obtained from regional and national sources). It is recommended to include the phytoremediation component in the project files for which funding is to be obtained (for example, future mobility corridors can be accompanied by alignment plantations with species capable of phytoremediation).

2.IN-DEPTH STUDIES. The resources of the SPIRE project allowed the taking of soil samples in key areas at the level of TAU for the Baia Mare FUA. However, with a view to additional interventions or related to SIDU interventions, it is considered necessary to take additional soil samples to establish exactly the necessary plant species (relative to the level of pollution).

3.NEGOTIATIONS WITH PLOT OWNERS AND/OR LAND EXPROPRIATION The collection of soil samples and the identification of intervention lands in areas owned by the municipality or in areas regulated by PUG for future development were pursued. However, some lots may be privately owned. In the situation where the intervention is considered a priority (for example curtains / protective corridors), it is necessary to evaluate an expropriation or collaboration mechanisms (25-50 year contract).

4. COLLABORATION BETWEEN ADMINISTRATIVE UNITS and/or different bodies of public authorities (bodies of the national or regional administration for water management, environment, forestry, transport). Especially in the case of SIDU-related projects, it is necessary to harmonize the various public authorities and departments involved in the elaboration/implementation of the project.

3.1.2 NATURE BASED SOLUTIONS TOOLKIT

F1. PHYTOREMEDIATION FORESTS / MAJOR PLANTING ACTIONS

SOURCE: https://www.groundsure.com/

Industrial activities have affected the quality of green infrastructure at the metropolitan level. The waters and related vegetation were affected, traces of pollution being observable even today. The local hydrographic network is a valuable landscape resource that requires remediation to restore local ecosystems, also acting as a protection zone against pollution.

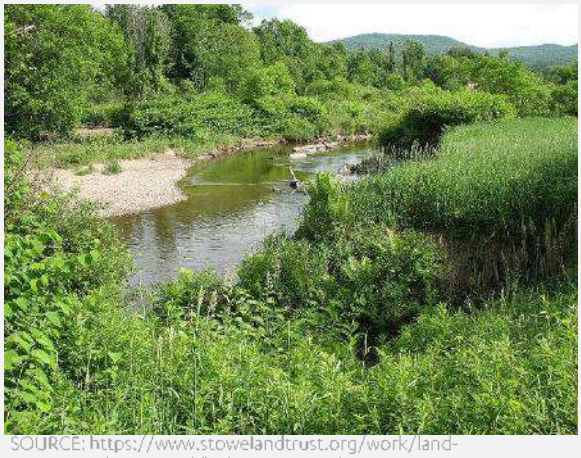
F3. PLANTATIONS WITH A PROTECTIVE ROLE (BUFFER ZONES)

SOURCE: https://www.wikiwand.com/en/Buffer_zone

The green corridors related to the mobility infrastructure are extremely relevant to combat pollution resulting from traffic, but also to combat the greenhouse effect (by reducing the temperatures of mineral surfaces). In the absence of alignment plantations, dust, along with other pollutants (possibly suspended heavy metals) can affect residential areas. Thus, these corridors act as barriers.

They represent large areas of dense plantations, with a role in the remediation of heavily polluted land and/or with the potential to provide stable and consistent sources of biomass for local energy systems. They have an important role in creating protection zones related to residential areas.

F2. REGENERATION AND RESTORATION OF THE GREEN-BLUE CORRIDORS



SOURCE: https://www.stowelandtrust.org/work/land-protection/conserved/little-river-corridor

Plantations with a protective role such as green corridors or buffer zones are particularly relevant in the case of proximity to tailings dumps and cyanide ponds. These areas act as buffer spaces against pollution carried by meteorological phenomena.

F4. GREEN CORRIDORS IN CONNECTION WITH MOBILITY INFRASTRUCTURES

SOURCE: https://www.deeproot.com/blog/blog-entries/planning-for-successful-street-trees-in-arid-climates/

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F5. GREEN CORRIDORS AND STRATEGIC CONNECTIONS WITH THE NATURAL AREAS

SOURCE: https://www.zameen.com/blog/green-corridors-importance-urban-areas.html

It is important to protect residential areas from meteorological phenomena that can affect the quality of the environment (through the "migration" of pollution). The creation of protection zones in peripheral areas ensures an optimal transition from functional areas, rural areas, agricultural areas, natural areas. Thus, the living areas have an improved microclimate.

F7. PHYTOREMEDIATION PLANTATIONS FOR THE REHABILITATION OF ABANDONED LANDS

SOURCE: https://wwf.ca/biopolis-projects/green-alleys-of-montreal/

The intervention is relevant for existing green areas and planted public spaces that present valuable developed vegetation, but which still allow or require the implementation of additional plantings with a phytoremediation role.

In this case, the priority is to create links between planted public spaces and green areas with natural elements (forests, meadows, green-blue corridors). The goal is to create a coherent green system at local and possibly inter-municipal level, to restore the quality of natural ecosystems (biodiversity, air quality, soil remediation).

F6. PROTECTION AREA PLANTATIONS IN THE PERIPHERAL AREAS OF THE SETTLEMENT

SOURCE: https://en.wikipedia.org/wiki/Buffer_strip#/

Abandoned/vacant land at the locality level represents a relevant resource for the communities in the area. Similar to the situation of the SPIRE pilot sites, these sites can be transformed ecologically as well as functionally, providing safe access for occasional activities.

F8. ADDITIONS WITH SPECIES CAPABLE OF PHYTOREMEDIATION IN EXISTING GREEN SPACES

SOURCE: https://www.ucl.ac.uk/urban-lab/events/2020/feb/urban-green-space-reflections-ecological-design

Fig. 28 – Nature based solutions toolkit, source Urbasofia

3.1.3 SIDU AND PMUD RELATED/SYNERGIC PROJECTS

In order to support the increase of the replication potential of the SPIRE solution at the level of the Baia Mare Metropolitan Area (ZMBM) and to align with the development priorities of the ZMBM in the medium and long term, this strategy proposes a series of projects focused on phytoremediation through correlation with key projects related to the main strategic documents at the metropolitan level, such as the Integrated Urban Development Strategy for the Urban Functional Area of Baia Mare (SIDU 2015-2030), the Sustainable Urban Mobility Plan Baia Mare (2017-2030), the Integrated Urban Development Strategy of Tăuții Măgherăuș, as well as the local development strategies of the other localities that are part of the ZMBM.

In the selection of projects suitable for the introduction of the concept of phytoremediation, those that propose the regeneration, expansion or development of new public/green spaces, the renovation/development of road, pedestrian or bicycle infrastructure, the arrangement of protection zones between incompatible functions (in especially in relation to industrial areas), but also the regeneration/development of housing complexes or new leisure areas/activities - all these projects being accompanied by green spaces that can include this imperative of species with phytoremediation capacity. Considering the rich and versatile palette of species with this property, they are suitable in principle for any urban context (from alignment vegetation along boulevards, to ornamental green spaces in parks or squares, wooded areas, water areas, etc)

Fig. 34 - Example of a project implemented through structural funds - cycle track. There is the opportunity to create alignment plantations and protective vegetation with species capable of phytoremediation. - photo source: Anca Pleșa

F3. Plantations with a protective role (corridors or buffer zones)

BAIA MARE

S1[1]_BM[2]_F3[3]	Creation of plantations with a protective role ("buffer") with species capable of phytoremediation, delimiting the industrial areas inside the city (east, north) from residential and service areas (related to pr. 5.1.1 of SIDU Baia Mare).

F4. Green corridors in connection with mobility infrastructures

FUA

S1_FUA_F4	The development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes proposed at the level of Baia Mare Municipality and FUA (linked to pr. 2.2.9 in SIDU FUA Baia Mare)
S2_FUA_F4	The development of green corridors with plants capable of phytoremediation along the sustainable urban mobility corridors (linked to pr. 2.2.11-2.2.19 in SIDU FUA Baia Mare)
S3_FUA_F4	Development of green corridors with plants capable of phytoremediation along the major traffic corridors proposed at the level of the Baia Mare ZMO (Petea-Satu Mare-Baia Mare express road, connecting corridor (c.l.) Baia Mare-Tăuții de Sus-Baia Sprie, c.l. Recea-Baia Mare-Tăuții Măgherăuș, c.l. Recea-Groși - connected to pr. R01, R04, R07, R08 from PMUD Baia Mare)
S4_FUA_F4	The inclusion of plants capable of phytoremediation in projects to reorganize the infrastructure for non-motorized mobility at the Baia Mare municipality level (related to roads I09, I10, I14 of PMUD Baia Mare).
S5_FUA_F4	Including plants capable of phytoremediation in the mobility infrastructure reorganization projects - bypass belts and new traffic arteries.

BAIA SPRIE

S1_BS_F4	Creation of a green corridor comprising species with phytoremediation properties along the proposed ring road connecting Oborului str. to the departure area of the Gutâi Pass (Flotatia Baia Sprie) (linked to pr. 2.2.1 in SIDU FUA Baia Mare).

TĂUTIII MĂGHERĂUS

S1_TM_F4	The creation of green corridors including species with phytoremediation properties along the new pedestrian areas provided in the local development plan. (related to pr. 2.2.5 in SIDU FUA Baia Mare).
S2_TM_F4	The creation of green corridors that include species capable of phytoremediation, along the major traffic routes proposed by the road infrastructure projects (related to projects 1.1.1.15, 1.1.2.3, 1.1.2.5, 1.1.2.8 in SIDU Tăuții Magherăuș)

RECEA

S1_R_F4	The creation of green corridors including species capable of phytoremediation along the new bicycle paths provided for in the local development plan (along the European Road and the main secondary roads of the municipality) (linked to pr. 2.2.5 in SIDU FUA Baia Mare).

[1] Project number in the reference territorial area. "S" stands for Strategic project

[2] Territorial reference area – locality within the ZUF, or relevant projects for the ZUF

[3] Nature-Based Solutions Toolkit

GROSI

S1_G_F4	The creation of green corridors including species capable of phytoremediation in the arrangements proposed for the renovation of pedestrian areas. (related to pr. 2.2.5 of SIDU FUA Baia Mare).

F5. Green corridors and strategic connections with the natural setting

BAIA MARE

S1_BM_F5	The inclusion of species capable of phytoremediation within the safe corridor for cycling along the Săsar river (connected to pr. V04 from PMUD Baia Mare).

TĂUTII MĂGHERĂUS

S1_TM_F5	The creation of a green-blue corridor in the southern part of the city, which connects Tăutii Măgherăuș with Nistru lake (and the future recreation area near the lake).

F7. Local plantations and brownfield conversion

BAIA MARE

S1_BM_F7	Local plantations with species capable of phytoremediation intended for the rehabilitation of mining sites/tailing dumps in Baia Mare Mining (eastern part of the city) and the industrial area in the north of the city (linked to pr. 5.1.1 in SIDU FUA Baia Mare).

BAIA SPRIE

S1_BS_F7	Local plantations intended for the rehabilitation of mining sites/tailing dumps in the residential areas of Tăutii de Sus - within the Baia Sprie Mining Exploitation (linked to pr. 5.1.1 in SIDU FUA Baia Mare).
S2_BS_F7	The inclusion of species with phytoremediation properties in urban regeneration plans for the capitalization of technological dependencies, conservation infrastructure and mining works for economic and tourist purposes (related to pr. 5.1.1 in SIDU FUA Baia Mare).
S3_BS_F7	The inclusion of species with phytoremediation properties in the new social housing areas provided for in SIDU (related to pr 6.1 in SIDU FUA Baia Mare).

TĂUTII MĂGHERĂUS

S1_TM_F7	Inclusion of species with phytoremediation properties in urban regeneration plans of vacant/abandoned land in the central city area, including along industrial railways and in former military units of the city (link to pr. 2.2.1.4 and 2.2.1.5 in SIDU Tăutii Măgherăuș).
S2_TM_F7	The inclusion of species with phytoremediation properties in the layout plans for the new agro-industrial business incubator in Tăutii Măgherăuș.
S3_TM_F7	The inclusion of species with phytoremediation properties in the development plans for the new social infrastructure projects expected for the city (social housing, Tăutii Măgherăuș-Busag residential area, exhibition and conference center, Hosteze and Nistru community centers, multifunctional residential center, kindergarten, nursery) (related to pr. 2.3.1.1 -> 2.3.2.9 & 3.1.1.1, 3.1.3.1 -> 3.1.4.10, 4.1.2.1 in SIDU Tăutii Măgherăuș).

GROSI

S1_G_F7	The inclusion of species with phytoremediation properties in the new social housing areas provided for in SIDU (related to pr 6.1 in SIDU FUA Baia Mare).

RECEA

S1_R_F7	The inclusion of species with phytoremediation properties in the new social housing areas provided for in SIDU (related to pr 6.1 in SIDU FUA Baia Mare).

F8. Additions of species capable of phytoremediation in existing green spaces

BAIA MARE

S1_BM_F8	The inclusion of species capable of phytoremediation in the urban regeneration project of the interstitial spaces between the blocks (Săsar, Depozitelor, Republicii, Gării, Progresului, Traian and Vasile Alecsandri neighbourhoods - in connection with the C02 project from the Baia Mare PMUD).
S2_BM_F8	The inclusion of species with phytoremediation properties in the integrated urban regeneration project provided for in SIDU (eco-districts: Traian - zone 8; Republicii - zone 5,6; Gării - zone 9 (linked to pr. 4.2.1 - 4.2.4 in SIDU).FUA Baia Mare).
S3_BM_F8	The inclusion of species with phytoremediation properties in the rehabilitation plans of the following recreational areas/public spaces: the Ostașul Român area, the banks of the Săsar river, Craica Park, Dacia Park, Regina Maria Park, Lake Bodi/Ferneziu (related to pr. 4.3.1 - 4.3.6 in SIDU FUA Baia Mare).

BAIA SPRIE

S1_BS_F8	The inclusion of species with phytoremediation properties in the development plans for the new recreational areas/playgrounds provided for in the Baia Sprie local development plan.
S2_BS_F8	Inclusion of species with phytoremediation properties in the development plans for the area around the multifunctional centre in the vicinity of the Medspria centre.

TĂUTII MĂGHERĂUS

S1_TM_F8	The inclusion of species with phytoremediation properties in the integrated project of urban regeneration of public spaces in the city (Hoteze area, Băița commune - connection with projects 2.2.1.1 and 2.2.1.2 of SIDU Tăuții Măgherăuș).

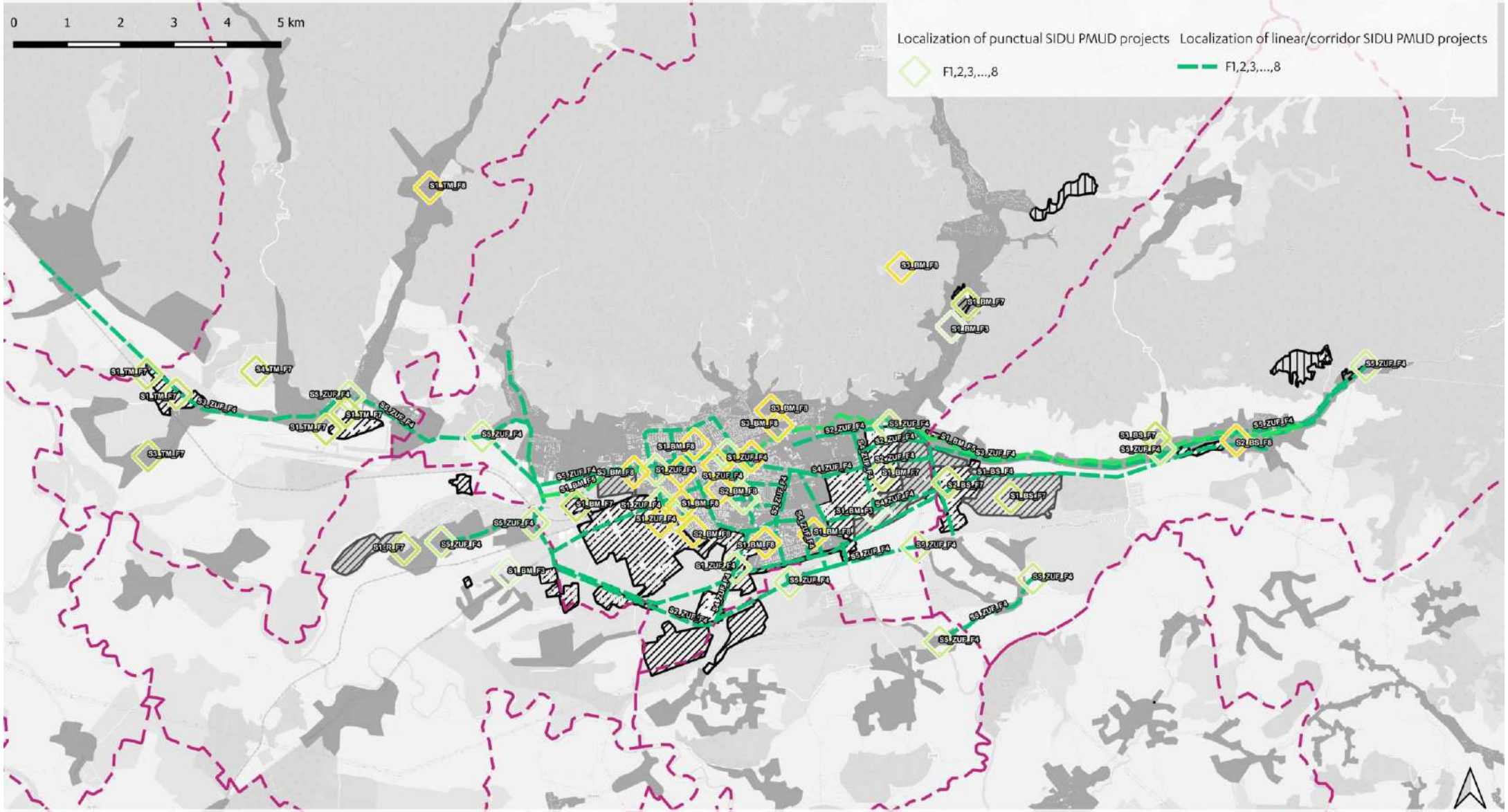
GROȘI

S1_G_F8	Inclusion of species with phytoremediation properties in the new parks and other social facilities of the municipality (sports fields, cultural campus, playgrounds).

RECEA

S1_R_F8	Development of an educational project focused on the greening/beautification of schoolyards using species with phytoremediation properties, as part of the local strategy to capitalize on the unused potential of schoolyards.
S2_R_F8	Inclusion of the imperative of using plants with phytoremediation properties in the local campaign for urban landscape projects in the commune.
S3_R_F8	S3_R_F8 Inclusion of species with phytoremediation properties in the new parks (V1 zones) and other social facilities of the municipality (sports fields).

LOCALIZATION OF SIDU AND PMUD RELATED SYNERGISTIC PROJECTS AT FUNCTIONAL URBAN AREA LEVEL



S_
S1, S2, S3, etc...: represents the project number within the reference territorial area (UAT or ZUF)

_BM_: relevant project at the local level Baia Mare Municipality
_TM_ : relevant project at the local level, Town of Tăuții Magherăuș
_BS_ : relevant project at the local level City of Baia Sprie
_R_: relevant project at the local level, Commune Recea
_G_: relevant project at the local level, Groși Commune
ZUF: project relevant at territorial level Functional Urban Zone

_F - Intervention typology related to Nature-based solutions Toolkit
_F1: Forests with phytoremediation role / major planting actions
_F2: Regeneration and renaturation of the green-blue corridors
_F3: Plantations with a protective role (corridors or buffer zones)
_F4: Green corridors in connection with mobility infrastructures
_F5: Green corridors and strategic connections with the natural environment
_F6: Protection zone plantations in the peripheral areas of the settlement
_F7: Plantings and additions of vegetation for the rehabilitation of abandoned lands
_F8: Additions with species capable of phytoremediation in existing green spaces

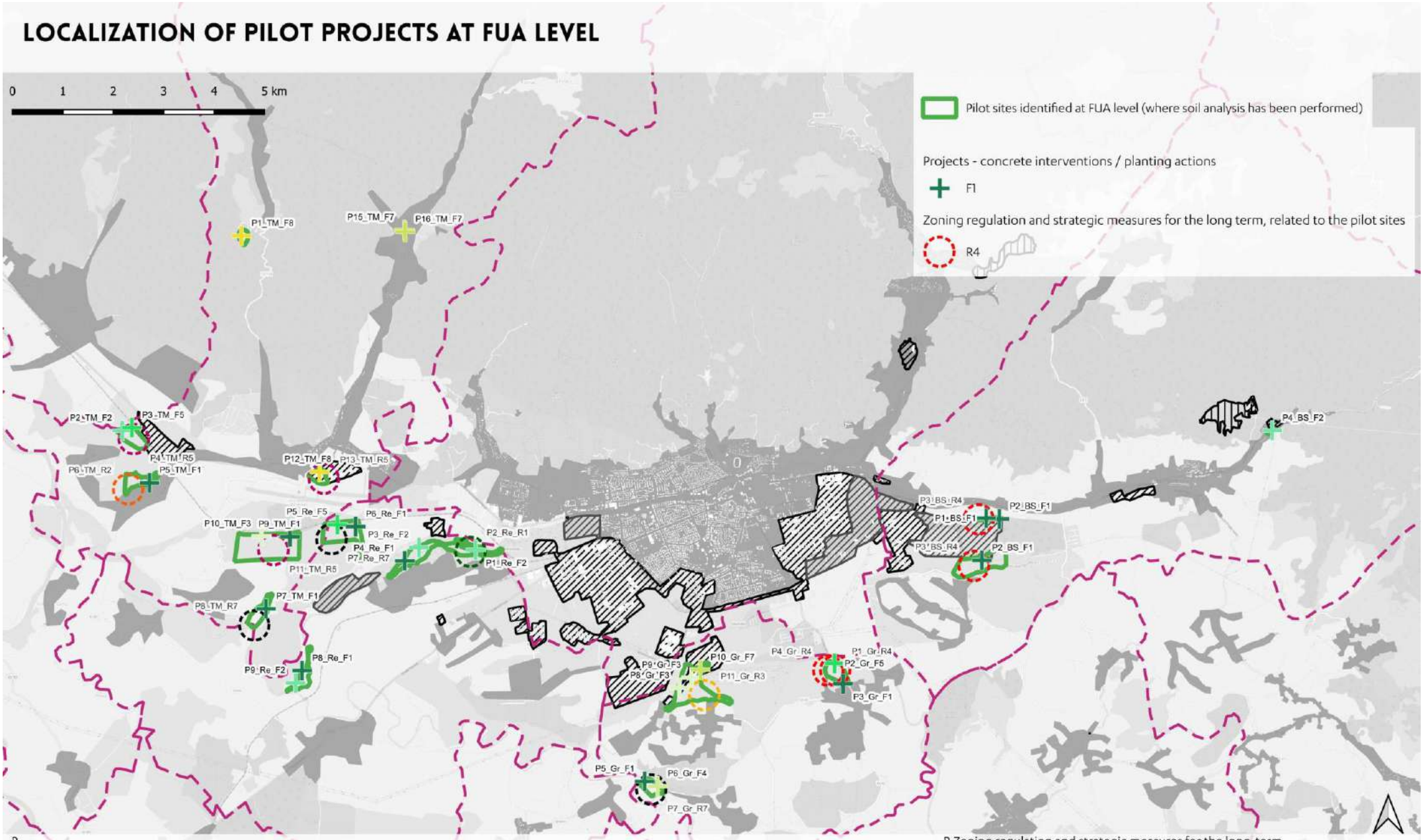
3.1.4 PILOT PROJECTS

Pilot projects are developed based on soil samples and medium-long-term remediation scenarios. The spatial distribution of land for the projects was achieved by identifying optimal areas for new green projects. The following project sheets require in some cases additional studies – especially additional soil samples, as the pollution may not be evenly distributed).

The lands are identified based on the General Urban Plans and are considered valuable lands at the local level for: reducing the impact of pollution created by tailings dumps and cyanide ponds, expanding/consolidating green infrastructure, strategic recommendations for future development areas. Protecting residential areas is a priority for these interventions.

Fig. 35 – Panoramic perspective from one of the sites where soil samples were taken at the ZUF level. Most of these lands present a valuable natural landscape, although most of them are contaminated - photo source: Anca Pleșa

LOCALIZATION OF PILOT PROJECTS AT FUA LEVEL



P_
P1, P2, P3, etc...: represents the project number within the reference territorial area (UAT or ZUF)

_BM_: relevant project at the local level Baia Mare Municipality
_TM_ : relevant project at the local level, Town of Tăuții Magherăuș
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_F6: Protection zone plantations in the peripheral areas of the settlement
_F7: Plantings and additions of vegetation for the rehabilitation of abandoned lands
_F8: Additions with species capable of phytoremediation in existing green spaces

_R Zoning regulation and strategic measures for the long-term
_R1. Requirements for inclusion of species capable of phytoremediation in existing green areas
_R2. Requirements for green infrastructure related to mixed areas/collective housing
_R3. Requirements for green infrastructure related to new residential areas (individual housing)
_R4. Requirements for green infrastructure related to areas with public institutions/services
_R5. Requirements for green infrastructure related to active industrial areas
_R7. Restrictions for food crops

Table 2 – Pilot projects Baia Sprie, Tăuții de Sus

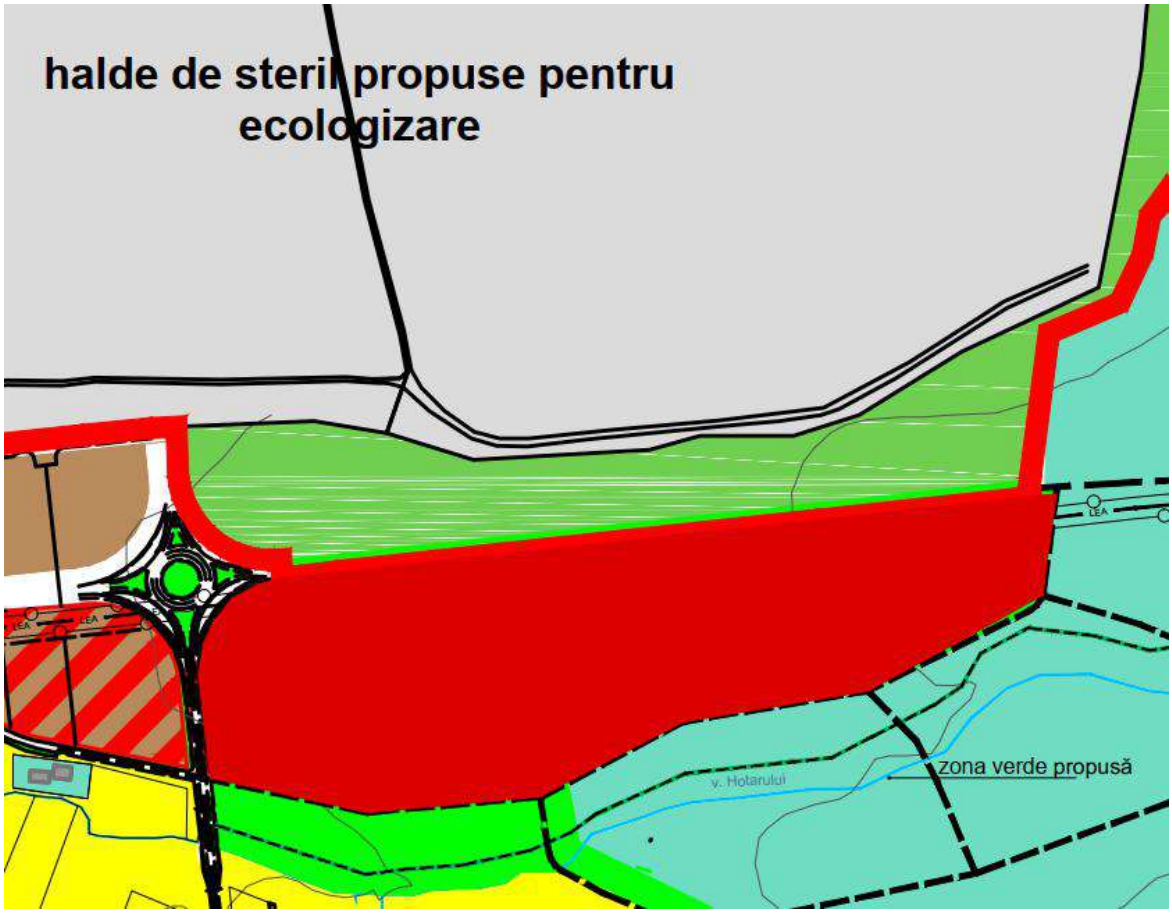
BAIA SPRIE - TĂUȚII DE SUS
Surface: approx 1,5 ha.
Estimate of remediation period:
Pb 660 ± 18 [26 yrs], Cd 13 ± 7 [24 yrs], Cu 213 ± 14 [28 yrs], Zn 692 ± 16 [12 yrs].

EUROPEAN UNION

Urban regulations	• According to the PUG, the land is regulated as an Industrial Units and Warehouses Zone, on the border between the Zone Intended for the Development of Productive Economic Units. Located in the urban area. The land is crossed by LEA. • Urbanization of the land (warehouses, industry, logistics areas) is not recommended, due to the proximity to the tailings dumps in the southern area. The dimensions of the land (approximately 30 m wide and 300 m long) are not considered optimal dimensions for the functions proposed in the PUG. • It is proposed to adapt green solutions, in relation to the nearby forest area, which have a protective role against the tailing dumps.
Current land use	• The land has no use, being devoid of vegetation (except for an irrigation channel/ditch that facilitated the development of spontaneous vegetation)
Urban and local landscape considerations	• In the south and east there is a forest area with a protective role. In the northern area there is a residential area (with plots specific to rural lowland areas). • The land is bounded by Plevnei street to the north and a forest area to the south. • The land is easily accessible.
Environmental considerations	• Heavy metal pollution values far exceed the alert threshold for Pb, Cd, Cu, Zn. Considering the proximity to residential areas, it is considered a priority that the pollution be secured in the first step and remedied in the long term.
Proposal	**Project:** **Phytoremediation forests / Major planting actions with the role of protection zone: protection curtain for the living area.** It is proposed to connect the existing natural areas and create a buffer zone / protection zone for the residential area against the sources of pollution - waste dumps. Dense plantings with trees outside the LEA protection zone are proposed: Acer platanoides, Pinus nigra (approx. 1 ha) and dense plantings with medium and low vegetation in the LEA protection zone: Mischanthus giganteus, Juniperus spp. (approx. 0.5 ha). In the event of greening the tailings dump (recurring source of pollution), it is recommended to keep the area as a protective green zone. The existing irrigation channel can be rehabilitated and expanded to ensure natural irrigation of the planted area.
Biomass potential - for local heating/energy systems	It is recommended to keep the land as a green protection zone without exploitation for biomass. The amounts of biomass resulting, periodically, at two year intervals, following the maintenance and cleaning works, can be integrated into potentially existing systems at the ZMBM level, systems that are based, in order to be functional, on the waste collected annually from range of TAUs – wood waste resulting from: households, silvo-cultural works, maintenance of green spaces, banks of watercourses.

Table 3 - Pilot projects Baia Sprie, Satu Nou de Sus

BAIA SPRIE - SATU NOU DE SUS
Surface: approx 1,5 ha.
Estimated remediation period:
Pb 90 ± 5 [15 yrs], Cd 9 ± 6 [24 yrs], Cu 0 [ok], Zn 48 ± 7 [ok].



Urban regulations	• According to the PUG, the land is regulated as a Green Spaces Recreation Sports Zone and a Public Institutions and Services Zone. • It is recommended to preserve the function of Green Spaces and ensure adequate management as a forest area with a protective role (currently the land has no vegetation) • Area with potential transport infrastructure interventions.
Current land use	• The land is not occupied by functions • There is no tree vegetation
Urban and local landscape considerations	• The land limits the southern area of the tailings dump. • The studied land and the surrounding areas are undeveloped. In the west, the Industrial Units and Warehouses Zone is regulated, and in the east, the Agro-zootechnical Units Zone • The land is crossed by the Baia Sprie – Baia Mare connection road
Environmental considerations	• The heavy metal pollution values (from the proposed Public Institutions and Services area) present an alarm threshold for Cd, and an intervention threshold for Pb. • Phytoremediation of the land is considered optimal until the evalTAUion of future developments.
Intervention proposal	**Project:** **P2_BS_F1. Phytoremediation forests / Major planting actions: Green Spaces Area related to the tailings dump** Dense plantings with trees outside the LEA protection zone are proposed, with an area of approximately 8 ha: 10% Acer platanoides, 20% Betula pendula, 10% Fraxinus excelsior, 10% Pinus nigra, 20% Robinia pseudoacacia, 30% Salix viminalis. Dense planting of medium and low vegetation is recommended in the LEA protection zone (from the SPIRE plant selection). It is recommended to calibrate the percentage of Salix viminalis according to the estimated biomass requirement (if the system is to be adopted). **Local regulation proposals and long-term strategic measures** **P3_BS_R4. Specific Green Infrastructure for the Public Institutions and Services Area.** It is proposed that the future functions (institutions and services) contain protective green spaces especially towards the traffic routes, creating protective green curtains (with species: Betula pendula, Fraxinus excelsior, Pinus nigra, Robiniapseudoacacia). Strips of vegetation of at least 3m are recommended. For green areas with an ornamental role, we recommend: Acer platanoides, Betula pendula, Juniperus spp., Lavandula angustifolia, Mischanthus giganteus, Iris germanica, Salix babylonica. It is recommended that at least 30% of the development surface be represented by green spaces

Biomass potential - for local heating/energy systems

Extension of the green area from the south (Craica stream - Mălinului str. - total area of approx. 7 ha) with a corridor of Robinia pseudoacacia tree vegetation - stabilization, remediation, rehabilitation of degraded land and at risk of landslides.

The same recommendation applies to the north side of the road. Thus, the protection of human settlements against suspended particles carried by the wind, particles carrying heavy metals from the nearby tailings dump, is strengthened, and a role of snow guards is adopted (the distance from the road

will be determined depending on the topography, the direction of the wind, the amount of snow, the height and density of the snow guards - the maximum distance from the roadside is up to 35 m).

This vegetation would not be exploited to obtain biomass for thermal energy, the approximate total investment cost being 20,000 euros.

AREA GIVEN: 3,5 HA + 6,5 HA	
COST TO PLANT (EURO/10 HA)	20 000

To obtain woody biomass for the production of thermal energy, but also for the faster extraction of heavy metals from the soil and adding local added value, it is recommended that the land between the strip north of Mălinului Street and the tailings dump be planted either with *Robinia pseudoacacia or with Salix viminalis*.

For a homogeneity of the plantation, below is an example of an investment and amortization cost for a plantation of *Robinia pseudoacacia*, on the surface indicated:

Area given 20 ha exploitation; 10 ha buffer zone	Worst case scenario	Best case sceenario
Cost FIRST YEAR euro	44000	38000
Cutting, chopping, packaging and transport to the place of storage	200	
Harvest (t/year, humidity 20%)	300	400
Price/mincing (eur/ton)	40	
Total Income	12000	16000
Profit total (eur/an)	**11800**	**15800**
Investment 2024-2025	44200	38200
Profit 2026	11800	15800
Profit 2027	11800	15800

	Profit 2028	11800	15800
	Profit 2029	11800	15800
	Investment amortization - exploitation area - 2029	3000	25000
	Profit 2030	11800	15800
	Profit 2031	11800	15800
	Investment in creating a buffer zone	20000	
	Investment amortization 2032 - exploitation area & protection area 2029	6600	40800

Observation:

The burning of the biomass obtained from the indicated lands must be carried out in local burning facilities, to optimize transport costs, and at the same time in carefully monitored facilities that capture, on the one hand, the heavy metals from the resulting smoke (in biofilters), and then to ensure a compliant disposal of the ash containing the heavy metals extracted from the soil (thus concentrated in a material that is easier to manage and dispose of, compared to dispersing them on the ground).

Resulting in:

- Green areas to protect human settlements from the winds that transport the heavy metals from the tailings dump;
- Green protection lane against snow and road blockages;
- A payback of the investment in less than 10 years;
- Source of local biomass, accessible thermal energy and energy independence;
- Setting an example of good practice at local level, useful for replication in other contaminated and potentially contaminated sites.

Table 4 – Pilot projects Baia Spire, Flotație

BAIA SPRIE - FLOTAȚIE
Surface: approx 0,5 ha
Estimated remediation period:
Pb 415 ± 19 [26 yrs], Cd 11 ± 7 [22 yrs] Cu 216 ± 14 [28 yrs], Zn 126 ± 10 [1,5 yrs].

Urban regulations	• According to the PUG, the land is regulated as a Leisure and Sports Green Space Zone. • The location of the land (related to the water course) and its surroundings (residential area and industrial area proposed for functional conversion) make it necessary to approach the land as a component element of the blue green infrastructure and with the role of public space.
Current land use	• The land is free of constructions and without vegetation. • There are concrete platforms (with an access road), used as parking and a crossing/bridge over the water course.
Urban and local landscape considerations	• The proposal is to preserve the functional nature of the PUG with the mention that this land can only have occasional and very well secured recreational functions - paths and bike paths. • The land is bounded by George Coşbuc Street and the Săsar River
Environmental considerations	• The heavy metal pollution values identified make it necessary to secure and remediate the land (alert thresholds for Pb, Cd, Cu, and intervention thresholds for Zn are exceeded). • The land has the potential to improve the local ecological green infrastructure, being a beneficial intervention from the perspective of ecosystem services, especially biodiversity and the restoring of riverbanks.
Intervention proposal Project:	**Project:** **P4_BS_F2. The regeneration/restoring of the green-blue corridors as a green space with minimal, secure facilities. The parking area is proposed to be maintained and minimal works/extensions are recommended at most** Permitted functions: Pedestrian circulation (walkways with permeable surfaces) to connect the parking lot to the bridge, and sidewalk/cycleway area related to the main street. Due to the location, the land contributes to the specific landscape of the locality - thus, ornamental species are recommended, especially in the areas related to the main street and the parking lot. In the rest of the area, dense planting of the land is proposed for the long-term security and remediation of pollution. Possibility of biomass plantations will be assessed according to local estimates for green waste/harvests. Related to the river course, on a width of 10m, it is recommended to plant: *Salix alba* and possibly *Salix viminalis* - approximately 0.4ha. Related to road traffic, we recommend: *Acer platanoides* (alignment) and % *Pinus nigra* (restricted groups in access areas and towards traffic routes). In the open areas (approximately 0.3 ha) we recommend 20% *Fraxinus excelsior*, 20% *Salix viminalis*,

30% Robinia pseudoacacia medium/low size ornamental vegetation – 30%: *Lavandula angustifolia, Hibiscus syriacus.*

Biomass potential - for local heating/energy systems

Option 1:

Considering the present existing functions, as well as those permitted, the area is not one that generates biomass in considerable quantities to support a chipping system.

In any case, the wood waste that could result from the maintenance and toileting works can be managed and used in a heating system that would ensure the capture in ash and biofilter of the heavy metals extracted from the soil (and not in other conventional forms such as be: open field burning, shredding and composting – which would basically just reallocate these heavy metals, without actually contributing to pollution reduction).

Option 2:

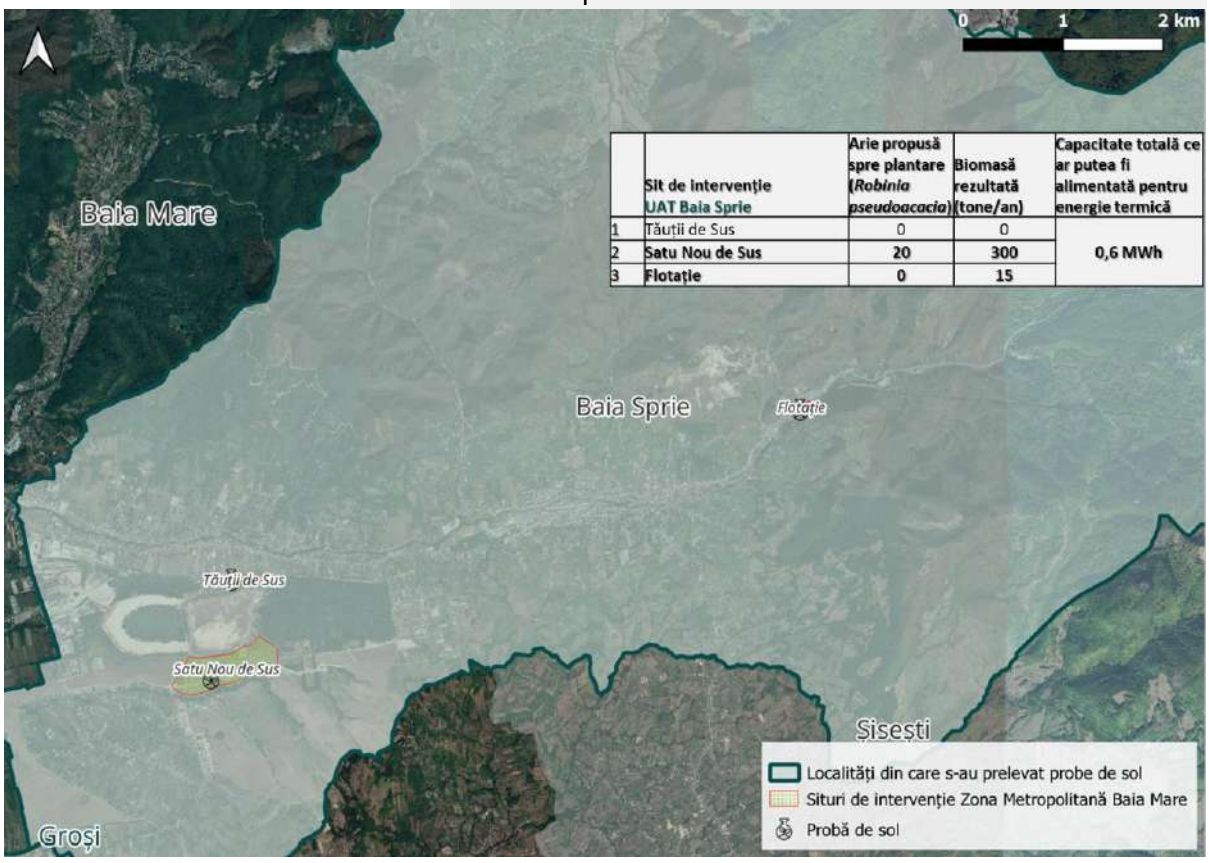
In the case of the evalTAUion of a possibility of biomass plantations (assessed according to local estimates for green waste/harvests), the result would be, for the indicated area, an annual amount of:

-4 tons of *Robinia pseudoacacia* biomass (from approx. 0.1 ha)

-11.25 tons of *Salix viminalis biomass* (from approx. 0.45 ha)

This amount could ensure the heating of an area of approximately **700 m2 for a period of 35-40 days (12 hours/day).**

The biomass potential that could result from the phytoremediation proposed for the intervention sites in ZMBM, TAU Baia Sprie.



	Sit de intervenție UAT Baia Sprie	Arie propusă spre plantare (*Robinia pseudoacacia*)	Biomasă rezultată (tone/an)	Capacitate totală ce ar putea fi alimentată pentru energie termică
1	Tăuții de Sus	0	0	0,6 MWh
2	Satu Nou de Sus	20	300	
3	Flotație	0	15	

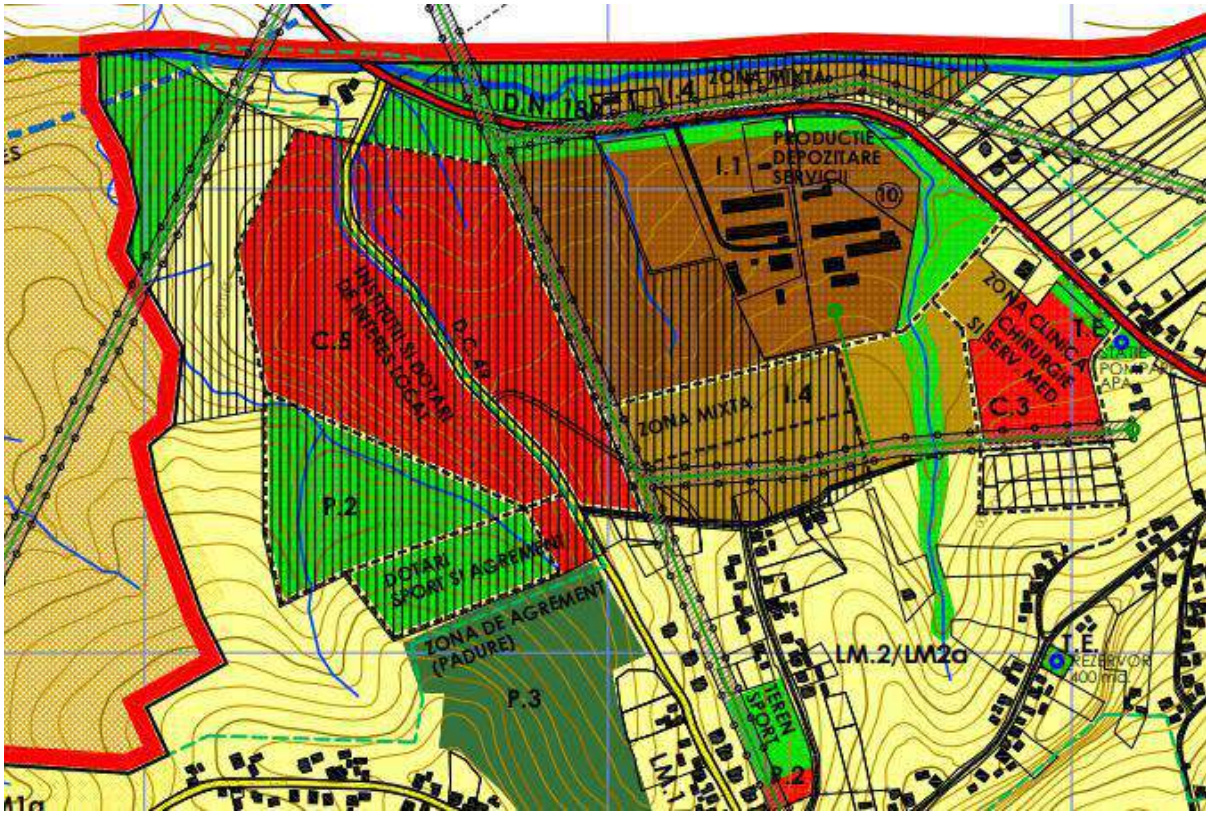
Table 5 – Pilot projects Groși, site Groși

GROȘI – SITE GROȘI

Surface: approx 13 ha

Estimated remediation period

Pb 59 ± 4 [11 yrs], Cd 10 ± 5 [20 yrs], Cu 0 [ok], Zn 37 ± 6 [ok].



Urban regulations

- According to PUG, it is located in the area of Public Institutions / Services of local interest. The land is prohibited from building until the development of urban planning documentation dedicated to PUZ/PUD. Thus, both dedicated projects and long-term strategic regulation proposals and measures are proposed (in the situation where new areas of local interest will be built/developed). The land is included in the urban area.

Land use

- No constructions.

Urban and local landscape considerations

- The land is crossed by the Main Road – Strada Principală. The land is bounded by grazing areas and areas regulated as Industrial Units / Storage to the east.

Environmental considerations

- Heavy pollution values exceed the alert thresholds for Pb and Cd.
- The secondary watercourse present in the western part of the site must be ecologically integrated into the proposed plantations.

Intervention proposal

Projects:

P1_Gr_F4. Green corridors (in relation to transport infrastructure) protective curtains and pedestrian areas.

The proposal is to create green corridors related to DN18B streets and Main Street (min 5m wide, recommended 10-15m) composed of: *Acer platanoides, Betula pendula, Fraxinus excelsior, Pinus nigra, Sorbus aucuparia* but also medium/low ornamental vegetation: Lavandula angustifolia. Total area: approx 0.5 ha.

P2_Gr_F5. Peripheral green corridor and strategic links with the natural environment + Plantations with the role of a protection zone.

The proposal is to create densely planted corridors related to the secondary water course (for the development of ecological green infrastructure) and buffer zones (15-30m) - planted areas within the boundaries of the land, especially related to the southern area: *Acer platanoides, Fraxinus excelsior, Salix white, Salix viminalis. Total area: about 0.3-0.5 ha.*

P3_Gr_F1. Phytoremedial forests / Major planting actions that can later be integrated into PUG extensions.

Dense plantations are proposed with areas of 30-50% of the total area (4-6ha, with a potential role of providing biomass) - fast-growing and affordable species (in the event of the decision to build in the future): Salix alba, Salix viminalis, but also species that support biodiversity: Sorbus acuparia, Mischanthus giganteus.

Local regulation proposals and long-term strategic measures:

P4_Gr_R4. Specific Green Infrastructure for the Public Institutions and Services Area

It is recommended that future developments contain a high percentage of planted green spaces, which mostly maintain pre-planted vegetation. In the sitTAUion where no planting is done beforehand, it is recommended to keep the requirements of green corridors and use species capable of phytoremediation (Cd, Pb) in the future planted spaces.

Biomass potential - for local heating/energy systems

Option 1:

The situation in the field is favourable for the establishment of green corridors of Robinia pseudoacacia, because locally one can observe a row started, on one side and the other of Main str. (an intention in this direction):

At the same time, there is also a storage of construction materials (both construction waste and materials such as sand and gravel). According to data provided by Google Earth, the sitTAUion in 2021-2022 is as follows:

As previously specified in this study, a strip with a width of at least 5 meters wide is recommended, with the role of protection and green corridor, continued by an exploitation area for the exploitation of

biomass. Green corridor, with a protective role: Robinia pseudoacacia (would continue the plantation already started)
Harvesting area: Salix viminalis (it would be better because the area is one with temporary streams, which maintain a high relative humidity of the soil – *To be nored: a survey of the land is recommended before starting any planting work in the area)*

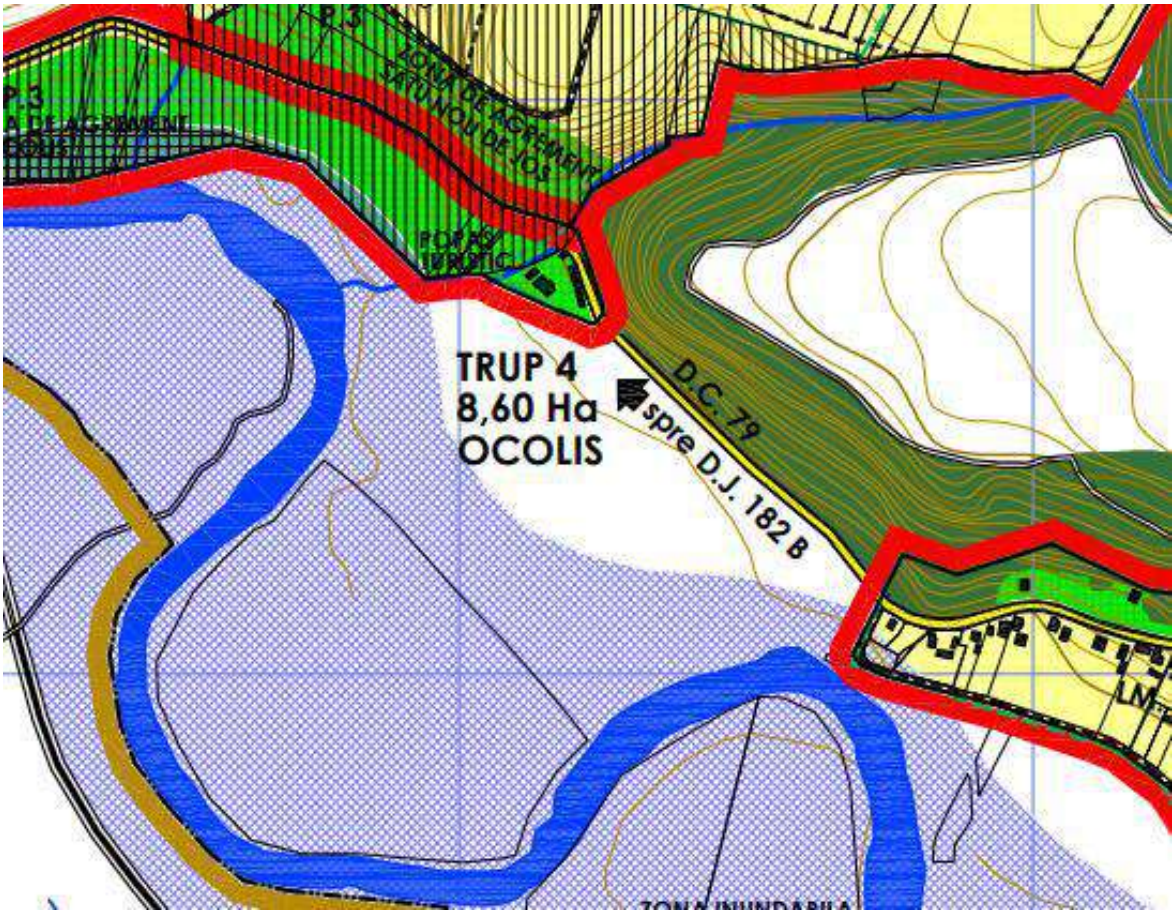
Approximate plantation investment cost:
Robinia pseudoacacia – 2000 eur
Salix viminalis – 23400 eur

Surface 11,7 ha	Worst case scenario	Best case scenario
Cost YEAR I euro	25740	19890
Cost YEAR II euro	3510	
Total maintenance cost (eur/2 years)	3510	
Harvest (t/2 years, humidity 0%)	468	585
Price/mincing (eur/ton)	40	
Total Income	18720	23400
Total profit (eur/2 years)	15210	19890
Investment 2024-2025	29250	23400
Profit 2026-2027	15210	19890
Profit 2028-2029	15210	19890
Profit and amortization of investment 2028	**1170**	**16380**
Profit 2030-2031	15210	19890

According to the investment and cost amortization calculations, exemplified above, it follows that in 2028 the willow plantation would turn a profit and, at the same time, cover the investment cost for *Salix viminalis as well as over 50% of the investment cost for Robinia pseudoacacia.*

Table 6 – Pilot projects Groşi, Ocoliş

GROŞI - OCOLIŞ
Surface: approx 9 ha Estimated remediation period: Pb 100 ± 5 [16 yrs], Cd 8 ± 6 [19 yrs], Cu 75 ± 10 [16,5 yrs], Zn 277 ± 11 [6,5 yrs].



Urban regulations

- According to the PUG, the land is located outside the urban area, with agricultural land use.

Current land use

- The land is not occupied by constructions or developments - it is currently used for agriculture.
- The land is composed of several lots, according to the ANCPI Geoportal - eterra real estate.

Urban and local landscape considerations

- The land is bounded by forest area to the north, residential area to the east, and bordered by the blue green corridor.
- The land is adjacent to a locally imported link – there is potential for the development of pedestrian/bicycle paths – a green mobility corridor connecting the bodies/villages of Ocoliș and Satu Nou de Jos village.

Environmental considerations

- Heavy metal pollution values exceeded the alert thresholds for Pb, Cd.
- Considering the location – the land has the potential to strengthen the natural green system (being bounded by the water course).

Proposal

Considering the uncertainty of the property regime (being multiple lots), 2 intervention options are proposed (they can be implemented together).

Project – Option 1:

P5_Gr_F1. Phytoremedial forests / Major planting actions.

It is necessary to identify the property regime. The proposed interventions are considered for both scenarios: (i) the lands are owned by the municipality or managed by the municipality; (ii) the lands are privately owned with agricultural utility - thus a public-private collaboration can be created to plant energy willow (Salix viminalis) with the aim of providing biomass for heating/energy systems at the local level.

Project - Option 2 (can be implemented together with Option 1):

P6_Gr_F4. Green corridors (in relation to transport infrastructure).

Green mobility corridor related to the DC79 circulation path. Alignment vegetation is recommended, and a buffer zone in the agricultural land area of minimum size 10m (approximate area 0.35 ha). For tall vegetation, we recommend: *Acer platanoides, Betula pendula, Fraxinus excelsior.* For medium-low vegetation, we recommend: *Mischanthus giganteus.* Valuable existing vegetation will be preserved

Local regulation proposals and long-term strategic measures:

P7_Gr_R7. Harvest restrictions

In the situation where there are no resources for the implementation of the Phytoremediation Forests project, it is recommended that potential economic actors be restricted to the cultivation of plants for biomass production (SPIRE plant selection).

Biomass potential - for local heating/energy systems

The creation of a public-private collaboration with the main objective of decontamination of agricultural land in the area, through the exploitation of agricultural land and the harvesting of energy willow

Collaboration would involve:

1. Encouraging farmers to join an associative form by:
   providing expertise to access funds for agricultural exploitation
   promoting the practices of exploitation of energy plantations and commercialization of biomass
   the adoption of measures to discourage agricultural exploitation of land for food crops
2. Establishment and delimitation of a permanent storage area for willow wood shavings
3. Construction of a channelized storage platform or to ensure the drainage of rainwater
4. Establishing a storage and exploitation plan for the resulting shredding

Note: At the northern limit of the demarcated land there is a tourist complex type construction. The partnership could also involve the construction of a biomass warehouse in its vicinity, with the possibility of direct exploitation of the wood chips to obtain thermal energy within the business.

Surface 9 ha	Worst case scenario	Best case scenario
Cost year i (euro)	19800	15300
Cost year ii (euro)	2700	
Total maintenance cost (eur/2 years)	2700	
Harvest (t/2 years, humidity 0%)	360	450
Price/chop (euro/tonne)	40	
Total revenue (euro)	14400	18000
Total profit (euro/2 years)	11700	15300
Investment 2024-2025	22500	18000
Profit 2026-2027	11700	15300
Profit 2028-2029	11700	15300
Investment amortization 2028	900	12600
Profit 2030-2031	11700	15300

The average annual production per hectare is 20-25 tons at the theoretical humidity of 0% (33-42 tons at the natural humidity of about 40%), with the observance of culture technologies and ensuring the optimal conditions for this species.



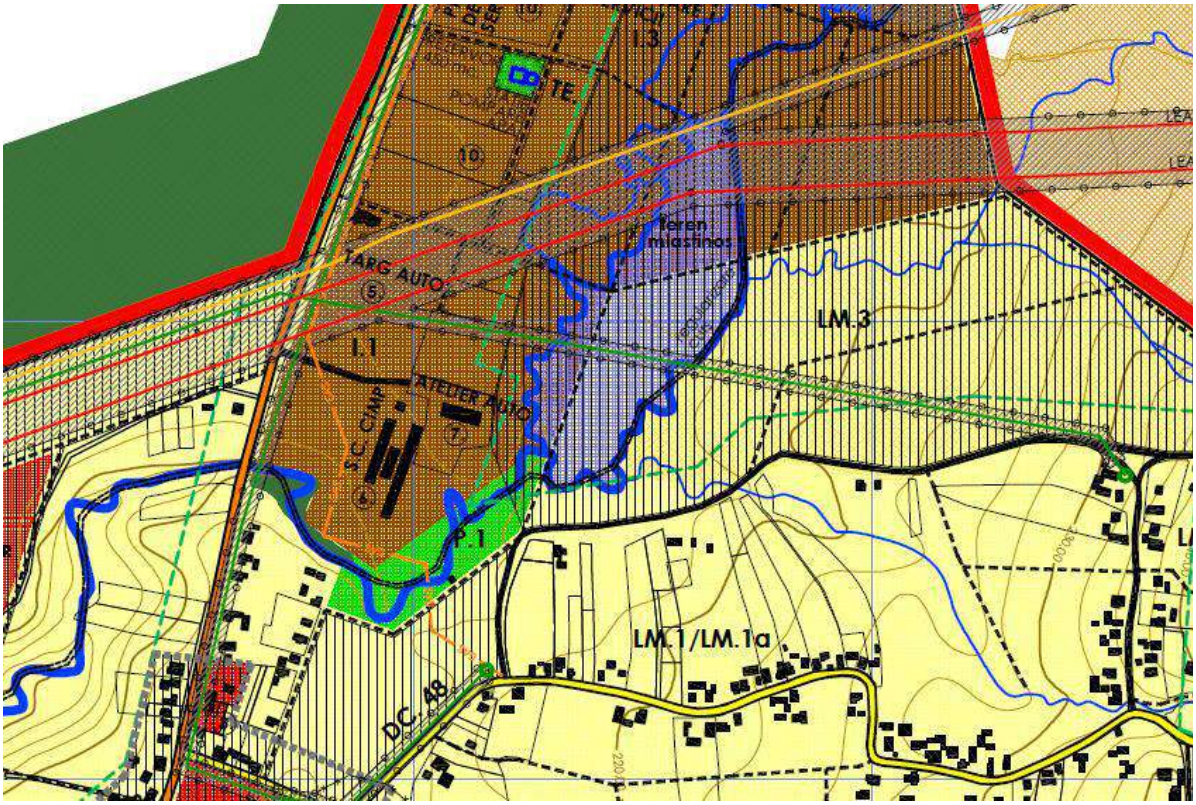
Table 7 – Pilot project Groși, Satu Nou de Jos

GROȘI - SATU NOU DE JOS

Surface: approx 40 ha

Estimated remediation period:

Pb 148 ± 6 [19 yrs], Cd 10 ± 6 [20,5 yrs], Cu 74 ± 10 [16,5 yrs], Zn 80 ± 7 [ok].



Urban regulations	The soil sample is located in the Industrial Units Zone, in the vicinity of the Protection Zone against Constructions and Technical Color - Power Stations, Power Stations, High Voltage Lines, Gas Networks, Telecommunications Networks. The land is considered a complex area, new developments being regulated: Housing and complementary functions, the expansion of the Industrial Area/Storage and the creation of new Planted Spaces (P.1). The land is located in the urban area, regulated as a Temporary Construction Prohibition (being a marshy area).
Current land use	Free land located on the outskirts of the town, strong natural area.
Urban and local landscape considerations	The land presents valuable natural landscape elements. Considering the proximity of the Residential area to the Industrial/Storage area, it is necessary to build a N-S green protection area (which also includes the area regulated as Planted Space – P.1). In the Northern area there is a waste collection platform (considered a source of pollution).
Environmental considerations	Heavy metal pollution values exceed the alert threshold for Pb, Cd and the intervention threshold for Cu. The area is crossed by watercourses, un-stabilized, and without major vegetation.
Proposal	!!! For interventions in these natural/marsh areas, it is recommended to develop specific environmental studies. **Projects:** **P8_Gr_F3. Plantations with a protective role (buffer zones or green belts) - adjacent to the industrial zone** The land regulated as Planted Areas is also included. Strip of vegetation min 5m wide, surface 0.4-0.8ha. **P9_Gr_F3. Plantations with a protective role (buffer zones or green belts) – Restored green-blue corridors (E-V).** With an ecological role (biodiversity), but also with a protective role – creating successive protective curtains (protecting the living area from pollution from the external environment in the northern area). Min. 10m wide, 1ha surface. **P10_Gr_F7. Local plantations and conversion of neglected land – Ecological planted space with a community role in the Planted Spaces area (P.1).** If the land presents a level of contamination similar to the Satu Nou de Sus soil sample, remedial options will be evaluated, modelled on the SPIRE pilot lands. It is recommended to create phytoremediation plantations, along with pedestrian walkways and access roads. Approximate area - 3ha. **Local regulation proposals and long-term strategic measures:** **P11_Gr_R3. Specific Green Infrastructure for new residential developments (single family houses).** It is recommended that new developments contain a high percentage of green space (30%). The use of species capable of phytoremediation of Pb, Cd, Cu is proposed: *Salix viminalis, Salix alba, Fraxinus excelsior, Lavandula angustifolia, Miscanthus*

Biomass potential - for local heating/energy systems

The area has the Satu Nou de Jos Landfill located at the northern limit. This would represent an advantage for the eventual setting up of a branch collection area in the vicinity - considering that waste collection machines already have established routes from the city of Baia Mare towards this area. The suggested arrangement would achieve:

(i) A protection zone;

(ii) An exploitation area;

(iii) A branch storage area; The branch storage area was chosen in such a way that the access with the branch transport equipment is as easy as possible. Consideration should also be given to fencing off the area with a mesh fence (around 550 meter perimeter) and monitoring the area.

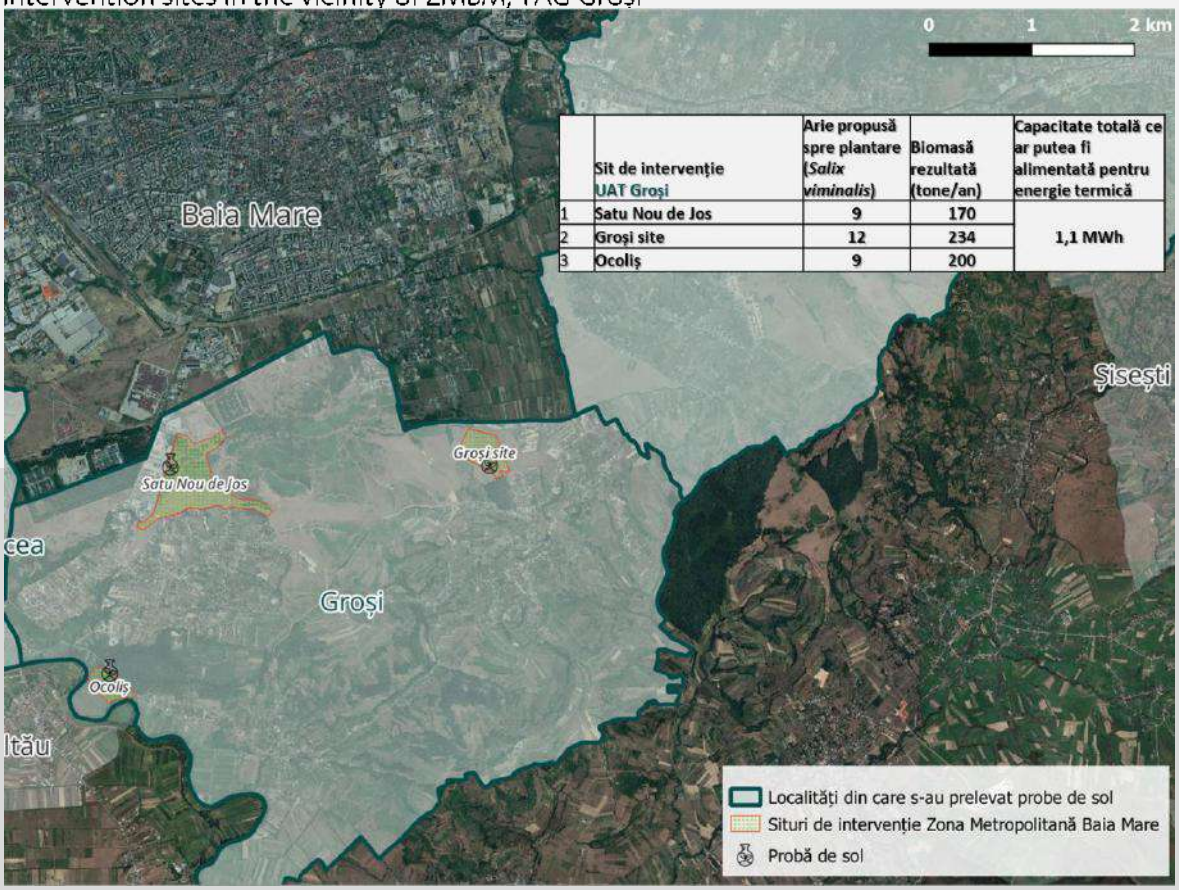
(iv) Branch transport routes. *Salix viminalis* is proposed for planting to also target exploitation for production of thermal energy as a result of the marshy specifics of the area, which favours higher soil moisture.

Environmental studies are recommended for any interventions in the area, essential to protect the soil and biodiversity in the area

Willow harvesting involves:

Surface 8,5 ha	Worst case scenario	Best case scenario
Cost year I euro	18700	14450
Cost year II euro		2550
Total maintenance cost (eur/2 years)		2550
Harvest (t/2 years, humidity 0%)	340	425
Price/mincing (eur/ton)		40
Total Income	13600	17000
Total profit (eur/2 years)	11050	14450
Investment 2024-2025	21250	17000
Profit 2026-2027	11050	14450
Profit 2028-2029	11050	14450
Investment amortization 2028	**850**	**11900**
Profit 2030-2031	11050	14450

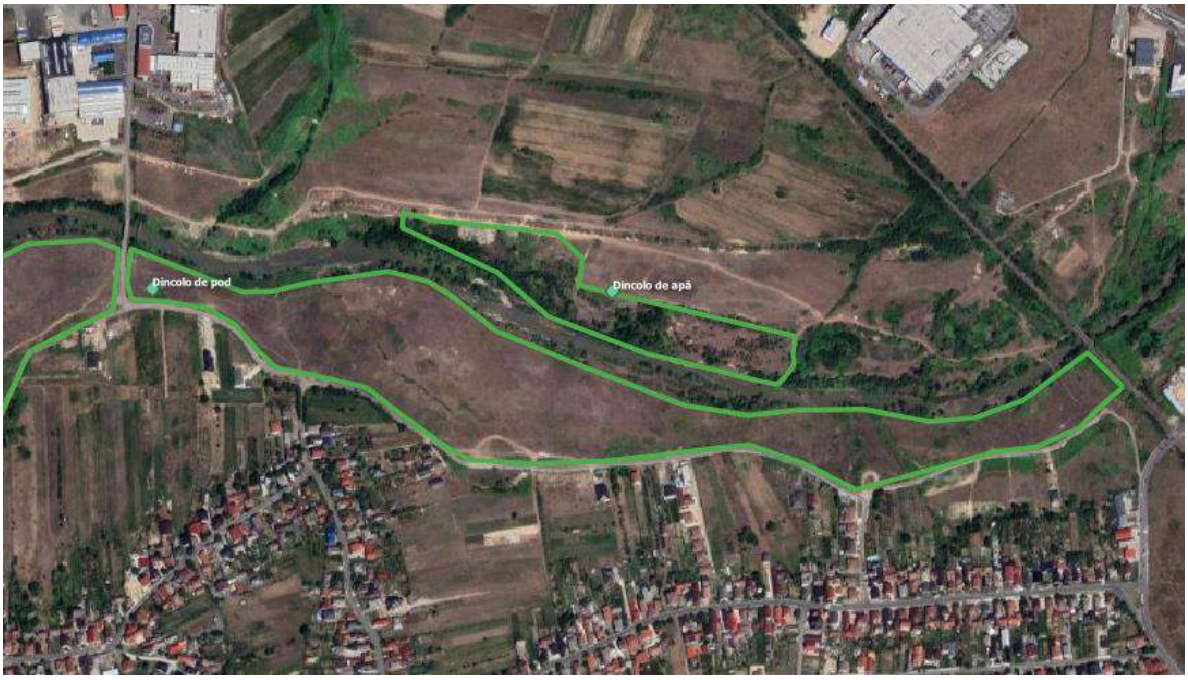
The biomass potential that could result from the phytoremediation proposed for the intervention sites in the vicinity of ZMBM, TAU Groși

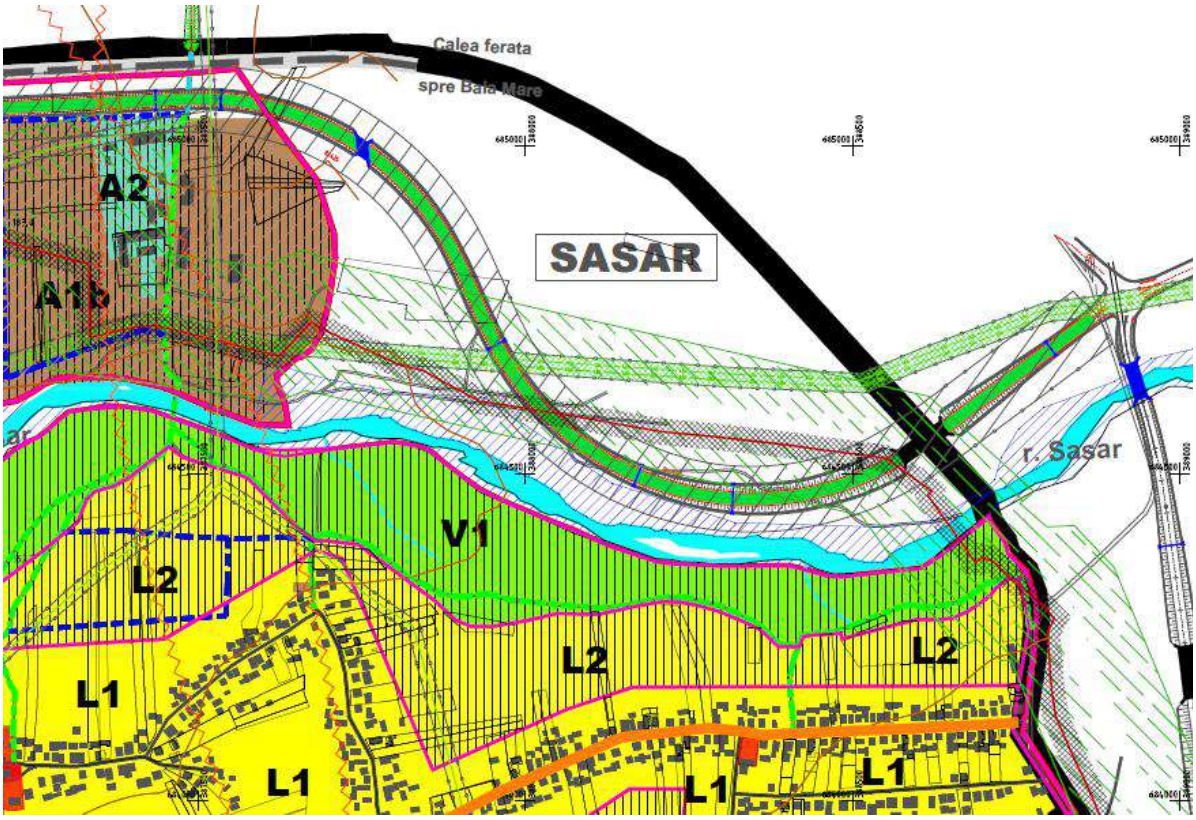


	Sit de intervenție UAT Groși	Arie propusă spre plantare (*Salix viminalis*)	Biomasă rezultată (tone/an)	Capacitate totală ce ar putea fi alimentată pentru energie termică
1	Satu Nou de Jos	9	170	1,1 MWh
2	Groși site	12	234	
3	Ocoliș	9	200	

Table 8 – Pilot projects Recea, Beyond the water and Beyond the bridge

RECEA – Beyond the water and Beyond the bridge
Surface Beyond the water: approx 3ha
Estimated remediation period:
Pb 1429 ± 24 [36 yrs], Cd 9 ± 7 [20 yrs], Cu 281 ± 16 [34 yrs], Zn 268 ± 13 [6 yrs].
Surface Beyond the bridge: approx 12ha
Estimated remediation period:
Pb 40 ± 5 [7 yrs], Cd 12 ± 6 [23 yrs Cu 0 [ok], Zn 74 ± 7 [ok].





Urban regulations

Two lands related to the river course were identified: Beyond the water - being located N of the Săsar river, and Beyond the bridge to the S of the river.

- Beyond the water: located in the vicinity of the proposed expressway, without use - located in the suburbs. The area is considered at risk of flooding.
- Beyond the bridge: the land is regulated as a Land Area with Potential for Park Development, Leisure and compatible Constructions (sport-tourism facilities, culture, health, commerce, public food). The land has a construction ban until the development of the PUZ/PUD.

Current land use

- Both lands are devoid of any kind of construction or development (except for some dirt roads).

Urban and local landscape considerations

- Both lands work together from an ecological point of view - a natural corridor, which requires measures to improve the quality of the vegetation.
- The southern land Beyond the bridge presents a strategic position regarding the residential area. Considering the level of pollution, measures can be considered to transform the site with a multifunctional character: ecological, area with a protective role, and "ecological" public green space

Environmental considerations

- The land Beyond the water presents pollution above the alert threshold for Pb, Cd, Cu, and above the intervention threshold for Zn. The Land Beyond the Bridge presents pollution above the alert threshold for Cd, and above the alert threshold for Pb.
- The lands require restoration, especially the Southern part.

Intervention proposal

Project:

P1_Re_F2. Regeneration/rehabilitation of green-blue corridors: Green corridor on the banks of Săsar river

Restoration of the ecological corridor - plantings (permanent - without deforestation) are proposed, in addition to the existing vegetation. Recommended for tall vegetation: *Fraxinus excelsior, Salix viminalis, Salix alba*. The measure is applicable for both lands - planting area 20-30m from water. Total area – approximately 3.6ha

Local regulation proposals and long-term strategic measures:

P2_Re_R1. Requirements for green spaces Natural recreation area.

The land can support leisure/leisure activities. It is important to secure the land - planting species capable of retaining heavy metal pollution. An ecological layout is proposed - with natural ambience, which may contain pedestrian/bicycle paths and small community interaction areas: rest spaces, nature observation spaces, meadow areas. It is NOT recommended to create a public space planted with the character of a public park/garden, until the land is completely pollution free.

Biomass potential - for local heating/energy systems

In this case, it is recommended to extend the green corridor on both banks of the Săsar river, with the extension on the left bank of a potential exploitation area of *Salix viminalis*

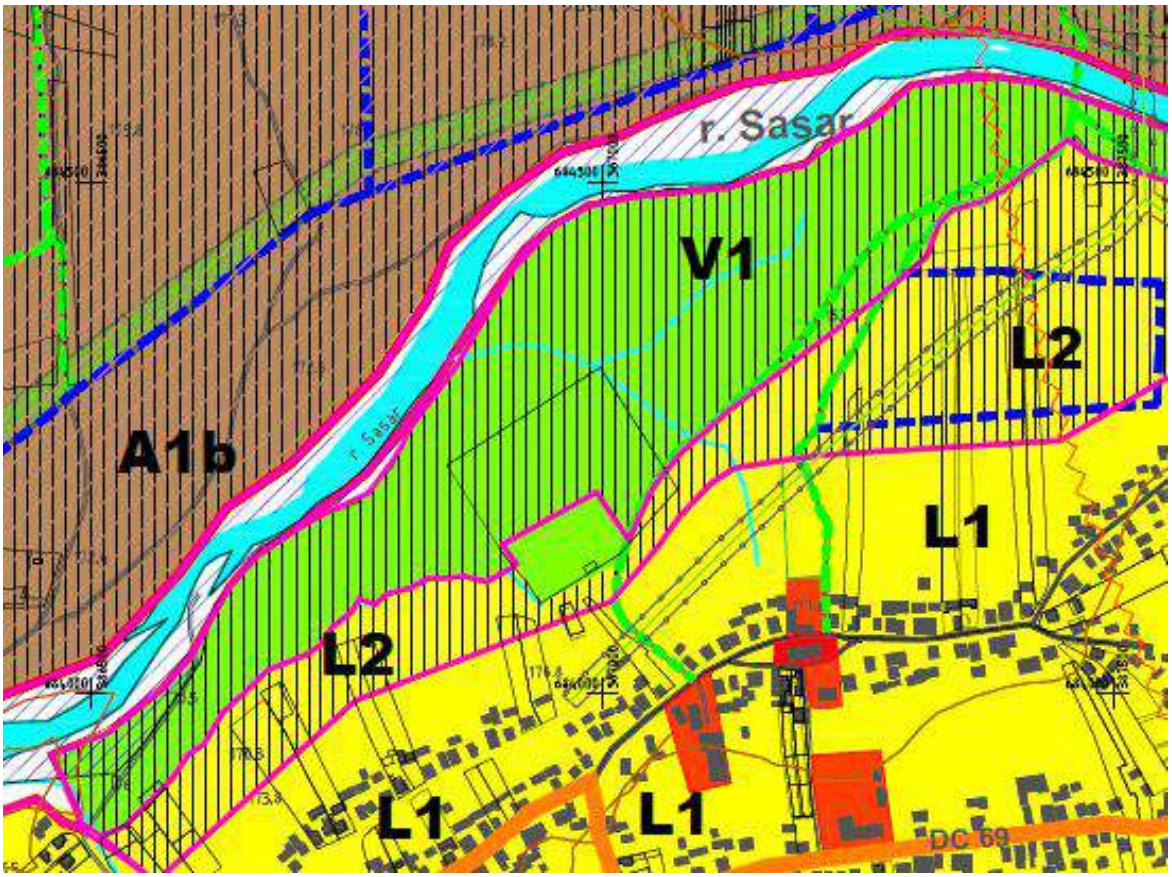
Harvesting willow involves:

Surface 9 ha	Worst case scenario	Best case scenario
Cost year I euro	19800	15300
Cost year II euro	2700	
Total maintenance cost (eur/2 years)	2700	
Harvest (t/2 years, humidity 0%)	360	450
Price/mincing (eur/ton) 40	40	
Total Income	14400	18000
Total profit (eur/2 years)	11700	15300
Investment 2024-2025	22500	18000
Profit 2026-2027	11700	15300
Profit 2028-2029	11700	15300
Investment amortization 2028	**900**	**12600**
Profit 2030-2031	11700	15300

An advantage of this willow plantation is its proximity to the Baia Mare Wastewater Treatment Plant (approximately 2 km). This could ensure a flow of sludge from the station to the plantation. Sludge is considered a fertilizer that stimulates the plantation, while willow is considered a filter that helps purify it and establish it in the soil:

Table 9 – Pilot project Recea, Football field

RECEA – Football field
Surface: approx 18ha
Estimated remediation period
Pb 483 ± 13 [27 yrs], Cd 10 ± 7 [20,5 yrs], Cu 277 ± 15 [33 yrs], Zn 1250 ± 20 [22 yrs].



Urban regulations	• The land is regulated as Lands with Potential for Park Development, Leisure, Compatible Constructions.
Current land use	• The field has only one layout – a football field. There is an access road, dirt road. The land is free of tall vegetation and other constructions/developments
Urban and local landscape considerations	• The land is constituted as a possible green area with a role of protection and interest for the locality, being a functional area that separates the residential area from the area regulated as Non-Polluting Productive Activities Zone. • The land represents a valuable resource to build an ecological, planted area with a potential role for leisure and socializing.
Environmental considerations	• The land shows pollution above the alert threshold for Pb, Cd, Cu, Zn. • The development of heavy-use social and recreational activities is recommended after remediation of pollution to lower thresholds.

Photo: USAMV (Anca Plian)

Intervention proposal

Projects:

P3_Re_F2. Regeneration/rehabilitation of the green-blue corridors related to the Săsar river

It is recommended to plant a green corridor related to the river bank, on a minimum width of 15m, with species adapted to wet areas: *Salix alba, Salix viminalis* (approximately 1.7-2ha), together with other plant species to support biodiversity *(Robinia pseudoacacia, Mischanthus giganteus, Lavender angustifolia).*

P4_Re_F1. Phytoremediation forests / Major planting actions with the preservation of some meadow areas for future leisure/recreational functions

Dense planting of approximately 10ha with species capable of phytoremediation for the 4 heavy metals and fast growing is recommended *(30% Salix viminalis, 15% Acer platanoides, 15% Betula pendula, 15% Pinus Nigra, 10% Mischanthus giganteus, 15% other species* of trees and shrubs with a chromatic/ornamental role from the SPIRE plant list).

Similar to the SPIRE Baia Mare pilot lands, it is recommended to create pedestrian and bicycle paths and paths (as permeable surfaces, areas of earth, gravel or green tiles). It is recommended to keep a system of unplanted areas, where natural meadows can be developed (with the role of accommodating occasional community activities) and which can accommodate future recreational and leisure facilities (when the pollution level presents a low threshold).

Biomass potential - for local heating/energy systems

Considering the potential of the area with a role of leisure and socialization, the planted area proposed for exploitation is a smaller one (*30% Salix viminalis*) and has as its main role the extraction of heavy metals from the soil, optionally imposing a possible exploitation).

If it is decided to exploit the approximately 5.4 ha of Salix, this would entail:

Surface 5,4 ha	Worst case scenario	Best case scenario
Cost year I euro	11880	9180
Cost year II euro	1620	
Total maintenance cost (eur/2 years)	1620	
Harvest (t/2 years, humidity 0%)	216	270
Price/mincing (eur/ton)	40	
Total Income	8640	10800
Total profit (eur/2 years)	7020	9180
investment 2024-2025	13500	10800
Profit 2026-2027	7020	9180
Profit 2028-2029	7020	9180
Investment amortization 2028	**540**	**7560**
Profit 2030-2031	7020	9180

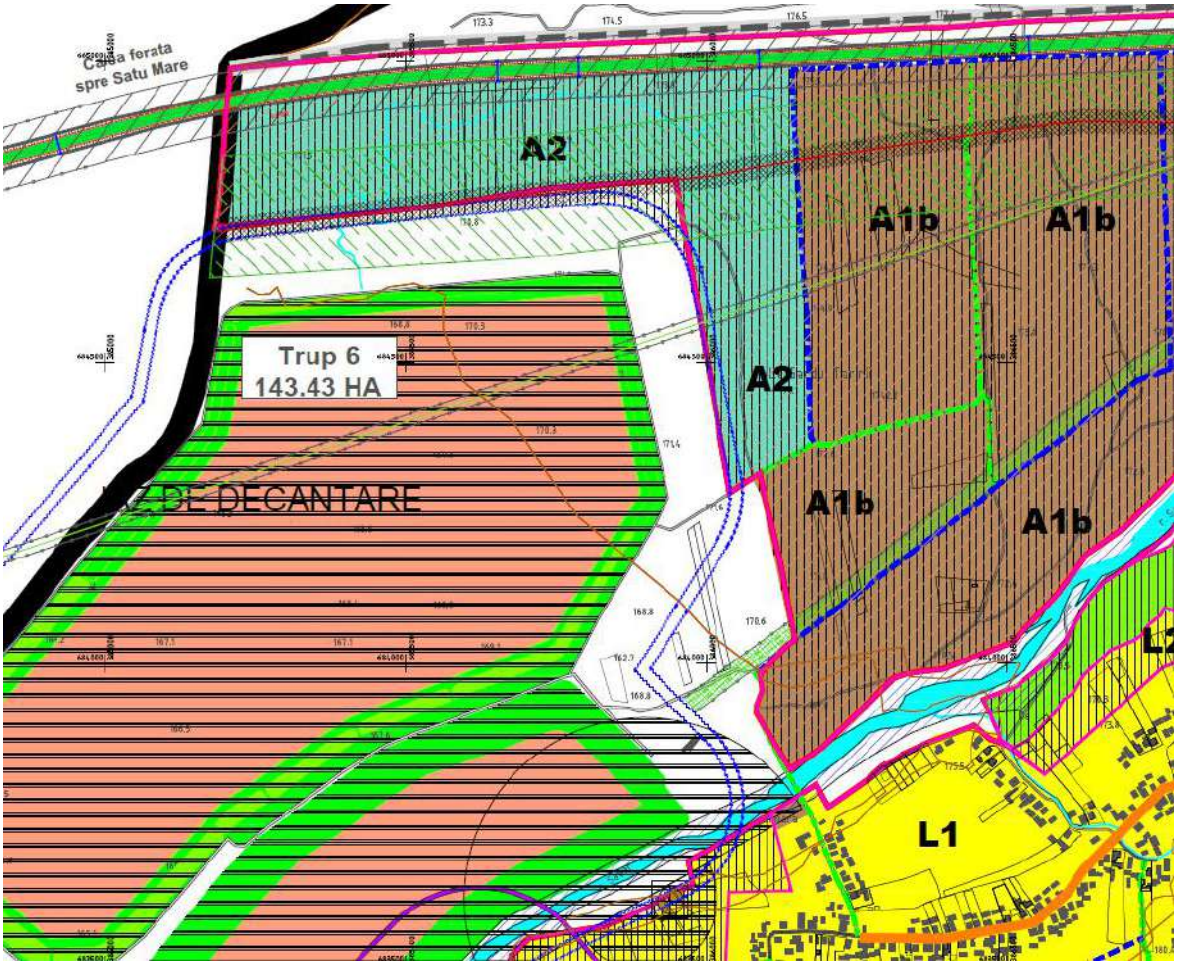
Table 10 – Pilor projects Recea, Săsăr pasture and pond

RECEA - SĂSAR PASTURE AND POND

Area: approx 30ha

Estimated remediation period:

Pb 217 ± 9 [22 yrs Cd 10 ± 7 [20,5 yrs], Cu 64 ± 10 [14,5 yrs], Zn 170 ± 10 [3,5 yrs].



Urban regulations

- The land is located in the vicinity of the settling pond, and related to the protection zone designated in the PUG.
- The land located outside the protection zone related to the settling pond is regulated as an Agricultural Units Zone.

Current land use

- The land is voided of developments or constructions. Agricultural cultivation with edible products is not recommended, given the level of pollution present and the proximity to the tailings pond. Agricultural crops for biomass production are allowed (to feed local heating systems).

Urban and local landscape considerations

- The land is relatively detached from the functional areas. It is considered optimal to continue the forest area in the N, and to create a dense protection zone around the settling pond.

Environmental considerations

- The pollution values exceed the alert thresholds for Pb and Cd, and the intervention thresholds for Cu, Zn.
- The presence of former watercourses can be seen. It is recommended to preserve the morphology of the land together with the creation of channels (starting from these meanders) to retain rainwater, facilitating the growth of willow areas.
- The land has the potential to turn into a green protection zone, but also with a biomass production role.

Intervention proposal

Projects:

P5_Re_F5. Peripheral green corridor and strategic links with the natural environment plantations as a protection zone.

Dense planting of tall trees is recommended in the protection zone, and towards the existing forest area (approximately 4.5-5ha): *30% Acer platanoides, 30% Pinus nigra, 30% Fraxinus excelsior, 10% other plant species with biodiversity role (from SPIRE plant selection)*

P6_Re_F1. Phytoremedial forests / Major planting actions with the role of protection zone and biomass production.

It is recommended that the remaining 25 ha be transformed into a phytoremediation forest, with the role of biomass production *(Salix viminalis, Betula pendula, Robinia pseudoacacia)*

Local regulation proposals and long-term strategic measures:

P7_Re_R7. Cultivation restrictions.

In the situation where there are no resources for the implementation of the Phytoremediation Forests project, it is recommended that potential economic actors be restricted to the cultivation of plants for biomass production (SPIRE plant selection).

Biomass potential - for local heating/energy systems

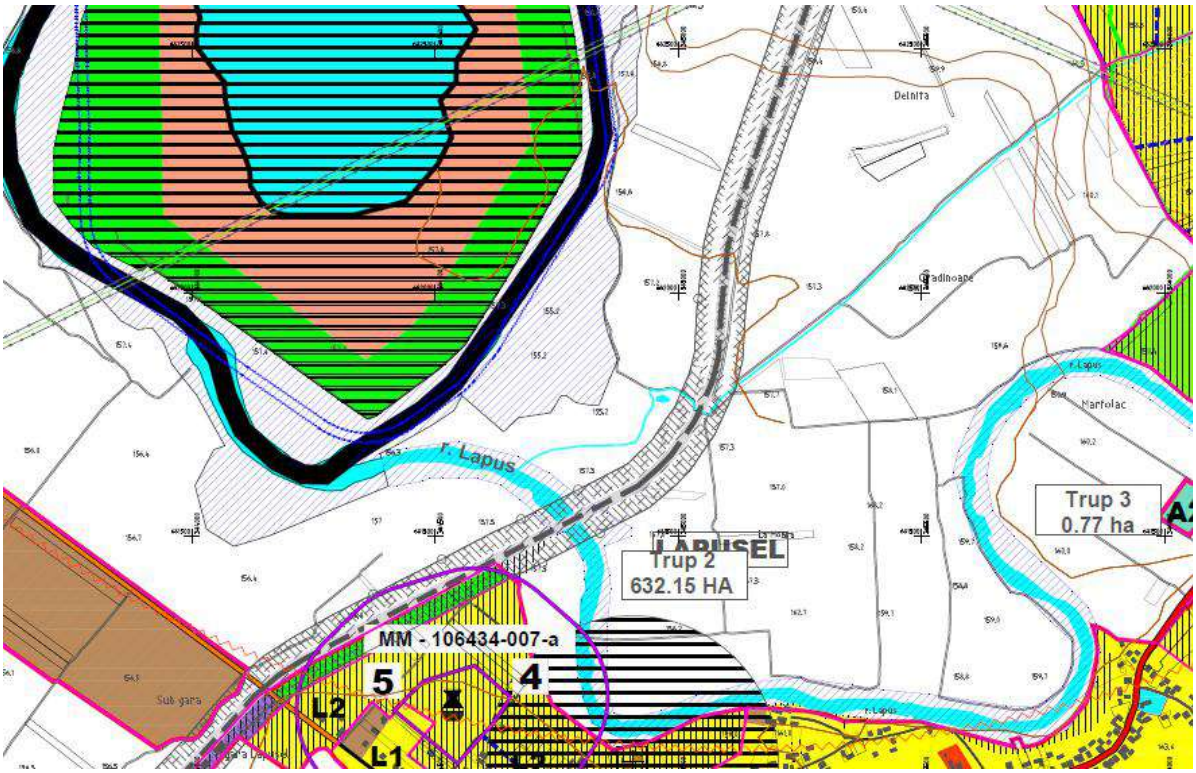
Option 1: For the 25ha area proposed to be used for biomass exploitation, the investment would involve:

Surface 25 ha	Worst case scenario	Best case scenario
Cost year I euro	55000	42500
Cost year II euro	7500	
Total maintenance cost (eur/2 years)	7500	
Harvest (t/2 years, humidity 0%) m	1000	1250
Price/mincing (eur/ton)	40	
Total Income	40000	50000
Total profit (eur/2 years)	32500	42500
Investment 2024-2025	**62500**	**50000**
Profit 2026-2027	32500	42500
Profit 2028-2029	32500	42500
Investment amortization 2028	2500	35000
Profit 2030-2031	32500	42500

Option 2: Expansion of the plantation around the tailing pond can also be considered. Thus, stopping the pollution caused by the movement of suspended dust that increases the possibility of dispersal of heavy metals towards human settlements would be increased:

Table 11 – Pilot projects Recea, Săsar Sands 1 și Săsar Sands 2

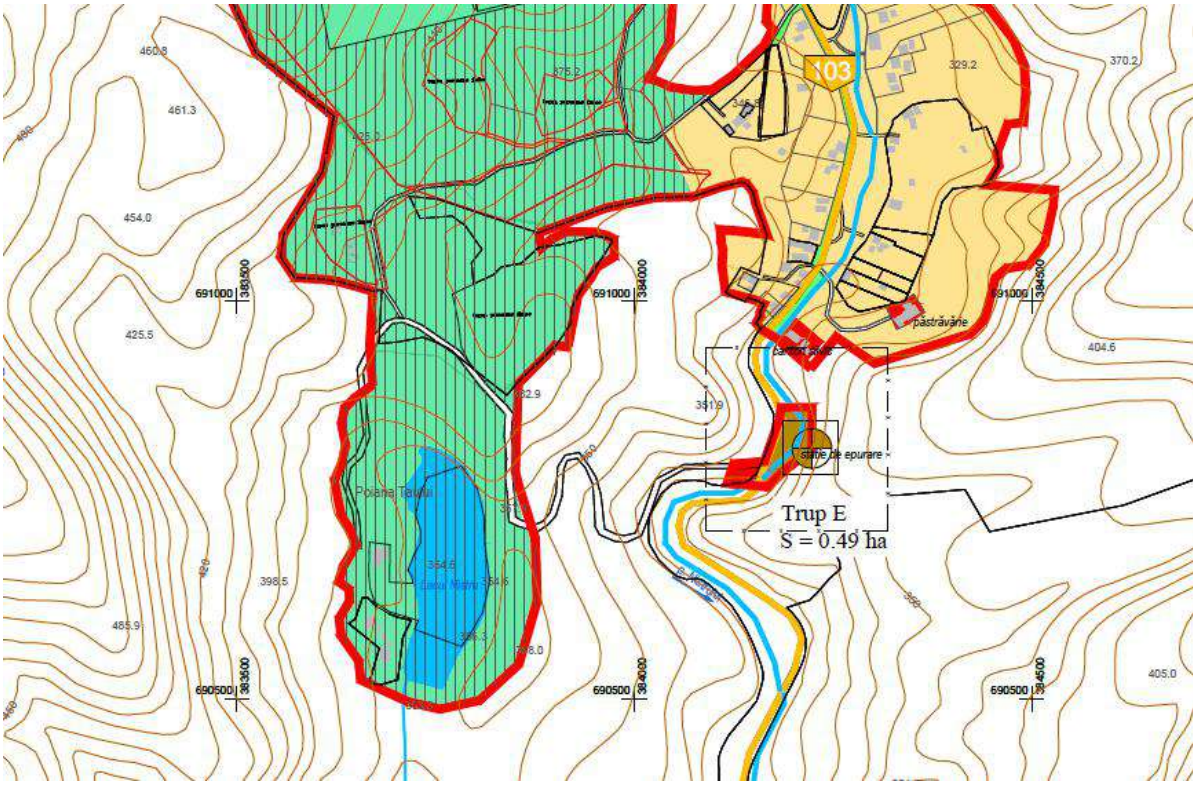
RECEA - SĂSAR SANDS 1 SI SĂSAR SANDS 2
Surface: approx 11ha
Sands 1
Estimated remediation period:
Pb 593 ± 17 [29 yrs], Cd 7 ± 7 [18,5 yrs], Cu 266 ± 14 [32 yrs], Zn 386 ± 14 [8,5 yrs].
Sands 2
Estimated remediation period:
Pb 753 ± 19 [30 yrs], Cd 10 ± 7 [20,5 yrs], Cu 289 ± 16 [34 yrs], Zn 766 ± 17 [14 yrs].



Urban regulations	• The land has no uses or functional areas of any kind. • The land is considered as an area at risk of flooding.
Current land use	• The land has no facilities or functions, and is relatively difficult to access (no direct access roads).
Urban and local landscape considerations	• The land is relatively isolated from the functional areas, delimiting the eastern shore of the settling pond and agricultural land. • The land has the potential of a protection zone, which can improve the environmental conditions for the locality's agricultural areas and residential areas.
Environmental considerations	• Heavy metal pollution values exceed alert thresholds for Pb, Cd, Cu, Zn. • The planting of the area is considered optimal, both from the point of view of pollution and environmental conditions, and for reducing the impact of possible floods in the area. • The land can be constituted both as a protection zone and as an ecological zone, making relevant connections with the water course and related vegetation areas, facilitating the creation of a more resilient natural green system.
Proposal	**Project - Option 1:** **P8_Re_F1. Phytoremedial forests / Major planting actions with the role of protection zone.** It is recommended to plant species adapted to wet areas, capable of phytoremediation for all 4 identified heavy metals: Salix alba, Salix viminalis. No landscaping or use of the area for recreational activities is recommended. **Project - Option 2:** **P9_Re_F2. Regeneration/rehabilitation of green-blue corridors + Plantations with a protective role (green buffer zones or green belts) - related to the settling pond.** It is recommended to create a protective green curtain of at least 20m wide on the eastern bank of the Săsar river, with the role of restoring the ecological area, and creating a protective barrier against pollution that can be carried by the wind towards the locality. It is recommended to plant *Salix alba, Salix viminalis* - approximate area of the corridor 2ha
Biomass potential - for local heating/energy systems	It is not recommended to exploit plantations that may be established in the protection zone.

Table 12 – Pilot projects Tăuții Măgherăuș, Nistru

TĂUȚII MĂGHERĂUȘ - NISTRU
Surface: approx 4ha
Estimated remediation period:
Pb 67 ± 5 [12 yrs], Cd 11 ± 6 [22 yrs], Cu 0 [ok], Zn 83 ± 8 [ok].



Urban regulations	• The area is part of a natural landscape area, forest, being regulated as a Leisure and Tourism Area
Current land use	• The land has an accommodation and camping area. • The meadow may have occasional plantings, but it is necessary that the recreational meadow function be preserved.
Urban and local landscape considerations	• The area has landscape value for leisure and recreational activities. • Future interventions for phytoremediation must take into account the preservation of the natural character, and not affect the panoramic or observation areas, towards the lake or towards the edge of the forest. • It is proposed to create a landscaping plan, which includes species capable of phytoremediation for the identified pollution, and which ensures the preservation of the functionality of the meadow and the perspectives and the specific natural image.
Environmental considerations	• The pollution values exceed the alert thresholds for Pb and Cd. It is considered appropriate to remedy the pollution through local plantations (clumps of vegetation that do not change the function and landscape value of the meadow).
Intervention proposal	**Project:** **P1_TM_F8. Local plantations and the transformation of neglected lands: planting clumps of vegetation with a phytoremedial role.** It is recommended to carry out small local plantings, so that the natural local landscape is not affected, the meadow function is preserved, and the interventions contribute to the local ambience. It is recommended to create 3-5 areas of mixed vegetation, with an organic shape, with a maximum size of 1000 sqm (total planted areas being min. 3000 sqm and maximum 5000 sqm). A diverse mix of species is recommended: *Sorbus acuparia, Fraxinus excelsior, Acer platanoides, Mischanthus giganteus, Berberis thunbergii.*
Biomass potential - for local heating/energy systems	Exploitation of established plantations is not recommended.  Source: USAMV (Anca Pleșa)

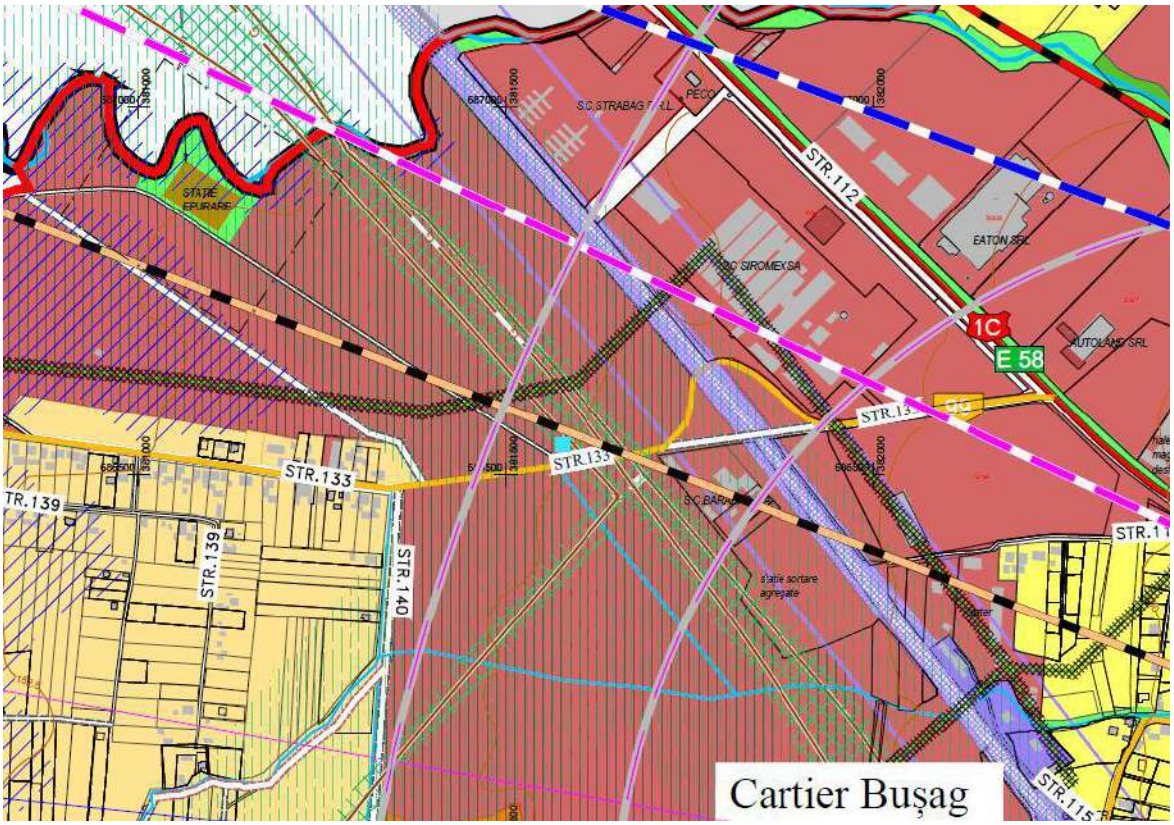
Table 13 – Pilot projects Tăuții Măgherăuș, Merișor pasture

TĂUȚII MĂGHERĂUȘ – MERIȘOR PASTURE

Surface: approx 14ha

Estimated remediation period:

Pb 672 ± 12 [27 yrs], Cd 11 ± 7 [22 yrs], Cu 413 ± 15 [43 yrs], Zn 425 ± 13 [9 yrs].



Urban regulations	• The land is regulated as Industrial units and warehouses, with a ban on building until the development of PUZ, PUD with AACR approval. It is recommended to include the phytoremediation solution in future urban planning documents.
Current land use	• The land has no constructions, and is bounded by 2 traffic routes, the railway to the east, and a watercourse (with the role of an ecological corridor) to the north.
Urban and local landscape considerations	• The land has potential for development in a storage area, logistics or an area with non-polluting industrial activities, due to its proximity to the airport and to the town of Tăuții Măgherăuș and the Baia Mare Municipality. However, the level of pollution must be reduced to optimal levels. • The land is crossed by a water course - potential ecological green corridor.
Environmental considerations	• Pollution levels exceed alert thresholds for all identified metals. Land remediation and pollution remediation is required.
Intervention proposal	**Project:** **P2_TM_F2. Regeneration/rehabilitation of green-blue corridors** It is recommended to create a phytoremediation plantation with species adapted to wetlands, related to the existing water course (mix of Salix alba, Salix babilonica, and other trees that help pollination: Robinia pseudoaccacia, Sorbus acuparia, and medium/low vegetation Mischanthus giganteus). It is proposed to rehabilitate the green corridor with a vegetation area of min. 5m wide from the water's edge - in total approx. 0.6 ha (of which min. 50% groups of Salix). **P3_TM_F5. Peripheral green corridor and strategic links with the natural setting** Plantations with the role of a protection zone in the perimeter of the identified land and related roads - Street 133 and the related agricultural road. It is recommended to create green alignments related to traffic routes with the role of a green corridor in connection with the local green infrastructure. The alignment has the role of a green protective curtain for possible pollution carried by the wind (protecting the individual living area). The proposed alignments have a total of approximately 800m (400m street 133, 400m agricultural road). Recommended: Acer platanoides, Robinia pseudoacacia, Fraxinus excelsior. Deforestation for biomass is not recommended. **Local regulation proposals and long-term strategic measures:** **P4_TM_R5. Requirements for green infrastructure related to industrial areas.** In the scenario of the creation of the Industrial Units and warehouses area, it is recommended to include specific development directions and indicators in the PUD, PUZ documentation, to ensure the adaptation of phytoremediation techniques within the new functional areas. At least 30% green space with species capable of phytoremediation is recommended.

Biomass potential - for local heating/energy systems

Option 1:

Green corridor on the bank of the water course + protective curtain next to the road + *Salix viminalis* holding:

Surface 10,7 ha	Worst case scenario	Best case scenario
Cost year I euro	23540	18190
Cost year II euro	3210	
Total maintenance cost (eur/2 years)	3210	
Harvest (t/2 years, humidity 0%)	428	535
Price/mincing (eur/ton)	40	
Total Income	17120	21400
Total profit (eur/2 years)	13910	18190
Investment 2024-2025	**26750**	**21400**
Profit 2026-2027	13910	18190
Profit 2028-2029	13910	18190
Investment amortization 2028	**1070**	**14980**
Profit 2030-2031	13910	18190

Option 2:

Green corridor on the bank of the water course + protective curtain next to the road + recreational and functional area: logistics, parking lots, etc.:

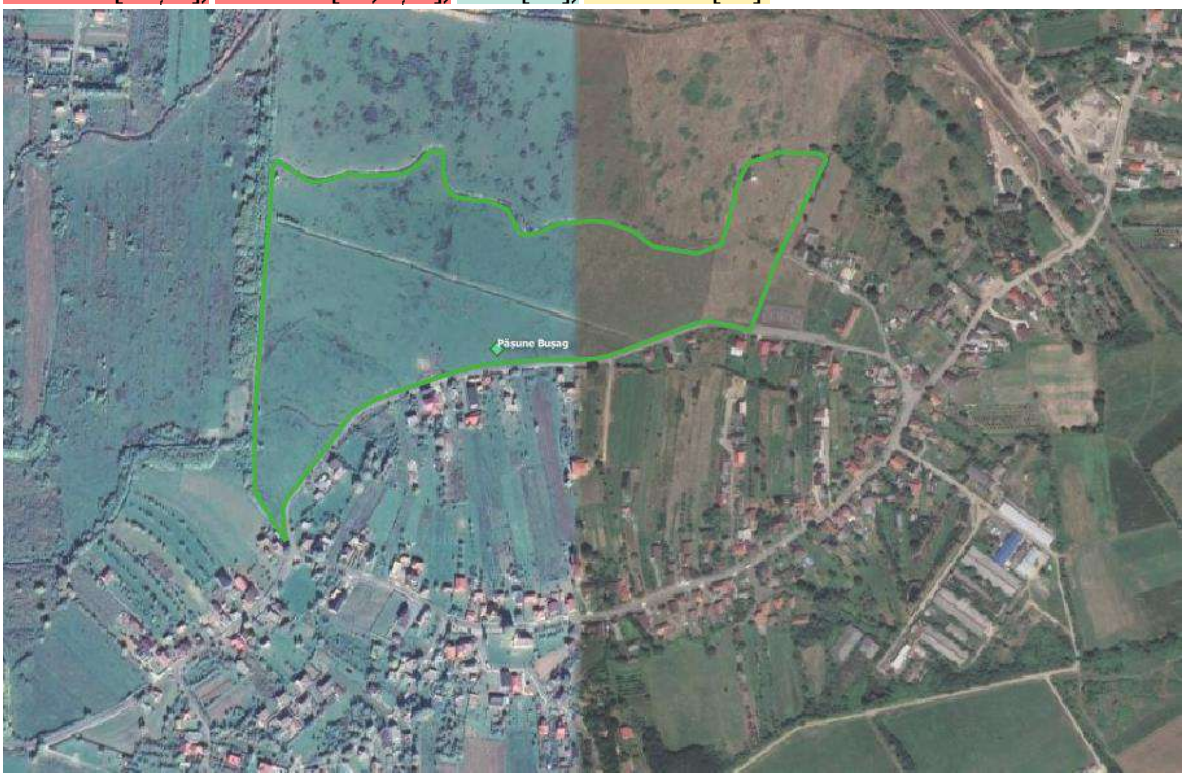
Table 14 – Pilot projects Tăuții Măgherăuș, Bușag Pasture

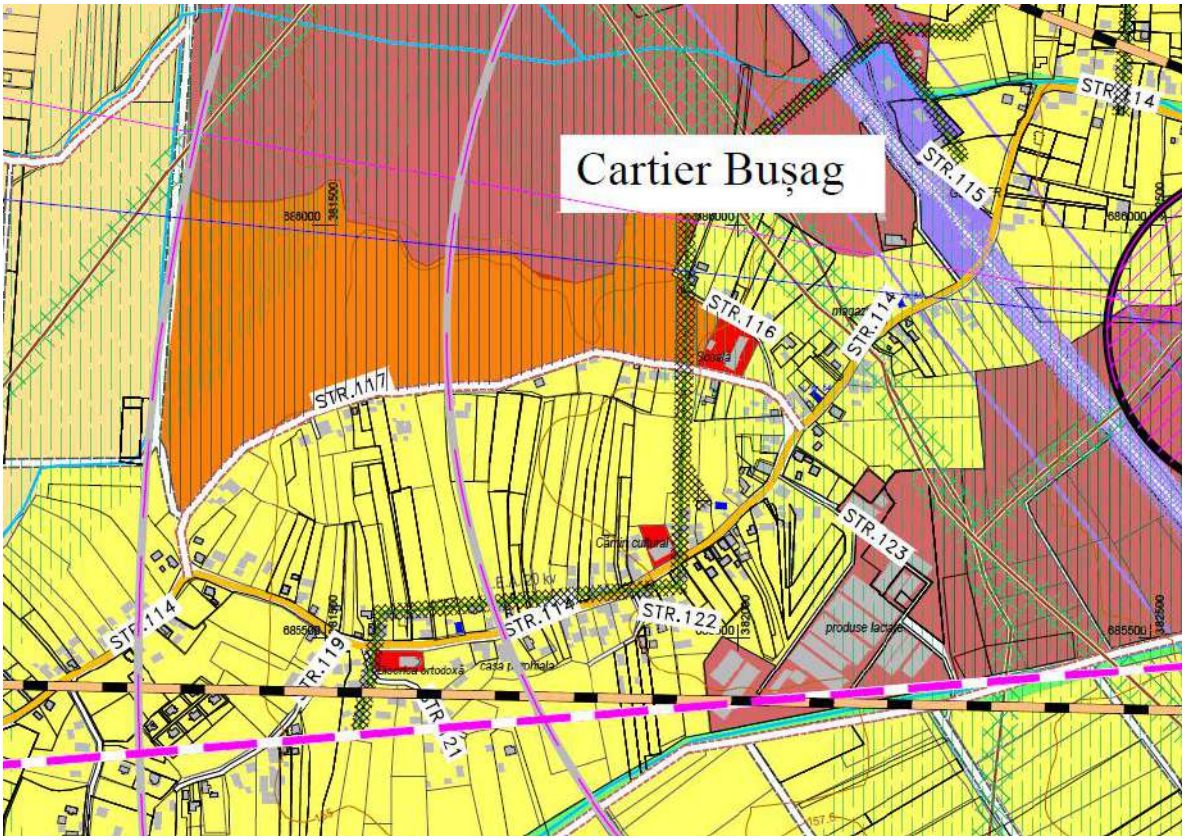
TĂUȚII MĂGHERĂUȘ – BUȘAG Pasture

Surface: approx 13ha

Estimated remediation period:

Pb 81 ± 6 [14 yrs], Cd 10 ± 6 [20,5 yrs], Cu 0 [ok], Zn 102 ± 8 [ok].





Urban regulations	• The land is regulated as an Area for Collective Housing, being an Area with a temporary ban on construction until the development of the P.U.Z, P.U.D with AACR approval. The UTR in the northern part of the land is regulated as Industrial Units and warehouses, bounded by the secondary water course. It is recommended to turn this water course into a green corridor with the role of a buffer zone.
Current land use	• The land is devoid of buildings, except for a former irrigation canal (it is recommended to preserve (at least part of) the canal, to create a green corridor, part of the future development)
Urban and local landscape considerations	• The identified land is bounded by the residential area, road (street 114), secondary water course to the north, and green corridor related to pastures/open areas to the west. • Although regulated as an area for collective housing, an overall typology with a relatively low percentage of land occupation (maximum 50%) is recommended
Environmental considerations	• Pollution values exceed the alert thresholds for Pb and Cd, and the intervention threshold for Zn. • Immediate pollution remediation measures are recommended to ensure optimal environmental conditions for future residential areas.
Intervention proposal	**Project:** **P5_TM_F1. Forests with phytoremediation role / major planting actions to secure pollution** Dense plantings with a phytoremediation role are recommended to increase soil quality in the long term, especially in the event of residential development. The land can act as a source of biomass for possible local energy/heating systems. **Local regulation proposals and long-term strategic measures:** **P6_TM_R2. Requirements for green infrastructure related to residential areas.** It is recommended that the future residential areas be realized after the quality of the soil is improved. It is recommended that at least 30% of the land use be planted public spaces, using species capable of phytoremediation, in particular: *trees – Betula pendula, Catalpa bignoides, Fraxinus excelsior, Salix alba, Sorbus acuparia and medium and low vegetation Berberis thunbergii, Thuja (hedges), Hibiscus syriacus, Juniperus.*

Biomass potential - for local heating/energy systems

Plantations of Salix viminalis are recommended over the entire surface of the analysed site for:

- to accelerate the period of remediation and extraction of heavy metals from the soil, with a view to the establishment of potential housing settlements in the future;
- to produce local biomass – a safe and cheap source for thermal energy

Except for the corridor formed by the irrigation channel, exploitation for a maximum period of 25-30 years is recommended, also ensuring an increased yield of the willow plantation, but also a phytoremediation of the soils (14 years needed to decrease within normal limits the amount of Pb and 21 years needed to decrease the amount of Cd within normal limits).

Willow harvesting would mean:

Surface: 12 ha	Worst case scenario	Best case scenario
Cost year I euro	26400	20400
Cost year II euro	3600	
Total maintenance cost (eur/2 years)	3600	
Harvest (t/2 years, humidity 0%)	480	600
Price/mincing (eur/ton)		40
Total income	19200	24000
Total profit (eur/2 years)	15600	20400
Investment 2024-2025	30000	24000
Profit 2026-2027	15600	20400
Profit 2028-2029	15600	20400
Investment amortization 2028	**1200**	**16800**
Profit 2030-2031	15600	20400

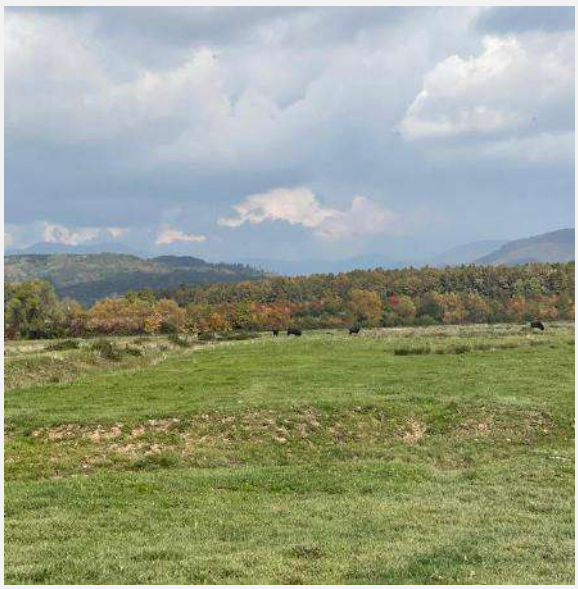


Photo: USAMV (Anca Pleșa)

Table 15 – Pilot projects Tăuții Măgherăuș, Bozânta Pasture, Graveyard, Pond

TĂUȚII MĂGHERĂUȘ - Bozânta Pasture, Graveyard, Pond

Surface: approx 12ha

Estimated remediation period:

Pb 116 ± 6 [17 yrs], Cd 9 ± 6 [20 yrs], Cu 62 ± 10 [19 yrs], Zn 141 ± 9 [2,5 yrs].

Urban regulations	• The land is regulated as an arable area, located in the immediate vicinity of the protection zone related to the cyanide pond. Due to the location and the level of pollution identified, it is not recommended to cultivate products for consumption, or which through processing may affect the health of the population. The land belongs to outskirts.
Current land use	• The land is devoid of constructions and features an access road. Areas of spontaneous vegetation are present. • A precise identification of the property regime is required (according to the ANPI web portal, the land has property bodies).
Urban and local landscape considerations	• The land is bordered along the perimeter by areas of tall vegetation and to the south by the Lăpuș river, with the related vegetation. • It is considered opportune to create major phytoremediation plantations on the available land, in relation to the existing green protection zone and other free land suitable for the expansion of the protection zone
Environmental considerations	• The pollution values exceed the alert threshold for Cd, and the intervention thresholds for Pb, Cu, Zn. • Cyanide ponds pose a threat to the environmental quality of the area. Major buffer zones are needed to reduce environmental risks.
Intervention proposal	**Project:** **P7_TM_F1. Forests with a phytoremediation role / Major planting actions to secure pollution.** The proposal is to create major dense plantations of tall vegetation capable of phytoremediation: *Fraxinus excelsior (20%), Salix alba (in areas near water) (20%), Robinia pseudoacacia (40%), Pinus nigra (20%).* **Local regulation proposals and long-term strategic measures:** **P8_TM_R7. Harvest restrictions** If there are no resources for the implementation of the Phytoremediation Forests project, it is recommended that potential economic actors be restricted to the cultivation of plants for biomass production (SPIRE plant selection).

Biomass potential - for local heating/energy systems

The creation of a public-private collaboration with the main objective of decontamination of agricultural land in the area, through the exploitation of agricultural land and the harvest of energy willow.

Collaboration would involve:

1. Encouraging farmers to join an associative form by:

-providing consultancy to access funds for agricultural exploitation
-promoting the practices of exploitation of energy plantations and commercialization of biomass
-the adoption of measures and taxes to discourage agricultural exploitation of land for food crops

2. Establishment and delimitation of a permanent storage area for willow wood shavings
3. Construction of a channelized storage platform or to ensure the drainage of rainwater
4. Establishing a storage and exploitation plan for the resulting shredding

Note: In the vicinity (300 m; 1.1 km; 1.1 km) there are three religious buildings and a cultural hostel. It is proposed to establish a partnership with them to store and use the resulting biomass.

Willow mining would involve:

Surface 12 ha	Worst case scenario	Best case scenario
Cost year I euro	26400	20400
Cost year II euro	3600	
Total maintenance cost (eur/2 years)	3600	
Harvest (t/2 years, humidity 0%)	480	600
Price/mincing (eur/ton)	40	
Total Income	19200	24000
Total profit (eur/2 years)	15600	20400
Investment 2024-2025	30000	24000
Profit 2026-2027	15600	20400
Profit 2028-2029	15600	20400
Investment amortization 2028	**1200**	**16800**
Profit 2030-2031	15600	20400

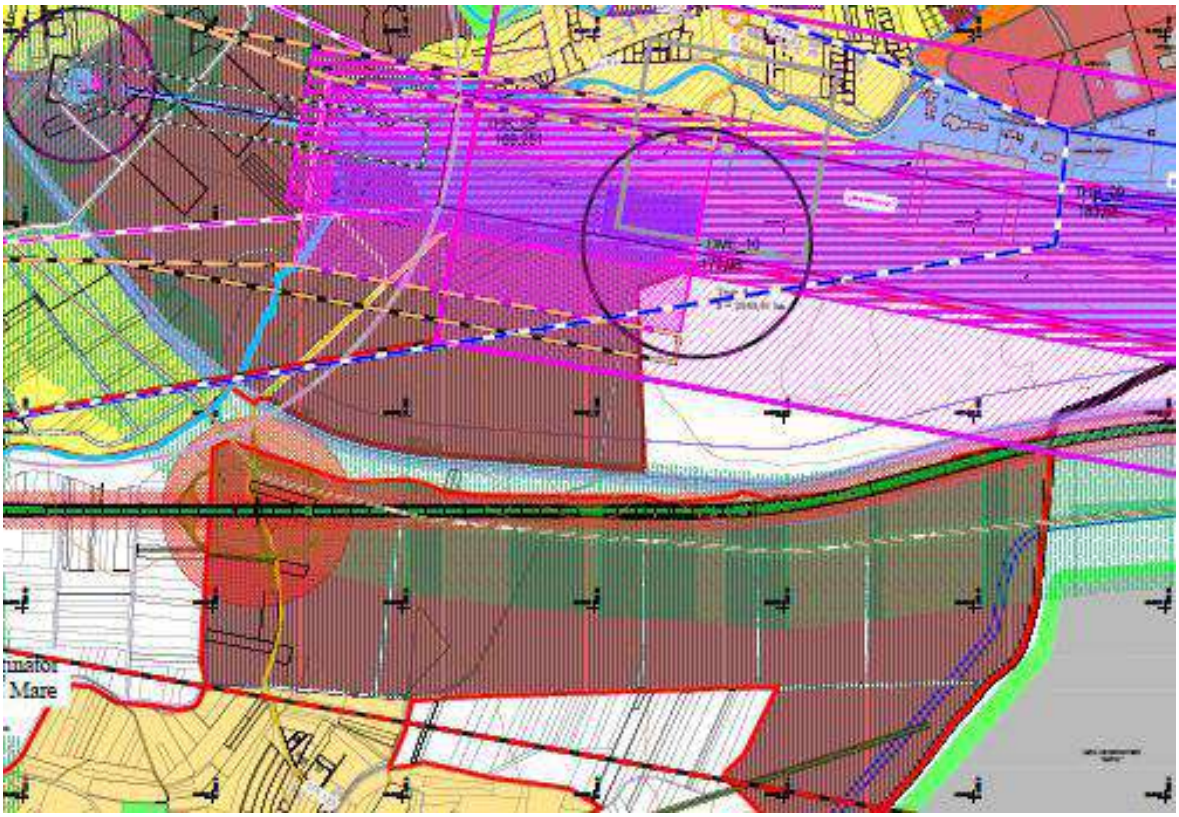
Table 16 – Pilot projects Tăuții Măgherăuș, Bozânta Mare Pasture

TĂUȚII MĂGHERĂUȘ - BOZÂNTA MARE PASTURE

Surface: approx 62ha

Estimated remediation period:

Pb 73 ± 5 [13 yrs], Cd 14 ± 6 [25 yrs], Cu 0 [ok], Zn 113 ± 8 [1 yr].



Urban regulations	• The land is regulated as Industrial units and warehouses, with a ban on building until the development of PUZ, PUD with AACR approval. It is recommended to include the phytoremediation solution in future urban planning documents. The creation of a major traffic artery is planned, being a necessary investment to develop future industrial activities/warehouses (of a non-polluting nature).
Current land use	• Except for a dirt road and a shelter for animals, the land is devoid of buildings, but also of medium and tall vegetation.
Urban and local landscape considerations	• The land is located in the vicinity of the cyanide pond. In the northern part there is a forest area. It is considered optimal to continue the forest area with major plantations with a phytoremediation role.
Environmental conditions	• Pollution alert values are exceeded for Pb and Cd.

Intervention proposal

Project - Option 1:

P9_TM_F1. Forests with phytoremediation role / Major planting actions

Planting actions are recommended on the entire surface of the identified land, with species capable of phytoremediation and optimal for providing biomass: *Salix viminalis (30%), Betula pendula (30%), Robinia pseudoacacia (30%), and the remaining 10% trees with a role in the pollination process: Sorbus aucuparia.*

Project - Option 2:

P10_TM_F3. Plantations with a protective role (corridors or buffer zones) and strategic links with the natural environment.

The recommendation is to draw up a development plan for the entire area to establish the structure of the traffic arteries, in relation to the future bypass belt and the current structure of the locality. Depending on this structure, it is recommended to create dense protective curtains, at least 50m wide. Thus, a compact grid of green corridor-type protective curtains is created, with a phytoremediation role. Future developments can be accommodated in the areas left free, and traffic routes can be made related to the green corridors.

Available for both Option 1&2 - Local regulation proposals

P11_TM_R5. Requirements for green infrastructure related to industrial areas

In the scenario of the creation of the Industrial Units and warehouses area, it is recommended to include specific development directions and indicators in the PUD, PUZ documentation, to ensure the adaptation of phytoremediation techniques within the new functional areas. At least *30% green space with species capable of phytoremediation* is recommended.

Biomass potential - for local heating/energy systems

Planting the forest area with Salix viminalis/ Robinia pseudoacacia.

Willow harvesting would involve:

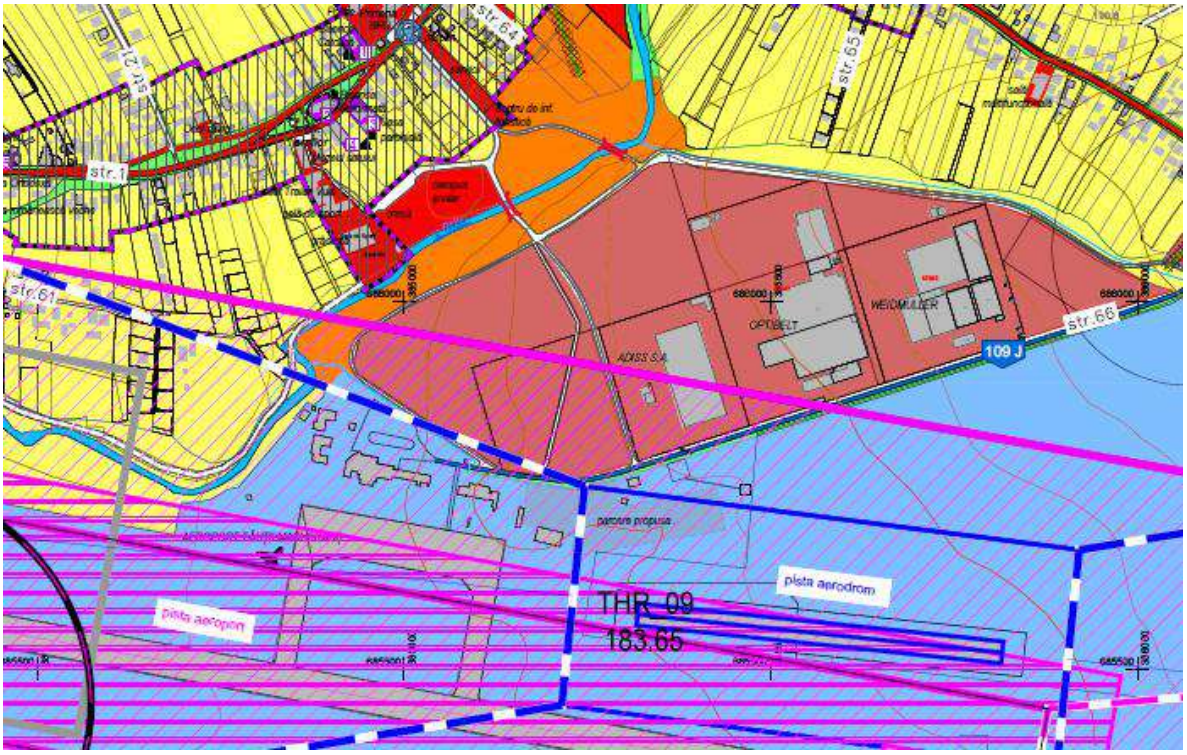
Surface 62 ha	*Worst case scenario*	*Best case scenario*
Cost year I euro	136400	105400
Cost year II euro	18600	
Total maintenance cost (eur/2 years)	18600	
Harvest (t/2 years, humidity 0%)	2480	3100
Price/mincing (eur/ton)	40	
Total Income	99200	124000
Total profit (eur/2 years)	80600	105400
Investment 2024-2025	155000	124000
Profit 2026-2027	80600	105400
Profit 2028-2029	80600	105400
Investment amortization 2028	**6200**	**86800**
Profit 2030-2031	80600	105400

Robinia pseudoacacia harvesting would involve:

Surface 62 ha	*Worst case scenario*	*Best case scenario*
Cost year I euro	136400	117800
Cutting, chopping, packaging and transport to the place of storage	200	
Harvest (t/year, humidity 20%)	930	1240
Price/mincing (eur/ton)	40	
Total Income	37200	49600
Profit total (eur/an)	37000	49400
Investment 2024-2025	136600	118000
Profit 2026	37000	49400
Profit 2027	37000	49400
Profit 2028	37000	49400
Profit 2029	37000	49400
Investment amortization 2029	**11400**	**79600**
Profit 2030	37000	118000

Table 17 – Pilot projects Tăuții Măgherăuș, Airport

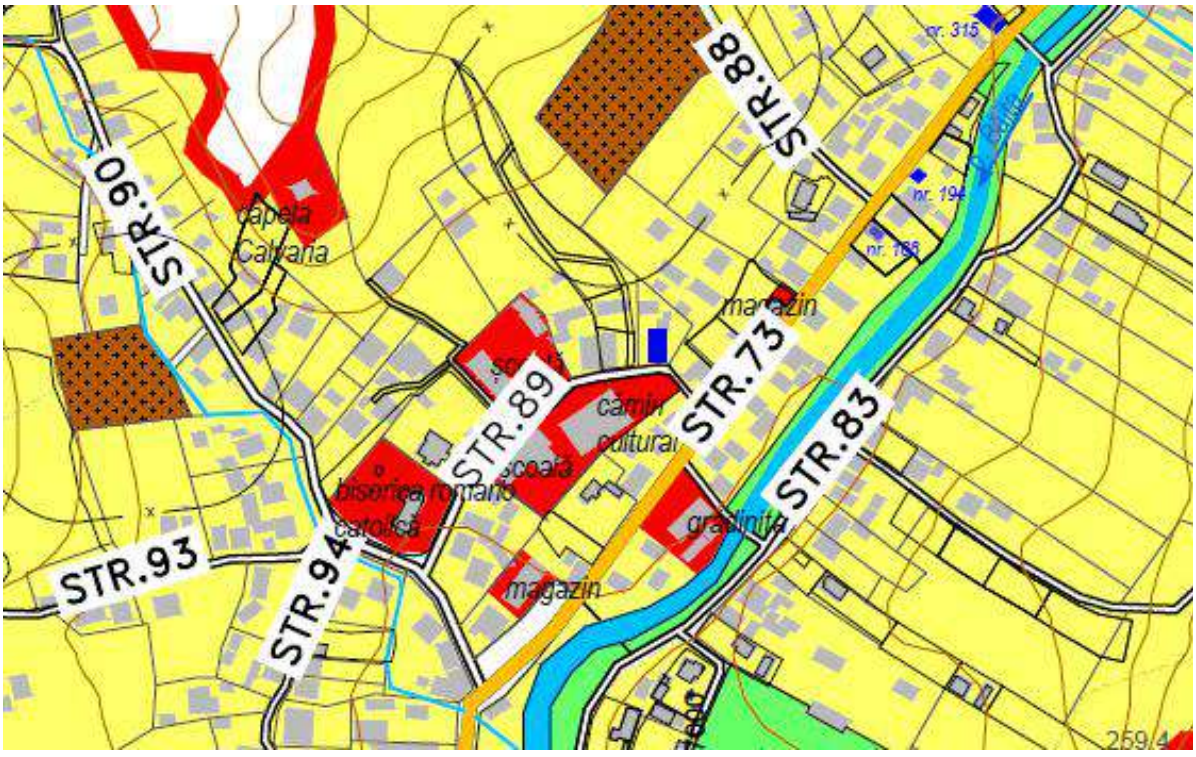
TĂUȚII MĂGHERĂUȘ - AIRPORT
Surface: approx 7ha & 0,2ha
Estimated remediation period:
Pb 74 ± 5 [13 yrs], Cd 12 ± 6 [23 yrs], Cu 0 [ok], Zn 80 ± 7 [ok].



Urban regulations	• The land is regulated as Industrial Units and warehouses
Current land use	• The land has no buildings, and is without relevant vegetation
Urban and local landscape considerations	• Proximity to the airport makes this land a desirable destination for industrial units/warehouses (without polluting activities). • The land is bounded to the NW by the blue green corridor and the airport access road, in the E area are industrial activity areas and logistics/storage areas. Based on the soil sample taken, 2 plots were demarcated (one of 7ha in the N and one of 0.2 ha – with the potential of a public planted space)
Environmental considerations	• The pollution values exceed the alert thresholds for Pb and Cd.
Intervention proposal	**Projects for the 0,2ha plot:** **P12_TM_F8. Additions with species capable of phytoremediation in the existing green spaces – the transformation of the green space within the parking lot into a leisure space.** The recommendation is to carry out landscaping with an ecological and ornamental role. Mineral areas for rest areas are allowed - max 20% of the land. Permeable mineral surfaces will be used. Tall trees are recommended: *Fraxinus excelsior, Robinia pseudoacacia, Betula pendula, and medium-low vegetation: Berberis thunbergii, Miscanthus, Juniperus, Lavandula angustifolia* **Proposed local regulations and long-term strategic measures for the 7ha plot:** **P13_TM_R5. Requirements for green infrastructure related to industrial areas** In the scenario for the creation of the Industrial Units and warehouses area, it is recommended to include the adaptation of phytoremediation techniques within the new functional areas. At least 30% green space with species capable of phytoremediation is recommended. It is recommended to create a green corridor as a protection zone on the NW side, towards the green-blue corridor.
Biomass potential - for local heating/energy systems	Planting is recommended to create recreation spaces, parking, with an ecological and ornamental role. Biomass resources are insignificant to support a biomass system, but in an integrated scenario at the level of ZMBM, the residues resulting from the maintenance of the plantations would be able to be managed and capitalized in order to obtain thermal energy.

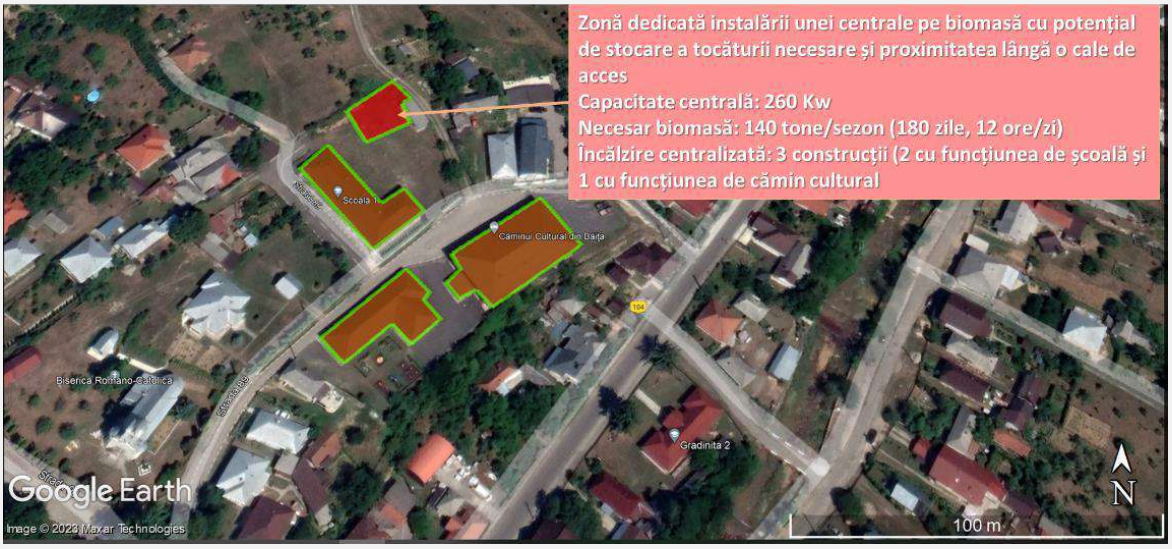
Table 18 - Pilot Projects Tăuții Măgherăuș, Băița Pasture

TĂUȚII MĂGHERĂUȘ – BĂIȚA PASTURE
Surface: approx 0.5ha
Estimated remediation period:
Pb 208 ± 8 [22 yrs], Cd 10 ± 6 [20,5 yrs], Cu 67 ± 9 [15 yrs], Zn 206 ± 9 [4,5 yrs].



Urban regulations	• The soil sample collection point is related to the regulated land Public Institutions and Services Zone, with the function of education - school and community centre – culture home.
Current land use	• The land is occupied by 3 buildings (2 with the function of a school and 1 with the function of a cultural centre), and is devoid of vegetation.
Urban and local landscape considerations	• The land is located in the central area of the town of Băița, close to the residential area. • It can fulfil the role of public space, being transformed into a planted area with an ecological and ornamental character
Environmental considerations	• The pollution values exceed the alert threshold for Pb, Cd, and the intervention threshold for Cu, Zn. • Intervention measures are needed to secure soil pollution
Intervention proposal	**Project - Option 1:** **P15_TM_F7 Local plantations and the transformation of neglected lands with a multifunctional role (ecological, ornamental, and educational).** **Project – Option 2:** **P16_TM_F7 Local plantations and conversion of neglected land. Regeneration of the school yard land through phytoremediation plantations with biomass production role.** Local plantations and the transformation of neglected lands Regeneration of the land belonging to the school yard through phytoremediation plantations with the role of biomass production. Given the size of the land, it is recommended to implement irrigation systems for a fast-growing plantation. A dense plantation with: *Salix viminalis, Fraxinus excelsior is proposed, and for medium-low vegetation (with an ornamental character) it is proposed: Mischanthus giganteus, Hibiscus syriacus.*

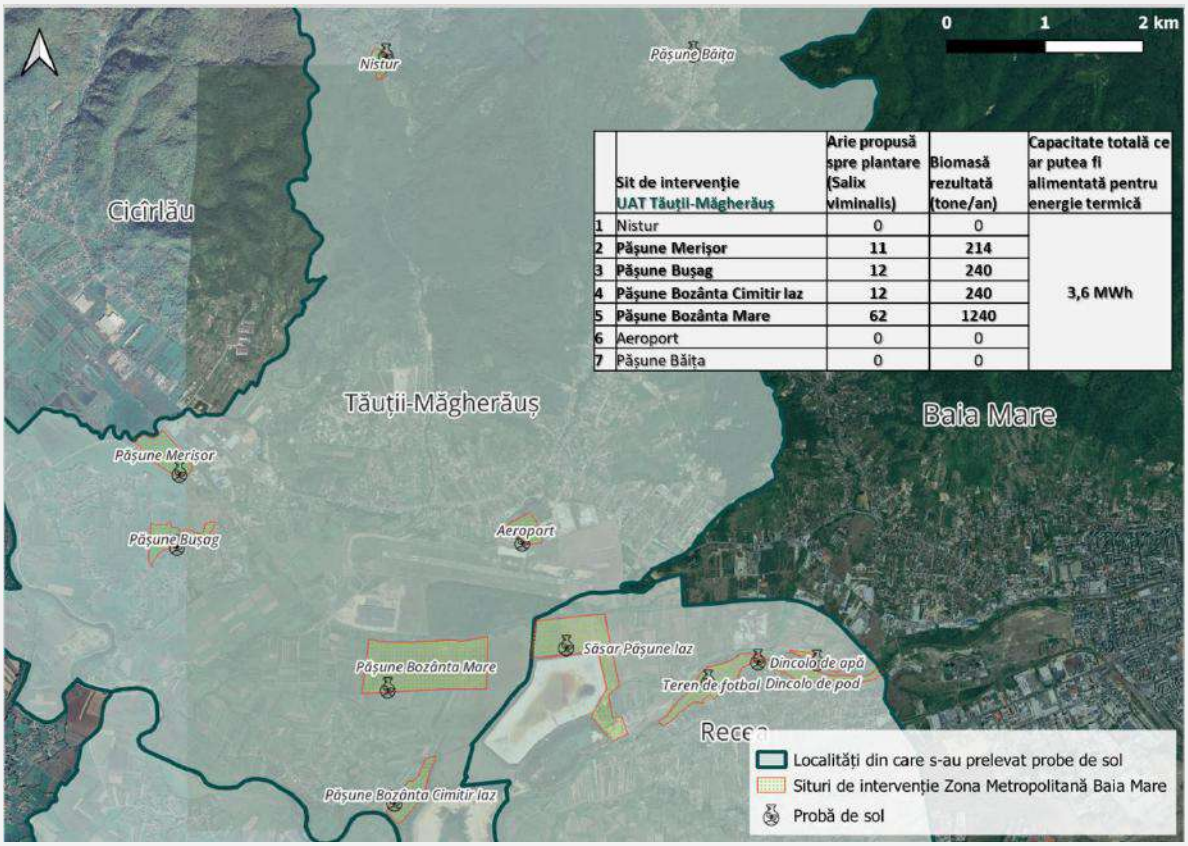
Biomass potential - for local heating/energy systems



The implementation of a biomass-based heating system is considered optimal for the school/cultural center - together with thermal rehabilitation works. The available land does not provide all the biomass needed. A 260kwh power plant is required for the 3 buildings - with an annual requirement of 140 tons of biomass.

Option 1: Unexploited local land (with a role in recreation spaces for students and residents participating in educational and cultural activities) and transport of biomass from a nearby generation point (eg: Bușag Pasture/ Merișor Pasture - a distance of approximately 9 km from where, annually, a quantity of 200 tons of biomass could be produced separately).

The biomass potential that could result from the phytoremediation proposed for the intervention sites in ZMBM, TAU Tăuții Măgherăuș.



	Sit de intervenție UAT Tăuții-Măgherăuș	Arie propusă spre plantare (Salix viminalis)	Biomasă rezultată (tone/an)	Capacitate totală ce ar putea fi alimentată pentru energie termică
1	Nistur	0	0	3,6 MWh
2	**Pășune Merișor**	**11**	**214**	
3	**Pășune Bușag**	**12**	**240**	
4	**Pășune Bozânta Cimitir Iaz**	**12**	**240**	
5	**Pășune Bozânta Mare**	**62**	**1240**	
6	Aeroport	0	0	
7	Pășune Băița	0	0	

Photo: USAMV (Anca Pleșa)

3.1.5 ADDITIONAL INTERVENTIONS

The additional interventions compared to those correlated with the priorities in the existing strategies comply with the regulations imposed by the General Urban Plans of the localities members of the Baia Mare Metropolitan Area and aim to complete the system of green spaces at the ZMBM level through urban greening/regeneration projects that involve the use of species capable of phytoremediation. Projects are proposed for all localities except Baia Mare, because the projects proposed by the current strategy in relation to the existing strategies (SIDU, PMUD) were considered sufficient.

Thus, the additional interventions consider the development of forests with a role of phytoremediation to complement the existing ones (F1), the regeneration or restoration of the green-blue corridors (F2), the creation of corridor/buffer type protection areas (especially in relation to industrial areas) (F3), the development of green corridors in relation to the major traffic infrastructure (F4) and the natural environment (F5) but also plantations intended to restore/rehabilitate abandoned land (F7).

Fig. 29 – Green and blue-green corridors have a very important role at the urban and territorial level, with an impact on securing and remediating pollution, rebuilding local ecosystems, and regenerating the landscape. Example green-blue corridor Săsar - photo: Codruț Papina

Table 19 – Additional strategic interventions – TAU Baia Sprie

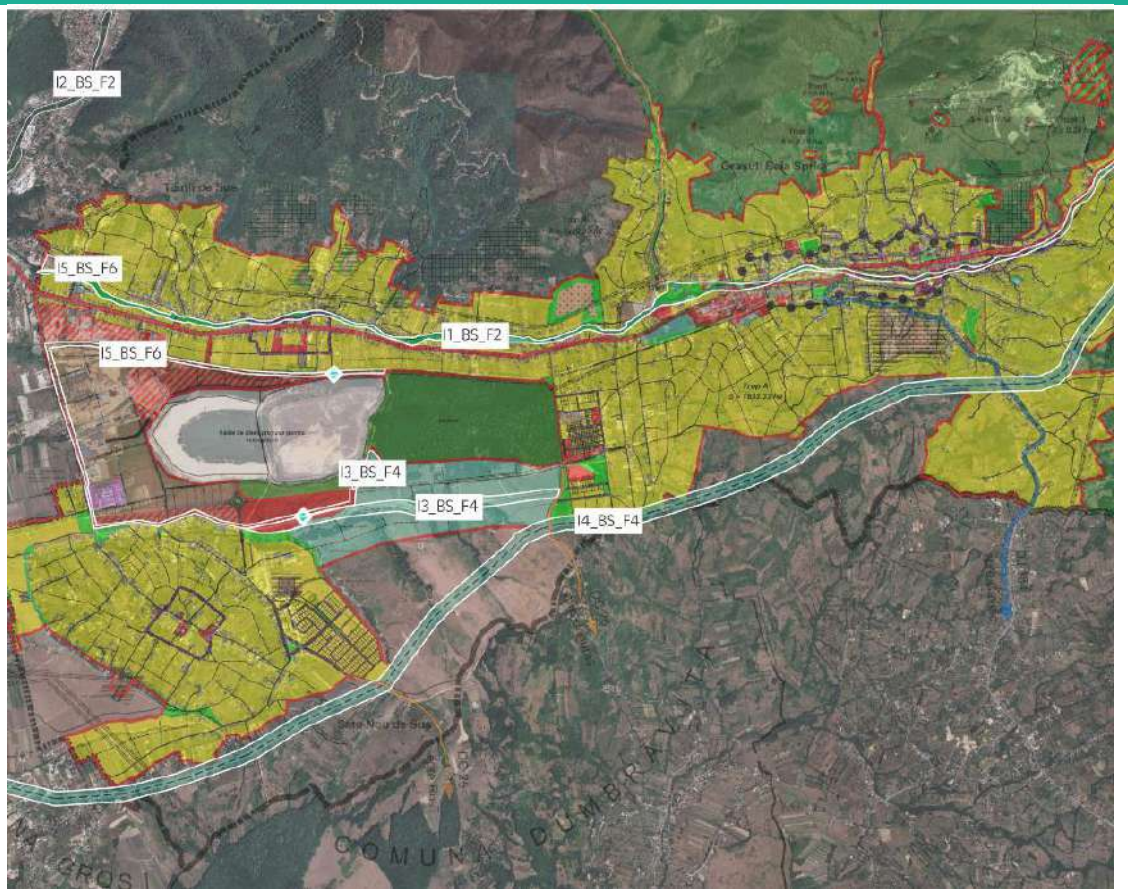
NEW PROJECTS PROPOSED FOR TAU BAIA SPRIE	
	
F2. REGENERATION AND RESTORATION OF THE GREEN-BLUE CORRIDORS	**I1_BS_F2** Regeneration of the green-blue corridor along the Săsar River, including species with phytoremediation properties **I2_BS_F2** Regeneration of the blue-green corridor along the Chiuzbaia river (connecting Baia Sprie to Chiuzbaia village) including species with phytoremediation properties.
F4. GREEN CORRIDORS IN CONNECTION WITH MOBILITY INFRASTRUCTURES	**I3_BS_F4** The creation of green corridors with plantations capable of phytoremediation, along the circulation paths that will connect the planted spaces in the south of the tailings dump (within the agro-industrial zone). **I4_BS_F4** Development of a green belt with species capable of phytoremediation along the new bypass road proposed by the PUG in the southern part of the city.
F6. PLANTATIONS WITH A PROTECTIVE ROLE (CORRIDORS OR BUFFER ZONES)	**I5_BS_F6** Development of a protective green buffer zone, including species with phytoremediation properties, to demarcate industrial areas in the western part of the city from residential/commercial areas.

Table 20 - Additional interventions of a strategic character TAU Groși

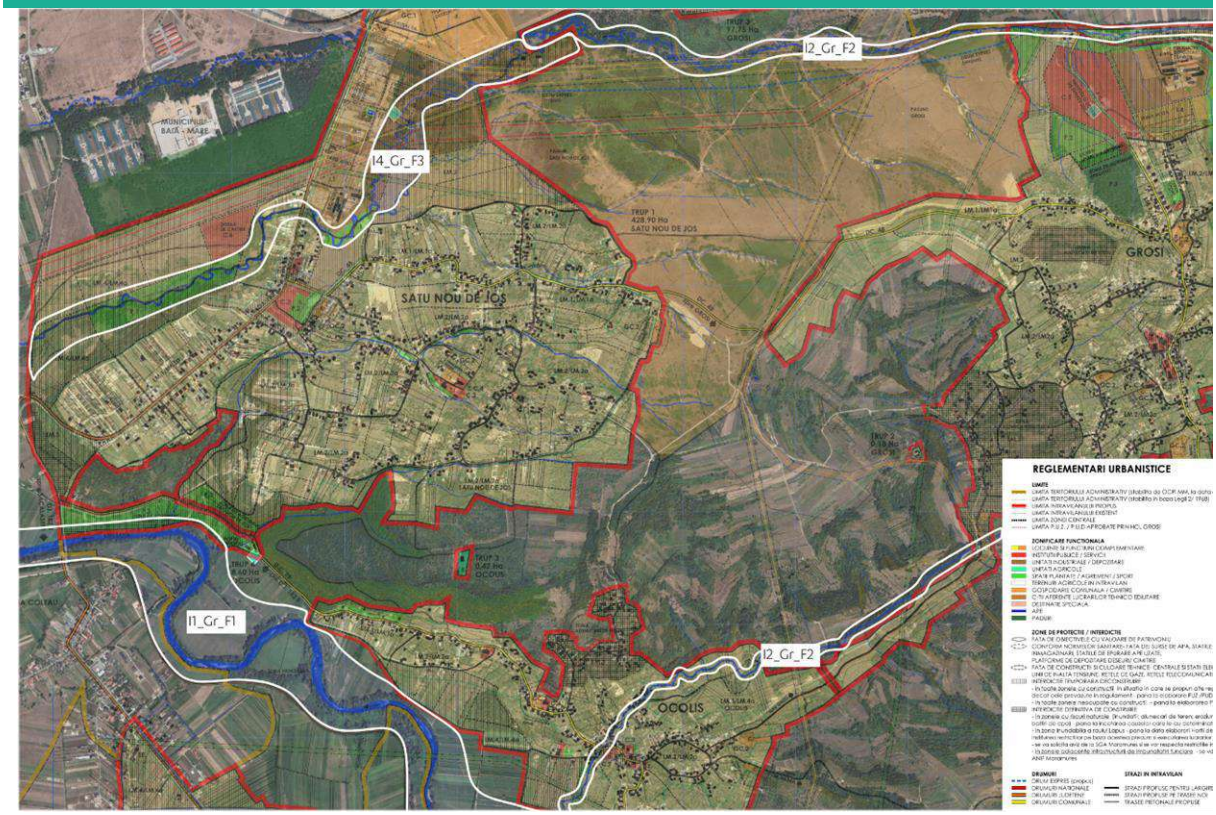
NEW PROJECTS PROPOSED FOR TAU GROȘI	
	
F1. FORESTS WITH A PHYTOREMEDIATION ROLE / MAJOR PLANTING ACTIONS	**I1_Gr_F1** Creation of an urban forest with species adapted to humidity capable of phytoremediation between the flood zone of the Lăpuș River and the administrative border of the villages of Ocolis and Satu Nou de Jos (in the situation where the municipality owns land, phytoremediation forests with a diverse mix of plants are recommended; in the situation where there are private agricultural lands, it is recommended to establish public-private collaborations for biomass plantations - for example Salix viminalis).
F2. REGENERATION AND RESTORATION OF THE GREEN-BLUE CORRIDORS	**I2_Gr_F2** Creation of a green-blue corridor connecting the localities of Ocoliș and Groși **I3_Gr_F2** Creation of a green-blue corridor connecting the localities of Satu Nou de Jos and Groși, by connecting (and) to the green spaces proposed by the urban general plan in the locality of Groși.
F3. PLANTATIONS WITH A PROTECTIVE ROLE (CORRIDORS OR BUFFER ZONES)	**I4_Gr_F3** The creation of "buffer" zone of green areas around the industrial areas of Satu Nou de Jos, to complement the green-blue corridor related to the Craica stream.

Table 21 - Additional strategic interventions - TAU Recea

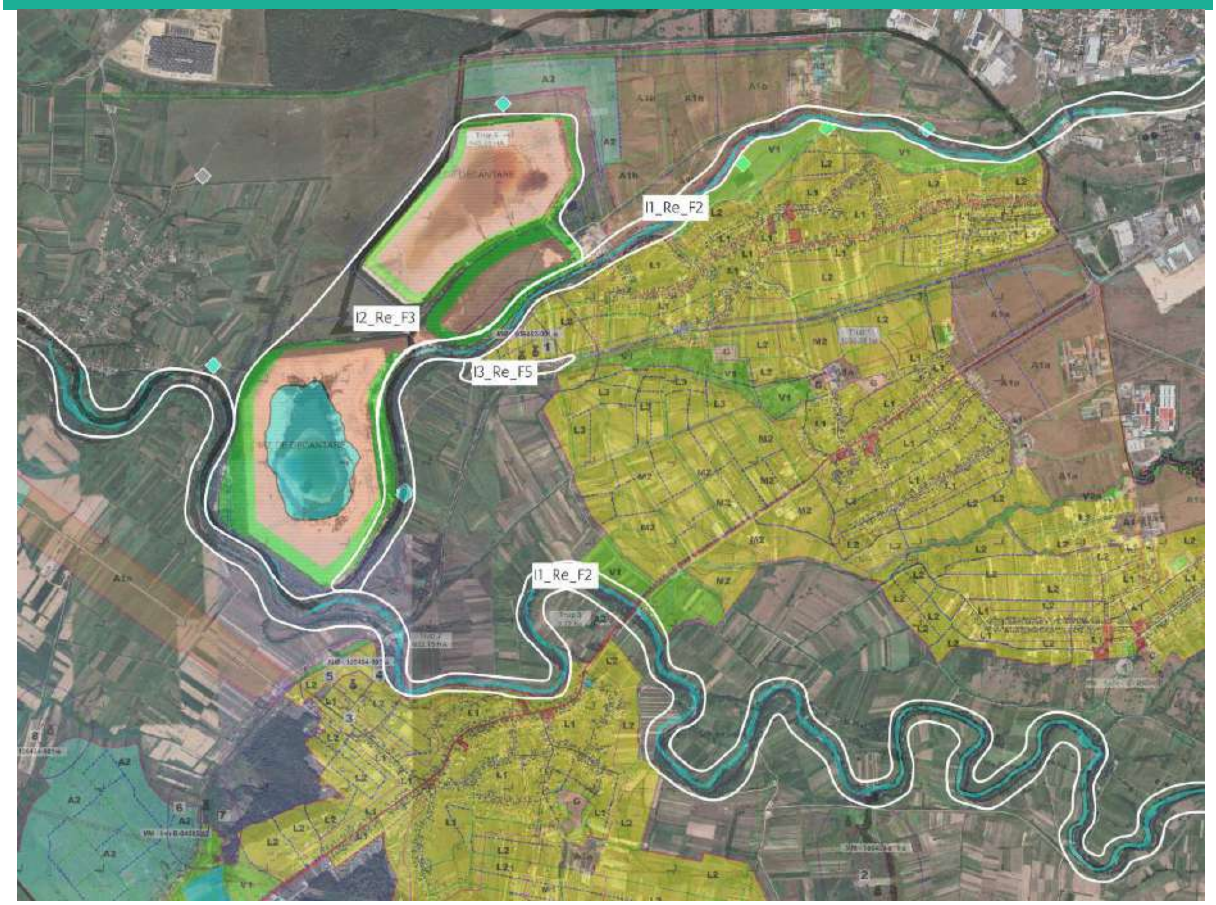
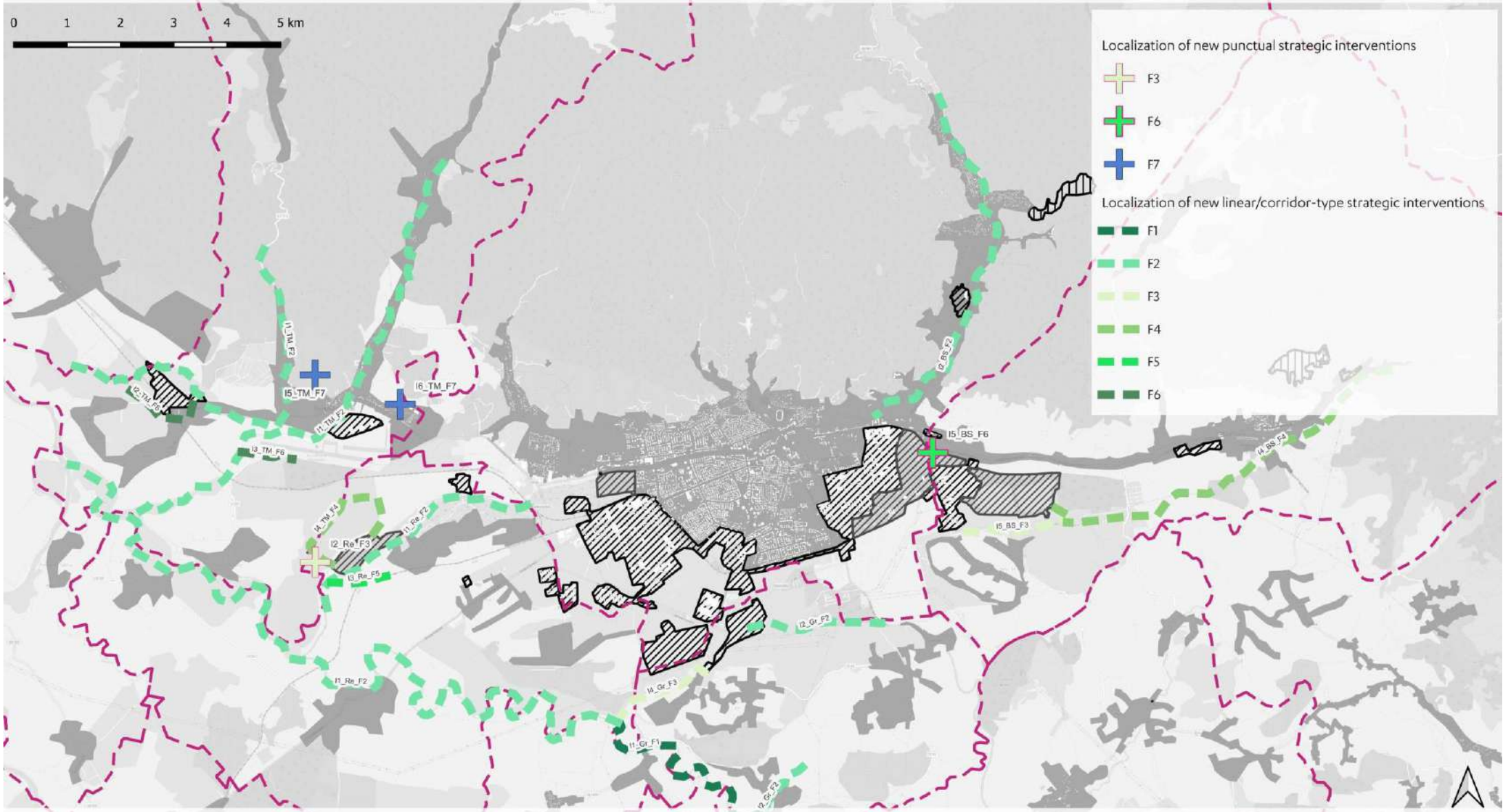
NEW PROJECTS PROPOSED FOR TAU RECEA	
	
F2. REGENERATION AND RESTORATION OF THE GREEN-BLUE CORRIDORS	**I1_Re_F2** Creation of a continuous green-blue corridor with species capable of phytoremediation to act as a barrier for suspended particles from tailings ponds, along the rivers Săsar and Lăpuș, which will also connect with the large, planted areas in the north and from the southwest of Recea.
F3. PLANTATIONS WITH A PROTECTIVE ROLE (CORRIDORS OR BUFFER ZONES	**I2_Re_F3** Inclusion of species with phytoremediation properties in green belts protecting tailings ponds and connecting them through a planted area.
F5. GREEN CORRIDORS AND STRATEGIC CONNECTIONS WITH THE NATURAL FRAMEWORK	**I3_Re_F5** Planting a green corridor with species capable of phytoremediation between the new planted area along the Săsar river and the large planted green area proposed by the urban general plan.

Table 22 - Additional strategic interventions - Tăuții Măgherăuș TAU

NEW PROJECTS PROPOSED FOR TAU TAUȚII MĂGHERĂUȘ	
	
F2. REGENERATION AND RESTORATION OF THE GREEN-BLUE CORRIDORS	**I1_TM_F2** Regeneration of the blue-green corridor along the Băița river with species with phytoremediation properties. Where there are relevant land resources, accessible green corridors can be developed in relation to residential areas (alleys and footpaths.)
F3. PLANTATIONS WITH A PROTECTIVE ROLE (CORRIDORS OR BUFFER ZONES)	**I2_TM_F3** The creation of a green protection zone of "buffer" type that delimits the industrial areas in the W, S-W and the central part of the city from the residential area (in connection with the new green-blue corridor - Băița), using species capable of phytoremediation.
F6. PROTECTION PLANTATIONS IN THE PERIPHERAL AREAS	**I3_TM_F6** Creation of a buffer green protection zone in the south of the town, which connects the proposed green-blue corridor with the forested area, using species capable of phytoremediation.
F4. GREEN CORRIDORS IN CONNECTION WITH MOBILITY INFRASTRUCTURES	**I4_TM_F4** The creation of a green corridor with species capable of phytoremediation along the street that surrounds the settling pond in the south of the town, which will also create a connection with the nearby forest.
F7. PLANTATIONS AND REPLACEMENT OF VEGETATION FOR THE REHABILITATION OF ABANDONED LANDS	**I5_TM_F7** Conversion of the abandoned industrial land in the vicinity of Street 26/Trup A area into public green space, which includes species capable of phytoremediation. **I6_TM_F7** Conversion of the abandoned industrial land on Street 5 (near the park) into public green space, which includes species capable of phytoremediation.

LOCALIZATION OF NEW ADITIONAL INTERVENTIONS/STRATEGIC INVESTMENTS AT FUNCTIONAL URBAN AREA LEVEL



I_
I1, I2, I3, etc...: represents the project number within the reference territorial area (UAT or ZUF)

_BM_: relevant project at the local level Baia Mare Municipality
_TM_ : relevant project at the local level, Town of Tăuții Magherăuș
_BS_ : relevant project at the local level City of Baia Sprie
_R_: relevant project at the local level, Commune Recea
_G_: relevant project at the local level, Groși Commune
ZUF: project relevant at territorial level Functional Urban Zone

_F - Intervention typology related to Nature-based solutions Toolkit
_F1: Forests with phytoremediation role / major planting actions
_F2: Regeneration and renaturation of the green-blue corridors
_F3: Plantations with a protective role (corridors or buffer zones)
_F4: Green corridors in connection with mobility infrastructures
_F5: Green corridors and strategic connections with the natural environment
_F6: Protection zone plantations in the peripheral areas of the settlement
_F7: Plantings and additions of vegetation for the rehabilitation of abandoned lands
_F8: Additions with species capable of phytoremediation in existing green spaces

3.2 LAND USE RECOMMENDATIONS – LOCAL REGULATIONS

3.2.1 METHODOLOGY

Regulatory requirements and long-term strategic measures are translated into development recommendations or zoning recommendations (through indicators and guidelines) for existing urban structures or for future developments. The purpose of this set of solutions is to ensure: (i) the long-term sustainable development of settlements, capitalizing on private investments instead of budgets administered at the local level (the case of flagship projects and independent interventions), or capitalizing on the local budget reserved for projects /developments of civic interest (equipment, green spaces, mobility, etc...); (ii) sustainable and ecological transformation of existing urban or rural areas, by including phytoremediation and value chains based on bioresources (green waste and deforestation) in the local framework.

For each type of regulation, the degree of complexity of the regulation, its impact and sustainability over time were estimated, on a scale from 1 (low) to 5 (highly relevant). The values for each type of regulation are general/indicative in nature and are closely dependent on the context in which they are applied (and its evolution), the most important aspect being the ratio between the planted area and the pollution level of the soil.

THE DEGREE COMPLEXITY refers to how easily it can be adapted to the reality in the field, but also to how complex/permissive the regulation is in terms of the possibilities of concrete intervention in the field. For example, in the case of the requirements for the inclusion of species capable of phytoremediation within existing green spaces (R1), the level of complexity is maximum, as the diversity of approaches is directly proportional to the types of public spaces targeted (e.g. parks, squares, gardens, green alignments, water areas, etc.). On the contrary, in the case of the requirements for green infrastructure related to areas with public institutions/services (R4), the level of complexity of the approaches is much lower, since considerations such as similar spatial configurations of public spaces, the specific urban image that must be maintained, the need to maintain visibility of constructions, etc., limit the possibilities of approach.

IMPACT refers to how strongly the regulation positively influences the sitTAUion on the ground compared to the implementation period and how effective it is in achieving its final goal – the phytoremediation of contaminated soils. For example, in the case of green infrastructure requirements related to active industrial areas, the impact is a relevant one, in the sense that these areas certainly have heavy metal pollution. At the same time, the impact is relevant in the medium and long term, as the phytoremediation process is a long-term one. On the other hand, regarding

the requirements for the inclusion of species capable of phytoremediation within the existing green spaces (R1), given their generous distribution at the locality level, and, most likely, the moderate presence of heavy metals in the soil, the impact is likely to be more relevant if opting for the integration of species capable of phytoremediation.

LONG-TERM SUSTAINABILITY represents the ability of the proposed solution to comply with the development priorities of the territory that may evolve over time, from an urban point of view: built-up areas and densities, urban facilities, public spaces, from an environmental point of view: requirements of compliance of the green infrastructure in relation to the transport infrastructure and the ecological zones, from a social point of view: the needs or preferences of the population regarding the layout of the spaces adjacent to the residence/activity areas. In this sense, in the case of the proposed regulations for the existing green spaces (R1), considering both the various configurations, which allow the accommodation of various adjacent functions, and the interest of the local public authorities for their long-term maintenance, their sustainability over time has a degree high probability. Regarding, on the other hand, the proposed requirements for the green infrastructure related to individual residential areas (R3), both the planted area and the typology of the facilities can change a lot over time, depending on the needs and preferences of the community.

Fig. 30 – Example: The existing green spaces present a high potential for adaptation of plant species capable of phytoremediation for the remediation of possible existing pollution and for the rehabilitation of the local landscape - photo: Codruț Papina

3.2.2 TOOLKIT OF INTERVENTIONS AND CONCRETE EXAMPLES

R1. Requirements for the inclusion of species capable of phytoremediation within existing green spaces

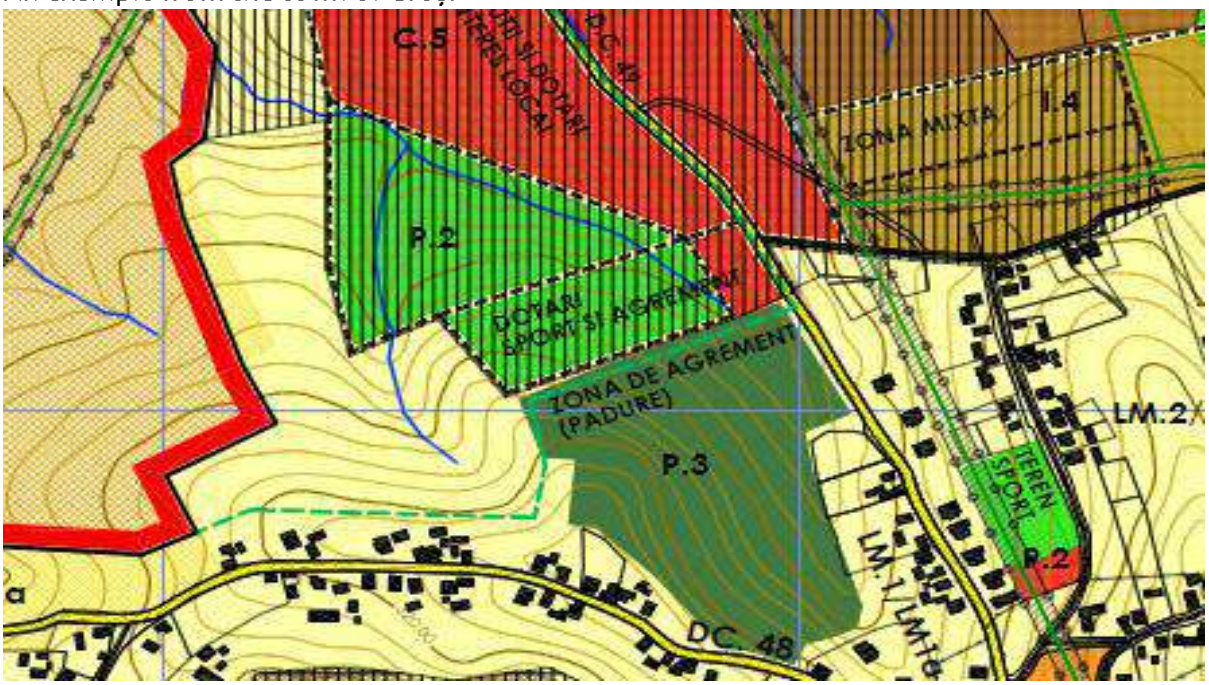
Green public spaces located in the city center (such as parks, squares, etc.) should integrate a mix of diverse species capable of phytoremediation, depending on the landscape. Species with ornamental traits could be used for gardens (such as Berberis thunbergii, Lavandula angustifolia, Mischanthus giganteus, etc.), while different types of trees could accompany various contexts (Thuja spp. could be used along walkways for opaque alignments or to provide better visibility; Fraxinus excelsior, Robinia pseudoacacia, Sorbus aucuparia could be used for shaded walkways, while salix species could be used around water areas such as lakes and ponds). Medium-height bush species (such as Prunus laurocerasus and Juniperus spp) could be used for hedges, while grassland vegetation could be used for greening public spaces. Green spaces located on the outskirts of the city (especially those located near industrial areas) should integrate areas with a high density of plants capable of phytoremediation (urban forests).

Complexity: ⊕⊕⊕⊕⊕

Impact: ⊕⊕⊕⊕

Long term sustainability: ⊕⊕⊕⊕⊕

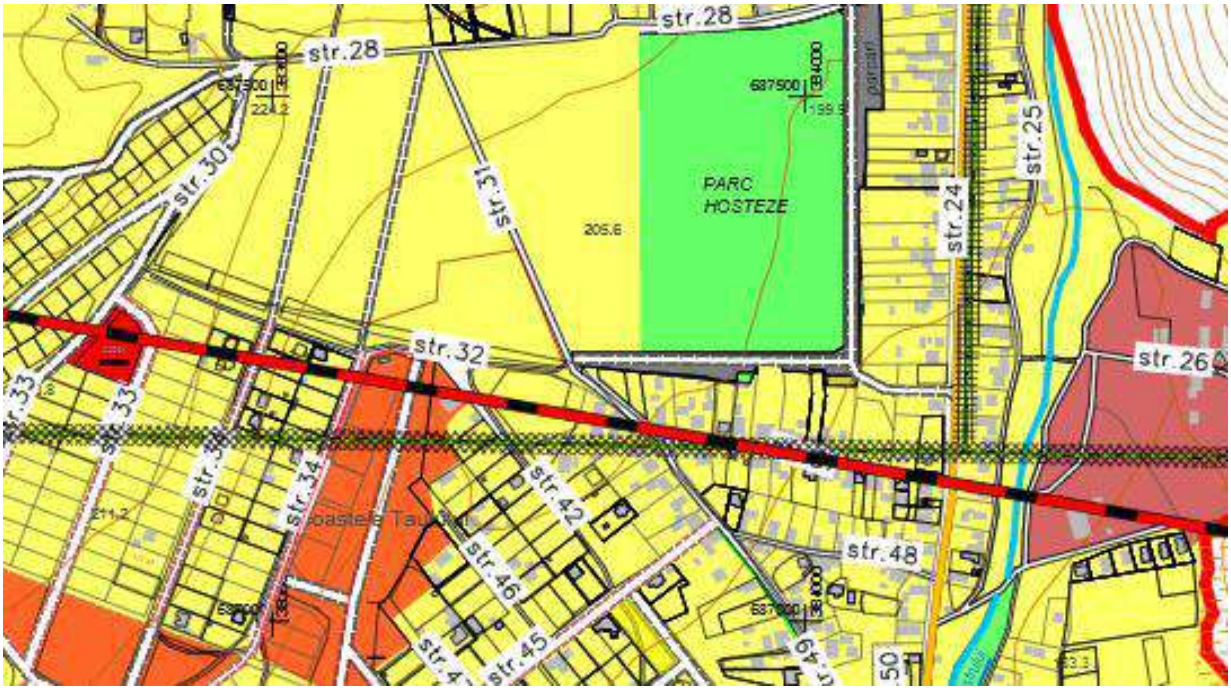
An example from the town of Groși



LEGENDĂ

- Locuințe individuale
- Instituții publice/servicii
- Spații plantate/Agrement/Sport
- Păduri
- Gospodărie comunală/Cimitire
- C-tii aferente lucrărilor tehnico-edilitare

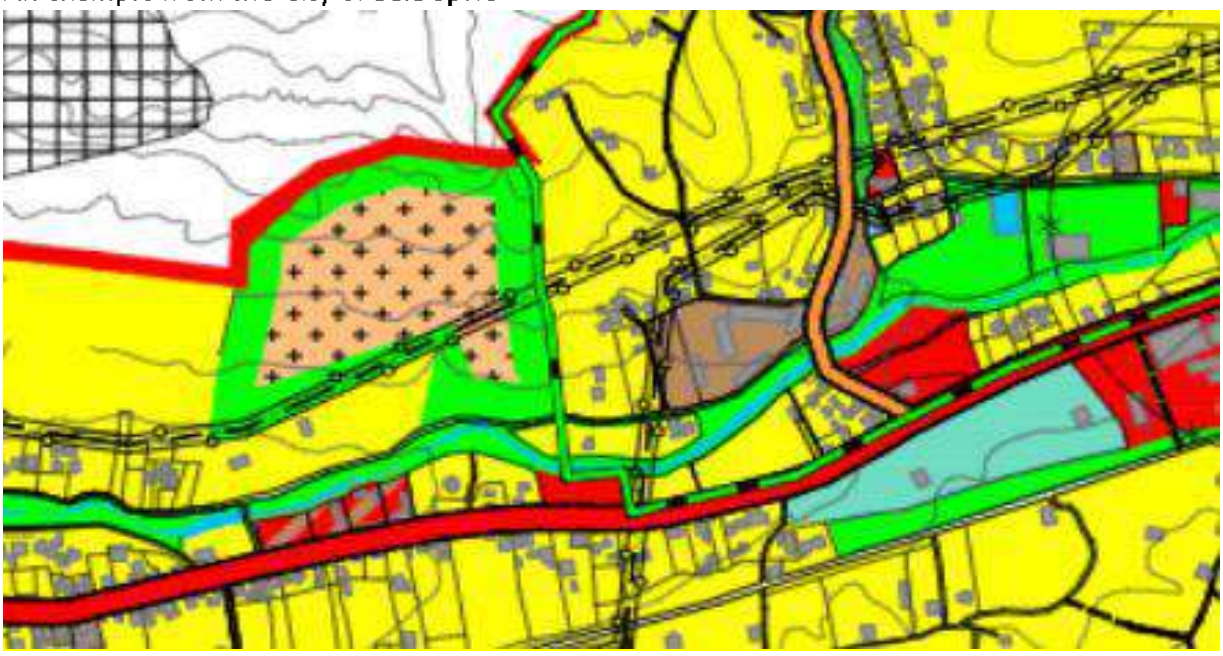
An example from the City of Tăuții Măgherăuș



LEGENDĂ

- Locuințe individuale
- Locuințe colective
- Zonă spații verzi, sport
- Unități industriale și depozite
- Zonă instituții publice și servicii

An example from the City of Baia Sprie



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă gospodărie comunală, cimitire
- Zonă unități agrozootehnice
- Zonă instituții publice și servicii
- Zonă unități industriale și depozite
- Zonă spații verzi, agrement și sport
- Ape

An example from the town of Recea

LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă funcțiuni mixte: servicii, comerț și locuire
- Zona terenurilor cu potențial de amenajare parc, agrement, construcții compatibile (dotări sport-turism, cultură, sănătate, comerț, alimentație publică)
- Zonă gospodărie comunală, cimitire
- Zonă activități productive nepoluante și depozite
- Zonă instituții publice și servicii
- Zonă cu interdicție temporară de construire până la elaborarea PUZ/PUD
- Ape

R2. Requirements for green infrastructure related to mixed areas/collective housing

New mixed-use/collective housing developments should include both medium-height ornamental species (such as Berberis thunbergii, Lavandula angustifolia, Mischanthus giganteus, etc.) in close proximity to buildings and trees with large canopies capable of shading the spaces public (such as Fraxinus excelsior, Robinia). pseudoacacia, Sorbus aucuparia, etc.) within the green corridors accompanying the transport infrastructure.

Medium-height bush species (such as Prunus laurocerasus and Juniperus spp) could be used for hedges, while grassland vegetation could be used for greening public spaces.

Complexity: ⊕⊕⊕⊕

Impact: ⊕⊕⊕⊕

Long term sustainability: ⊕⊕⊕⊕

An example from the City of Tăuții Măgherăuș

LEGENDĂ

- Locuințe colective
- Locuințe individuale
- Zonă instituții publice și servicii
- Gospodărie comunală, cimitire

R3. Green infrastructure requirements for new residential areas (single dwelling)

New residential developments should include both medium-height ornamental species that do not obstruct visibility (such as Berberis thunbergii, Lavandula angustifolia, Mischanthus giganteus, etc.) in close proximity to buildings, and trees with large crowns capable of shading public spaces (such as Fraxinus excelsior, Robinia pseudoacacia, Sorbus aucuparia, etc.), along the green corridors that accompany the transport infrastructure and on the lawns around the constructions, at the permitted distance from them.

Shrubs of medium height (such as Prunus laurocerasus and Juniperus spp) can be used for hedges, while vegetation characteristic of meadows can be used for greening public spaces.

Complexity: ⊕⊕⊕⊕

Impact: ⊕⊕⊕

Long term sustainability: ⊕⊕⊕

An example from the town of Groși

LEGENDĂ

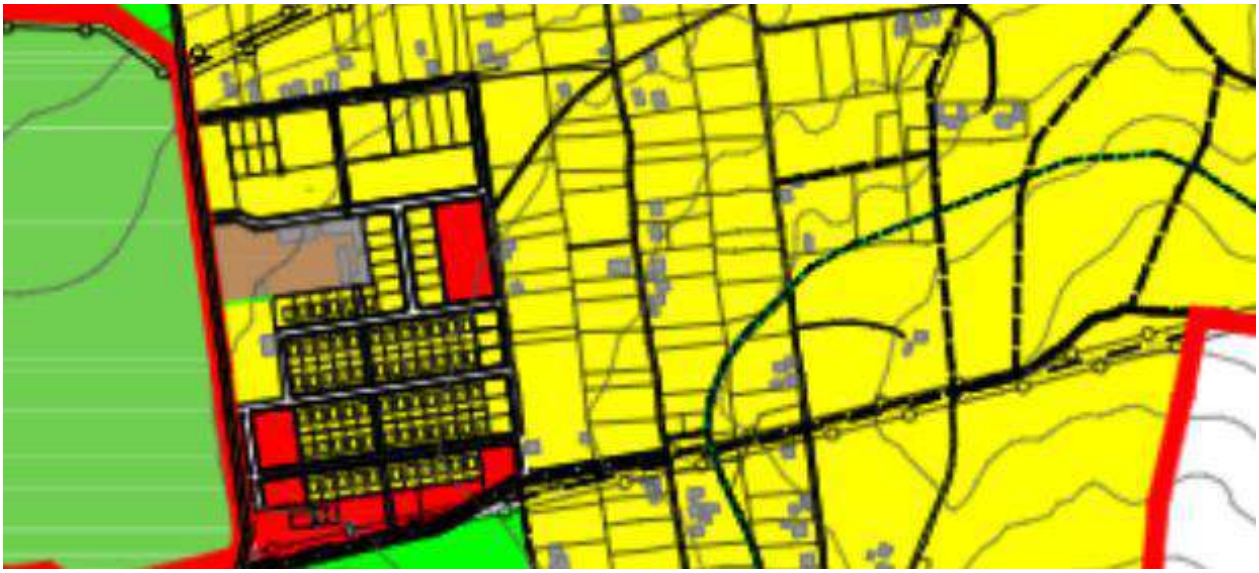
- Locuințe individuale
- Instituții publice/servicii
- Spații plantate/Agrement/Sport
- Gospodărie comunală/Cimitire

An example from the City of Tăuții Măgherăuș

LEGENDĂ

- Locuințe individuale
- Gospodărie comunală, cimitire

An example from the City of Baia Sprie



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă instituții publice și servicii
- Zonă spații verzi, agrement și sport
- Zonă împădurită
- Zonă unități industriale și depozite
- Zonă unități agrozootehnice

An example from the town of Recea

LEGENDĂ

- Zonăpentru locuințe și funcțiuni complementare
- Zona terenurilor cu potențial de amenajare parc, agrement, construcții compatibile (dotări sport-turism, cultură, sănătate, comerț, alimentație publică)
- Zonă activități productive nepoluante și depozite
- Zonă instituții publice și servicii
- Zonă funcțiuni mixte: servicii, comerț, producție și depozite
- Zonă cu interdicție temporară de construire până la elaborarea PUZ/PUD
- Ape

R4. Requirements for green infrastructure related to areas with public institutions/services

The specific character of the public endowment areas does not allow classic willow plantations, from the point of view of the landscape and the specific urban image. However, there are also variants of arrangement with an ornamental role in which the willow is used: tunnel-type plantations, or "green" sculptures. In these situation, an effort is made to maintain and care for the part of a specialist, which makes harvesting for biomass inopportune.

Areas with public institutions and services may include ornamental species (such as Berberis thunbergii, Lavandula angustifolia, Mischanthus giganteus, etc.). Medium height bush species (such as Prunus laurocerasus and Juniperus spp) could be used for hedges, while grassland vegetation should be used for greening public spaces around buildings. Trees from the SPIRE plant selection can be used in alignments (Betula pendula, Catalpa bignoides, Robinia pseudoaccacia) or mixed groups (trees mentioned in the alignments, plus Acer platanoides, Pinus nigra, Sorbus acuparia).

Complexity: ⊕⊕⊕

Impact: ⊕⊕

Long term flexibility: ⊕⊕⊕

An example from the town of Groși

LEGENDĂ

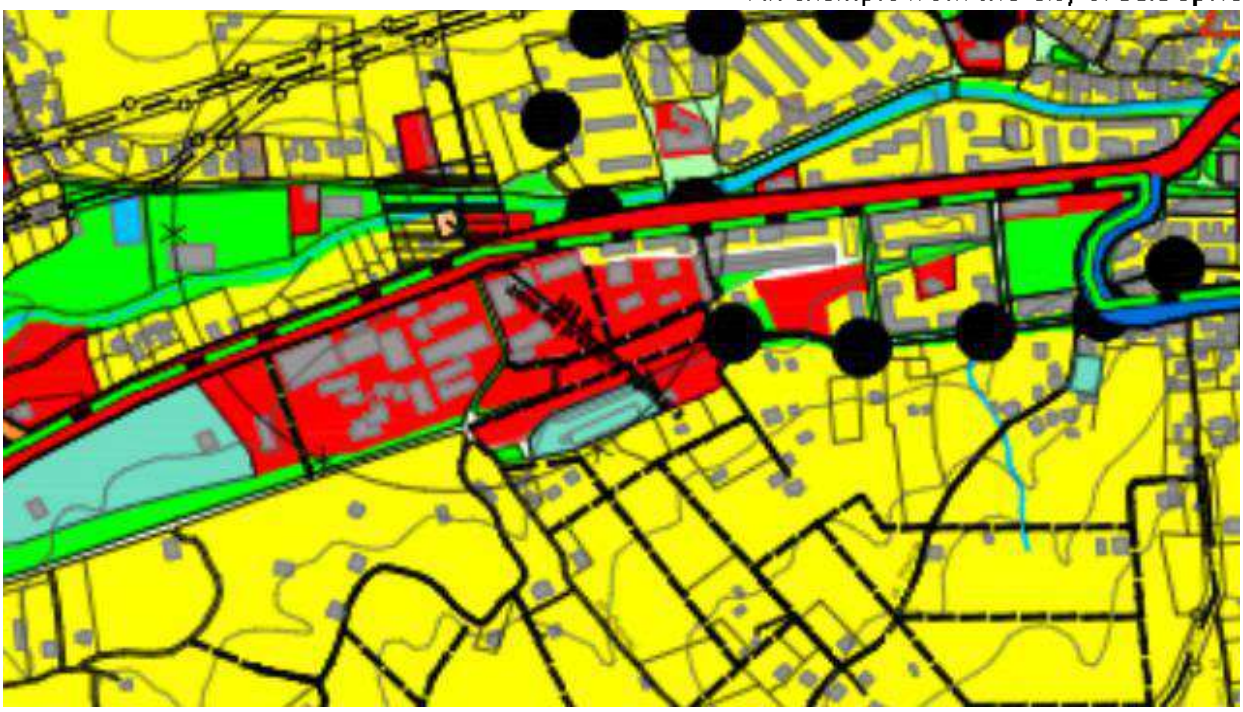
- Locuințe individuale
- Instituții publice/servicii
- Spații plantate/Agrement/Sport
- Locuințe colective
- Gospodărie comunală/Cimitire
- Păduri

An example from the City of Tăuții Măgherăuș

LEGENDĂ

- Locuințe individuale
- Zonă instituții publice și servicii
- Zonă spații verzi, sport

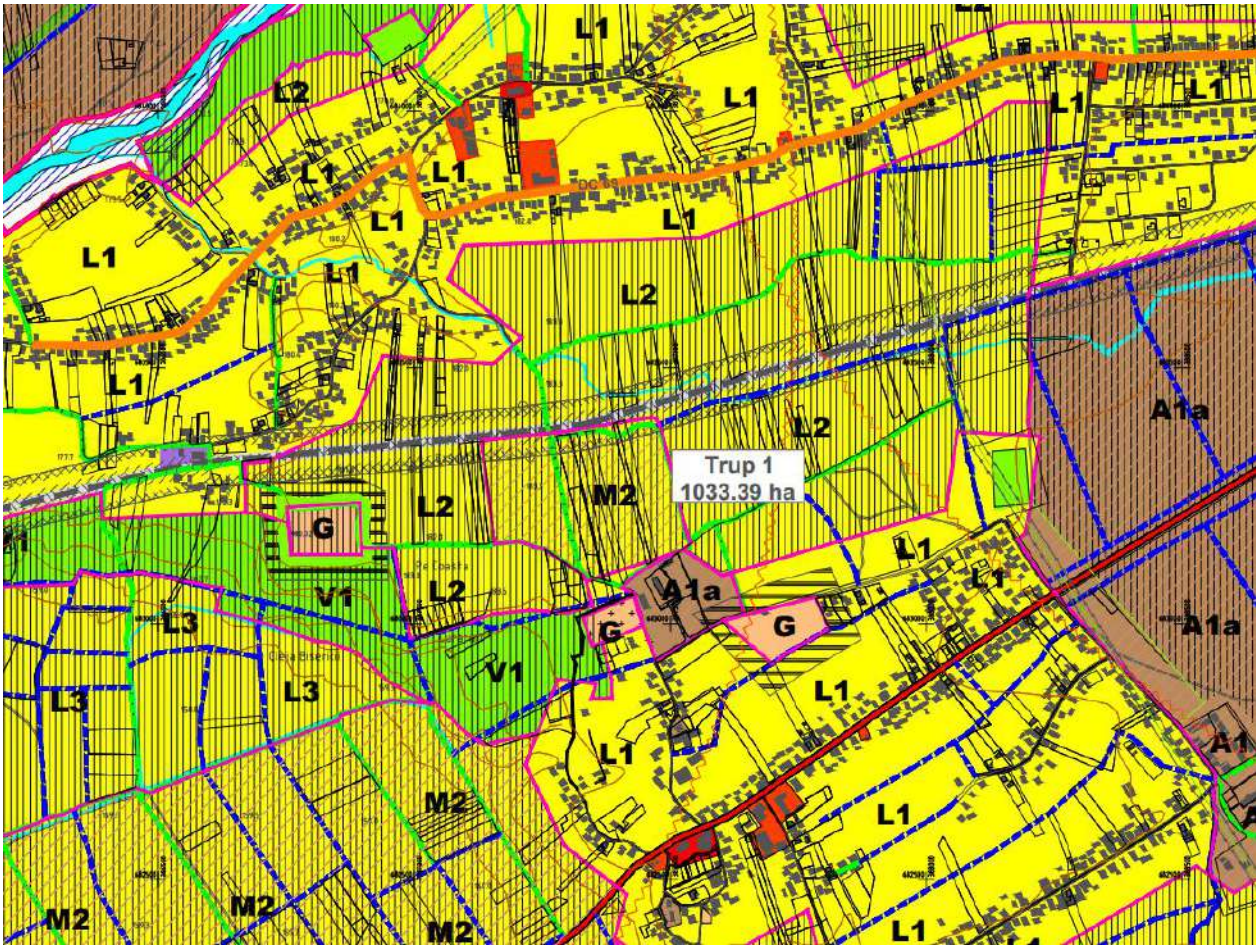
An example from the City of Baia Sprie



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă instituții publice și servicii
- Zonă spații verzi, agrement și sport
- Zonă unități agrozootehnice
- Ape

An example from the town of Recea



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă funcțiuni mixte: servicii, comerț și locuire
- Zona terenurilor cu potențial de amenajare parc, agrement, construcții compatibile (dotări sport-turism, cultură, sănătate, comerț, alim. publică)
- Zonă gospodărie comunală, cimitire
- Zonă activități productive nepoluante și depozite
- Zonă instituții publice și servicii
- Zonă cu interdicție temporară de construire până la elaborarea PUZ/PUD

R5. Requirements for green infrastructure related to active industrial zones

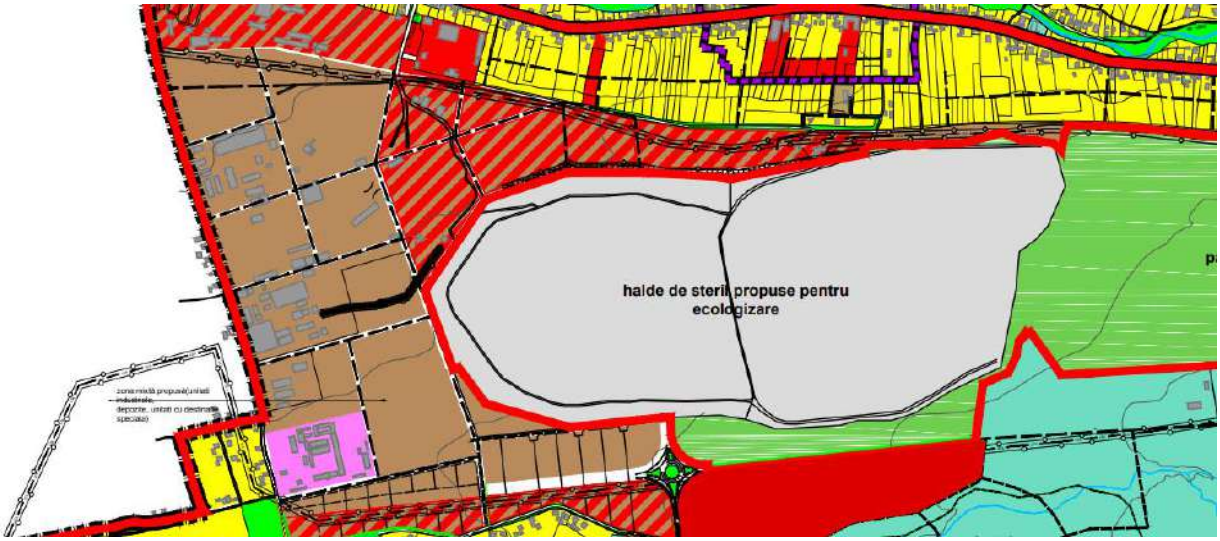
Active industrial areas should prioritize the use of species capable of sequestering HEAVY METAL dust for uplift (such as Prunus laurocerasus and Catalpa bignonioidesglobosa) and soil metal stabilization (such as grassland vegetation). Vegetation characteristic of meadows should be used in the process of greening landfills, while different types of species capable of absorbing more HEAVY METALS from the soil to be chosen according to the current HEAVY METALS) can be used for the green belts of around dumps/industrial areas

Complexity: ⊕⊕⊕⊕

Impact: ⊕⊕

Long term flexibility: ⊕⊕

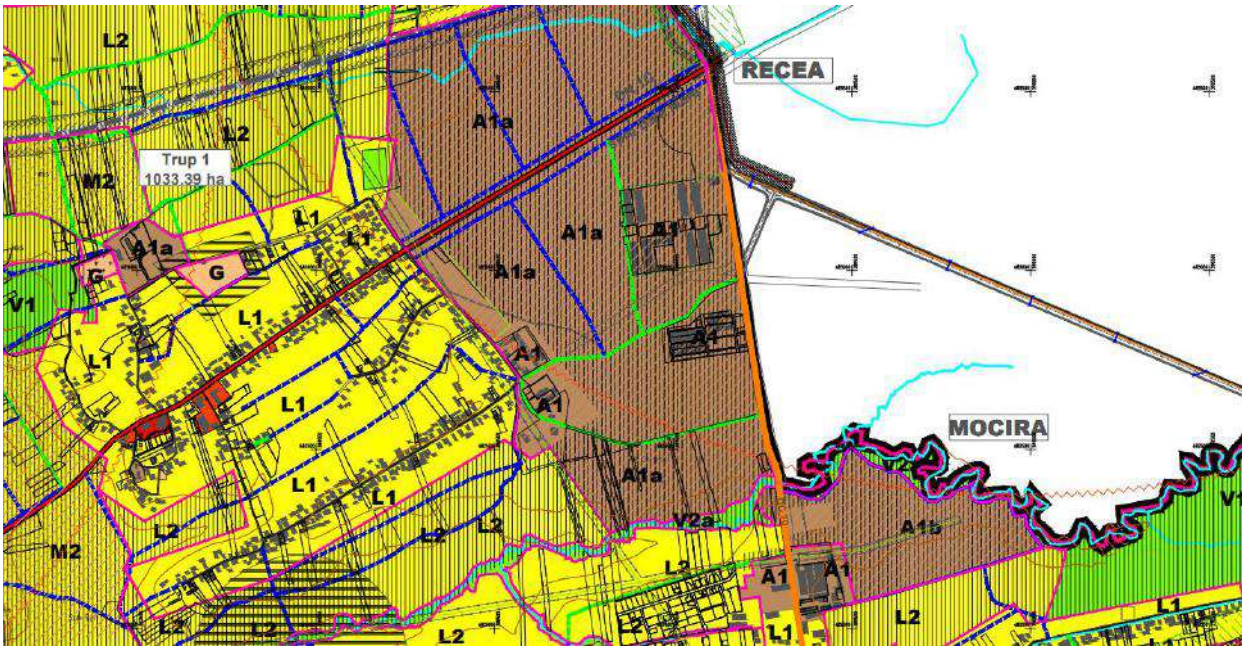
An example from the City of Baia Sprie



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă unități industriale și depozite
- Zonă instituții publice și servicii
- Zonă împădurită
- Zonă cu destinație specială
- Zonă unități agrozootehnice
- Ape
- Zonă destinată dezvoltării unităților economice productive, servicii, depozite

An example from the town of Recea



LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă activități productive nepoluante și depozite
- Zonă cu interdicție temporară de construire până la elaborarea PUZ/PUD
- Zone protejate pe baza normelor sanitare ale iazurilor de decantare
- Ape

R6. Requirements for green infrastructure focused on green-blue corridors

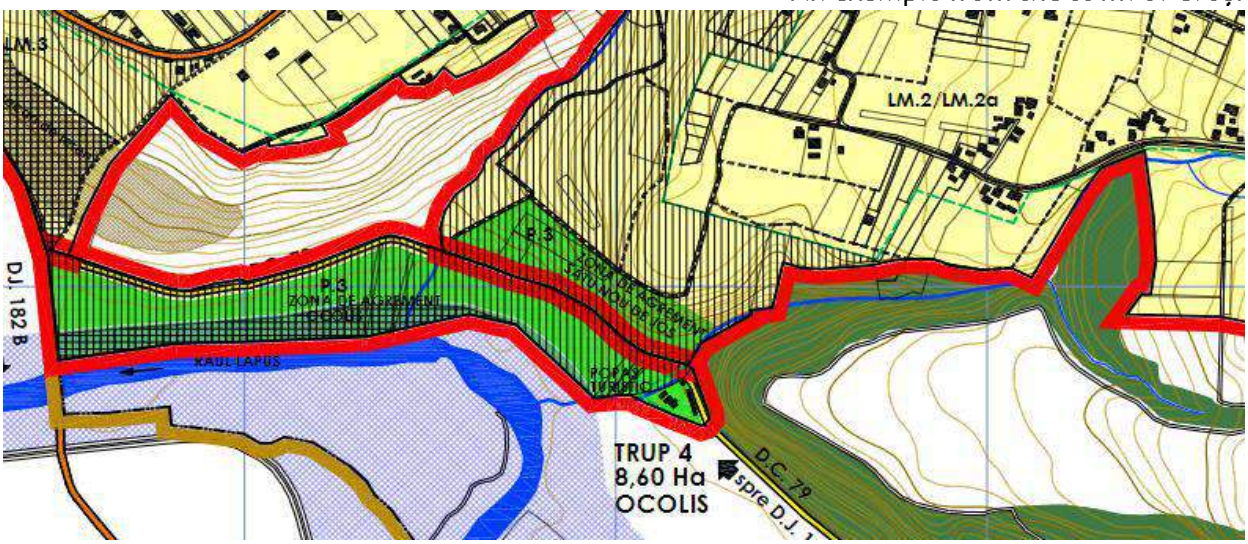
New or revitalized blue-green corridors should include plantings capable of phytoremediation suitable for wetlands, consisting of tree species such as Salix viminalis, Salix alba.

Complexity: ⊕⊕

Impact: ⊕⊕⊕⊕

Long term flexibility: ⊕⊕⊕

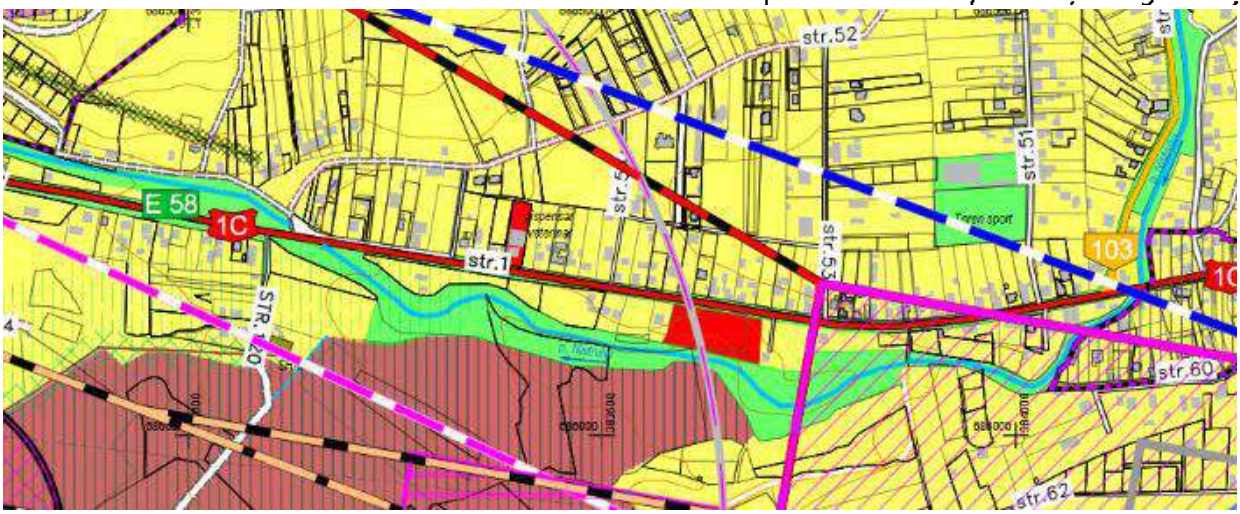
An example from the town of Groși



LEGENDĂ

- Locuințe individuale
- Păduri
- Spații plantate/Agrement/Sport
- Ape

An example from the City of Tăuții Măgherăuș



LEGENDĂ

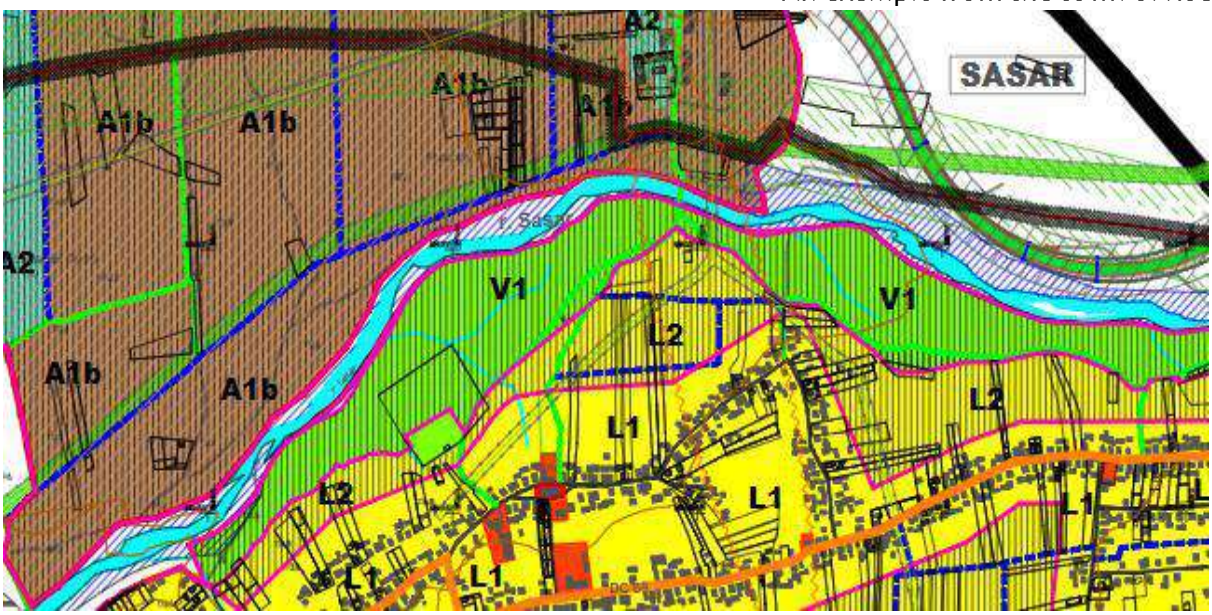
- Locuințe individuale
- Zonă instituții publice și servicii
- Zonă spații verzi, sport
- Unități industriale și depozite/Zonă cu interdicție temporară de construire

An example from the City of Baia Sprie

LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zonă împădurită
- Zonă gospodărie comunală, cimitire
- Zonă unități industriale și depozite
- Zonă spații verzi, agrement și sport
- Zonă instituții publice și servicii
- Zonă destinată dezvoltării unităților economice productive, servicii, depozite
- Ape

An example from the town of Recea



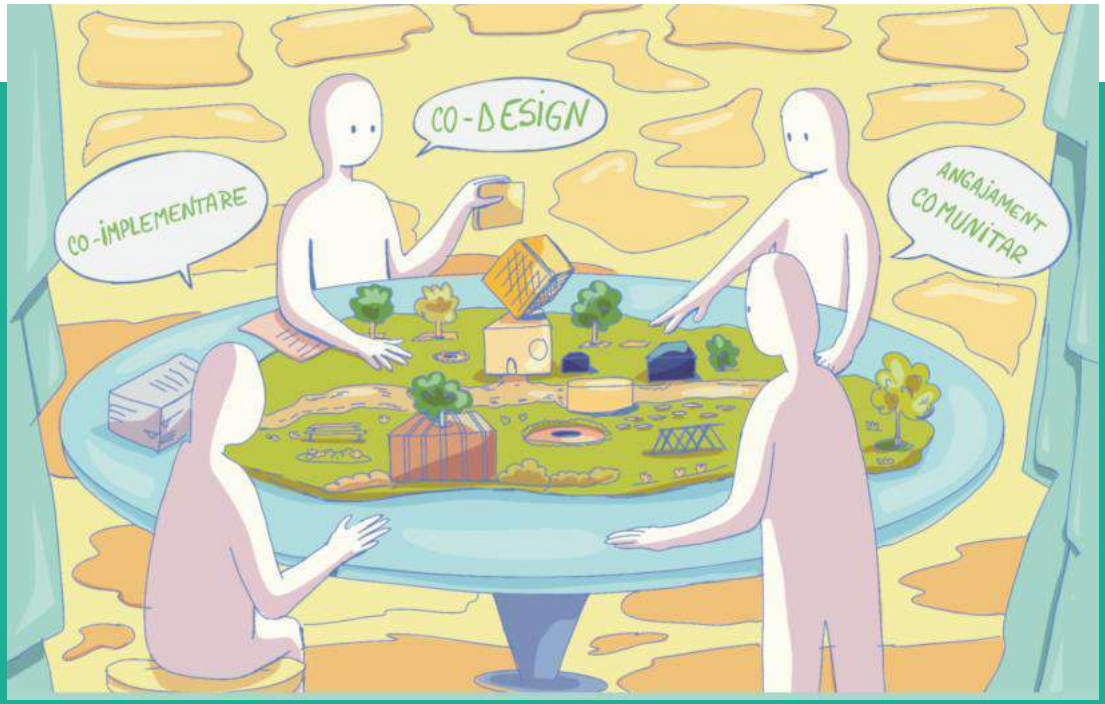
LEGENDĂ

- Zonă pentru locuințe și funcțiuni complementare
- Zona terenurilor cu potențial de amenajare parc, agrement, construcții compatibile (dotări sport-turism, cultură, sănătate, comerț, alim. publ.)
- Zonă instituții publice și servicii
- Zonă cu interdicție temporară de construire până la elaborarea PUZ/PUD
- Zonă funcțiuni mixte: servicii, comerț, producție și depozite
- Ape

3.3 PROPOSAL OF PUBLIC POLICIES AND CIVIC INITIATIVES

3.3.1 METHODOLOGY / INTERVENTION TOOLKIT AND LOCAL LEVEL ADAPTATION PROPOSAL

In chapter 5, a series of public policies and programs are proposed to encourage the community to get involved in the ambitious mission of this strategy to expand the phytoremediation concept throughout the metropolitan area with the support of all urban actors. Local public policy proposals aim to increase awareness and make the population responsible for the environmental problems facing the area in which they live, focusing on reducing historical pollution (through initiatives such as civic planting actions or greening the schoolyard), but integrating also other actions aimed at reducing pressure on the environment (through initiatives such as Christmas tree donation or the harvest festival). In addition, all these actions have a positive impact on civic spirit and community consolidation around a topic of local and even national interest, such as the reduction of heavy metal pollution. Each policy recommendation is accompanied by a brief description of the step-by-step implementation methodology as well as the potential targeted in three major directions: pollution reduction, biomass production and community strengthening.



3.3.2 POLICY PROPOSAL – CIVIC PLANTING ACTIONS

PLANTATHLONS / CIVIC PLANTINGS

Phytoremediation becoming a standard practice in the Baia Mare area.

High impact on environmental quality and urban/rural image.

Starting from the initiative of the SPIRE project, Plantathons will be replicated in all localities in FUA/MA. The program refers to intensive planting campaigns of species capable of phytoremediation identified by the project in key areas of the city identified in the local strategies/GUPs of localities to support the approach of diminishing historical heavy metal pollution in the metropolitan area of Baia Mare.

The species chosen for each planting action will be adapted to the context (e.g. in wetlands various species of salix are recommended, while in forest areas trees are recommended (eg Fraxinus excelsior, Robinia pseudoacacia, Sorbus aucuparia etc.), and in parks will be chosen mixtures of ornamental species. The planting actions will be organized annually in the form of open calls to the community and will be coordinated by specialists from the city hall team. Participants will be rewarded in iLeu, which can later be used to purchase goods and services offered by the partners / city.

3.3.3 POLICY PROPOSAL – DONATE YOUR CHRISTMAS TREE CAMPAIGN

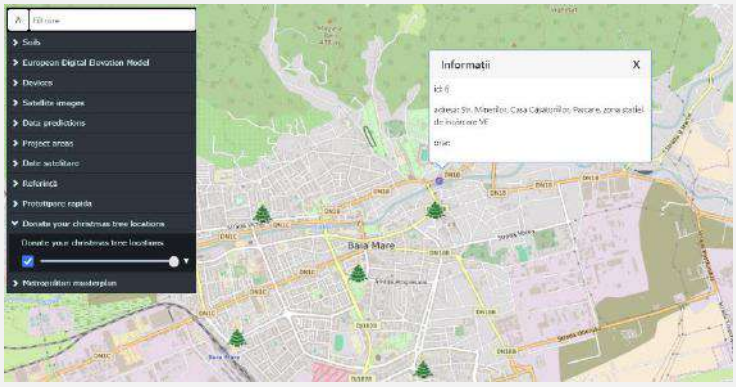
DONATE YOUR CHRISTMAS

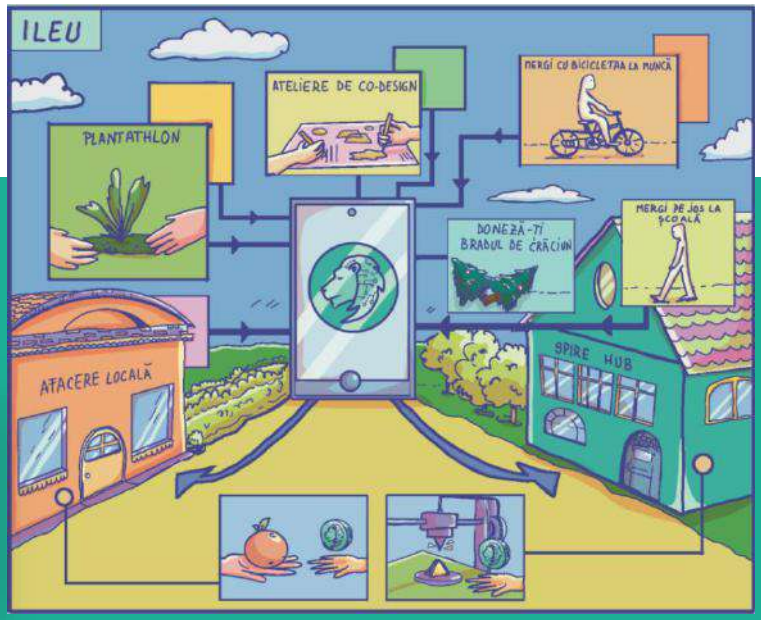
The program will be organized annually at the beginning of the calendar year, and will involve the donation of the Christmas tree in a space specially arranged by the city hall of each locality (public map in the iGIS application) to be subsequently processed and used for biomass production.

Participants will be rewarded in iLeu, which can later be used to purchase goods and services offered by project partners / municipality.

Promoting green behaviour

Annual provision of a relevant amount of biomass (for local systems).





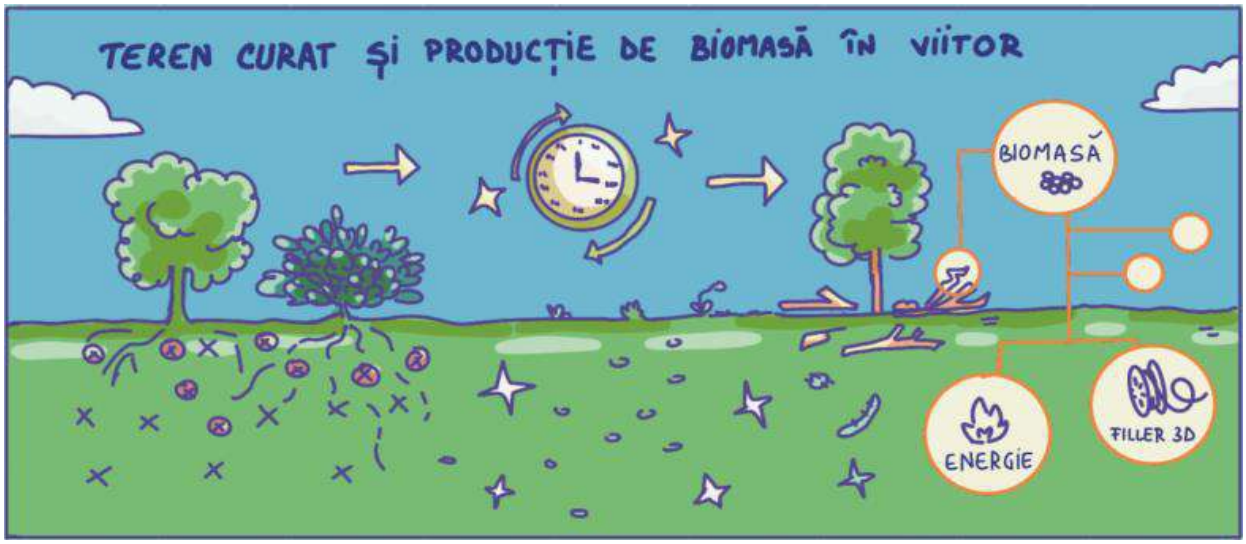
3.3.4 POLICY PROPOSAL – COLLECTION OF BIOMASS/GREEN WASTE

HARVESTFEST

Eco-friendly re-use of green waste for a local energy system.

Potential for achieving biomass energy communities.

The Harvest Festival will be held every year on the 18th of March. It aims to support the Global Recycling Day initiative, aiming to raise awareness about the importance of recycling and encourage people to take action to reduce waste and protect the environment. The festival will take place each year in a different neighbourhood of the partner cities/communes, and will consist of the display and exchange of personal belongings by community members. In addition, various thematic educational workshops will be organized aimed at both the reuse of materials/goods and discussions and campaigns on recycling. The focus will be on intergenerational exchange of experience, focusing on valuing and transferring sustainable practices of older people to the younger generation. Active involvement in the festival (either as an organizer or as a participant with an active contribution) will be rewarded in iLeu, which can later be used to purchase goods and services offered by project partners / municipality.



3.3.5 POLICY PROPOSAL – GREEN ACTIONS IN EDUCATIONAL INSTITUTIONS

GREENING THE SCHOOLYARD

Potential for creating teaching gardens and learning-by-doing programs

Ensuring a healthy, comfortable environment and a natural urban image

The program is addressed to all educational units (kindergartens, primary/secondary education) and involves the inclusion of species capable of phytoremediation in a proportion of at least 50% in the selection of plants for garden arrangement together with students. The targeted actions involve the development by teachers and students of a landscape concept for beautifying the school yard, arranging and planting it, adapting the new spaces to the needs of students (arranging areas dedicated to outdoor lessons / applied research areas on phytoremediation, biodiversity, etc. / recreation areas), ensuring medium and long-term maintenance. The spaces proposed for landscaping include, but are not limited to: lawn areas inside the schoolyard, ornamental gardens near the access to the institution, school walls, etc. In addition to the aesthetic and recreational purpose, the gardens will have a didactic purpose, as they aim to raise awareness among young people about the beneficial role of nature for a healthy environment in the particular context of their city, the role of biodiversity in sustaining ecosystems, the active role they can have in supporting ecosystem services in the urban environment.

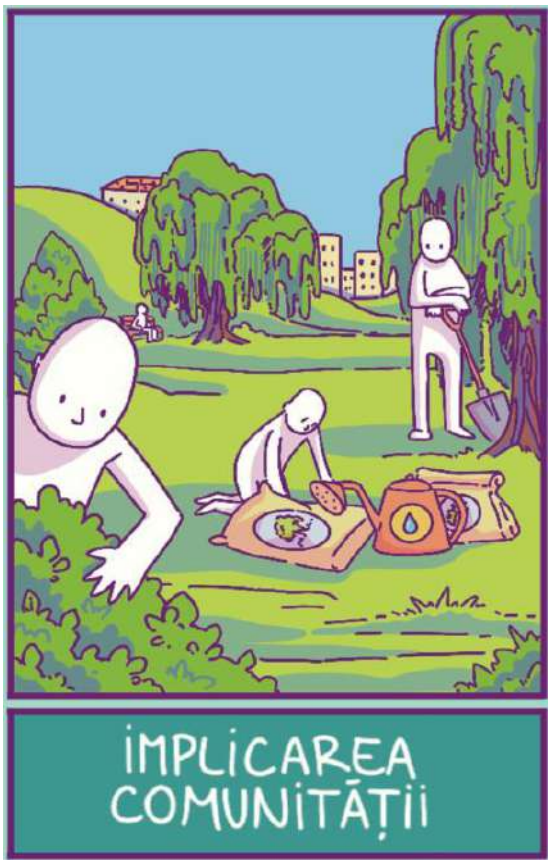
The beneficiaries of the program will be rewarded in the local currency iLeu, depending on the area planted with this type of plants Both students and participating teachers will be rewarded in recurring iLeu, if the garden is maintained/improved so as to further support the process of decontamination and continuous learning. iLeu can be used later for the purchase of goods and services offered by project partners / municipality.

3.3.6 POLICY PROPOSAL – PHYTOREMEDIATION IN PRIVATE GARDENS

PHYTOREMEDIATION IN ONE'S OWN GARDEN

Empowering citizens to ensure optimal living conditions.

Ensuring large-scale remediation of potentially affected land.



The program is addressed to both individual home owners and interested owners' associations, and involves the inclusion of species capable of phytoremediation in a proportion of at least 50% in the selection of plants for the arrangement of private/community gardens. The beneficiaries of the program will be rewarded in the local currency iLeu, depending on a series of criteria such as the area planted with this type of plants (relative to the total area), the contribution made to biodiversity (the diversity of the chosen species), the contribution made to the community (proposals for planning that will include spaces that encourage socialization will receive extra points), circular approaches (e.g. biomass production – with the support of the town hall for collection/transport and partnerships with local producers). The effort will be rewarded recurrently (annually) if the garden is maintained/improved so as to further support the decontamination process. iLEU will be able to be used later for the purchase of goods and services offered by the project partners / municipality.

4. METROPOLITAN MASTERPLAN – FUA

Table 23 - Legend: project tokens located at FUA level

Each localized project/measure/recommendation has an indicative, which contains 3 abbreviations: Position 1 – type of project/intervention, Position 2 – TAU or territorial level, Position 3 – Reference to Solutions and Recommendations Toolkit.	
Indicative position 1 – Type of project	
S_ : Related SIDU/SUMP projects	
P_ : Pilot Projects and Local Regulation Proposals and Long-Term Strategic Measures	
I_ : Additional strategic interventions	
Indicative position 2 – Territorial level	
FUA	Functional Urban area
_BM_	Baia Mare Municipality
_BS_	Baia Sprie (city)
_R_	Recea Commune
_G_	Groși Commune
_T_	Tăuții Măgherăuș (city)
Indicative position 3 – Nature-Based Solutions Toolkit – see 3.1 PRO	
_F - Intervention related to nature-based solutions toolkit	
_F1: Forests with phytoremediation role / major planting actions	
_F2: Regeneration and rewilding of green-blue corridors	
_F3: Plantations with a protective role (corridors or buffer zones)	
_F4: Green corridors linking mobility infrastructures	
_F5: Green corridors and strategic connections with the natural environment	
_F6: Protection zone type plantations in peripheral areas of settlement	
_F7: Plantations and vegetation completions for the rehabilitation of abandoned lands	
_F8: Additions with species capable of phytoremediation in existing green spaces	
Indicative position 3 – Intervention Toolkit Recommendations for land use – see 3.2	
_R Local regulation proposals and long-term strategic measures	
_R1. Requirements for inclusion of species capable of phytoremediation in existing green areas	
_R2. Requirements for green infrastructure related to mixed areas/collective housing	
_R3. Requirements for green infrastructure related to new residential areas (individual housing)	
_R4. Requirements for green infrastructure related to areas with public institutions/services	
_R5. Requirements for green infrastructure related to active industrial areas	
_R6. Requirements for green infrastructure focusing on green-blue corridors	
_R7. Restrictions for food crops	

MASTERPLAN 2050

- TAU limit
- SIDU/PMUD projects (S)
- Pilot projects - local interventions (P)
- Zoning regulaitons and strategic measures related to pilot projects (R)
- Additional strategic interventions/investments (I)

- _F1: Forests with phytoremediation role / major planting actions
- _F2: Regeneration and renaturation of the green-blue corridors
- _F3: Plantations with a protective role (corridors or buffer zones)
- _F4: Green corridors in connection with mobility infrastructures
- _F5: Green corridors and strategic connections with the natural environment
- _F6: Protection zone plantations in the peripheral areas of the settlement
- _F7: Plantings and additions of vegetation for the rehabilitation of abandoned lands
- _F8: Additions with species capable of phytoremediation in existing green spaces

- _R1. Requirements for inclusion of species capable of phytoremediation in existing green areas
- _R2. Requirements for green infrastructure related to mixed areas/collective housing
- _R3. Requirements for green infrastructure related to new residential areas (individual housing)
- _R4. Requirements for green infrastructure related to areas with public institutions/services
- _R5. Requirements for green infrastructure related to active industrial areas
- _R7. Restrictions for food crops

TĂUTII MAGHERĂUS

BAIA MARE

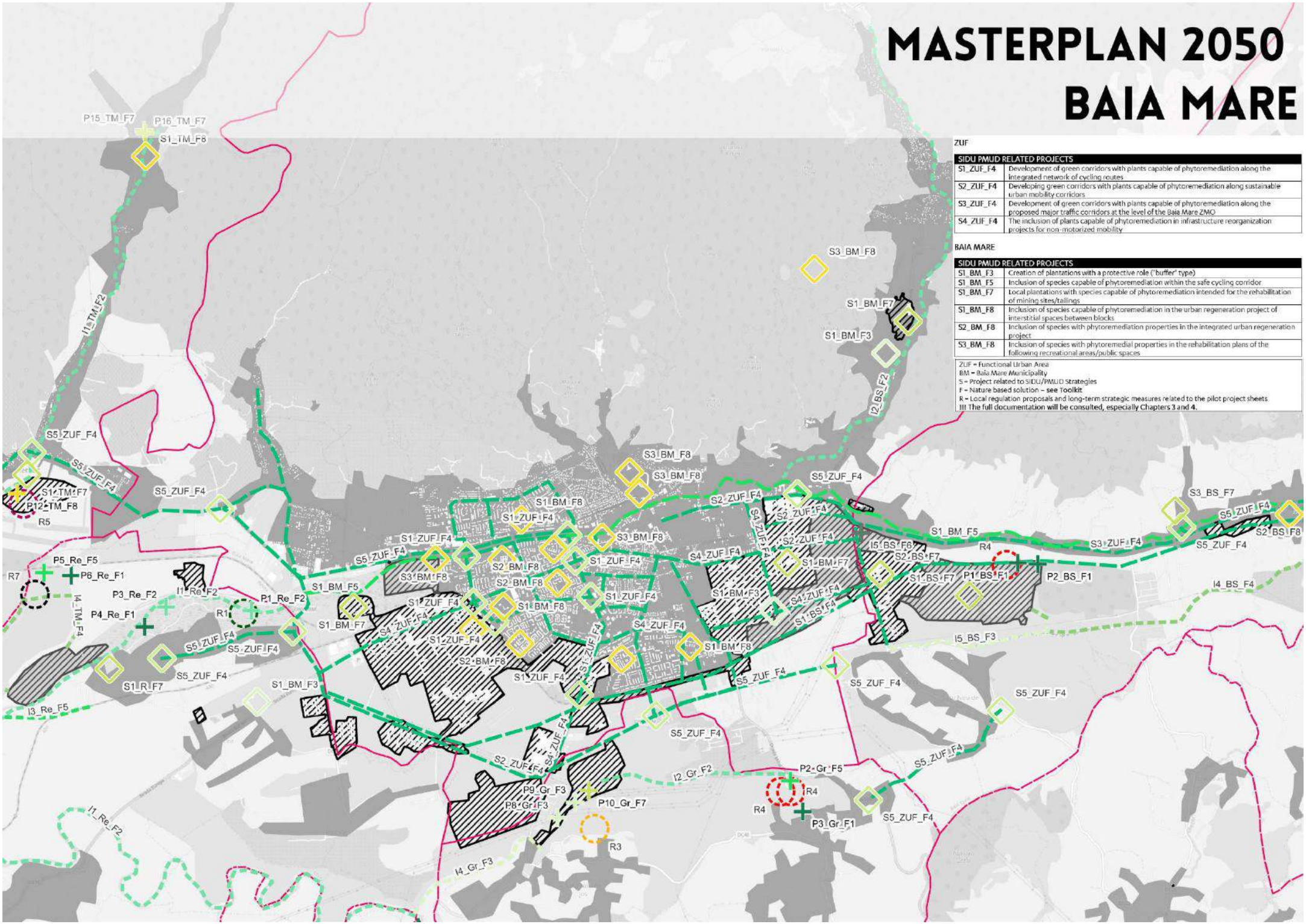
BAIA SPRIE

RECEA

GROSI

0 1 2 3 4 5 km

MASTERPLAN 2050
BAIA MARE



ZUF

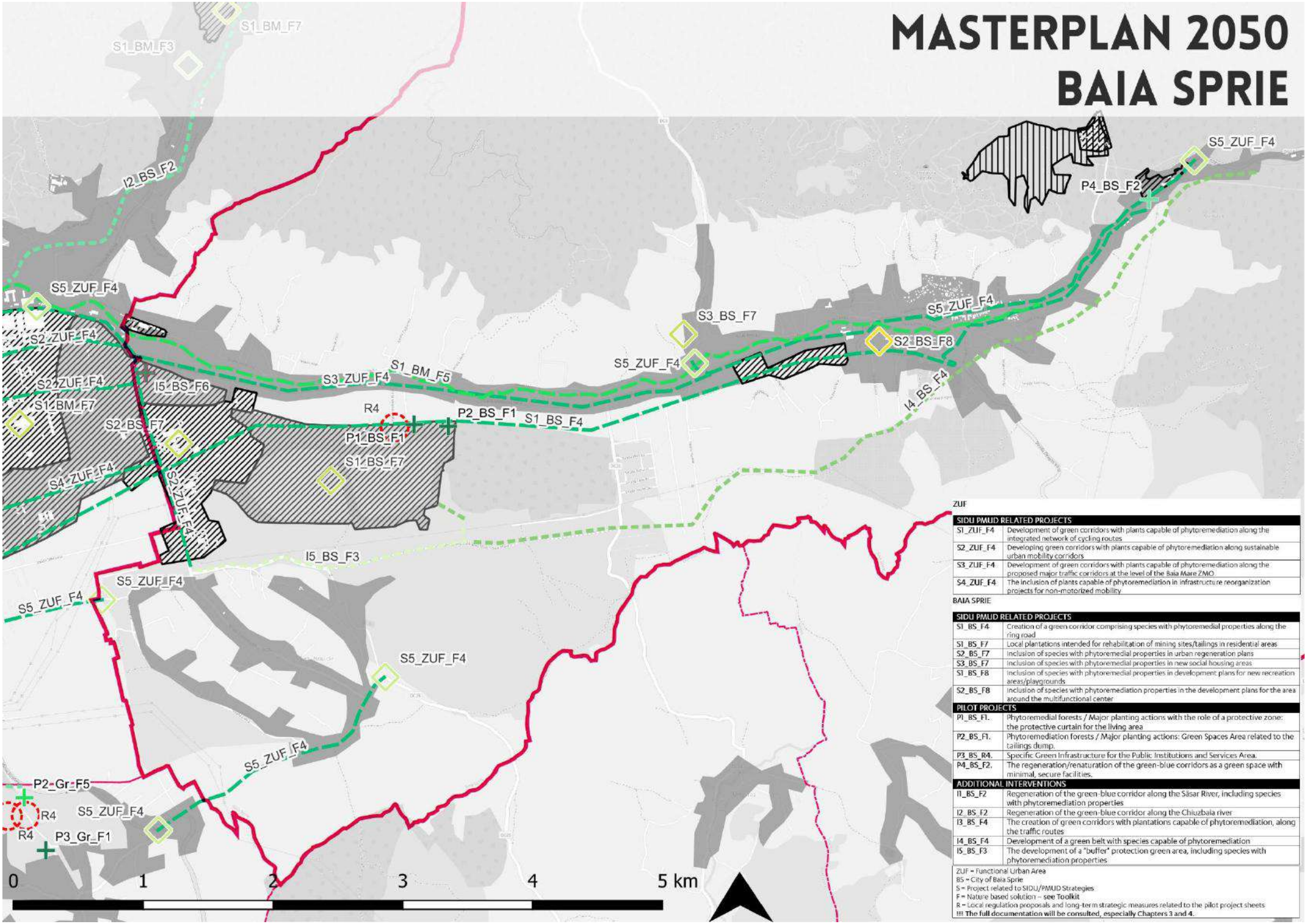
SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

BAIA MARE

SIDU PMUD RELATED PROJECTS	
S1_BM_F3	Creation of plantations with a protective role ("buffer" type)
S1_BM_F5	Inclusion of species capable of phytoremediation within the safe cycling corridor
S1_BM_F7	Local plantations with species capable of phytoremediation intended for the rehabilitation of mining sites/tailings
S1_BM_F8	Inclusion of species capable of phytoremediation in the urban regeneration project of interstitial spaces between blocks
S2_BM_F8	Inclusion of species with phytoremediation properties in the integrated urban regeneration project
S3_BM_F8	Inclusion of species with phytoremedial properties in the rehabilitation plans of the following recreational areas/public spaces

ZUF = Functional Urban Area
BM = Baia Mare Municipality
S = Project related to SIDU/PMUD Strategies
F = Nature based solution – **see Toolkit**
R = Local regulation proposals and long-term strategic measures related to the pilot project sheets
!!! The full documentation will be consulted, especially Chapters **3** and **4**.

MASTERPLAN 2050
BAIA SPRIE



ZUF

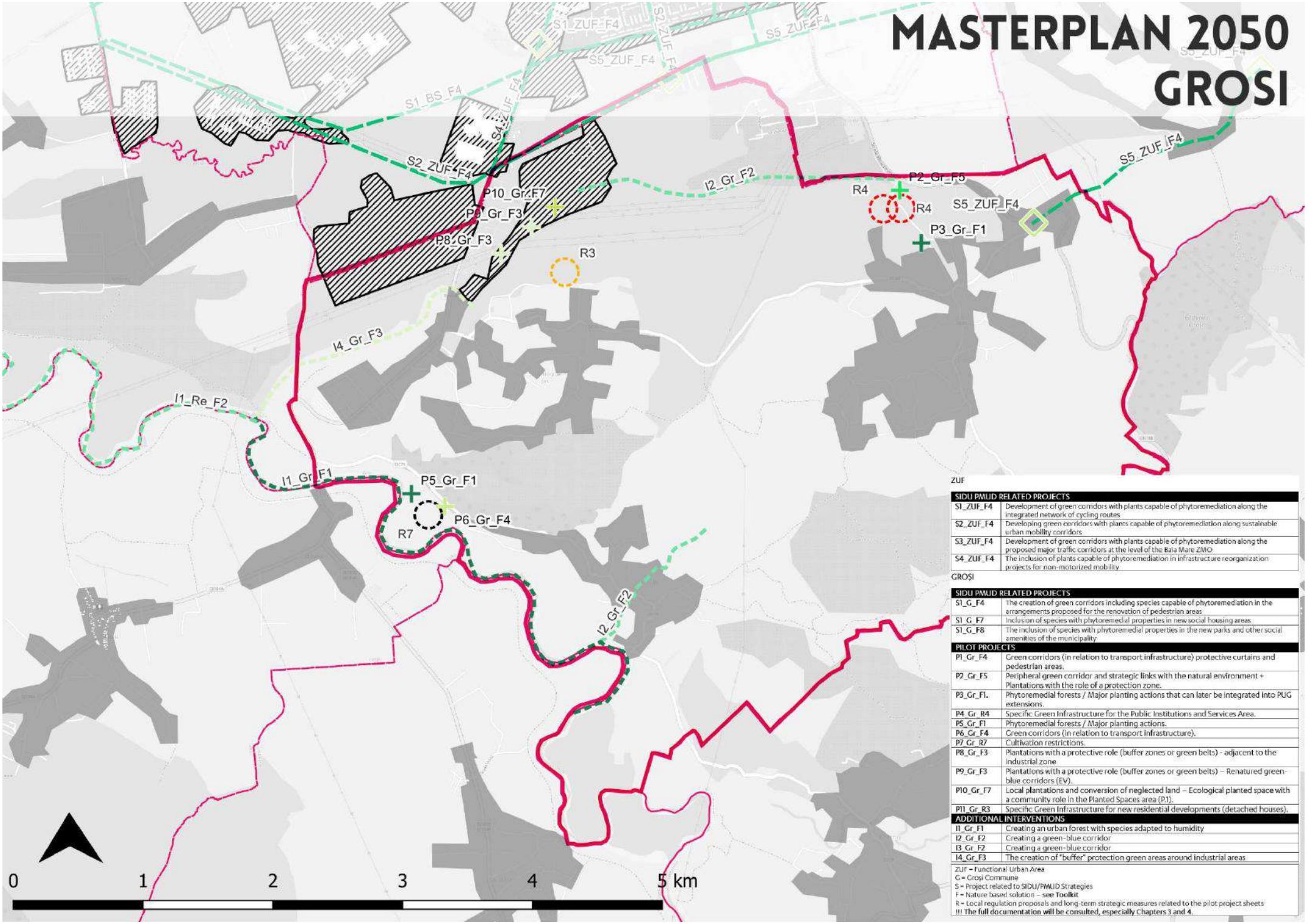
SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

BAIA SPRIE

SIDU PMUD RELATED PROJECTS	
S1_BS_F4	Creation of a green corridor comprising species with phytoremedial properties along the ring road
S1_BS_F7	Local plantations intended for rehabilitation of mining sites/tailings in residential areas
S2_BS_F7	Inclusion of species with phytoremedial properties in urban regeneration plans
S3_BS_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_BS_F8	Inclusion of species with phytoremedial properties in development plans for new recreation areas/playgrounds
S2_BS_F8	Inclusion of species with phytoremediation properties in the development plans for the area around the multifunctional center
PILOT PROJECTS	
P1_BS_F1.	Phytoremedial forests / Major planting actions with the role of a protective zone: the protective curtain for the living area
P2_BS_F1.	Phytoremediation forests / Major planting actions: Green Spaces Area related to the tailings dump.
P3_BS_R4.	Specific Green Infrastructure for the Public Institutions and Services Area.
P4_BS_F2.	The regeneration/renaturation of the green-blue corridors as a green space with minimal, secure facilities.
ADDITIONAL INTERVENTIONS	
I1_BS_F2	Regeneration of the green-blue corridor along the Săsar River, including species with phytoremediation properties
I2_BS_F2	Regeneration of the green-blue corridor along the Chiuzbaia river
I3_BS_F4	The creation of green corridors with plantations capable of phytoremediation, along the traffic routes
I4_BS_F4	Development of a green belt with species capable of phytoremediation
I5_BS_F3	The development of a "buffer" protection green area, including species with phytoremediation properties

ZUF = Functional Urban Area
BS = City of Baia Sprie
S = Project related to SIDU/PMUD Strategies
F = Nature based solution – see Toolkit
R = Local regulation proposals and long-term strategic measures related to the pilot project sheets
!!! **The full documentation will be consulted, especially Chapters 3 and 4.**

MASTERPLAN 2050
GROȘI



ZUF

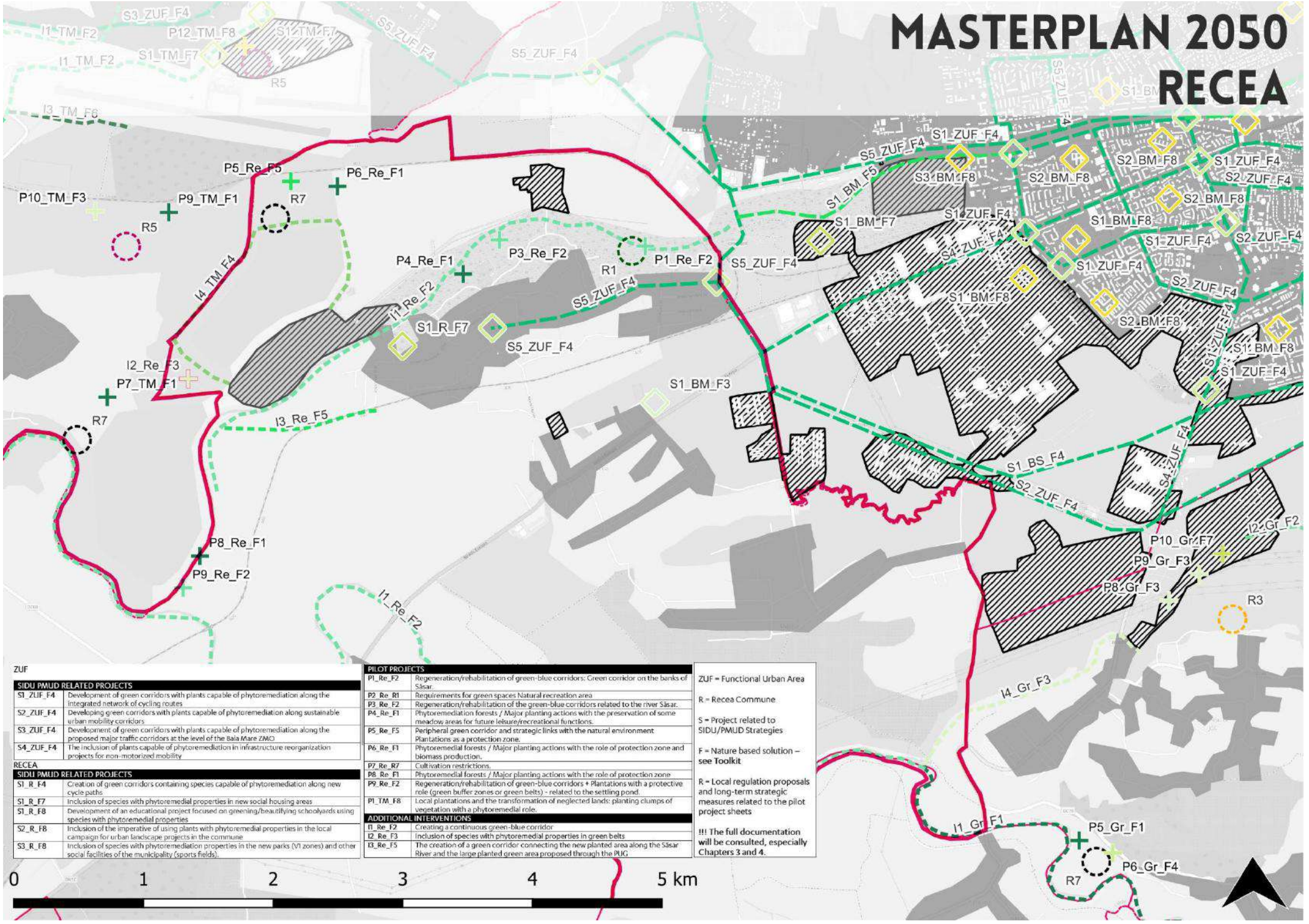
SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

GROȘI

SIDU PMUD RELATED PROJECTS	
S1_G_F4	The creation of green corridors including species capable of phytoremediation in the arrangements proposed for the renovation of pedestrian areas
S1_G_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_G_F8	The inclusion of species with phytoremedial properties in the new parks and other social amenities of the municipality
PILOT PROJECTS	
P1_Gr_F4	Green corridors (in relation to transport infrastructure) protective curtains and pedestrian areas.
P2_Gr_F5	Peripheral green corridor and strategic links with the natural environment + Plantations with the role of a protection zone.
P3_Gr_F1.	Phytoremedial forests / Major planting actions that can later be integrated into PUG extensions.
P4_Gr_R4	Specific Green Infrastructure for the Public Institutions and Services Area.
P5_Gr_F1	Phytoremedial forests / Major planting actions.
P6_Gr_F4	Green corridors (in relation to transport infrastructure).
P7_Gr_R7	Cultivation restrictions.
P8_Gr_F3	Plantations with a protective role (buffer zones or green belts) - adjacent to the industrial zone
P9_Gr_F3	Plantations with a protective role (buffer zones or green belts) – Renatured green-blue corridors (EV).
P10_Gr_F7	Local plantations and conversion of neglected land – Ecological planted space with a community role in the Planted Spaces area (P.1).
P11_Gr_R3	Specific Green Infrastructure for new residential developments (detached houses).
ADDITIONAL INTERVENTIONS	
I1_Gr_F1	Creating an urban forest with species adapted to humidity
I2_Gr_F2	Creating a green-blue corridor
I3_Gr_F2	Creating a green-blue corridor
I4_Gr_F3	The creation of "buffer" protection green areas around industrial areas

ZUF – Functional Urban Area
G – Groși Commune
S – Project related to SIDU/PMUD Strategies
F – Nature based solution – **see Toolkit**
R – Local regulation proposals and long-term strategic measures related to the pilot project sheets
!!! The full documentation will be consulted, especially Chapters 3 and 4.

MASTERPLAN 2050
RECEA



ZUF

SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

RECEA

SIDU PMUD RELATED PROJECTS	
S1_R_F4	Creation of green corridors containing species capable of phytoremediation along new cycle paths
S1_R_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_R_F8	Development of an educational project focused on greening/beautifying schoolyards using species with phytoremedial properties
S2_R_F8	Inclusion of the imperative of using plants with phytoremedial properties in the local campaign for urban landscape projects in the commune
S3_R_F8	Inclusion of species with phytoremediation properties in the new parks (VI zones) and other social facilities of the municipality (sports fields).

PILOT PROJECTS	
P1_Re_F2	Regeneration/rehabilitation of green-blue corridors: Green corridor on the banks of Săsar.
P2_Re_R1	Requirements for green spaces Natural recreation area
P3_Re_F2	Regeneration/rehabilitation of the green-blue corridors related to the river Săsar.
P4_Re_F1	Phytoremediation forests / Major planting actions with the preservation of some meadow areas for future leisure/recreational functions.
P5_Re_F5	Peripheral green corridor and strategic links with the natural environment Plantations as a protection zone.
P6_Re_F1	Phytoremedial forests / Major planting actions with the role of protection zone and biomass production.
P7_Re_R7	Cultivation restrictions.
P8_Re_F1	Phytoremedial forests / Major planting actions with the role of protection zone
P9_Re_F2	Regeneration/rehabilitation of green-blue corridors + Plantations with a protective role (green buffer zones or green belts) - related to the settling pond.
P1_TM_F8	Local plantations and the transformation of neglected lands: planting clumps of vegetation with a phytoremedial role.
ADDITIONAL INTERVENTIONS	
I1_Re_F2	Creating a continuous green-blue corridor
I2_Re_F3	Inclusion of species with phytoremedial properties in green belts
I3_Re_F5	The creation of a green corridor connecting the new planted area along the Săsar River and the large planted green area proposed through the PUG

ZUF = Functional Urban Area

R = Recea Commune

S = Project related to SIDU/PMUD Strategies

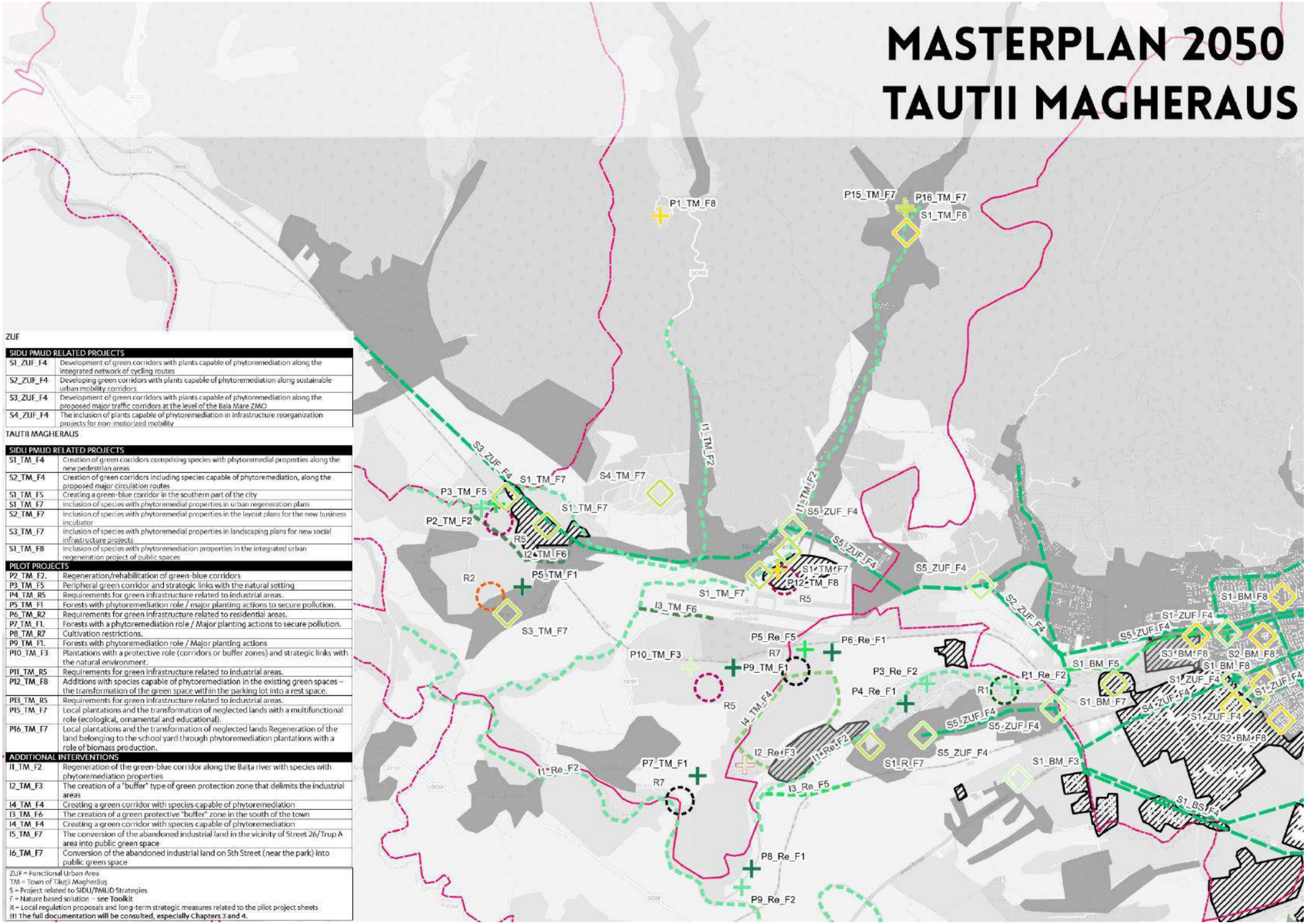
F = Nature based solution – **see Toolkit**

R = Local regulation proposals and long-term strategic measures related to the pilot project sheets

!!! The full documentation will be consulted, especially Chapters 3 and 4.

0 1 2 3 4 5 km

MASTERPLAN 2050
TAUTII MAGHERAUS



ZUF

SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

TAUTII MAGHERAUS

SIDU PMUD RELATED PROJECTS	
S1_TM_F4	Creation of green corridors comprising species with phytoremedial properties along the new pedestrian areas
S2_TM_F4	Creation of green corridors including species capable of phytoremediation, along the proposed major circulation routes
S1_TM_F5	Creating a green-blue corridor in the southern part of the city
S1_TM_F7	Inclusion of species with phytoremedial properties in urban regeneration plans
S2_TM_F7	Inclusion of species with phytoremedial properties in the layout plans for the new business incubator
S3_TM_F7	Inclusion of species with phytoremedial properties in landscaping plans for new social infrastructure projects
S1_TM_F8	Inclusion of species with phytoremediation properties in the integrated urban regeneration project of public spaces
PILOT PROJECTS	
P2_TM_F2.	Regeneration/rehabilitation of green-blue corridors
P3_TM_F5	Peripheral green corridor and strategic links with the natural setting
P4_TM_R5	Requirements for green infrastructure related to industrial areas.
P5_TM_F1	Forests with phytoremediation role / major planting actions to secure pollution.
P6_TM_R2	Requirements for green infrastructure related to residential areas.
P7_TM_F1.	Forests with a phytoremediation role / Major planting actions to secure pollution.
P8_TM_R7	Cultivation restrictions.
P9_TM_F1.	Forests with phytoremediation role / Major planting actions
P10_TM_F3	Plantations with a protective role (corridors or buffer zones) and strategic links with the natural environment.
P11_TM_R5	Requirements for green infrastructure related to industrial areas.
P12_TM_F8	Additions with species capable of phytoremediation in the existing green spaces – the transformation of the green space within the parking lot into a rest space.
P13_TM_R5	Requirements for green infrastructure related to industrial areas.
P15_TM_F7	Local plantations and the transformation of neglected lands with a multifunctional role (ecological, ornamental and educational).
P16_TM_F7	Local plantations and the transformation of neglected lands Regeneration of the land belonging to the school yard through phytoremediation plantations with a role of biomass production.
ADDITIONAL INTERVENTIONS	
I1_TM_F2	Regeneration of the green-blue corridor along the Baița river with species with phytoremediation properties
I2_TM_F3	The creation of a "buffer" type of green protection zone that delimits the industrial areas
I4_TM_F4	Creating a green corridor with species capable of phytoremediation
I3_TM_F6	The creation of a green protective "buffer" zone in the south of the town
I4_TM_F4	Creating a green corridor with species capable of phytoremediation
I5_TM_F7	The conversion of the abandoned industrial land in the vicinity of Street 26/Trup A area into public green space
I6_TM_F7	Conversion of the abandoned industrial land on 5th Street (near the park) into public green space

ZUF = Functional Urban Area
TM = Town of Tăuții Măgherăuș
S = Project related to SIDU/PMUD Strategies
F = Nature based solution – see Toolkit
R = Local regulation proposals and long-term strategic measures related to the pilot project sheets
!!! The full documentation will be consulted, especially Chapters 3 and 4.

CONCLUSIONS

Tackling historical pollution is a national priority, reducing the area of contaminated sites and achieving an acceptable risk of pollution to human health and the environment by 2050 is a national desideratum. The management of contaminated areas is a complex process that requires close collaboration between public authorities at national, regional and local level, private actors and the community, involving the development of efficient tools and mechanisms for inventory, investigation, remediation and reintroduction into the socio-economic circuit.

Baia Mare Metropolitan Area presents a series of critical areas in terms of soil pollution with heavy metals, both public and private, which significantly affects the decontamination approach. Their presence has significant socio-economic repercussions, generating a negative impact on the health and well-being of the population (serious diseases, unemployment, poverty, marginalization, disadvantaged areas).

Within the SPIRE project, a consultation process of all stakeholders in the ZMBM area took place. As a result of participatory activities (workshops and questionnaires) emerges the need of residents to have access to a greener, healthier and safer built environment. The studied territory has a number of qualities relevant from the perspective of the natural landscape, but which, as a result of mining and industrial activities, has been severely affected. The regeneration of polluted lands and the recovery of gradient areas through green actions in an integrated manner is considered a priority.

Currently, green and green-blue infrastructure at FUA and metropolitan level is relatively fragmented. The 2050 Masterplan locates a series of projects and initiatives with the aim of reconnecting natural elements, urban green areas and the specific landscape of rural areas, all with the aim of GREEN REGENERATION - creating an infrastructure that ensures a better relationship of people with Nature and protects communities from pollution, creating an ecological environment that in time will erase the traces of environmental disasters of the last 40 years.

Targeting such green investments, although badly needed, can be difficult for a territory that is still going through a socio-economic post-industrial transition. Thus, the 2050 Strategy has developed an adaptive and flexible instrument of interventions to ensure the adaptation of phytoremediation by all relevant means: targeted investments, related investments, land use regulations, public policies.

BIBLIOGRAPHY

Atlas of Marginalized Urban Areas. Link: https://documents1.worldbank.org/curated/en/857001468293738087/pdf/882420WP0P143008523 2B00OUO0900Atlas.pdf

Damian, F., Damian, G., Lacatusu, R., Macovei ,G., Iepure, G., Napradean I., Chira R., Kollar L., Rata L., Zaharia D. (2008). Soils in Baia Mare area and heavy metal pollution, Carpathian Journal of Earth and Environment Sciences, 3, 85 – 98.

Pietro Lupo Verga, Natalia Onesciuc, Tania Cecilia,Mihailescu, Anca Dorina Plesa, Boglarka Vajda, Sebestyen Tihamer,Sorin Pop, Ciprian Radu Ghise, Carmen Irina Ghise, Ana Maria Pop. D4.3.1 State of Art and Innovation Landscape report. Link: https://www.researchgate.net/publication/341151297_D431_-_State_of_the_Art_Innovation_Landscape_Report

Pietro Lupo Verga, Tania Cecilia Mihaiescu, Anca Dorina Plesa, Natalia Onesciuc. D4.3.3 State of Play in Baia Mare. Desk analysis research repository and awareness appraisal. Link: https://www.researchgate.net/publication/342437863_State_of_Play_in_Baia_Mare_Desk_Analysis_Research_Repository_and_Awareness_Appraisal

Baia Mare Sustainable Urban Mobility Plan 2017-2030. Link: https://www.baiamare.ro/Baiamare/Plan%20de%20Mobilitate%20Urbana/PMUD%20Baia%20Mare%2001.09.2017.pdf

North-West Regional Operational Plan 2021-2027. Link: https://www.nord-vest.ro/wp-content/uploads/2022/05/POR-NV-2021_2027.pdf

General Urban Plan of Baia Mare / Baia Sprie / Recea / Tăutii Măgherăuș

Annual Report on the State of the Environment in Romania for 2019. Link: http://www.anpm.ro/documents/12220/2209838/RSM+2019_final.pdf/b11fb172-f220-4d0a-8cc8-7a4863935518

Data report on potentially contaminated sites. http://www.anpm.ro/date-situri-potential-contaminate

Ruxandra Tănase, Alice Iliescu, Teodora Predescu, Evelina-Maria Grigorean –SPIRE Guide. Link: https://spire.city/wp-content/uploads/2023/06/1.GHID-SPIRE-RO-11.05.2023.pdf

National Strategy and Action Plan for the Management of Contaminated Sites in Romania. Link: http://www.mmediu.ro/beta/wp-content/uploads/2014/02/2014-02-13_STRATEGIA.pdf

Maramureș County Sustainable Development Strategy for 2014-2020. Link: https://www.cjmaramures.ro/attachments/strategie/Strategia%20de%20Dezvoltare%20Durabila%20a%20Judetului%20Maramures%202014-2020.pdf

Baia Mare Functional Urban Area Integrated Development Strategy (SIDU 2015-2030).Link: https://www.baiamare.ro/Baiamare/Strategia%20Integrata%20de%20Dezvoltare%20Urbana/02.ANEXA_SIDU1.pdf

Integrated Urban Development Strategy Tăutii Măgherăuș

ANNEX 1 – LIST OF PROJECTS AND RECOMMENDATIONS

LEGEND

Each localized project/measure/recommendation has an indicative, which contains 3 abbreviations: Position 1 – type of project/intervention, Position 2 – TAU or territorial level, Position 3 – Reference to Solutions and Recommendations Toolkit.

Indicative position 1 – Type of project

S_ : Related SIDU/SUMP projects
P_ : Pilot Projects and Local Regulation Proposals and Long-Term Strategic Measures
I_ : Additional strategic interventions

Indicative position 2 – Territorial level

FUA	**Urban Functional Area**
_BM_	**Baia Mare Municipality**
_BS_	**Baia Sprie City**
_R_	**Recea Commune**
_G_	**Groși Commune**
_T_	**Tăuții Măgherăuș City**

Indicative position 3 – Nature-Based Solutions Toolkit

_F - Interventions related to the nature-based solutions toolkit
_F1: Forests with phytoremediation role / major planting actions
_F2: Regeneration and rewilding of green-blue corridors
_F3: Plantations with a protective role (corridors or buffer zones)
_F4: Green corridors linking mobility infrastructures
_F5: Green corridors and strategic connections with the natural environment
_F6: Protection zone type plantations in peripheral areas of settlement
_F7: Plantations and vegetation completions for the rehabilitation of abandoned lands
_F8: Additions with species capable of phytoremediation in existing green spaces

Indicative position 3 – Intervention Toolkit Recommendations for land use

_R Local regulation proposals and long-term strategic measures
_R1. Requirements for inclusion of species capable of phytoremediation in existing green areas
_R2. Requirements for green infrastructure related to mixed areas/collective housing
_R3. Requirements for green infrastructure related to new residential areas (individual housing)
_R4. Requirements for green infrastructure related to areas with public institutions/services
_R5. Requirements for green infrastructure related to active industrial areas
_R6. Requirements for green infrastructure focusing on green-blue corridors

EUROPEAN UNION

ZUF

SIDU PMUD RELATED PROJECTS	
S1_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the integrated network of cycling routes
S2_ZUF_F4	Developing green corridors with plants capable of phytoremediation along sustainable urban mobility corridors
S3_ZUF_F4	Development of green corridors with plants capable of phytoremediation along the proposed major traffic corridors at the level of the Baia Mare ZMO
S4_ZUF_F4	The inclusion of plants capable of phytoremediation in infrastructure reorganization projects for non-motorized mobility

BAIA MARE

SIDU PMUD RELATED PROJECTS	
S1_BM_F3	Creation of plantations with a protective role ("buffer" type)
S1_BM_F5	Inclusion of species capable of phytoremediation within the safe cycling corridor
S1_BM_F7	Local plantations with species capable of phytoremediation intended for the rehabilitation of mining sites/tailings
S1_BM_F8	Inclusion of species capable of phytoremediation in the urban regeneration project of interstitial spaces between blocks
S2_BM_F8	Inclusion of species with phytoremediation properties in the integrated urban regeneration project
S3_BM_F8	Inclusion of species with phytoremedial properties in the rehabilitation plans of the following recreational areas/public spaces

BAIA SPRIE

SIDU PMUD RELATED PROJECTS	
S1_BS_F4	Creation of a green corridor comprising species with phytoremedial properties along the ring road
S1_BS_F7	Local plantations intended for rehabilitation of mining sites/tailings in residential areas
S2_BS_F7	Inclusion of species with phytoremedial properties in urban regeneration plans
S3_BS_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_BS_F8	Inclusion of species with phytoremedial properties in development plans for new recreation areas/playgrounds
S2_BS_F8	Inclusion of species with phytoremediation properties in the development plans for the area around the multifunctional center
PILOT PROJECTS	
P1_BS_F1.	Phytoremedial forests / Major planting actions with the role of a protective zone: the protective curtain for the living area

P2_BS_F1.	Phytoremediation forests / Major planting actions: Green Spaces Area related to the tailings dump.
P3_BS_R4.	Specific Green Infrastructure for the Public Institutions and Services Area.
P4_BS_F2.	The regeneration/renaturation of the green-blue corridors as a green space with minimal, secure facilities.
ADDITIONAL INTERVENTIONS	
I1_BS_F2	Regeneration of the green-blue corridor along the Săsar River, including species with phytoremediation properties
I2_BS_F2	Regeneration of the green-blue corridor along the Chiuzbaia river
I3_BS_F4	The creation of green corridors with plantations capable of phytoremediation, along the traffic routes
I4_BS_F4	Development of a green belt with species capable of phytoremediation
I5_BS_F3	The development of a "buffer" protection green area, including species with phytoremediation properties

GROSI	
SIDU PMUD RELATED PROJECTS	
S1_G_F4	The creation of green corridors including species capable of phytoremediation in the arrangements proposed for the renovation of pedestrian areas
S1_G_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_G_F8	The inclusion of species with phytoremedial properties in the new parks and other social amenities of the municipality
PILOT PROJECTS	
P1_Gr_F4	Green corridors (in relation to transport infrastructure) protective curtains and pedestrian areas.
P2_Gr_F5	Peripheral green corridor and strategic links with the natural environment + Plantations with the role of a protection zone.
P3_Gr_F1.	Phytoremedial forests / Major planting actions that can later be integrated into PUG extensions.
P4_Gr_R4	Specific Green Infrastructure for the Public Institutions and Services Area.
P5_Gr_F1	Phytoremedial forests / Major planting actions.
P6_Gr_F4	Green corridors (in relation to transport infrastructure).
P7_Gr_R7	Cultivation restrictions.
P8_Gr_F3	Plantations with a protective role (buffer zones or green belts) - adjacent to the industrial zone
P9_Gr_F3	Plantations with a protective role (buffer zones or green belts) – Renatured green-blue corridors (EV).

P10_Gr_F7	Local plantations and conversion of neglected land – Ecological planted space with a community role in the Planted Spaces area (P.1).
P11_Gr_R3	Specific Green Infrastructure for new residential developments (detached houses).
ADDITIONAL INTERVENTIONS	
I1_Gr_F1	Creating an urban forest with species adapted to humidity
I2_Gr_F2	Creating a green-blue corridor
I3_Gr_F2	Creating a green-blue corridor
I4_Gr_F3	The creation of "buffer" protection green areas around industrial areas

RECEA

SIDU PMUD RELATED PROJECTS	
S1_R_F4	Creation of green corridors containing species capable of phytoremediation along new cycle paths
S1_R_F7	Inclusion of species with phytoremedial properties in new social housing areas
S1_R_F8	Development of an educational project focused on greening/beautifying schoolyards using species with phytoremedial properties
S2_R_F8	Inclusion of the imperative of using plants with phytoremedial properties in the local campaign for urban landscape projects in the commune
S3_R_F8	Inclusion of species with phytoremediation properties in the new parks (V1 zones) and other social facilities of the municipality (sports fields).
PILOT PROJECTS	
P1_Re_F2	Regeneration/rehabilitation of green-blue corridors: Green corridor on the banks of Săsar.
P2_Re_R1	Requirements for green spaces Natural recreation area
P3_Re_F2	Regeneration/rehabilitation of the green-blue corridors related to the river Săsar.
P4_Re_F1	Phytoremediation forests / Major planting actions with the preservation of some meadow areas for future leisure/recreational functions.
P5_Re_F5	Peripheral green corridor and strategic links with the natural environment Plantations with the role of a protection zone.
P6_Re_F1	Phytoremedial forests / Major planting actions with the role of protection zone and biomass production.
P7_Re_R7	Cultivation restrictions.
P8_Re_F1	Phytoremedial forests / Major planting actions with the role of protection zone
P9_Re_F2	Regeneration/rehabilitation of green-blue corridors + Plantations with a protective role (green buffer zones or green belts) - related to the settling pond.

P1_TM_F8	Local plantations and the transformation of neglected lands: planting clumps of vegetation with a phytoremedial role.
ADDITIONAL INTERVENTIONS	
I1_Re_F2	Creating a continuous green-blue corridor
I2_Re_F3	Inclusion of species with phytoremedial properties in green belts
I3_Re_F5	The creation of a green corridor connecting the new planted area along the Săsar River and the large planted green area proposed through the PUG

TAUTII MAGHERAUS

SIDU PMUD RELATED PROJECTS	
S1_TM_F4	Creation of green corridors comprising species with phytoremedial properties along the new pedestrian areas
S2_TM_F4	Creation of green corridors including species capable of phytoremediation, along proposed major traffic routes
S1_TM_F5	Creating a green-blue corridor in the southern part of the city
S1_TM_F7	Inclusion of species with phytoremedial properties in urban regeneration plans
S2_TM_F7	Inclusion of species with phytoremedial properties in the layout plans for the new business incubator
S3_TM_F7	Inclusion of species with phytoremedial properties in landscaping plans for new social infrastructure projects
S1_TM_F8	Inclusion of species with phytoremediation properties in the integrated urban regeneration project of public spaces
PILOT PROJECTS	
P2_TM_F2.	Regeneration/rehabilitation of green-blue corridors
P3_TM_F5	Peripheral green corridor and strategic links with the natural setting
P4_TM_R5	Requirements for green infrastructure related to industrial areas.
P5_TM_F1	Forests with phytoremediation role / major planting actions to secure pollution.
P6_TM_R2	Requirements for green infrastructure related to residential areas.
P7_TM_F1.	Forests with a phytoremediation role / Major planting actions to secure pollution.
P8_TM_R7	Cultivation restrictions.
P9_TM_F1.	Forests with phytoremediation role / Major planting actions
P10_TM_F3	Plantations with a protective role (corridors or buffer zones) and strategic links with the natural environment.
P11_TM_R5	Requirements for green infrastructure related to industrial areas.

P12_TM_F8	Additions with species capable of phytoremediation in the existing green spaces – the transformation of the green space within the parking lot into a rest space.
P13_TM_R5	Requirements for green infrastructure related to industrial areas.
P15_TM_F7	Local plantations and the transformation of neglected lands with a multifunctional role (ecological, ornamental and educational).
P16_TM_F7	Local plantations and the transformation of neglected lands Regeneration of the land belonging to the school yard through phytoremediation plantations with a role of biomass production.
ADDITIONAL INTERVENTIONS	
I1_TM_F2	Regeneration of the green-blue corridor along the Baița river with species with phytoremediation properties
I2_TM_F3	The creation of a "buffer" type of green protection zone that delimits the industrial areas
I4_TM_F4	Creating a green corridor with species capable of phytoremediation
I3_TM_F6	The creation of a green protective "buffer" zone in the south of the town
I4_TM_F4	Creating a green corridor with species capable of phytoremediation
I5_TM_F7	The conversion of the abandoned industrial land in the vicinity of Street 26/Trup A area into public green space
I6_TM_F7	Conversion of the abandoned industrial land on 5th Street (near the park) into public green space

PROPOSAL FOR PUBLIC POLICIES AND CIVIC INITIATIVES – FOR ZUF AND THE METROPOLITAN AREA	
1	Civic planting actions – Plantathlons
2	Donate the Christmas tree
3	Biomass/green waste collection
4	Green actions in educational institutions
5	Phytoremediation in private gardens

ANNEX 2 – THE SELECTION OF SPIRE PLANTS FOR THE PHYTOREMEDIATION OF POLLUTED LAND

EUROPEAN UNION

ACER PLATANOIDES

Acer platanoides

Popular name: Ar tsar, Field paltin
Category: tree
Characteristics: height 15-30 m, diameter 9-15 m

It has low demands on the soil, is resistant to very low temperatures and drought, with a very fast growth rate. It is appreciated both for the quality of the wood and for the therapeutic effects of the leaves and fruits. It has a high tolerance to pollution.

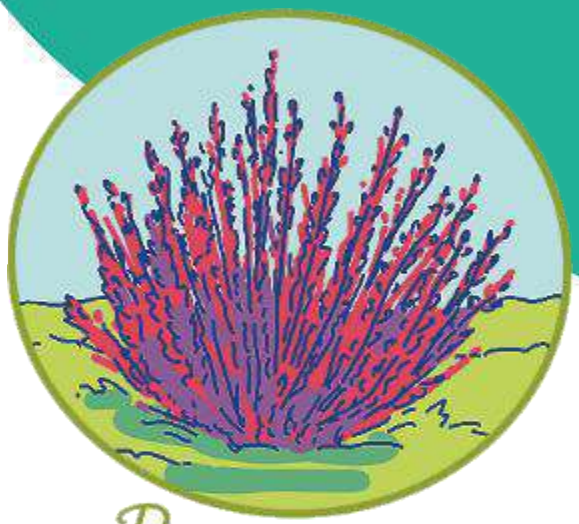
High CO_2 absorption capacity from the air: up to 5 t CO_2/30 years.

Pb Zn Cu Cd

Leaf

Inflorescence

BERBERIS THUNBERGII



Berberis thunbergii

Common name: Japanese gorse (Dracila)
Category: shrub
Characteristics: height 2-3 m, diameter 1-1.5 m

It has low soil requirements but prefers well-drained soils (does not tolerate excess moisture - waterlogging). It is cold and drought tolerant and slow to medium growing. It grows very well in polluted areas , which makes it very suitable for cultivation in the big city and e .

Pb Zn Cu Cd

Leaf

Inflorescence

BETULA PENDULA

Betula pendula

Popular name: Birch
Category: tree
Characteristics: height 20-25 m, diameter 6-8 m

It has low demands on the soil, is resistant to very low temperatures and medium-resistant to drought . Birch is fast growing and grows well even in more polluted urban areas. The wood is used in the furniture industry, for decorative items and as firewood.

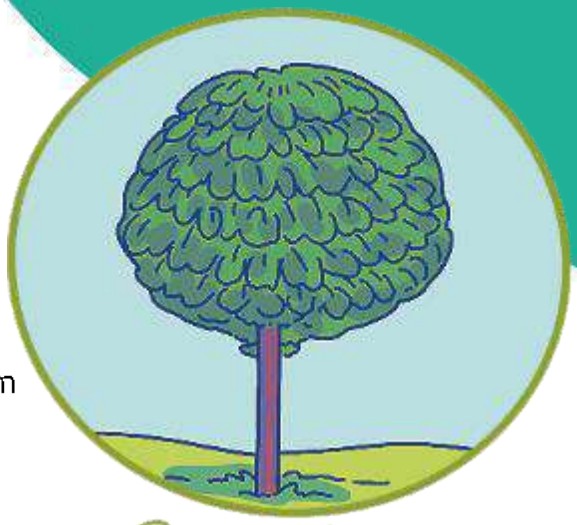
High absorption capacity of CO_2 from the air: up to 3100 k g CO_2 .

Pb Zn Cu Cd

Leaf

Inflorescence

CATALPA BIGNONIOIDES GLOBOSE



Common name: Catalpa
Category: tree
Characteristics: height 10-15 m, diameter 8-10 m

It has high demands on the soil (fertile and loose soils). Species sensitive to frost, drought and wind. It grows quickly and grows well even in areas with a high level of pollution (cities and industrial centers). Contributes to improving air quality by absorbing suspended particles from the air.

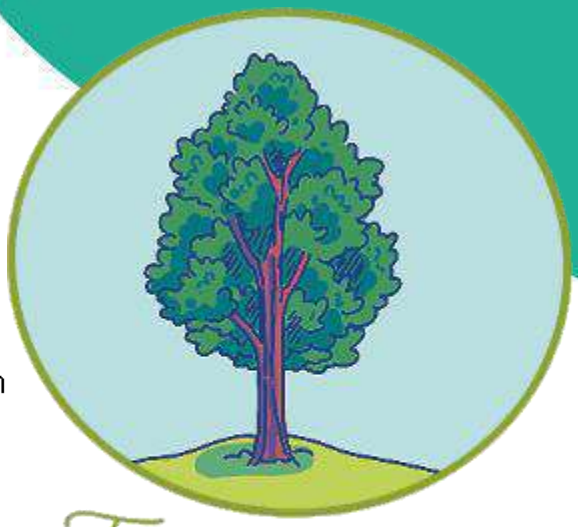
Catalpa bignonioides globosa

Pb Zn Cu Cd

Leaf

Inflorescence

FRAXINUS EXCELSIOR



Fraxinus excelsior

Common name: Ash (common)
Category: tree
Characteristics: height 20-25 m, diameter 1.5-2 m

with low demands on the soil, resistant to very low temperatures and drought . It is fast growing and resistant to air pollution in big cities. The wood is used for making various objects (sports equipment) and for furniture or flooring.

High CO_2 absorption capacity from the air: over 3000 kg CO_2/30 years.

Pb Zn Cu Cd

Leaf

Inflorescence

HIBISCUS SYRIACUS

Hibiscus syriacus

Popular name: Garden hibiscus (Syria hibiscus)
Category: shrub
Characteristics: height 3-4 m, diameter 1-1.5 m

Species with low demands on the soil, resistant to frost and drought. It grows quickly and develops very well even in polluted areas, which makes it recommended for cultivation in big cities.

Pb Zn Cu Cd

Leaf

Inflorescence

IRIS GERMANICA

Iris germanica

Popular name: Garden Iris, Stânjenel
Category: Flowering plant
Characteristics: height 120 cm, diameter 30 cm

Irises are plants that are not demanding on the soil (they prefer well-drained soils), with good resistance to frost. It also grows well in polluted areas and has remedial potential of soils polluted with heavy metals (phytostabilization of Zn, Pb, Cd and Mn; phytoextraction of Ni).

Pb Zn Cu Cd

Leaf

Inflorescence

JUNIPERUS

Juniperus

Popular name: Juniper
Category: shrub
Characteristics: height 4-8 m, diameter 2.5-4 m

The juniper has no particular demands on the soil and is resistant to drought and frost. It grows well in sunny or semi-shaded places and has a decorative, aromatic and medicinal role. It tolerates atmospheric pollution very well.

Pb Zn Cu Cd

Leaf

Inflorescence

LAVANDULA ANGUSTIFOLIA

Lavandula angustifolia

Common name: Lavender
Category: Subshrub
Characteristics: height 0.1-0.5 m, diameter 0.5-1 m

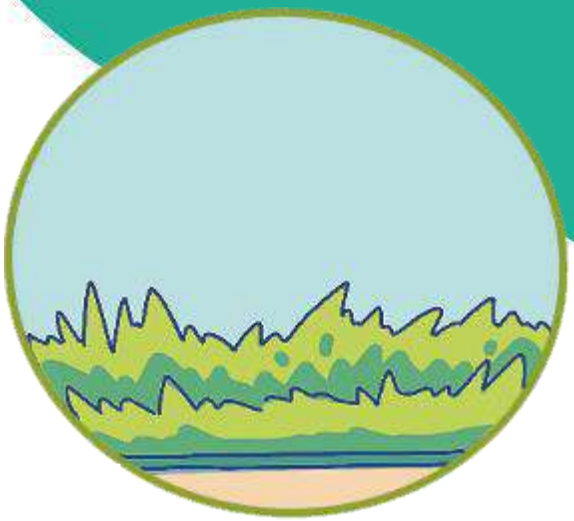
Lavender has no special demands on the soil, but it is sensitive to drought and frost. It grows well in sunny places and has a decorative, aromatic and medicinal role. The essential oil extracted from lavender grown in soils polluted with heavy metals does not contain metals and can be used in cosmetics, perfumes, etc.

Pb Zn Cu Cd

Leaf

Inflorescence

THE GRASS OF THE FIELD



Common name: Field grass
Category: fodder plant
Characteristics: height 10-70 cm

Species not pretentious to the soil , with good resistance to variations of climatic factors . It has fast growth, high biomass potential and resistance/tolerance to heavy metal soil pollution.

Lawn turf grass

- Agrostis capillaris -

Pb Zn Cu Cd

Leaf

Inflorescence

MISCANTHUS GIGANTEUS

Miscanthus giganteus

Common name: Elephant grass
Category: Perennial energy plant
Characteristics: height 3-4 m, diameter 4-6 cm

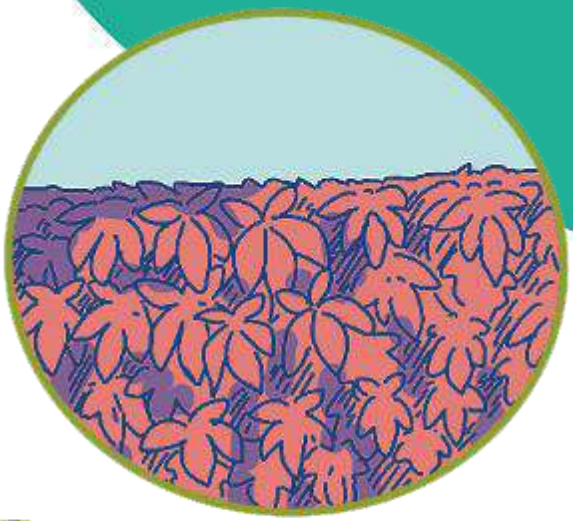
Species not pretentious to the soil , with good resistance to frost and drought . It produces a large amount of dry matter per ha and is used as an energy plant, being an important biomass resource. It can be planted on soils less suitable for other crops, having extraordinary carbon capture and soil regeneration-stabilization properties.

Pb Zn Cu Cd

Leaf

Inflorescence

PARTHENOCISSUS QUINQUEFOLIA



Common name: Canadian vine/ ivy
Category: Shrubby plant
Characteristics: height 9-15 m

Species not pretentious to the soil, with good resistance to frost and drought. It also develops well in conditions of atmospheric pollution and can be successfully used for air pollution (through the ability to absorb and store suspended particles in the air).

Parthenocissus quinquefolia

Pb Zn Cu Cd

Leaf

Inflorescence

PINUS NIGRA

Pinus nigra

Common name: Black pine
Category: tree
Characteristics: height 40-50 m, diameter 1-1.5 m

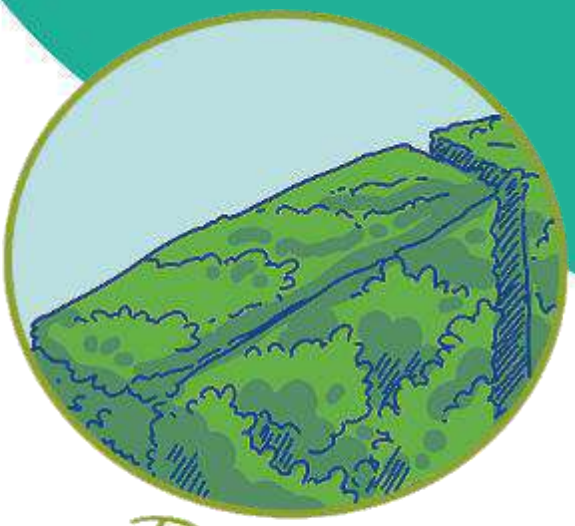
Not pretentious to the soil, with very good resistance to frost and drought. It is widely used for reforestation , being effective in controlling soil erosion and landslides. Black pine bark can be used for biomonitoring Hg in air.

Pb Zn Cu Cd

Leaf

Inflorescence

PRUNUS LAUROCERASUS



Prunus laurocerasus

Common name: Laurel
Category: shrub
Characteristics: height 2-3 m, diameter 1.5-2 m

The laurel has no particular demands on the soil and is resistant to drought and low temperatures (up to -20 °C). It is fast growing and develops well in both sunny and shady areas. It is resistant to pollution and can contribute to the absorption of toxic substances from the air, which is why it is recommended for planting in big cities , in areas with heavy traffic.

Pb Zn Cu Cd

Leaf

Inflorescence

ROBINIA PSEUDOACACIA

Popular name: Acacia
Category: tree
Characteristics: height 25-30 m, diameter 1 m

Acacia grows well on permeable, light, fertile soils, but does not tolerate calcareous soils. It has good resistance to frost and drought and loves light. It belongs to the category of hardwood trees, being heavy, hard and particularly resistant to moisture. It has the ability to fix nitrogen from the atmosphere.

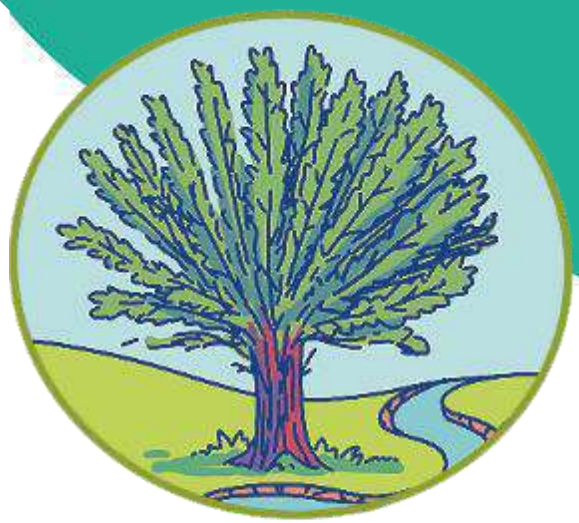
Robinia pseudoacacia

Pb Zn Cu Cd

Leaf

Inflorescence

SALIX ALBA



Salix alba

Common name: White willow
Category: tree
Characteristics: height 20-30 m, diameter 1 m

The white willow has no particular demands on the soil and is resistant to drought and low temperatures. Tolerates wet soils and at risk of long-term flooding. It is a fast-growing species that develops well even in polluted conditions, so it is also suitable for planting in big cities.

Pb Zn Cu Cd

Leaf

Inflorescence

SALIX BABYLONICA

Salix babylonica

Common name: Weeping willow
Category: tree
Characteristics: height 10-15 m, diameter 6-8 m

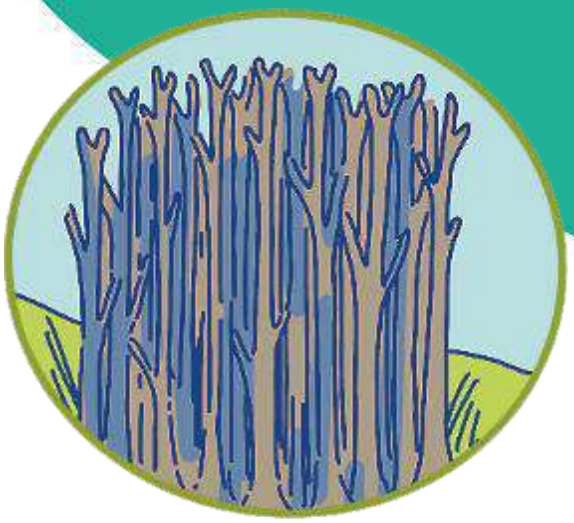
Weeping willow has no particular demands on the soil and is resistant to frost and drought. Tolerates wet soils and at risk of long-term flooding. It is a fast growing species and can be successfully used for soil erosion control. Tolerates high levels of sulfur dioxide.

Pb Zn Cu Cd

Leaf

Inflorescence

SALIX VIMINALIS



Salix viminalis

Popular name: Wicker
Category: shrub
Characteristics: height 4-6 m, diameter 3-5 m

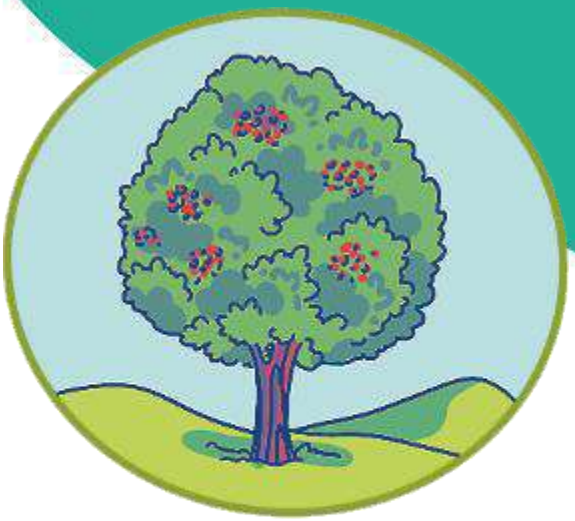
It grows well on almost all types of soil, less so on salty ones. It has good frost tolerance and moderate drought tolerance. It stands out for its high biomass and energy potential, being used for the production of pellets and briquettes, or by direct combustion to produce thermal and/or electrical energy.

Pb Zn Cu Cd

Leaf

Inflorescence

SORBUS OCCUPIED



Sorbus aucuparia

Common name: Mountain dogwood
Category: tree/shrub
Characteristics: height 10-12 m, diameter 5-7 m

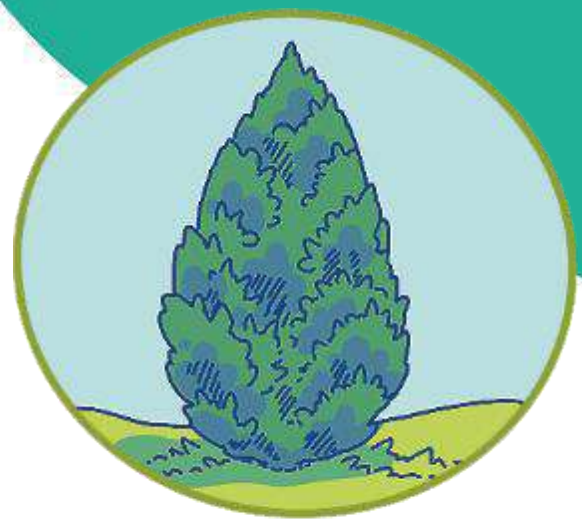
It has no particular demands on the soil and is resistant to frost and drought. This species has both aesthetic and medicinal properties, the fruits of the mountain dogwood having a high content of vitamin C. It tolerates atmospheric pollution, so it can be successfully planted in big cities, being also used as a bioindicator of atmospheric pollution.

Pb Zn Cu Cd

Leaf

Inflorescence

THUJA TREE



Thuja

Popular name: Tuia
Category: tree/shrub
Characteristics: height 10-12 m, diameter 2-4 m

Tuia prefers SOIL fertile, well drained . It has a good resistance to frost and drought (does not tolerate excess moisture). It has a slow growth rate and can also be planted in polluted areas, as it has good resistance to atmospheric pollution.

Pb Zn Cu Cd

Leaf

Inflorescence