FINAL PROJECT REPORT

1. Contestant profile

▪ Contestant name:	Klára Zahradníčková
▪ Contestant occupation:	Radoslava Krylová Anežka Pelikánová Vilém Jurek Jiří Lojda
▪ University / Organisation	*Interdisciplinary platform*
▪ Number of people in your team:	5

2. Project overview

Title:	**BIODIVERSITY AND HUMAN: A synthesis of anthropological and ecological relations of Bytča gravel pit**
Contest: (Research/Community)	Community
Quarry name:	Bytča

ABSTRACT

In our project, we examined the Bytča-Predmier gravel pit in Slovakia from an interdisciplinary perspective: our research team consisted of anthropologists, ecologists, biologists, and landscape specialists. Using ethnographical research methods, we mapped anthropogenic impacts on this site, determined how the site could potentially be used by the local community, and sought out issues that connect the community with the studied site. In the biological part of our research, we studied the local fauna and flora and its relationships to the environment. We used our findings to determine the "ecological effect" and to define types of biotpes. On the basis of our findings, we have proposed management measures for strengthening biodiversity. In our project we also focused on urbanism and landscape issues related to the site and the distinctive esthetics of a quarry landscape. By studying these issues and communicating with stakeholders, we then produced a synthesis of findings that takes into account the needs of all stakeholders in using the gravel pit, including its plant and animal communities. The findings of this study are displayed in our "opportunities map," which comprises a comprehensive strategy for restoring this site and the surrounding area.Our most important findings were communicated to the local community during an educative walk through the site. The methods we used to conduct this innovative interdisciplinary study are described in the guidelines we have developed. They may be applied at other sites belonging to the HeidelbergCement Group.

INTRODUCTION

We examined the Bytča-Predmier gravel pit site from an interdisciplinary perspective, using the methods and knowledge of **the social sciences, the natural sciences, and landscape studies**. This approach enabled us to study this site in its broader context. We studied the quarry's **anthropological aspects** it is a place where people live, work, and spend their free time. The site's **ecology**, which is related to its anthropological aspects, was also very important for us because mining landscapes are associated with specific plant and animal communities. We also examined this site, located in the mountain-lined floodplain valley of the Váh River, in terms of its **urban structure and landscape**. The floodplain is home to small planned villages and their adjacent fields and cultural landscape. It also features the distinct esthetics of a mining landscape. **All of these important pillars together contribute to the overall identity of this site. By studying these issues and communicating with stakeholders, we created an interdisciplinary synthesis of findings that takes into account all of the stakeholders involved in using the gravel pit site, including plant and animal communities.**

The methods we used to conduct this innovative interdisciplinary study are described in the guidelines we have written. They may be applied at other sites belonging to the HeidelbergCement Group.

A. THE OBJECTIVES OF THE PROJECT

The objective of our project was to produce a comprehensive environmental analysis of the Bytča-Predmier gravel pit.

The objective of the **social science part** of our project was

- to map the relationships that all user groups have with this gravel pit, suggest basic issues that need to be resolved and determine the limits imposed on this space by these issues, and address the main stakeholders. The outputs of this part of the project were also used to create an opportunities map.

- to organize a community event, specifically a participatory educative excursion.

The objectives of the biological part of the project was

- to determine the quarry's biological potential by determining the **ecological effect,** as no systematic research had been conducted here before; by using the principles of **biological assessment** we discovered the most significant ecological aspects of the gravel pit.
- **to reconcile the interests of nature conservation (and nature itself) with the needs of visitors,** who have varying degrees of impact on the biodiversity of the study site
- to support **biodiversity** to the greatest extent possible; we have proposed a conservation management plan based on the principles of active ecological restoration. This plan does not conflict with quarry operations or with the use of this site by other groups

- to support sites where protected species occur (e.g., a proposal for protecting sand martin colonies, expanding amphibian habitats on tailings deposits, a plan for eliminating invasive plants)
- to follow the principles of ecological restoration, that is, to leave some areas to "**develop wildly**"; several areas were designated for **spontaneous succession** (in planning restoration efforts, we considered the impact of invasive plants, human visitors, and the interests of the quarry operator).

The objective of **landscape and urbanism** research was to verify documents related to land use (land use plans, land ownership records, accessible technical plans, etc.) The landscape architect on our team conducted field research in order to gain an understanding of the site and its broader spatial context and to determine what landscape elements are present and any management measures in place, and other issues related to the landscape. She also mapped and interlinked the findings of both research teams in order to determine potential conflicts and to create an interdisciplinary opportunity map.

The objective of the interdisciplinary synthesis was to determine the site's potential for **fostering biodiversity (making the site more attractive for plant and animal species)** and for **being used by the local community**, all while **extraction activities** are still going on.

A BRIEF DESCRIPTION OF THE SITE

Broader relationships and the current landscape

The project site, a gravel pit, is located in the deep alluvial valley of the Váh River. The rugged terrain of the Bytča Basin contributes to its picturesqueness; steep terraces rise out of the river, gradually transforming into hills and finally into the Súľov Mountains. Sand and gravel pits are abundant along the entire length of the river's floodplain. Resource extraction is associated with the extensive industrial and manufacturing areas located on the edges of villages. Running parallel to the Váh River valley are two busy transport corridors of national importance: highway D1 and the 120 railway line. For both people and biota they are impermeable barriers in the landscape. The surrounding cultural landscape consists primarily of extensive fields, usually without any smaller landscape structures such as balks and tree avenues.

The project site
For our project we selected a borrow-pit lake site located on the northwestern edge of the village of Predmier. In the north, the above-mentioned highway built upon an embankment separates the site from the Váh's river bed. The quarry is still active. Special biotopes have developed on the rugged shores of the lake, which is frequently used by local inhabitants for recreation. This site's dynamicity and diversity are what attracted us to study it. The area around this site is of crucial importance for our study as well. Two other borrow-pit lakes lie adjacent to the site. One is currently used by the local fishing association. The other is owned by a private individual who is attempting to restore it to a natural state.

TEAM MEMBERS

Mgr. Radoslava Krylová (anthropologist and environmental specialist)
Her work focuses on "urban wilderness" and its social science aspects, the social aspects of gardening colonies in the Czech Republic and abroad, research on public space, and public participation.

Mgr. Anežka Pelikánová (anthropologist)
Her works deals with social exclusion. The idea of interdisciplinary collaboration resonates strongly with her.

Ing. Vilém Jurek (landscape ecologist)
He currently works at Rezekvítek, an environmental organization. He deals with conservation management, the ecological restoration of post-mining landscapes, and reforestation efforts.

Mgr. Jiří Lojda (zoologist and geographer)
He is a field worker for Rezekvítek, an environmental organization. He specializes in bird and aquatic life conservation. He has degrees in geography and environmental studies.

Ing. Klára Zahradníčková M.A. (landscape architect)
She designs public urban spaces and produces plans for large cultural and near-natural landscapes in cooperation with interdisciplinary teams.

PROJECT TARGET GROUPS

In the earliest phases of project planning we determined several target groups whose members have some connection to the space of the gravel pit. We conducted interviews with members of each of these groups. In the resulting opportunities map we included their ideas about the site's use and any limits therein.

Fishermen: Fisherman make up the most noticeable group of people frequenting the site. Fishing is permitted from the left shore of the lake. Flooding in 2011 introduced large fish, which have been capable of reproducing here. As a result, the site has become a popular fishing destination.

Dogwalkers: Because this site is located in the immediate vicinity of a village, many people (particularly local inhabitants) use the area around the lake to walk their dogs. We have noted several potential minor conflicts regarding the use of this space that could arise between dogwalkers and fishermen. An abundance of dog excrement at the site was frequently mentioned in interviews.

Walkers: Local families with children and other local inhabitants. This group would welcome shade along the main walking path, greater safety (particularly less steep shores), and overall improvement of the area.

Adventurous swimmers: Swimmers mainly seek out the lake's more gradual shores, which the quarry operator has deliberately reduced to prevent people from swimming. Fire pits can be found here. People often camp at this location. In the past, locals frequented the lake to go swimming, but now most describe the water as being "dirtier" after the floods.

Quarry workers: Only a small area of the flooded gravel pit is currently being actively mined. The mining company is opening a new quarry on the other side of the highway. As it is an active quarry, special safety rules, measures, and prohibitions have been put in place. They have resulted in conflicts with people who would like to use the area for recreational purposes.

The owner of the former gravel pit adjacent to the site: The owner carefully manages the borrow-pit lake that was restituted to him and which is in close proximity to the project site. He is building wetlands and pools here and taking care of the alluvial forest that is forming. He is working in cooperation with the State Nature Conservancy of the Slovak Republic. He is aware of all the protected animal and plant species that occur here. He stated that in the northernly most lakes bird species such as the common kingfisher (*Alcedo atthis*), the black stork (*Ciconia nigra*), and the great bittern (*Botaurus stellaris*) can be found. His interests are in conflict with fishermen and in some regards quarry management. They are, however, in harmony with efforts to support biodiversity at this site.

B. EVENTS AND ACTIVITIES INVOLVING THE LOCAL COMMUNITY

Our work with the local community revolved around standard anthropological research. The methods we used were observation, in-depth interviews, and mental mapping. As a result of our interdisciplinary synthesis of our findings, several topics emerged that we wanted to verbalize and discuss with local inhabitants. Therefore, we decided to conclude our project with a participatory scientific excursion.

In the first stage of research we made field observations at the site focused on its overall character and how it is used. We observed activities directly and also examined artefacts produced during such activities: litter, fire pits, etc.

In the second stage of research we conducted in-depth interviews with key local stakeholders (the deputy mayor, the manager of the gravel pit, the fire chief, the school principal, the head of the local fishing association). We conducted a semi-structured interview with each of them that lasted approximately one to one and a half hours (see appendix no. A1 for interview script). With some of our informants we also conducted a mental mapping exercise focused on the project site using a current map of the lake and its surroundings as a base.

In the third stage of research we spoke to approximately ten random passers-by in Predmier and conducted shorter structured interviews and mental mapping exercises with them. In this stage of research, our early findings were verified and expanded upon.

In the final stage of research we organized an interdisciplinary walk for local inhabitants. A diverse group of about twenty-five people took part: school students, inhabitants of Predmier, the school principal, the deputy mayor, and the manager of the gravel pit. We also invited a guest from the Strážov Mountains Protected Landscape Area. The purpose of the walk was for these people to get to know each other and to hold a group discussion about the main points of conflict at the site (public use of the site, the impact of the quarry on groundwater levels, litter). The quarry manager had an opportunity to informally present the public with future reclamation plans and explain some of the measures being taken by the company. The natural scientists from our team informed local inhabitants about invasive plant species at the site and presented possible solutions to the problems they caused. We also presented the participants with some of the results and findings of our project. We showed them nesting sand martin colonies and tailings deposits. We also talked to them about several invasive plant species and explained how they endanger biodiversity. This event took place in a very friendly, positive atmosphere. All of the people who participated were allowed enough space to express their concerns. (see appendix no. A2)

Proposed events in the future: Based on our findings (see the opportunities map and the discussion section in this report), we propose developing an educative program for the public about the issue of water in the landscape. It could include organizing an artistic performance (e.g., a theater or music event) for the community about water in the landscape; planning community work, such as planting trees or cleaning up the site; organizing a participatory workshop focused on recreational use of the site in the future; holding children's events, such as plays on this topic or creative activities focused on protected bird species or map making.

C. DISCUSSION

By analyzing the interviews and synthesizing our findings with those of the biological and geographical research, through inductive reasoning we were able to determine the most fundamental issues associated with the quarry site.

1. Conflicts of interest // limits on use

Because this quarry site is in the immediate proximity of a village, its lake has become a natural magnet for local people to spend their free time. People want to use this area for walking, swimming, and fishing. (see appendix no. A3) Thus, conflicts have naturally arisen between the quarry operator, which is responsible for enforcing safety rules established by legislation, and local inhabitants. Defining the boundaries of prohibited areas here is a problematic issue. Interview data indicate that ideas about such boundaries very greatly among locals. Although there are several signs prohibiting activities along the perimeter of the lake, local people interpret them differently. The prohibitions are ignored, or the signs have been altered in some way. As a result, **the boundaries between where people may be and where quarry operations take place** are not clearly marked.

Therefore, in the past the quarry operator took radical steps to limit large-scale swimming and made the gradual shoreline steeper. Thus, the water is accessible only from a few places on the site. In some of these places mining equipment is present. (see appendix no. A4)

Another issue that has hampered the ability to legally use this space for recreational purposes is that the site lacks a manager. This space is not officially managed by the village; there is no waste management infrastructure in place. There have been problems with recreation seekers and fishermen littering. Illegal dumping also takes place here (see appendix no. A5).

The gravel pit is frequented by fishermen, who can primarily be found by the lake to the northwest of the project site, where fishing is permitted. They can also be found in smaller numbers around the lake on the project site. These fisherman take good care of the lake's shores; they clean up rubbish and scold unruly swimmers. They have also made this space "more comfortable" for themselves by making small modifications to the land. Some of these modifications seem problematic though, such as removing reeds and needlessly cutting down trees. Some fishermen also litter. Fishermen comprise a group of stakeholders with the strongest interest in the site; therefore, planning for ecological restoration and fostering biodiversity should occur in close dialogue with them.

There is the potential risk that the small pools in the northwestern part of the site may be stocked with fish. This move could have fatal results for amphibians.

2. Floods // water // myths

The gravel pit is located in the Váh River floodplain. It thus serves as a natural antiflood retention basin. Several myths appeared in the narratives related by local inhabitants. They also displayed a lack of understanding about how groundwater levels work. Some locals think that water levels in the lake affect well water. They believe that when water levels in wells drop it is because the lake has drained them. On the other hand, they think that flooding causes water levels in the lake to rise and that this results in increased water levels in wells. People are also afraid that groundwater might be contaminated by quarrying activities and equipment. Thus, in some local narratives the gravel pit is a place of fear, concern, and danger. We also heard stories about mythical "whirlpools" that drown people.

3. Ecological restoration, reclamation, and returning the site to a near-natural state

(see appendix no. K2)

A "Proposal for Reclamation and Land Use" was created for the gravel pit in 2005. We obtained a copy of it; it was the starting point for our work. This proposal, however, only spatially delimits functional zones. Českomoravský štěrk is currently beginning reclamation work that is based on this study.

This study, however, lacks a strategy for developing biotopes associated with quarry landscapes, or even any mention of such activities. Map documents only include circles indicating trees as "suggested greenery." We suggest that reclamation work be planned in greater detail.

This proposal is also not based on up-to-date land ownership data (see appendix no. K1). For example, according to the proposal, the main recreational area should be on what is now private farmland behind the Predmier cemetery.

4. Biodiversity conservation

The fauna in the gravel pit is disturbed by swimmers and to a lesser extent by fishermen who fish along the lake's shores. Most of the water birds found in the gravel pit most likely do not nest there. They seek out calmer lakes nearby to nest in. Waders are highly dependent on special biotopes, such as tailings deposits (which consist of waste material created during the process of washing gravel, especially clay). Unfortunately, these biotopes are frequently covered with other materials or removed all together. Another issue is the protection of vertical quarry faces where sand martins nest. These areas are accessible to people, who disturb these birds during nesting season. The boundaries between areas for nature conservation and recreation are poorly defined. If at least fifty percent of the gravel pit is to be managed to increase biodiversity (i.e., to increase the "ecological effect"), we must propose measures for managed recreational use and for supporting at the very least the most valuable flora and fauna that occurs here. These ideas are reflected in our proposed measures, which we have also included in our opportunities map (see below).

5. Determining the ecological effect

To determine which species should receive priority protection, we have applied the concept of the "ecological effect." This concept has helped us determine the species that will guide conservation work and the management of the gravel pit's entire ecosystem. We identified as indicator species those that are typically present in each biotope (see Appendix B2). Keystone species include both "popular" and "unpopular" species that make the gravel pit an ecologically interesting place. "Unpopular species" include invasive plants, which have an effect biodiversity. "Popular" species on the other hand are attractive ones, such as the great crested grebe (*Podiceps cristatus*) or the little ringed plover (*Charadrius dubius*). We identified the sand martin (*Riparia riparia*) as this site's flagship species. The sand martin is a protected species that is dependent on a specific habitat type. It could be the gravel pit's main "draw" and could be used to demonstrate that the gravel pit is an interesting place to visit besides for swimming or fishing. We identified bird species from the *Charadrii* suborder, or waders, as umbrella species. Conservation management should be centered around protecting these birds.

6. Biotope types

In addition to identifying important species, we also created a list of biotope types. We gave each a unique name and have proposed for each management interventions that will foster and conserve biodiversity. We identified the following types of biotopes: water surface, wetlands and pools, reedbeds and shallows, vertical quarry faces, wetlands shrubland and alluvial forests, mesophilic meadows, tailings, areas covered in early stages of succession, and cultural and recreational areas. For exact descriptions that include indicator species, see Appendix B2. Our biotopes are not defined based merely on vegetation features; we also took into consideration fauna and present ecological processes, such as disturbances.

The project's value for society and the quarry

- presenting the issue of biodiversity and the natural value of the site to the local community
- taking the needs of the local public into consideration in proposing and implementing measures for developing biodiversity and in planning recreational areas
- the opportunities map will provide inspiration for using the site's recreational potential
- increasing the local area's tourism potential and improving the quality of life of local inhabitants
- landscape and conservation proposals take into consideration the local community and its needs, land ownerships issues, and already existing proposed measures

The project's value for biological diversity

- During our mapping, planning, and assessment work, we determined the biological communities present in the gravel pit:
  - ➔ We discovered 167 taxa of vascular plants at the study site (see Appendix B1), none of which were protected species.
  - ➔ The most significant species include purple loosestrife (*Lythrum salicaria*), silverweed (*Potentilla anserina*), and broadleaf plantain (*Plantago major*).
  - ➔ Woody species and invasive plants were special groups of plants (see Appendix B3). In total we discovered 40 invasive species, which fundamentally endanger biodiversity.
  - ➔ We noted better diversity among animal species (see Appendix B1). In total we observed 36 bird species and three amphibian species. Other interesting species occurring here included the European eel (*Anguilla anguilla*), the European roe deer (*Capreolus capreolus*), the emperor dragonfly (*Anax imperator*), and the dusky large blue butterfly (*Maculinea nausithous*).
  - ➔ The small pools in the northwestern part of the site formed an interesting biotope. Here we discovered the edible frog (*Pelophylax esculentus*), the pool frog (*Pelophylax lessonae*), and the marsh frog (*Pelophylax ridibundus*).
- Our proposal for the site is a "compromise" solution that gives equal weight to the interests of nature conservation, the quarry operator, and visitors.
- We have proposed a conservation plan, which can be used as a new reclamation study.
- Our proposals are based on state-of-the-art scientific findings and practices in ecological restoration and near-natural restoration of mining sites (two team members work for a top Czech NGO focused on restoration ecology).

The project's value for the operator or company

- more clearly defined zones for different groups of users and for different functions in the study site, which will make quarry operations easier
- greater involvement of the mining company with the local community
- involvement of local people in solving problems with the use of this area (leads to greater understanding between recreation seekers and the quarry operator)
- improving the company's reputation among local people (because local people will become involved in making decisions about the future of the site)
- improving the company's reputation among scientific experts and the larger public
- testing and applying an interdisciplinary approach to research and introducing measures to former quarry sites that could be transferable to other areas
- modern approaches to ecological restoration that have been proven to be practical.

D. OUTPUTS

The main practical outputs of our project were

i. GUIDELINES FOR CONDUCTING INTERDISCIPLINARY RESEARCH AT MINING SITES

ii. AN INTERDISCIPLINARY SYNTHESIS OF FINDINGS FROM THE BYTČA GRAVEL PIT

i. GUIDELINES FOR CONDUCTING INTERDISICPLANARY RESEARCH AT MINING SITES

These guidelines combine methods and approaches used in the social sciences, the biological sciences, and landscape studies into one coherent system that allows the interests and needs of various stakeholders and natural ecosystems to be reconciled; they will help foster biodiversity on a given site as well as develop the site's potential for use by the local community. Exact budgets and timeframes cannot be established for each project. They depend upon the size of the study area, the conflicts present in it, the extent to which the site is a topic of social discussion, the level of social coherence in the local community, ecosystem conditions, etc.

GUIDELINES FOR CONDUCTING SOCIAL SCIENCE RESEARCH

From a **social perspective**, mining sites are places with which local inhabitants have a specific relationship. Here we can observe local narratives (i.e., what people say about a quarry), social action (how people behave in the quarry), how the space is used (which social groups use the quarry and how), or perhaps the absence of any or all of these things. Therefore, researchers should focus their interviews on the past, present, and potential future of such areas. How social action has left its mark on the material space of the quarry should be examined. With the help of the social sciences, reclamation measures will be based not only on things that are critical for biological species, but also on the position of the mining site in various local social networks. If researchers can learn something about the relationship of local inhabitants to a quarry, a restoration project that respects local history, needs, and relationships can be designed.

The **methods of ethnographical research** are critical for such projects: field observation, semi-structured interviews with selected stakeholders, and mental mapping, which is particularly helpful for research projects that also examine geographical and biological issues (see more in the section "Events and activities with the local community"). Although in our research project we did not use other **participatory methods**, they may be useful in other situations. Such methods include focus groups (a facilitated meeting of a group of people meant to collect data from entire group of site users), participatory workshops (used to collect data from local inhabitants in a creative and collaborative fashion), and enhanced mental mapping methods (e.g., labelling areas on a map exhibited in a public space).

By inductively analyzing findings, researchers can identify key issues at the research site (in our case, they included conflicts in use of the site, poorly defined boundaries between functional zones, poorly defined responsibility for waste management, myths about the lake present at the site).

GUIDELINES FOR BIOLOGICAL RESEARCH

In the biological part of our research project we focused on determining the ecological effect. We consider the ecological effect to be a basic link that can help show what is essential for a site's biodiversity and its conservation. There are both positive factors (protected species) and negative factors (invasive species) that affect the ecological effect.

This part of our research was based on biological assessment principles. Researchers should first conduct a basic field assessment of the site and its environs. Researchers should survey the site to determine which organisms are essential for the site's biodiversity and which require more in-depth study. At the Predmier site, these organisms included vascular plants (particularly woody species and invasive species), amphibians, and birds. Other organisms were of little relevance for biodiversity, but nonetheless we recorded the occurrence of other species as well and took note of interesting and significant species. The result of such efforts is a list of species.

Based on this list, researchers can then identify and classify critical species. First, indicator species should be identified. These species help define biotopes. Next, keystone species should be identified. These are species that are typically found in gravel pits. Umbrella species and flagship species should also be identified. These two categories are crucial for defining management practices and for presenting nature conservation to the public. There are certain overlaps here with the sociological research conducted at the site.

Next, biotopes should be identified based on species occurrence and natural conditions, including soil type, water levels, and disturbances. Biotopes help determine the ecological effect as well as functional zones. Finally, determining ecological effects will aid in developing a conservation plan for the site.

GUIDELINES FOR CONDUCTING LANDSCAPE RESEARCH

It is the task of a landscape specialist to understand the site and its relationships with the surrounding environment and to identify elements in the landscape associated with the study site. This expert distinguishes between natural and culture landscape patches (e.g., alluvial, cultural, agricultural, and mining patches) and built-up areas (villages and towns, manufacturing and industrial areas, transportation infrastructure). He or she seeks out the relationships that connect them and the boundaries that divide them. He or she also verifies documents related to land use (land use plans, land ownership records, accessible technical plans, etc.), in addition to coordinating and creating cartographic outputs for the social science and biological sections of the research project. Together with the other team members, he or she will establish possible strategies for using each part of the study site.

INTERDISCIPLINARY SYNTHESIS OF FINDINGS

After conducting social, geographical, and biological research, synthesizing the findings should follow. The tools for conducting an interdisciplinary synthesis are

A: Interdisciplinary **discussion** about the key issues in each field of study with the aim of identifying solutions that satisfy the demands of each field.

B: **Creation of schematic maps.** Both the social science team and the biological team should create a map of their findings made during field work. These schematics will then be used to come to joint solutions for the issues and conflicts that were determined to be present at the given site.

The "HUMAN MAP" (see Appendix K3) depicts the presence of humans at the site. Paths and frequented areas are marked. This map also depicts elements that appear repeatedly in local narratives (e.g., places that are associated with a particular story).

The "NATURE MAP" (see Appendix K4) indicates the occurrence of specific plant and animal species and groups. It also depicts potential sites where natural biotopes could be developed.

C: By synthesizing all findings, a **map of opportunities** can be created (see Appendix K5). In our study, this map includes two layers: the HUMAN and NATURE map layers.

The **"human"** layer delineates areas with specific uses and indicates ways in which the entire site can be improved.

The **"nature"** layer depicts the biotopes that are present at the site and ones that could potentially develop with some minor interventions. Such measures would foster biodiversity. In the accompanying report, interventions and management plans are defined (see Appendix B2).

Clearly defining potential functional zones should be avoided. Instead, focal points where multiple functions could possibly overlap should be identified.

PROCEDURE FOR INTERDISCIPLINARY COLLABORATION

The social sciences

Stage one: Mapping the relationships of all user groups to the site

- observation
- interviews with the main stakeholders
- interviews with local inhabitants
- mental mapping

Stage two: Inductive analysis – identifying basic issues

- depicting on the map symbolic places and human impacts at the studied site, current conditions

Stage three: Interdisciplinary discussion

- synthesis of findings, discussion of team members specializing in all disciplines
- plotting the visions and proposals made by each disciplinary team on the opportunities map

The biological sciences

Stage one: Field survey

- surveying and mapping the site
- determining species with priority status

- in-depth biological surveys (e.g., botanical and ornithological surveys)
- communication with local experts and State Nature Conservancy offices

Stage two: Data assessment
- data sorting
- determining the ecological effect and priority species
- proposing measures for conserving and fostering biodiversity

Stage three: Interdisciplinary discussion
- synthesis of findings from all disciplines and an analysis of compromise solutions and measures
- plotting visions and proposals made by each disciplinary team on the opportunities map
- a final conservation plan that will define practical measures to be implemented

Landscape architect

Stage one: Surveying and assessing land use documents
- assessing land use planning documents for the cadastral communities involved
- studying land ownership issues related to the site
- assessing studies and other documentation produced by the quarry operator

Stage two: Field surveys and analysis
- determining homogenous landscape patches
- for each patch type, determining possible interventions and issues at play

3. Stage three: Interdisciplinary discussion
- synthesis of findings made by each disciplinary team
- plotting visions and proposals on the opportunities map
- producing graphs and maps

ii. AN INTERDISCIPNARY SYNTHESIS OF THE BYTČA GRAVEL PIT

We developed an overall strategy for the flooded gravel pit. We were, of course, familiar with already existing plans to close the quarry and conduct restoration work in three phases. First, the southeastern section, where public use is officially permitted, will be reclaimed, to be followed by the entire western section and finally the northeastern tip where gravel extraction is still ongoing.

- Our proposal for using the site **is based on how it is currently used**; other potential activities will be based on the opportunities map.
- In general, human activities are carried out in areas nearer to the village. In contrast, areas marked for conserving biodiversity are in the northern part of the site near the highway and near the vertical quarry faces.
- In the northern section, human activities (campfires, swimming, fishing) are conducted in only a few specific places; we propose a boardwalk be constructed here that follows an existing path through the wetlands shrubland biotope.
- Some areas are more prone to interactions between humans and nature (e.g., promontories, islands) and others less so (the inaccessible biotope of wetlands shrubland, the proposed vertical quarry face biotope with restricted access).
- The plan for the southeastern part of the site is to accommodate the needs of local people and modify it for recreational use of the lake. We have proposed making the shore more gradual here and building small beaches. Thus, swimming activities will be concentrated in the part of the site closest to the village.
- We propose defining more clearly marked functional zones; our objective is to ensure that areas intended for use by locals are clearly separated from potential conservation areas with restricted access.
- We propose lining paths leading to the site with trees. In the summer they will provide shade and help keep the site cool. We propose a community tree-planting event in which local school children, village residents, fishermen, and the quarry operator will be involved.
- We propose a parking area be legally established at the site of the current unofficial parking location.
- In order to conserve biodiversity, we propose restricting access to several parts of the site; on the other hand though we have proposed that some areas be earmarked as “observation sites,” where people can watch birds such as sand martins.

- Our priorities for active conservation measures are eliminating invasive plant species and regulating expansive plant species (see Appendix B3). In areas covered with shrubs, where the risk of plant invasions is lower, we do not recommend any interventions.
- In most cases, we plan on leaving succession to occur naturally, and therefore we propose only limited tree plantings. We have proposed a fruit-tree avenue for the western part of the site. A community tree-planting event could be held. The local school, local citizens, fishermen, and the quarry operator could all be involved. For the southern and southeastern part of the site we propose the planting of clusters of shrubs accompanied by trees.
- In certain areas of the site, we propose the vegetation be cut back. In contrast, reedbeds should not be cut.
- An important part of our proposal is to divide the entire shoreline into separate sections. The objective of doing so is to create a diverse littoral zone featuring shallows and pools. In areas intended for recreation, beaches will be built.
- We propose an island be created out of the promontory that now juts into the center of the lake from its southern shoreline.
- In contrast to the original reclamation plan, however, we do not suggest the other promontory in the southeast be extended to create a separate lake.
- Finally, we propose several experimental interventions for the site:
  - expanding the area of tailings deposits
  - building other small lakes and pools in the northwestern part of the site
  - installing floating islands
  - converting the meadows in the northern part of the site into near-natural plant communities (for management techniques we propose mosaic mowing, seeding great burnet, spring harrowing, and grazing)
  - preserving and maintaining vertical quarry faces for sand martins; purchasing a strip of land above the vertical face where sand martins are currently present; regularly stripping the vertical outer layer of the face; restricting visitor access during nesting season; we also propose creating new vertical faces in other parts of the site (on the island, in the northern parts below the meadow).

E. CONCLUSION

In this project we focused on the **relationship between the local community and our research site** and on the impact this relationship has on biodiversity. We have briefly outlined the **conflicts of interests** between groups that use the site, particularly the conflicts arising between active extraction operations and potential recreational use. We also examined **myths and narratives** about the gravel pit and the hydrological cycle. Based on our biological research, we determined that biodiversity at the site is neither weak nor strong. In any case, it must be strengthened. We consider creating ideal conditions for the nesting of sand martins and the occurrence of several species of wader to be most important. Paradoxically, the most significant plants here are invasive species. The flora and fauna occurring at the study site could be more diverse. Humans play a decisive role. As part of our project we also assessed current ecological restoration efforts. We proposed clear measures for fostering biodiversity that were developed with the needs of other users of this site in mind. We presented our findings and proposals to the local community during an **educative excursion** through the site. Our expectations for this event were exceeded. For example, participants expressed great interest in nature conservation (sand martins, invasive plants) and water in the landscape (flooding on the Váh).
Based on an interdisciplinary synthesis of our findings, we created an **opportunities map** that presents our proposals for the site, which take into account the needs of all user groups, including the quarry operator, and which also foster biodiversity. At a more general level we described the guidelines we followed in all stages of our project, including producing a synthesis of our findings. These guidelines can be applied to other similar sites where the needs of nature conservation and the local community should be reconciled.

Project tags (select all appropriate):
This will be use to classify your project in the project archive (that is also available online)

Project focus:
- ☐Beyond quarry borders
- ☒Biodiversity management
- ☒Cooperation programmes
- ☒Connecting with local communities
- ☒Education and Raising awareness
- ☒Invasive species
- ☒Landscape management
- ☐Pollination
- ☒Rehabilitation & habitat research
- ☒Scientific research
- ☐Soil management
- ☐Species research
- ☐Student class project
- ☒Urban ecology
- ☐Water management

Flora:
- ☒Trees & shrubs
- ☐Ferns
- ☒Flowering plants
- ☐Fungi
- ☒Mosses and liverworts

Fauna:
- ☒Amphibians
- ☒Birds
- ☐Insects
- ☐Fish
- ☐Mammals
- ☒Reptiles
- ☐Other invertebrates
- ☐Other insects
- ☐Other species

Habitat:
- ☐Artificial / cultivated land
- ☐Cave
- ☒Coastal
- ☒Grassland
- ☒Human settlement
- ☐Open areas of rocky grounds
- ☒Recreational areas
- ☒Sandy and rocky habitat
- ☐Screes
- ☐Shrub & groves
- ☐Soil
- ☐Wander biotopes
- ☒Water bodies (flowing, standing)
- ☒Wetland
- ☐Woodland

Stakeholders:
- ☒Authorities
- ☒Local community
- ☒NGOs
- ☒Schools
- ☐Universities

Negotiating the way how to use the lake _appendix A4

Holiday activities_appendix A3

Problems with garbage_appendix A5

„Proud Slovak don´t leave his garbage in nature. Who do you want to belong to? To us or to idiots?“ _appendix A5

Interview script used in field research conducted at the Bytča-Predmeir site

Interviews showed be semi-structured. This is a loose script, and the questions it contains are meant to aid the interviewers.

Topics that the interview should cover include the following:
- stories about the site (personal and community narratives, local stories, personal experiences, etc.)
- use of the site (in different seasons), the place's role for the community and for the communication partner
- the future of the area (planned as well as desired communication partner)
- natural significance

Questions:

Using a printed map of the site as an aid:
Do you visit this site? Where? When?
How would you divide this space up into sections?

Using the site:
Why do you go there? What do you like about it? What draws you there?
Do you go there in summer?
What is missing there?
How do you imagine this place to be if it were perfect?

Narratives:
How long have they been mining there?
Are there any stories about this place?
Has anything happened to you there?
What is the gravel pit's reputation in the village?

Significance for the community:
What do people wish to have there?
Does it have any importance for the village?
What about other people from the village? Is the quarry important for them?
Does the quarry have any use for children?
Does it divide people or bring them together?
Is it used more by local people or by people from elsewhere?
Who is happy with the way the gravel pit is now and who is not?

Significance for nature:
In your opinion is it a valuable natural site? Why?

Interview script_appendix A1

Interdisciplinary walk with local community_appendix A2

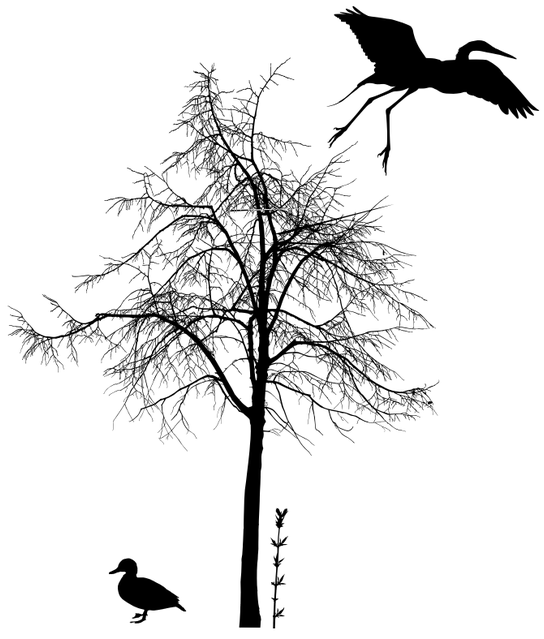
Appendix B1

LIST OF EVIDENCE SPECIES

We primarily focused on representatives of vascular plants and birds. These are all kinds that we have really seen.

Vascular plant (*Tracheophytamonster*):

Acer campestre	
Acer negundo	trash*
Acer platanoides	
Aegopodium podagraria	
Achillea millefolium	
Ailanthus altissima	trash
Ajuga reptans	
Alisma plantago-aquatica	
Alliaria petiolata	
Alnus glutinosa	
Alopecurus pratensis	
Amorpha fruticosa	trash
Anthriscus sylvestris	
Arctium lappa	
Arctium tomentosum	
Armoracia rusticana	
Arrhenatherum elatius	
Artemisia vulgaris	
Aster lanceolatum	trash
Aster novi-belgii	trash
Atriplex patula	trash
Bellis perennis	
Bromus sterilis	trash
Calamagrostis epigejos	trash
Caltha palustris	
Calystegia sepium	
Capsella bursa-pastoris	
Carduus acanthoides	
Carduus crispus	
Carex acuta	
Carex acutiformis	
Carex brizoides	
Cerastium holosteoides	
Cichorium intybus	
Cirsium arvense	trash
Cirsium oleraceum	trash
Cirsium palustre	trash
Convolvulus arvensis	
Conyza canadensis	trash
Cornus sanguinea	
Crataegus monogyna	
Crepis biennis	
Dactylis glomerata	
Daucus carota	
Deschampsia cespitosa	
Dipsacus fullonum	trash
Echinochloa crus-galli	trash
Elytrigia repens	
Epilobium adenocaulon	trash
Equisetum palustre	
Erigeron annuus	trash
Euonymus europaea	
Euphorbia cyparissias	
Euphorbia virgata	
Fallopia aubertii	trash
Festuca arundinacea	
Festuca gigantea	
Festuca pratensis	
Festuca rubra	
Ficaria verna	
Frangula alnus	
Galeopsis tetrahit	
Galium aparine	
Galium rivale	
Geranium pratense	
Geranium robertianum	
Geum urbanum	
Glechoma hederacea	
Glyceria maxima	
Heracleum sphondylium	
Humulus lupulus	
Hyoscyamus niger	trash
Hypericum tetrapterum	
Chaerophyllum hirsutum	
Chelidonium majus	
Chenopodium polyspermum	trash
Impatiens glandulifera	trash
Juncus effusus	
Knautia drymeja	
Lamium maculatum	
Leucanthemum vulgare	
Ligustrum vulgare	
Lolium perenne	
Lotus corniculatus	
Lycopus europaeus	
Lysimachia nummularia	
Lysimachia vulgaris	
Lythrum salicaria	
Maianthemum bifolium	
Medicago lupulina	
Melilotus officinalis	trash
Mentha aquatica	
Mentha longifolia	
Molinia caerulea	
Myosotis palustris	
Myosoton aquaticum	
Oenothera biennis	trash
Oxalis acetosella	
Papaver rhoeas	
Pastinaca sativa	
Phalaris arundinacea	
Phleum pratense	
Phragmites australis	trash
Plantago lanceolata	
Plantago major	
Plantago media	
Poa palustris	
Poa pratensis	
Poa trivialis	
Populus × canescens	trash
Populus alba	
Populus x canadensis	trash
Potentilla anserina	
Potentilla palustris	
Prunella vulgaris	
Prunus avium	
Prunus cerasifera	trash
Prunus padus	
Prunus spinosa	
Ranunculus lingua	
Ranunculus repens	
Reynoutria japonica	trash
Robinia pseudacacia	trash
Rosa canina	
Rubus caesius	trash
Rubus idaeus	trash
Rumex hydrolapathum	
Rumex obtusifolius	trash
Salix alba	
Salix caprea	
Salix elaeagnos	
Salix fragilis	
Salix pentandra	
Salix purpurea	
Salix triandra	
Salix viminalis	
Sambucus nigra	
Sanguisorba minor	
Sanguisorba officinalis	
Setaria pumila	trash
Silene vulgaris	
Solanum dulcamara	
Solidago canadensis	trash
Solidago gigantea	trash
Sonchus asper	trash
Sparganium erectum	
Stellaria nemorum	
Symphoricarpos albus	trash
Symphytum officinale	
Syringa vulgaris	trash
Tanacetum vulgare	
Taraxacum sect. ruderalia	
Tilia cordata	
Trifolium arvense	
Trifolium pratense	
Trifolium repens	
Tussilago farfara	
Typha angustifolia	
Typha latifolia	
Urtica dioica	trash
Urtica urens	trash
Verbascum densiflorum	trash
Veronica officinalis	
Viburnum opulus	
Vicia cracca	
Vicia sepium	
Viola palustris	



* „Trash“are invasive species (invasive archaeophytes and neophytes), naturalized species (naturalized archaeophytes or neophytes), native expansive species that are generally considered as an expansive or that behave expansively in the areas of our interest in gravel pit. In Appendix B3, we have a photograph and instructions how to effectively eradicate these plants.

Trees in grey frame are optimally for planting.

Birds (*Aves*):

Aegithalos caudatus
Anas platyrhychos
Anthus trivialis
Ardea alba
Ardea cinerea
Buteo buteo
Carduelis chloris
Ciconia ciconia
Columba palumbus
Emberiza citrinella
Erithacus rubecula
Falco tinnunculus
Fringilla coelebs
Fulica atra
Hippolais pallida
Charadrius dubius
Locustella naevia
Motacilla alba
Parus /Poecile/ coeruleus
Parus major
Phalacrocorax carbo
Phasianus colchicus
Phoenicurus ochruros
Phylloscopus trochillus
Pica pica
Picus viridis
Podiceps cristatus
Prunella modularis
Riparia riparia
Sitta europea
Sterna hirundo
Streptopelia turtur
Turdus merula
Turdus philomelos
Turdus pilaris
Vanellus vanellus

Insect (*Insecta*):

Anax imperator
Maculinea nausithous

Fish (*Osteichthyes*):

Anguilla Anguilla
Perca fluviatilis

Amphibian (*Amphibia*):

Pelophylax esculentus
Pelophylax lessonae
Pelophylax ridibundus

Reptiles (*Reptilia*)

Lacerta viridis
Natrix natrix

Mammals (*Mammalia*)

Capreolus capreolus

We have also observed other species of fauna that we add as a supplement.

Appendix B2

LIST OF BIOTOPES AND THEIR PROTECTION MANAGEMENT

TYPE OF BIOTOPE	CHARTERISTICS	INDICATION SPECIES	MANAGEMENT
Water surface biotope	Lake, island, water.	*Sterna hirundo* *Podiceps cristatus* *Fulica atra*	① Adding new islands. We propose to isolate and restoration the existing island using disturbing management⑧. 💣 Eradication of invasive plants is very important. Install floating islands for *Sterna hirundo*.
Wetlands and pools biotope	In the north-eastern part of the territory. There are two lakes. The area is quiet without visitors.	*Pelophylax* sp. *Ardea* sp. *Anax imperator* *Alisma plantago-aquatica* *Glyceria maxima* *Salix* sp.	② We plain the creation of new ponds, pools and wetlands. 💣 Eradication of invasive plants is very important.
Reed bed and shallows biotope	The shores are too sloping. The reed beds are cut.	*Ardea* sp. *Natrix natrix* *Phylloscopus trochillus* *Typha* sp. *Phragmites australis* *Mentha aquatica*	③ Creating different coast. There will be shallow, shores, bays and beaches. Do not cut of reeds!
Quarry vertical face biotope	Eastern border. The only colony, about ten nests. The wall gradually grows and hardens. The site does not expand much because the wall is private. At the time of nesting, the swimmers are disturbed of birds.	*Riparia riparia*	④ Restore and enlarge the existing wall. Create new walls in different parts of the lake (see map). ⑩ Limiting people's input.
Wetland shrublands biotope	All scrubs and little forests in the area.	*Picus viridis* *Columba palumbus* *Motacilla alba* *Alnus glutinosa* *Cornus sanguinea* *Salix* sp.	⑤ Leave natural succession. 💣 Eradication of invasive plants is very important.
Mesophilic meadow biotope	The meadow in the northeastern part. Currently mulled several times a year. Suitable habitat for *Phasianus colchicus*.	*Maculinea nausithous* *Phasianus colchicus* *Erithacus rubecula* Festuca pratensis *Sanguisorba officinalis* *Lolium perenne*	⑥ Use mosaic mowing. Maximum twice a year. Addition of *Sanguisorba officinalis* and vertictation.
Tailings biotope	Currently in the northeastern region. New ones are emerging. Unfortunately, management is not good. Even during the nesting of birds, the miners picked up another matter. The place is accessible and there was increased movement of people and cars during the summer.	*Charadrius dubius* *Vanellus vanellus* *Sterna hirundo* *Lythrum salicaria*	⑦ Restoration of the primal place and expansion of new. ⑩ Limiting people's input.
Areas covered in early stages of succession	Areas at the weights and in the places where the banks were dredged. They are characterized by a larger proportion of invasive plants.	*Echinochloa crus-galli* *Setaria pumila* *Aster lanceolatum*	⑧ Sometimes mowing or burning. 💣 Eradication of invasive plants is very important.
Cultural and recreational areas	Almost all places for bathing and fishing. Areas are currently illegal and officially inaccessible. These areas should be clearly separated from areas that are primarily intended to protect biodiversity.	*Populus × canadensis* *Calamagrostis epigejos* *Solidago* sp.	⑨ Planting of trees (NOT invasive species) and fruit trees. Planting can be community project. ③ Creating swimming beaches. ⑩ Definition of places for swimming and nature conservation. 💣 Eradication of invasive plants is very important.

Biotopes samples

Fig. 1 *Water surface biotope.*

Fig. 2 *Wetlands and pools biotope.*

Fig. 3 *Reed bed and shallows biotope.*

Fig. 4 *Quarry vertical face biotope*.

Fig. 5 *Wetland shrublands biotope.*

Fig. 6 *Mesophilic meadow biotope.*

Fig. 7 *Tailings biotope.*

Fig. 8 *Areas covered in early stages of succession.*

Fig. 9 *Cultural and recreational areas.*

Appendix B3

THE BEST OF INVASIVE PLANTS

NAME	PICTURE	RISK	URGENCY	MANAGEMENT
Acer negundo		This disturbs the primal forest place. There are new surfaces that we want to have woodless.	High	Systematic cutting and painting of herbicides.
Ailanthus altissima		Wood with large elevations. This is the last species-rich area.	High	Systematic cutting and painting of herbicides
Amorpha fruticosa		"Little" *Robinia pseudacacia*. It is very good in the root. Seeds eat birds and distribute them to the surrounding area.	Medium	Systematic cutting and painting of herbicides
Aster lanceolatum ***Aster novi-belgii***		Small flowers that fast expand into the landscape.	Medium	Pull out of the ground.
Calamagrostis epigejos		Expansive species that competes with other species.	Medium	Cutting or sowing of *Rhinanthus*.
Conyza canadensis ***Erigeron annuus***		Ruder species are persistent in the early years. Then they disappear.	Small	Pull out of the ground.
Fallopia aubertii		Uncontrollably spreads and blocks succession. It has unpleasant seeds that stick to shoes and clothes.	Small	Pull out of the ground.
Oenothera biennis		Colonizes shores and slopes in the area. Although it is a drug, it is expansive in the gravel pit.	Small	Pull out of the ground.
Impatiens glandulifera		“The standard equipment” of quarries and gravel pits where there is some forest with water.	High	Pull out of the ground.
Populus × canadensis		It is settling down banks, especially in the south-eastern part of the gravel pit.	Medium	Systematic cutting and painting of herbicides
Reynoutria japonica		In a short time everything changes - view, biocenosis and mood. Extremely invasive. It is not located directly in the area of interest.	High	Spraying on leaves using „Rezekvítek Methods“.
Robinia pseudacacia		Enfant terrible nature conservation. Useful and at heart harmless.	Medium	Systematic cutting and painting of herbicides Pasture is possible. Big pieces rotate or ring.
Rumex obtusifolius		It grows on the shores of the lake and flies everywhere.	Small	Pull out of the ground.
Solidago canadensis ***Solidago gigantea***		Of all the monsters, it is the most straight after the wing. It is quite everywhere.	High	Pull out of the ground.

"kamenivo Slovakia"
Slovak Republic
roman Catholic Church
private land
village of Predmier

10 m 100 m

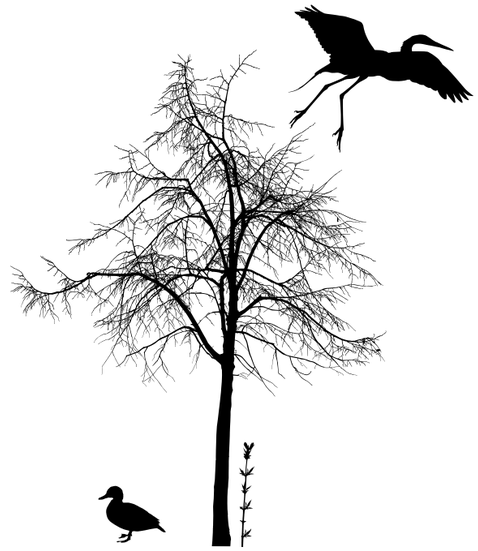
Landowners map_appendix K1

"Proposal for reclamation and land use"2005_appendix K2

HUMAN

- cars,cyclists
- walking path, dogwalkers
- reconnaissance path
- frequented areas (fire pit, picnic area, swimming)
- fishing area
- parking lot
- mining

10 m — 100 m



NATURE

- recolonized vegetation
- vegetation from early stages of succession
- invasive plants
- reeds
- birds
- amphibians

10 m — 100 m


RIVER VÁH
wooden path
6/ MESOPHILIC MEADOW BIOTOPE
FISHERMEN POND
7/ TAILINGS BIOTOPE
2/ WETLANDS AND POOLS BIOTOPE
swimming
3/ REED BED SHALLOWS BIOTOPE
1/ WATER SURFACE BIOTOPE
floating island
7/ TAILINGS BIOTOPE
5/ WETLAND SHRUBLANDS BIOTOPE
MOTORWAY
new pools
pools
4/ QUARRY VERTICAL FACE BIOTOPE
earthworks along shore
observation
5/ WETLAND SHRUBLANDS BIOTOPE
fishermen
P
3/ REED BED SHALLOWS BIOTOPE
gradual shore
fishermen
3/ REED BED SHALLOWS BIOTOPE
earthworks along shore
cluster
fishermen
gradual shore
avenue
CULTURAL LANDSCAPE
P
P
P
9/ CULTURAL AND RECREATION AREAS
VILLAGE PREDMIER
© EUROSENSE,
10 m
100 m