RFCS RESEARCH PROJECT

# Recovery of degraded and transformed ecosystems in coal mining-affected areas

847205-RECOVERY-RFCS-2018

## Deliverable 2.5

# Baseline mapping of relevant ecosystems of Mibrag Mines

European Commission

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## Executive Summary

The document reports the deliverable 2.5 of the RFCS projects “Recovery of degraded and transformed ecosystems in coal mining-affected areas”. The report explores the baseline mapping of the former pit mining area south of Leipzig in eastern central Germany.

The baseline mapping serves to inform the public as well as decision makers about the current composition and configuration of the post-mining landscape. The baseline mapping is prerequisite for the assessment of ecosystem services and the subsequent valuation of these ecosystem services. The baseline mapping further serves the purpose of achieving comparability within the different mining areas in the RECOVERY project.

The baseline mapping uses the land cover categories from the EU CORINE program and data from the EU COPERNICUS land monitoring service to define the land uses in the study area and supply additional information, such as elevation, hydrology and nature protection areas needed for the valuation of ecosystem services. The use of EU-widely available data facilitates integration into European land-cover change research and reproducibility of the project´s approaches for other European mining areas.

The study area, the post mining areas south of Leipzig Germany, named after the mining company responsible for the mining and restoration, the “Mitteldeutsche Braunkohlegesellschaft mbH (Mibrag)”. Covering approximately 200 km², the Mibrag area is the largest study area in the RECOVERY-project. It was under intensive mining impact from the 1920ies until the end of the GDR in 1989. The limits of the study area were selected to include the landscape impacted by the mining pits and the municipalities responsible for the planning of the post mining areas.

The CORINE land cover classification uses three levels of detail. In order to make the CORINE Land cover classification applicable for the purpose of ecosystem assessment the most detailed level of classification was used. Delineation and Classification was based on remote sensing imagery and cross checked using available CORINE LAND cover data. This way the classification of the land cover types was done in a finer spatial resolution than the provided CORINE data where this was considered necessary.

The COPERNICUS land monitoring data provides data that is not categorized into discrete polygons. The different COPERNICUS data layers, e.g. elevation, forest cover density, hydrology were used to further validate the land cover classification by checking for inconsistencies between the land cover classes and the COPERNICUS data. For the Mibrag Study Area no such inconsistencies were found.

The classification of land uses clearly shows the influence of the pit mining on the landscape. However, the transformation of the landscape following the end of the large-

scale mining activities is also visible in the pattern of land uses displayed by the CORINE land cover classification.

The deliverable report demonstrates the use of publicly and EU-wide available data and established procedures to delineate and classify mining and post mining landscapes. This way patterns of mining landscapes and subsequently assessment and valuation of ecosystem services of mining and post mining landscapes is possible. The Mibrag Stdy Area shows that this is possible even for areas as large as 200 km². The baseline mapping serves to assess the impact of mining activities for other mining areas in Europe as well.

# 1 Introduction

Work Package No 2 focuses on mapping and assessing the ecosystems and their services of the project's case studies.

Specific objectives are:

1. To identify the adequate boundaries of the different case studies based on existing spatial connectivity and functional cohesion for each coal mining-affected area.
2. To delineate, categorize and map the different ecosystems types of land covers in the study areas, according to CORINE Land Cover classes (Bossard et al, 2000; Kosztra et al., 2017), although doing detailed field mapping at a higher resolution.
3. To assess the ecosystem services according to the Common International Classification of Ecosystem Services V5.1 (Haines-Young & Potschin, 2018), in order to achieve standardization and to avoid any overlapping or redundancy within the different categories.
4. To implement a geographic information system (GIS) web interface for each case study, allowing constructing user desired information thematic maps for viewing purposes.

As the typology of ecosystems and ecosystem services will provide the analytical frame for the project, in order to operationalize this work package, in first place Task 2.1 will focus on the baseline mapping of relevant ecosystems.

Under the coordination of UBER, with a lot of experience in this field, for each case-study the surrounding limits of the different coal mining-affected areas will be defined on the basis of existing spatial connectivity and functional cohesion.

It is critical for establishing an ecosystem services context to determine with accuracy the adequate boundaries of the areas where the impact of the planned activities may produce changes in forms of land use, monetary value of properties, and potential of ecosystem services.

In second place, CORINE Land Cover classes will be used to delineate, categorize and map the different ecosystems types of land cover in the study areas, although doing detailed field mapping at a higher resolution than in the CORINE programme.

In 1985, the CORINE programme was initiated in the European Union. CORINE means 'coordination of information on the environment' and it was a prototype project working on many different environmental issues.

The CORINE databases and several of its programmes have been taken over by the European Environment Agency (EEA). One of these is an inventory of land cover in 44 classes, and presented as a cartographic product, at a scale of 1:100 000. This database is operationally available for most areas of Europe.

Deliverable 2.5 will undergo the baseline mapping of the relevant ecosystems from Mibrag Mines, in the South of Leipzig, Germany.

# 2 Mibrag Mines

The study area covers 200 km². There are five settlements in the study area with currently 45 900 inhabitants: Markkleeberg, Böhlen, Rötha, Großpösna and Zwenkau. The city of Leipzig, which lies north of the study area currently has approx. 588 900 inhabitants (Statistical Office of Saxony, 2019) (Figure 2-1).

**Figure 2-1. Mibrag Mines**

The construction of the opencast mines began in 1921. During the time from 1926 to 1989, eight large open cast mines were in operation in the area. After the reunification of Germany in 1990 restoration effort began for three inactive mines (Larondelle & Haase, 2012).

The lakes in the study area are former mining pits which were flooded as part of the restoration (Wiegand et al., 2003). The lakes, with approximately 37 km² of water surface, constitute man made landscape elements in a Pleistocene landscape for which large water bodies are not typical (Krüger et al., 2002; Hüttl & Gerwin, 2004).

Agricultural areas make up large proportions of the study area. Remnants of the floodplain forests of the Weiße Elster and Pleiße rivers make up most of the forest in the study area.

# 3 Identifying the adequate boundaries for the case-study area

The surrounding limits of the different coal mining-affected areas will be defined on the basis of existing spatial connectivity and functional cohesion. It is critical for establishing an ecosystem services context to determine with accuracy the adequate but flexible boundaries of the area where the impact of the planned activities may produce changes in forms of land use, monetary value of properties, and potential of ecosystem services.

The area that was selected for the Mibrag Mines is presented in Figure 3-1, and it covers an area of roughly 200 $km^2$ (199 930 ha).

**Figure 3-1. Boundaries of the Mibrag Mines case study**

The boundaries were selected according to the following aspects:

1. All the area of the mine and waste heaps was included in the polygon.
2. The north limit was selected according to the southern boundary of the city of Leipzig.
3. The east limit was selected according to the eastern boundaries of the municipalities of Gropösna and Rötha.
4. The west limit was selected to include the full area of the former mining pits in the northwest and the west of the study area as well as the Weiße Elster river.
5. The south limit was selected according to the southern borders of the municipalities of Böhlen, Rötha and Zwenkau.

# 4 Geospatial Data Available

A revision of the European and German online geospatial data that was available for Mibrag Mines area was developed.

## 4.1 CORINE Land Cover 2012

The information was obtained from the following site:

https://gis.uba.de/catalog/OpenSearch.do?type=/Query/OpenSearch.do&search=CORINE, the CLC downloading site of the German Environmental Agency (Umweltbundesamt) providing CLC data on at a minimum mapping unit of 10 ha (currently only available for 2012), which was not yet available for 2018.

Figure 4-1 presents the map of land cover in 2012. The Geodetic Reference datum used is ETRS89 and the UTM projection spindle 30.

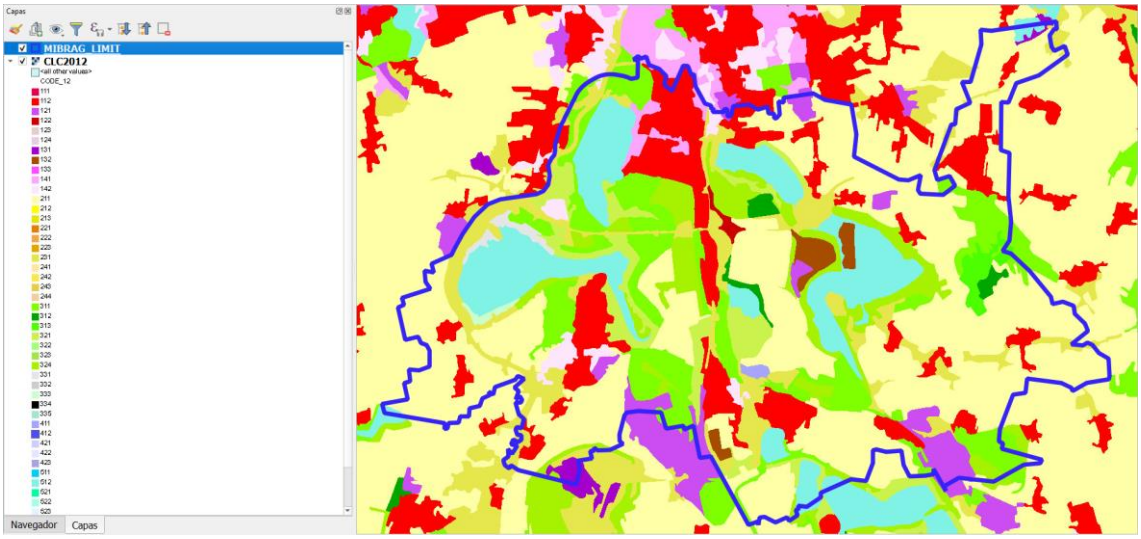


**Figure 4-1. CORINE Land Cover 2012 (Inspire View/WMS)**

The CORINE Land Cover (CLC) project has been the responsibility of the European Environment Agency since 1995 with the fundamental objective of obtaining a European database of land use at a scale of 1: 100 000, useful for territorial analysis and policy management. This project is currently included in the COPERNICUS Program whose main objective is to establish an Earth Observation System under the mandate of the European Commission.

On the other hand, Figure 4-2 presents the map of land cover in 2018, providing CLC data on at a minimum mapping unit of 25 ha.

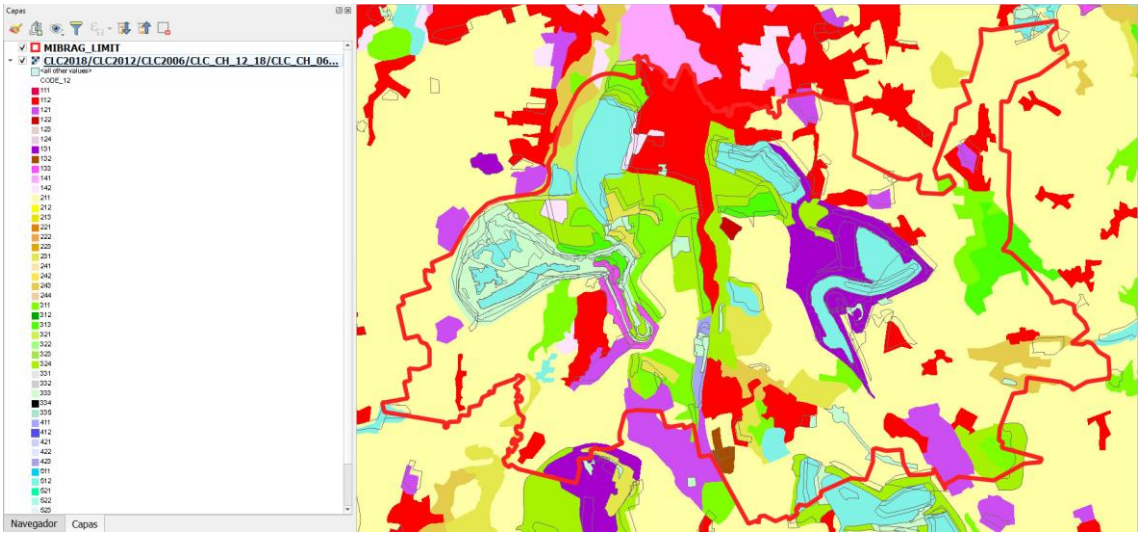


Figure 4-2. CORINE Land Cover 2018 (INSPIRE View/WMS)

## 4.2 COPERNICUS Land Monitoring System

Information was obtained from: https://land.copernicus.eu/pan-european/high-resolution-layers

Pan-European High Resolution Layers (HRL) provide information on specific land cover characteristics, and are complementary to land cover / land use mapping such as in the CORINE Land Cover (CLC) datasets.

The HRLs are produced from satellite imagery through a combination of automatic processing and interactive rule based classification. Since the production of the 2015 reference year the production is increasingly based on time series of satellite images from a number of different sensors, including the combination of optical and radar data.

The main sources are the Sentinel Satellites (in particular Sentinel-2 and Sentinel-1). In addition to high resolution (HR) data, since 2015, they also use very high resolution (VHR) imagery for some of the products.

Five themes have been identified so far, corresponding with the main themes from CLC, i.e. the level of sealed soil (imperviousness), tree cover density and forest type, grasslands, wetness and water, and small woody features.

Figure 4-3 presents the imperviousness density in 2015, capturing the percentage and change of soil sealing. Built-up areas are characterized by the substitution of the original (semi-) natural land cover or water surface with an artificial, often impervious cover.

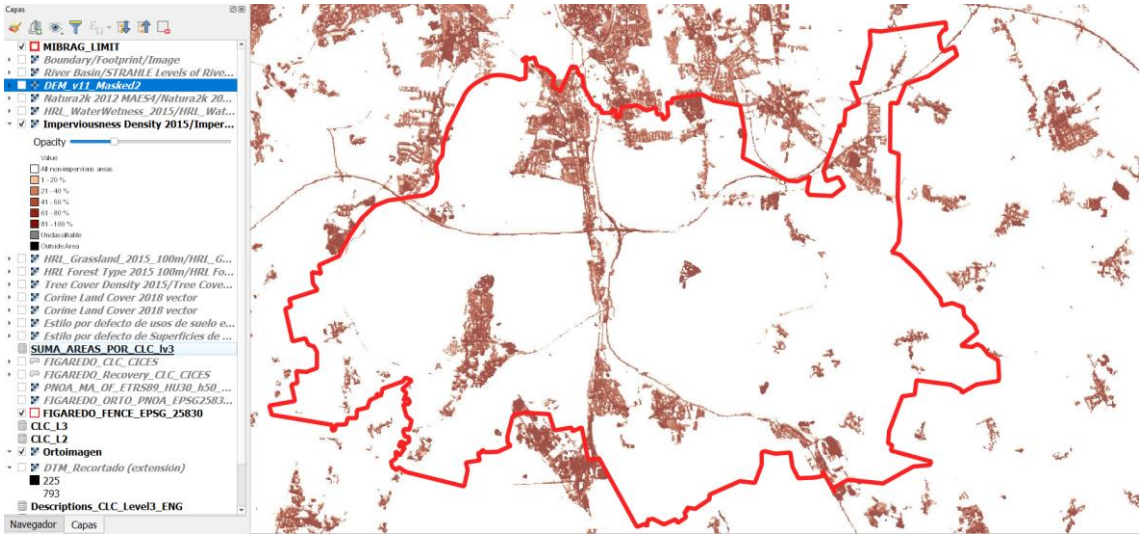


**Figure 4-3. COPERNICUS Imperviousness 2015. GSD: 20M. EPSG: 3035 (ETRS89, LAEA)**

Figure 4-4 presents the tree cover density in 2015, being the 'vertical projection of tree crowns to a horizontal earth's surface', providing information on the proportional crown coverage per pixel. This information is derived from multispectral High Resolution (HR) satellite data using Very High Resolution (VHR) satellite data and/or aerial ortho-imagery as reference data. Tree cover density is assessed on VHR sources by visual interpretation following a point grid approach and subsequently transferred to the HR data by a linear function.

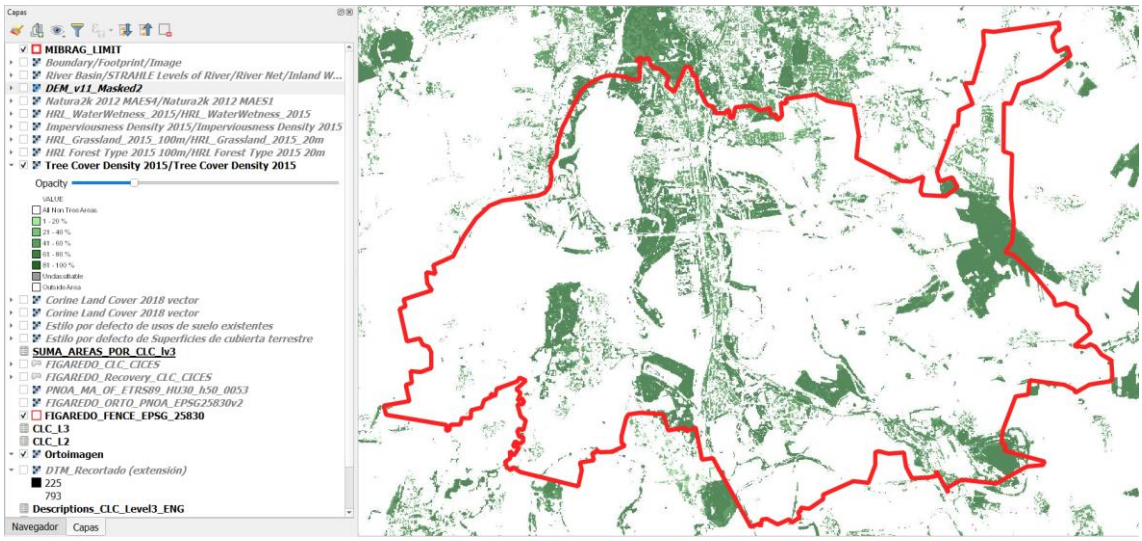


**Figure 4-4. COPERNICUS Tree Cover Density 2015. EPSG: 3035 (ETRS89, LAEA)**

Figure 4-5 presents the tree cover layer with two categories: broadleaved forest in light green and coniferous forest in dark green. White color represents non-forest areas.

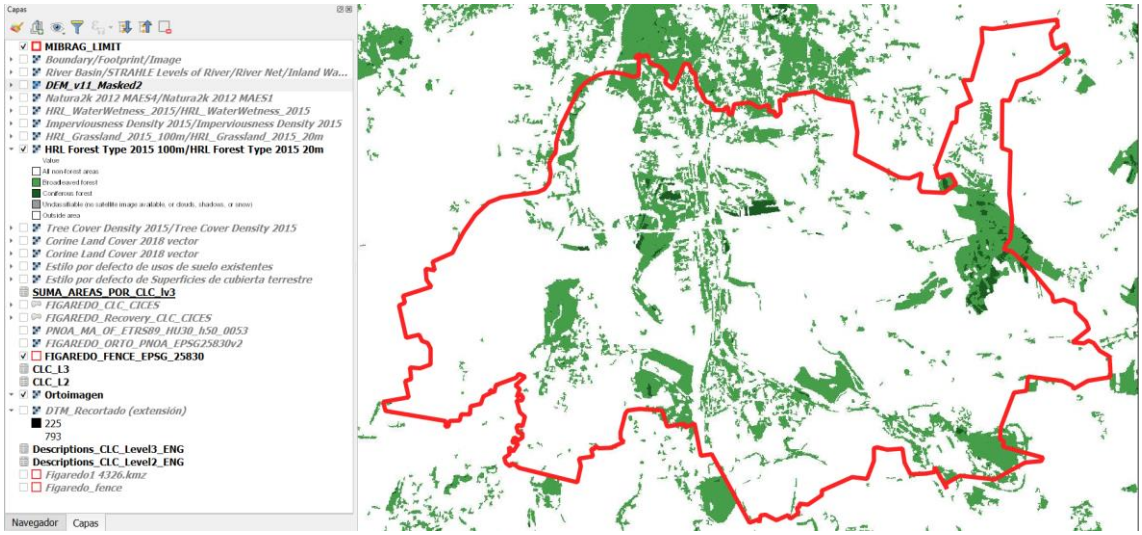


Figure 4-5. COPERNICUS Forest Type 2015. MMU: O.5Ha. EPSG: 3035 (ETRS89, LAEA)

Figure 4-6 presents the grassland layer, a binary status layer. This grassy and non-woody vegetation baseline product includes all kinds of grasslands: managed grassland, semi-natural grassland and natural grassy vegetation.


Figure 4-6. COPERNICUS Grassland 2015. GSD: 20M. EPSG: 3035 (ETRS89, LAEA)

Figure 4-7 presents the water and wetness layer, showing the occurrence of water and wet surfaces over the period from 2009 to 2015.

This layer has defined classes of (1) permanent water, (2) temporary water, (3) permanent wetness and (4) temporary wetness.

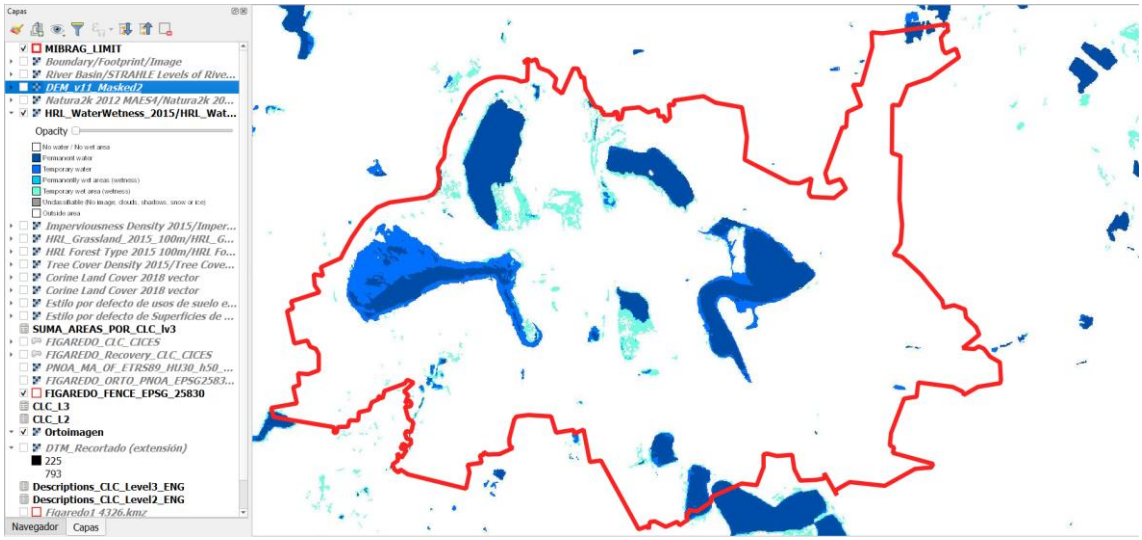


**Figure 4-7. COPERNICUS Water and Wetness 2015. GSD: 20M. EPSG: 3035 (ETRS89, LAEA)**

On the other hand, Natura 2000 is a network of core breeding and resting sites for rare and threatened species, as well as for some rare natural habitat types which are protected in their own right. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats that are listed under the Birds Directive and the Habitats Directive. The mapping product offers a detailed LC/LU product applying a hierarchical nomenclature with 55 thematic LC/LU classes. Figure 4-8 presents the NATURA 2000 mapping in the study area (updated in 2018), obtained from https://land.copernicus.eu/news/natura-2000-lc-lu-product-now-updated.

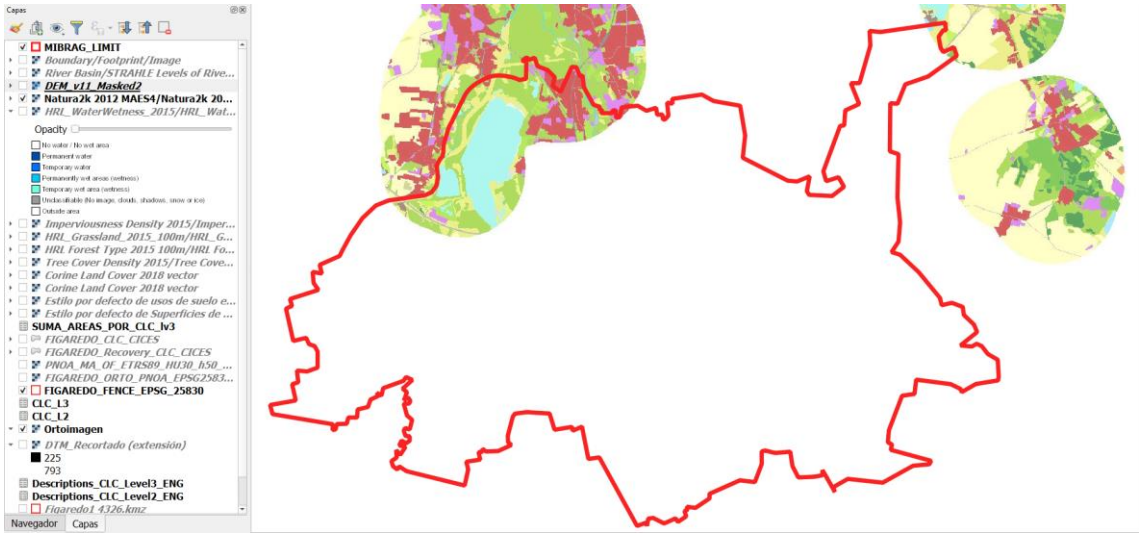


**Figure 4-8. COPERNICUS NATURA 2000, 2018. EPSG: 3035. Minimum Mapping Unit (MMU): 0.5 ha. MM Width (MMW): 10 m**

Finally, as CORINE Land Cover (CLC) is also a part of the COPERNICUS Land Monitoring Service, developed with a minimum mapping unit (MMU) for status layers is 25 hectares - minimum width of linear elements is 100 meters - minimum mapping unit (MMU) for Land Cover Changes (LCC) for change layers is 5 hectares (Figure 4-9).

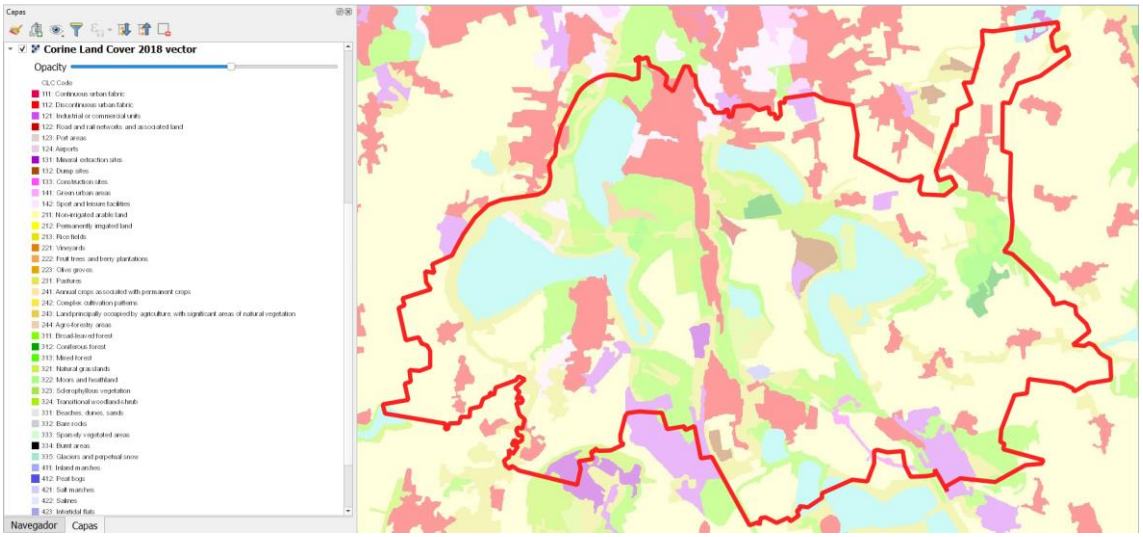


Figure 4-9. COPERNICUS CORINE Land Cover 2018

## 4.3 COPERNICUS imagery and reference data

Other intermediate products coming from COPERNICUS are the European Digital Elevation Model that is presented in Figure 4-10.

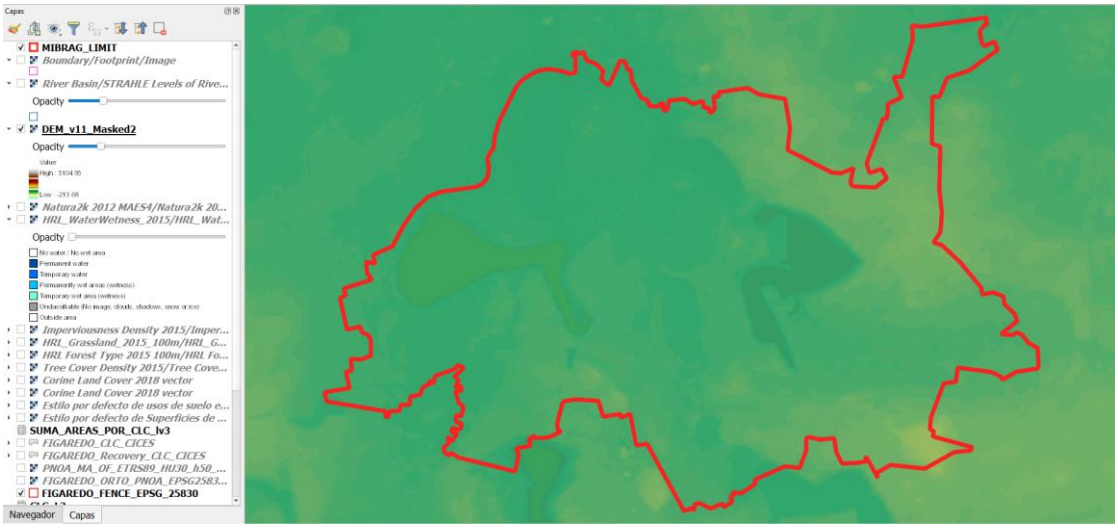


Figure 4-10. European Digital Elevation Model (EU-DEM), version 1.1. EPSG: 4326 (ETRS89, LAEA) grid width: 25m

In addition, the EU-Hydro, a dataset for all EEA39 countries providing photo-interpreted river network, consistent of surface interpretation of water bodies (lakes and wide rivers), and a drainage model (called Drainage Network), derived from EU-DEM, with catchments and drainage lines and nodes (Figure 4-11).


Figure 4-11. EU-Hydro EPSG: 4326 (ETRS89, LAEA) grid width: 25m

Finally, a cloud-free HR corresponding to the vegetation season in 2012, representing in false colour the vegetative zone (Figure 4-12).


Figure 4-12. High Resolution Imagery False Colour 2012. EPSG: 4326. GSD: 20m

# 5 Mapping of relevant ecosystems

CORINE Land Cover classes (Bossard et al., 2000) were used to delineate, categorize and map the different ecosystems types of land cover in the study areas (Figure 5-1).

| CLC Level 1 | CLC Level 2 | CLC Level 3 | Ecosystem types level 2 |
|---|---|---|---|
| 1. Artificial surfaces | 1.1. Urban fabric | 1.1.1. Continuous urban fabric | Urban |
| | | 1.1.2. Discontinuous urban fabric | |
| | 1.2. Industrial, commercial and transport units | 1.2.1. Industrial or commercial units | |
| | | 1.2.2. Road and rail networks and associated land | |
| | | 1.2.3. Port areas | |
| | | 1.2.4. Airports | |
| | 1.3. Mine, dump and construction sites | 1.3.1. Mineral extraction sites | |
| | | 1.3.2. Dump sites | |
| | | 1.3.3. Construction sites | |
| | 1.4. Artificial non-agricultural vegetated areas | 1.4.1. Green urban areas | |
| | | 1.4.2. Sport and leisure facilities | |
| 2. Agricultural areas | 2.1.Arable land | 2.1.1. Non-irrigated arable land | Cropland |
| | | 2.1.2. Permanently irrigated land | |
| | | 2.1.3. Rice fields | |
| | 2.2. Permanent crops | 2.2.1. Vineyards | |
| | | 2.2.2. Fruit trees and berry plantations | |
| | | 2.2.3. Olive groves | |
| | 2.3. Pastures | 2.3.1. Pastures | Grassland |
| | 2.4. Heterogeneous agricultural areas | 2.4.1. Annual crops associated with permanent crops | Cropland |
| | | 2.4.2. Complex cultivation patterns | |
| | | 2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation | |
| | | 2.4.4. Agro-forestry areas | |
| 3. Forests and semi-natural areas | 3.1. Forests | 3.1.1. Broad-leaved forest | Woodland and forest |
| | | 3.1.2. Coniferous forest | |
| | | 3.1.3. Mixed forest | |
| | 3.2. Shrub and/or herbaceous vegetation association | 3.2.1. Natural grassland | Grassland |
| | | 3.2.2. Moors and heathland | Heathland and shrub |
| | | 3.2.3. Sclerophyllous vegetation | |
| | | 3.2.4. Transitional woodland shrub | Woodland and forest |
| | 3.3. Open spaces with little or no vegetation | 3.3.1. Beaches, dunes, and sand plains | Sparsely vegetated land |
| | | 3.3.2. Bare rock | |
| | | 3.3.3. Sparsely vegetated areas | |
| | | 3.3.4. Burnt areas | |
| | | 3.3.5. Glaciers and perpetual snow | |
| 4. Wetlands | 4.1. Inland wetlands | 4.1.1. Inland marshes | Wetlands |
| | | 4.1.2. Peatbogs | |
| | 4.2. Coastal wetlands | 4.2.1. Salt marshes | Marine inlets and transitional waters |
| | | 4.2.2. Salines | |
| | | 4.2.3. Intertidal flats | |
| 5. Water bodies | 5.1 Inland waters | 5.1.1 Water courses | Rivers and lakes |
| | | 5.1.2 Water bodies | |
| | 5.2 Marine waters | 5.2.1 Coastal lagoons | Marine inlets and transitional waters |
| | | 5.2.2 Estuaries | |
| | | 5.2.3 Sea and ocean | Marine |

**Figure 5-1. Correspondence between CLC Classes and ecosystem types**

As resented in Figure 5-1, the number of ecosystem types level 2 is much lower than CLC level 3 (Maes et al., 2013), but as the area that is going to be studied is small, CLC level 3 seems to be much more appropriate in order to analyse future changes in the land cover classes and, subsequently, in their ecosystem services provision.

Moreover, Figure 5-2 presents the specific colours of CLC used in order to develop the mapping of relevant ecosystems (Source: http://www.gisandbeers.com/descarga-corine-land-cover-2018/).

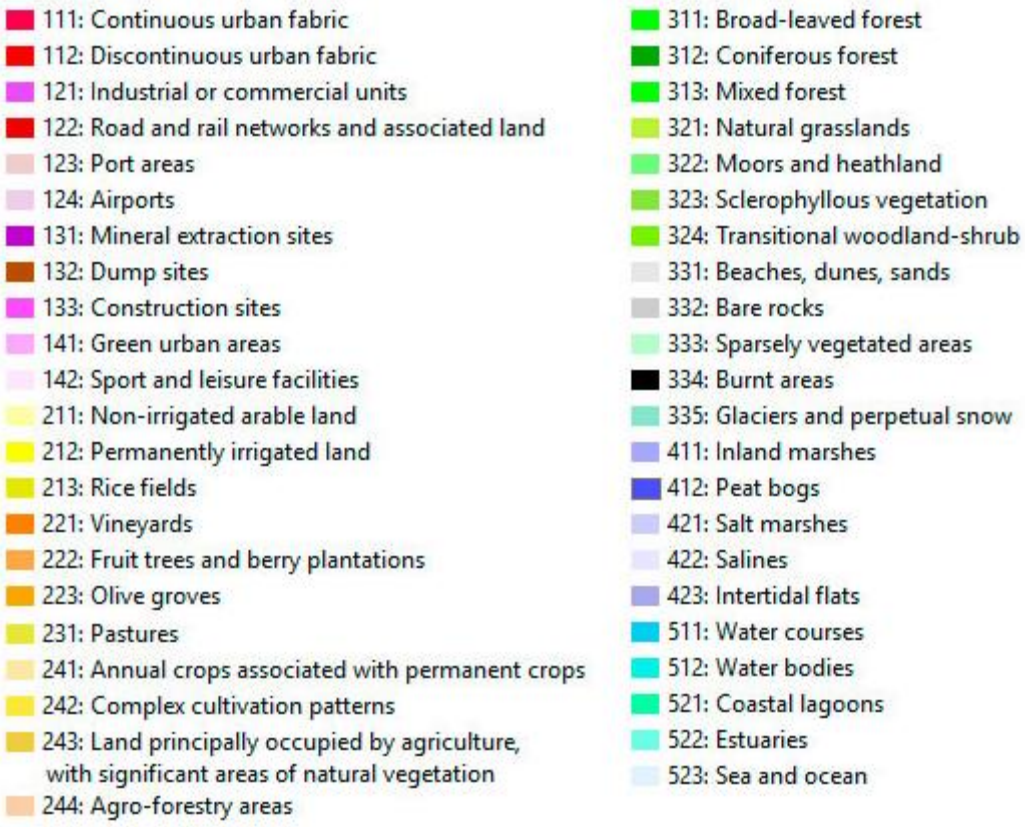


**Figure 5-2. CORINE Land Cover pantone**

Figure 5-3 presents the GIS aspect of CLC classes in Mibrag Mines that was developed with QGIS 3.8 Zanzibar. QGIS (previously known as Quantum GIS) is a free and open-source cross-platform desktop GIS application that supports viewing, editing, and analysis of geospatial data. On the other hand, Figure 5-4 presents the same image but over imposed to the orthoimage of the area.

Finally, Figure 5-5 presents an example of the polygon information that is available within the GIS: area (ha), perimeter (km), CLC class level 2 and level 3, and the total surface of this specific CLC class level 3 in the whole case-study.

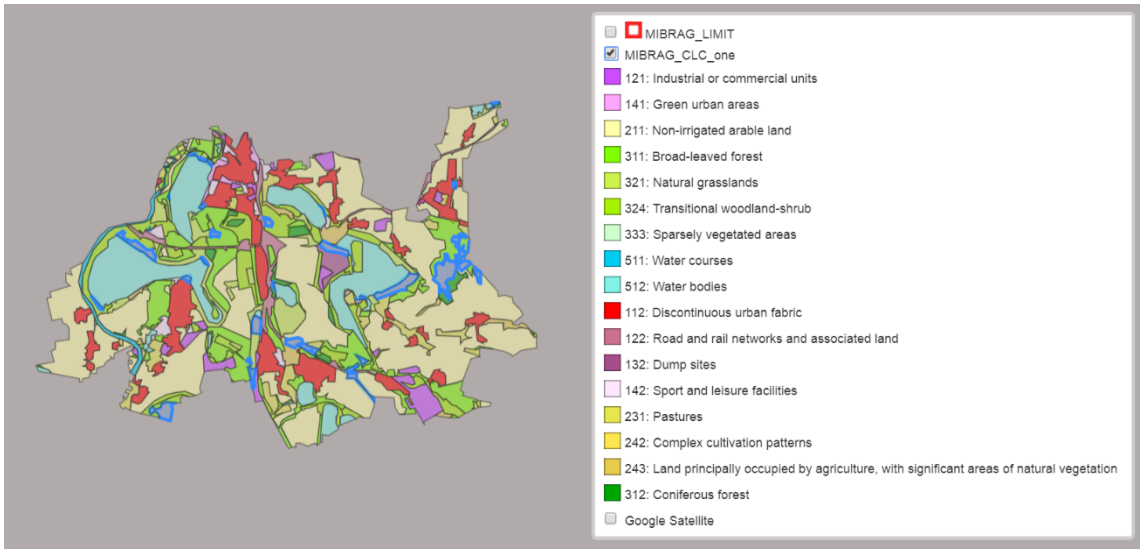


**Figure 5-3. GIS presentation of CLC classes in Mibrag Mines**

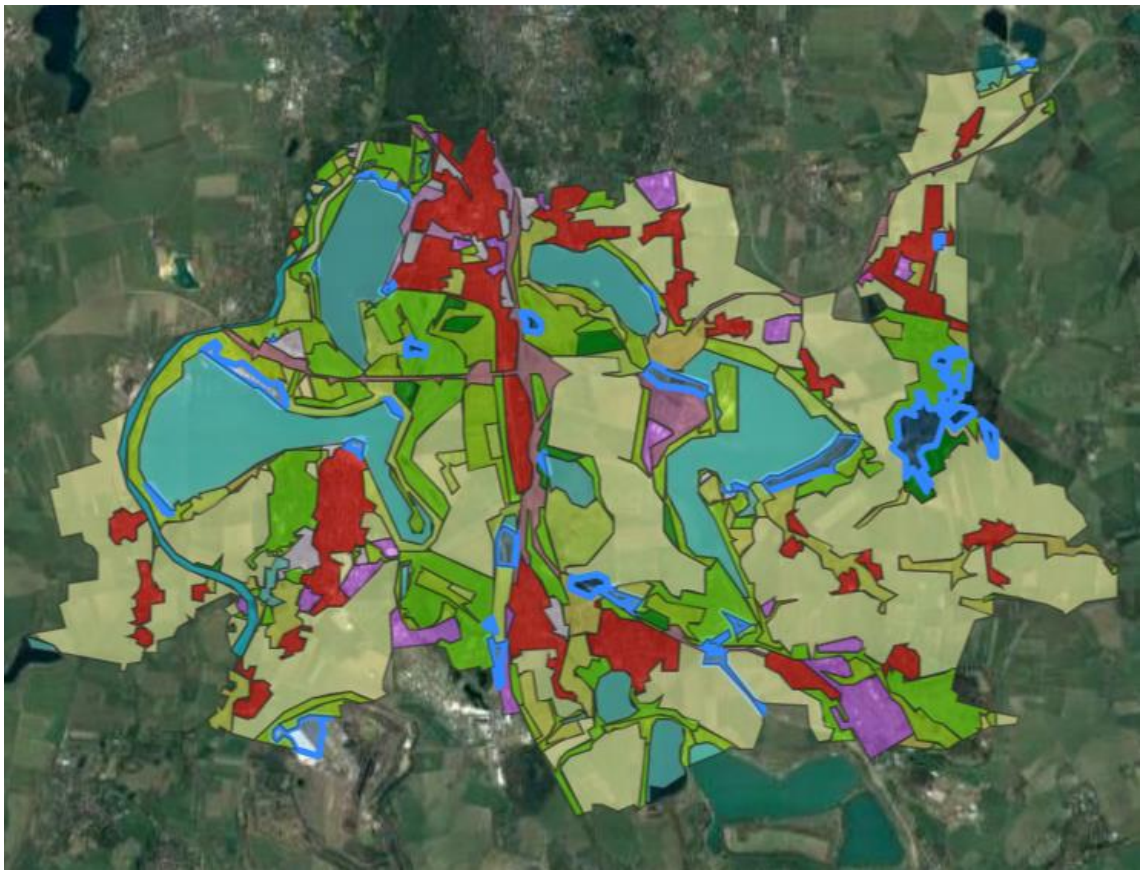

**Figure 5-4. GIS presentation of CLC classes in Mibrag Mines over the orthoimage of the area**

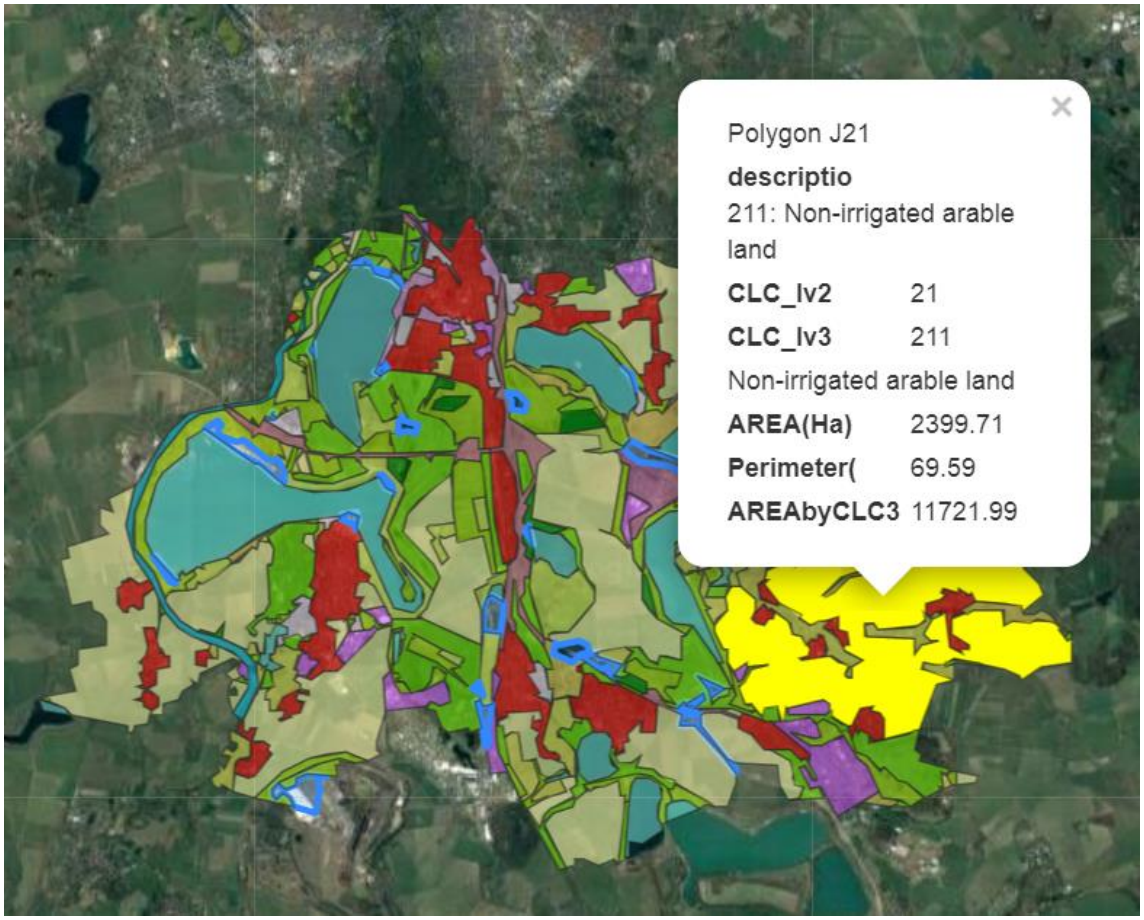


**Figure 5-5. Polygon description in the GIS**

This information will be used afterwards to develop the calculations concerning the ecosystem services valuation.

The explanation of the different CLC classes used in Mibrag Mines is the following (Bossard et al., 2000):

## 5.1 Artificial areas (Main Class 1)

In case of cultivated areas inter-mixed with built-up areas within a patchwork system, the minimum threshold to be considered to classify in discontinuous urban fabric is 30 % (at least 30 % of the small parcels are urban fabric). Otherwise, the area should be classified as complex cultivation patterns.

### 5.1.1 Discontinuous urban fabric (112)

Most of the land is covered by structures. Building, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces. Between 30 to 80 % of the total surface should be impermeable.

The discrimination between continuous and discontinuous urban fabric is set from the presence of vegetation visible illustrating either single houses with gardens or scattered apartment blocks with green areas between them.

The density of houses is the main criteria to attribute a land cover class to the built-up areas or to the agricultural area (242). In case of patchwork of small agricultural parcels and scattered houses, the cut-off-point to be applied for discontinuous urban fabric is 30 % at least of urban fabric within the patchwork area.

### 5.1.2 Industry or commercial units, public services and military installations (121)

Artificially surfaced areas (with concrete, asphalt, tarmacadam, or stabilised, e.g. beaten earth) without vegetation occupy most of the area, which also contains buildings and/or vegetation.

### 5.1.3 Road and rail networks and associated land (122)

Motorways and railways, including associated installations (stations, platforms, embankments, linear greenery).

In delineating 122 a maximum 15-20% exaggeration of width is allowed.

### 5.1.4 Port areas (123)

Infrastructure of port areas (land and water surface), including quays, dockyards and marinas.

### 5.1.5 Mineral extraction sites (131)

Areas with open-pit extraction of construction material (sandpits, quarries) or other minerals (opencast mines). Includes flooded gravel pits, except for riverbed extraction.

This class includes flooded gravel pits surface of which is less than 25 ha and temporary mining pools.

### 5.1.6 Dump sites (132)

Public, industrial or mine dump sites. This class includes dump sites of raw materials or liquid wastes.

### 5.1.7 Construction sites (133)

Spaces under construction development, soil or bedrock excavations, earthworks. This class is assigned for areas where landscape is affected by human activities, changed or modified into artificial surfaces, being in a state of anthropogenic transition.

### 5.1.8 Green urban areas (141)

Areas with vegetation within or partly embraced by urban fabric. This class is assigned for urban greenery, which usually has recreational or ornamental character and is usually accessible for the public.

### 5.1.9 Sport and leisure facilities (142)

This class is assigned for areas used for sports, leisure and recreation purposes. Camping grounds, sports grounds, leisure parks, golf courses, racecourses etc. belong to this class, as well as formal parks not surrounded by urban areas.

The criterion for assigning this class is the use of land. Areas of any land cover type can belong to this class if the purpose and use of it is sport, leisure or recreation.

## 5.2 Agricultural areas (Main class 2)

### 5.2.1 Non-irrigated arable land (211)

Cultivated land parcels under rain-fed agricultural use for annually harvested non-permanent crops, normally under a crop rotation system, including fallow lands within such crop rotation. Fields with sporadic sprinkler-irrigation with non-permanent devices to support dominant rain-fed cultivation are included.

### 5.2.2 Pastures (231)

Dense grass cover, of floral composition, dominated by graminacea, not under a rotation system. Mainly for grazing, but the fodder may be harvested mechanically. Includes areas with hedges (bocage). Grazing used by cattle.

Pastures can be described as extensively used grasslands with presence of farm structure such as fences, shelters, enclosures, watering places, drinking trough, or regular agricultural works: mowing, drainage, hay making, agricultural practices, manuring.

### 5.2.3 Land principally occup. by agriculture, with signif. areas of natural vegetation (243)

Areas principally occupied by agriculture, interspersed with significant natural or semi-natural areas (including forests, shrubs, wetlands, water bodies, mineral outcrops) in a mosaic pattern.

## 5.3 Forest and semi-natural areas (Main class 3)

### 5.3.1 Broad-leaved forest (311)

Vegetation formation composed principally of trees, including shrub and bush understoreys, where broad-leaved species predominate.

This class includes areas with a crown cover of more than 30% or a 500 subjects/ha density for plantation structure, broad-leaved trees represent more than 75% of the planting pattern. In case of young plants or seedlings, the proportion of broad-leaved plants to be considered is at least 75 % of the total amount of plants.

### 5.3.2 Coniferous forest (312)

Vegetation formation composed principally of trees, including shrub and bush understorey, where coniferous species predominate.

The predominant classifying parameter for this class is a crown cover density of >30% or a mini-mum 500 subjects/ha density, with coniferous trees representing >75% of the formation. The minimum tree height is 5 m (with the exception of Christmas tree plantations).

### 5.3.3 Mixed forest (313)

Vegetation formation composed principally of trees, including shrub and bush understorey, where neither broad-leaved nor coniferous species pre-dominate.

Mixed forests with a crown cover of >30% or a 500 subjects/ha density for plantation structure. The share of both coniferous and broad-leaved species exceeds 25% within the canopy closure. The minimum tree height is 5 m.

### 5.3.4 Natural grasslands (321)

Grasslands under no or moderate human influence. Low productivity grasslands. Often situated in areas of rough, uneven ground, steep slopes; frequently including rocky areas or patches of other (semi-)natural vegetation.

Natural grasslands are areas with herbaceous vegetation (maximum height is 150 cm and gramineous species are prevailing) covering at least 50 % of the surface. Besides herbaceous vegetation, areas of shrub formations, of scattered trees and of mineral outcrops also occur. Often under nature conservation. Sporadic extensive grazing with low livestock unit/ha is possible.

### 5.3.5 Transitional woodland/shrub (324)

Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/recolonization.

Areas of natural developmental forest formations (young broad–leaved and coniferous wood species with herbaceous vegetation and dispersed solitary trees) for instance; in abandoned meadows and pastures or after calamities of various origin, part of this class may be also various degenerative stages of forest caused by industrial pollution, etc.

### 5.3.6 Beaches, dunes, and sand plains (331)

Natural non-vegetated expanses of sand or pebble/gravel, in coastal or continental locations, like beaches, dunes, gravel pads; including beds of stream channels with torrential regime. Vegetation covers maximum 10%.

### 5.3.7 Sparsely vegetated areas (333)

Areas with sparse vegetation, covering 10-50% of surface. Includes steppes, tundra, lichen heath, badlands, karstic areas and scattered high-altitude vegetation.

Scattered vegetation is composed of herbaceous and/or ligneous and semi-ligneous species, the rest of area is naturally bare ground.

## 5.4 Wetlands (Main Class 4)

### 5.4.1 Inland marshes (411)

Low-lying land usually flooded in winter, and with ground more or less saturated by fresh water all year round.

## 5.5 Water bodies (Main Class 5)

### 5.5.1 Water courses (511)

Natural or artificial water-courses serving as water drainage channels. Includes canals.

In case of rivers with oscillating water level (when the width of the stream is less than 100 m in certain seasons of the year), the whole riverbed must be added to the narrow water surface and then classified as 511.

### 5.5.2 Water bodies (512)

Natural or artificial water bodies with presence of standing water surface during most of the year.

In the study area most of the water bodies is artificial either as flooded mining pits or as reservoirs.

# 6 Conclusions and lessons learnt

The methods used for the baseline mapping of relevant ecosystems of the Mibrag Mines study area are comprised of several steps. The first step, the identification of adequate boundaries had to meet the challenge of a large area being influenced by pit mining. As the geomorphological attributes of the area are mostly equal all over the area, the spatial connectivity and functional cohesion could not be subdivided into smaller units. Except for the western boundary of the study area, which uses the Weiße Elster river to delimit the study area, the use of administrative boundaries for the rest of the boundaries is the best possible solution. This solution takes the area of the responsible planning administrations into account.

The use of the CORINE Land Cover Classification for the baseline mapping ensures the comparability of the land use classes. The well documented reference compilations for the CORINE Land Cover Classification also enables—cross-Europe—planners without specialized knowledge to quickly learn and apply the classification. The discrete patches on which the CORINE Land Cover Classification is based also makes it easy to apply to mining landscapes with sharp divisions between the different land cover types, which is typical for landscapes under long-term human influence. The use of patches also makes it easier to comprehend for decision makers without specialized background knowledge and the interested public.

The use of COPERNICUS land monitoring data is a valuable addition for the procedure of the baseline mapping. It can be used to compare the land cover types, identified in the baseline mapping or supplied by an existing CORINE Land Cover dataset to find out if the land cover classes are consistent with the geophysical conditions identified in the COPERNICUS dataset. However expert knowledge in geosciences is needed to come to valid judgements about inconsistencies. The real value of the COPERNICUS data lies in the additional information it provides concerning ecosystem services assessment following the baseline mapping. In the ecosystem service assessment, the information about protected natural areas or forest cover density are important for the valuation of the ecosystem services provided by the land cover types.

The Mibrag Mines Study Area shows a wide variety of land cover categories. Especially the artificial areas and the forest and semi-natural areas show comparably many subdivisions. First of all the size of the study area has some influence on the amount of land cover classes, but a long tradition of mining and industrial development as well as the decline of the mining sector and following reclamation which has been ongoing for the past three decades has shaped the diversity of land covers in the area.

All in all the advantages of the presented approach for baseline mapping outweigh the challenges and limits by far. The baseline mapping is therefore a well-suited foundation for further assessment of mining impact and ecosystem services.

# 7 Glossary

CLC - CORINE Land Cover

CORINE - Coordination of information on the environment

EEA - European Environment Agency

GIS - Geographic information system

UBER - Humboldt-Universität zu Berlin

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