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MaGICLandscapes

MANUAL OF TRANSNATIONAL GREEN INFRASTRUCTURE ASSESSMENT

Decision Support Tool

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KRKONOŠSKÝ NÁRODNÍ PARK

Leibniz Institute of Ecological Urban and Regional Development

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MANUAL OF TRANSNATIONAL GREEN INFRASTRUCTURE ASSESSMENT – DECISION SUPPORT TOOL

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Project Lead Partner:
Technische Universität Dresden
Faculty of Environmental Sciences
Chair of Remote Sensing, Prof. Dr. Elmar Csaplovics
Helmholtzstr. 10
01069 Dresden

Authors of this Manual:
Marco Neubert[5], Henriette John[5], Christopher Marrs[1], Simonetta Alberico[9], Gabriele Bovo[9], Simone Ciadamidaro[10], Florian Danzinger[7], Martin Erlebach[6], David Freudl[8], Stefania Grasso[9], Anke Hahn[1], Zygmunt Jała[4], Ines Lasala[2], Mariarita Minciardi[10], Gian Luigi Rossi[10], Hana Skokanová[2], Tomáš Slach[2], Kathrin Uhlemann[3], Paola Vayr[9], Dorota Wojnarowicz[4], Thomas Wrbka[7]

1 **Technische Universität Dresden, Germany**

2 **Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Czech Republic**

3 **The Saxony Foundation for Nature and Environment, Germany**

4 **Karkonosze National Park, Poland**

5 **Leibniz Institute of Ecological Urban and Regional Development, Germany**

6 **The Krkonoše Mountains National Park, Czech Republic**

7 **University of Vienna, Austria**

8 **Thayatal National Park, Austria**

9 **Metropolitan City of Turin, Italy**

10 **ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy**

Editors: Marco Neubert, Henriette John
Layout: Anke Hahn
Illustrations cover and icons: Anja Maria Eisen

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Introduction and Aim of this Manual

This Manual of Transnational Green Infrastructure Assessment is the second output of a series of outputs, which were developed as part of the Interreg Central Europe project MaGICLandscapes - Managing Green Infrastructure in Central European Landscapes.

It is designed to be a tool that guides the reader through the process of undertaking a large-scale Green Infrastructure (GI) assessment at the transnational level in Central Europe. It will demonstrate using practical examples which, how and why particular datasets are the most useful in conducting such assessments at this level. It will also highlight where additional local/regional data can be used to increase accuracy and relevance. It will provide guidance on understanding the limitations of particular datasets and what to consider in choosing data. The description of the mapping process presented by this manual is meant to provide decision support to other users that want to fulfil similar tasks.

The manual describes at first the general procedure of mapping GI followed here. After a short introduction to GI and its classification as well as presenting first draft maps of GI the available data for assessing GI and Blue Infrastructure (BI) in Central Europe are summarised. General data needs for the transnational mapping were a) data comparable for all countries involved, b) classification systems applicable to all Central European countries, and c) free/open data access and usability.

This is followed by demonstrating a method on evaluating data suitability in an iterative process based on draft GI maps. The general and specific findings of this evaluation process are then presented. Using the methodology a final transnational GI map and a coordinated GI classification scheme/legend, both based on CORINE land cover (Coordination of Information on the Environment Land Cover, CLC) are provided.

After this process GI maps on transnational scale for the whole of Central Europe as well as for all case study areas were generated. Due to some shortcomings regarding transnational data (spatial resolution, accuracy, classified elements) a refined mapping at the national/regional level using available national/regional data (e.g. biotope maps) was initiated. This was especially important for subsequent tasks within the MaGICLandscapes project and could be important to other users that want to fulfil similar tasks in their region.

Disclaimer: The data used for these process/analyses refer to the processing period (mid 2017 till end of 2018). There will be new datasets available especially provided by the European programme Copernicus (like CORINE 2018) that would need a new evaluation.

1 General Procedure of Mapping Green Infrastructure

One of the rare studies mapping GI, conducted by the European Environment Agency (EEA 2014), follows a complex functional approach based on the mapping of ecosystem service potentials classifying the GI network into "conservation" ["providing key ecological functions, both for wildlife and for human well-being", EEA 2014, 12] and "restoration" ["provides important ecological functions, but its capacity could be improved with some protection or restoration", ibid]. The study suggests a concept of mapping but does not provide information on which data to use and what analyses to apply etc. The availability of ecosystem services information has been identified as a gap. The same applies for harmonised habitat data across Europe.

This manual follows a structural, rather data-driven approach using existing spatial datasets of GI and BI elements (i.e. potential green infrastructure) as a first step. In subsequent steps and as part of a second manual the elements classified as GI and BI (GI and BI classes) will be qualified according to the landscape services they provide.

The following steps in the procedure are explained in this manual:

1. Definition of GI,
2. Definition of GI and BI classes representing the objects of interest from Step 1 (legend) considering the needs of the target groups (see section 2.1),
3. Research of data that already mapped the GI and BI classes, depending on the scale the study is aimed at (European, national, regional, local) and acquisition of these data (see section 2.2),
4. Evaluating the content of the datasets (compared to the definition or aim) (see section 2.3),
5. Producing a map of potential GI and BI (see section 2.4).

Steps 2 to 5 might need to be repeated iteratively until a suitable result is obtained.

The mapping approach, presented in this manual can be used to identify the spatial distribution of GI and BI with a focus on the transnational (European) or national scale. For more detailed mapping we suggest using regional datasets and harmonising them when used in trans-boundary areas. By classifying the elements of GI and BI they can be used in subsequent steps to analyse the ecosystem or landscape services as well as benefits they provide. Based on the classified elements it is also possible to conduct analyses of connectivity since connected ecosystems are healthier as well as more resilient and allow for species movement such as migration and dispersal. Repeated analyses may show the impact of land use changes including the loss of biodiversity. The results can be used at the same time to inform the following target groups about the status of GI:

- the policy decision-makers (to take measures to protect and to enhance the GI Network)
- the planning sector (to implement measures) and
- the general public (to raise awareness)

2 Generating a Transnational Green Infrastructure Map: Lessons learnt

2.1 Definition of Green and Blue Infrastructure Elements representing the Objects of Interest

As already described in the MaGICLandscapes Green Infrastructure Handbook - Conceptual & Theoretical Background, Terms and Definitions' (John et al. 2019) we suggest to follow the Green Infrastructure (GI, including BI) definition of the European Commission (2016): "*Green infrastructure is a strategically planned network of **natural and semi-natural areas** with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of **green (land) and blue (water) spaces** can improve environmental conditions and therefore citizens' health and quality of life. It also supports a green economy, creates job opportunities and enhances biodiversity. The **Natura 2000 network** constitutes the backbone of the EU green infrastructure*" (EC 2016).

According to the applied definition of GI by EC (2016) and in close connection with the datasets available (see section 2.2) including the aim to use most recent and best resolution data, the following broad GI classes have been chosen at first:

- Broadleaved forest
- Coniferous forest
- Trees predominantly used for agricultural practices
- Trees in urban context
- Natural grasslands
- Wetlands
- Permanent water bodies

This broad classification was mainly driven by the promising datasets of the High Resolution Layers (HRL) provided by the Copernicus programme (EEA 2016). Elements of GI and BI were chosen and it was proved that the Natura 2000 areas are covered by overlaying both data sources. Based on the respective HRLs a first draft of the transnational GI map was designed (see Figure 1) and a general review by regional experts was conducted. This review revealed that these datasets (i.e. the status of the data used, see section 2.2) have some gaps (unclassified areas, due to clouds etc.) in coverage and some classes are missing, especially related to extensive farmland.

Based on the expert feedback provided and the user needs identified by asking regional experts, in the next iteration a second draft of the transnational GI map was adapted (see Figure 2). In addition to the HRLs used before, CORINE Land Cover (CLC), High Nature Value Farmland (HNVF) and European catchments and Rivers network system (Ecrins) was added to the map. The classes chosen for this second draft are shown in Table 1. The second draft map was subsequently used to perform a detailed quality check (ground-truthing as it is known from remote sensing applications, see section 2.3).

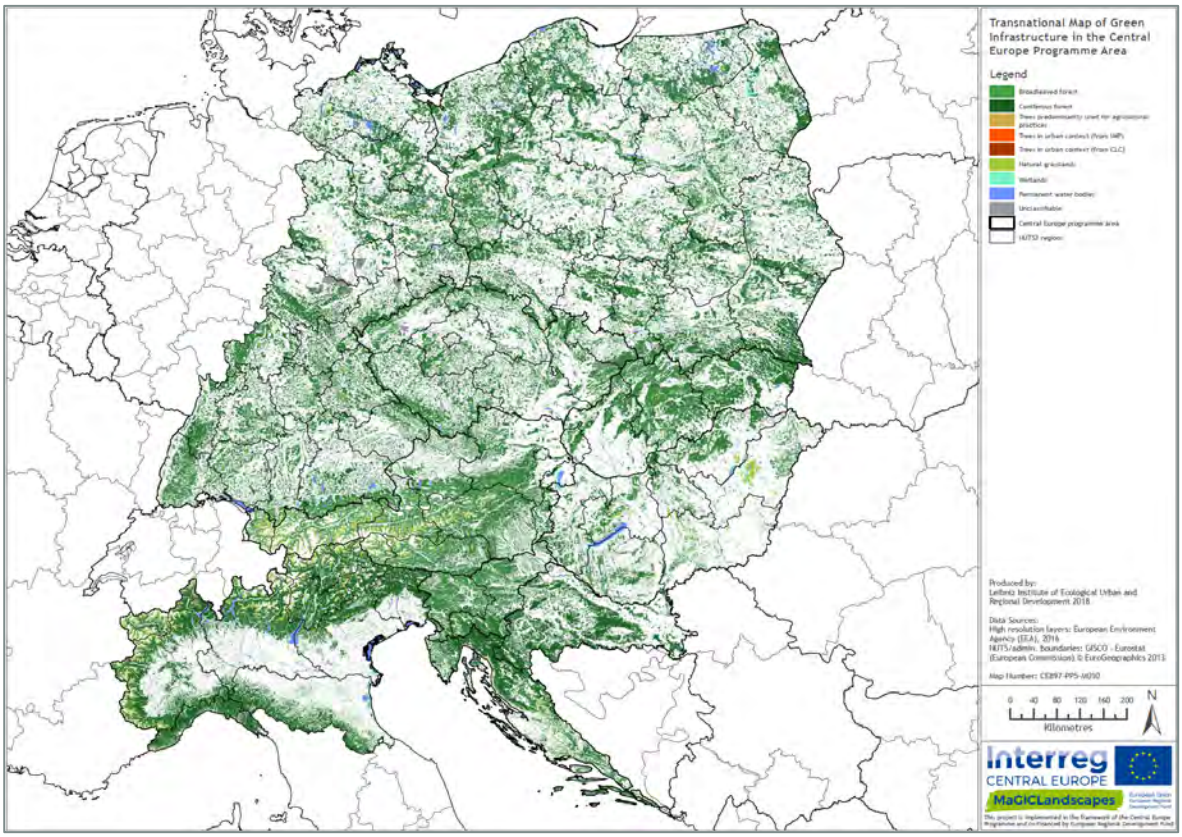

Figure 1: First draft map of GI in Central Europe developed using High Resolution Layers (HRL) provided by the Copernicus programme (EEA 2016)

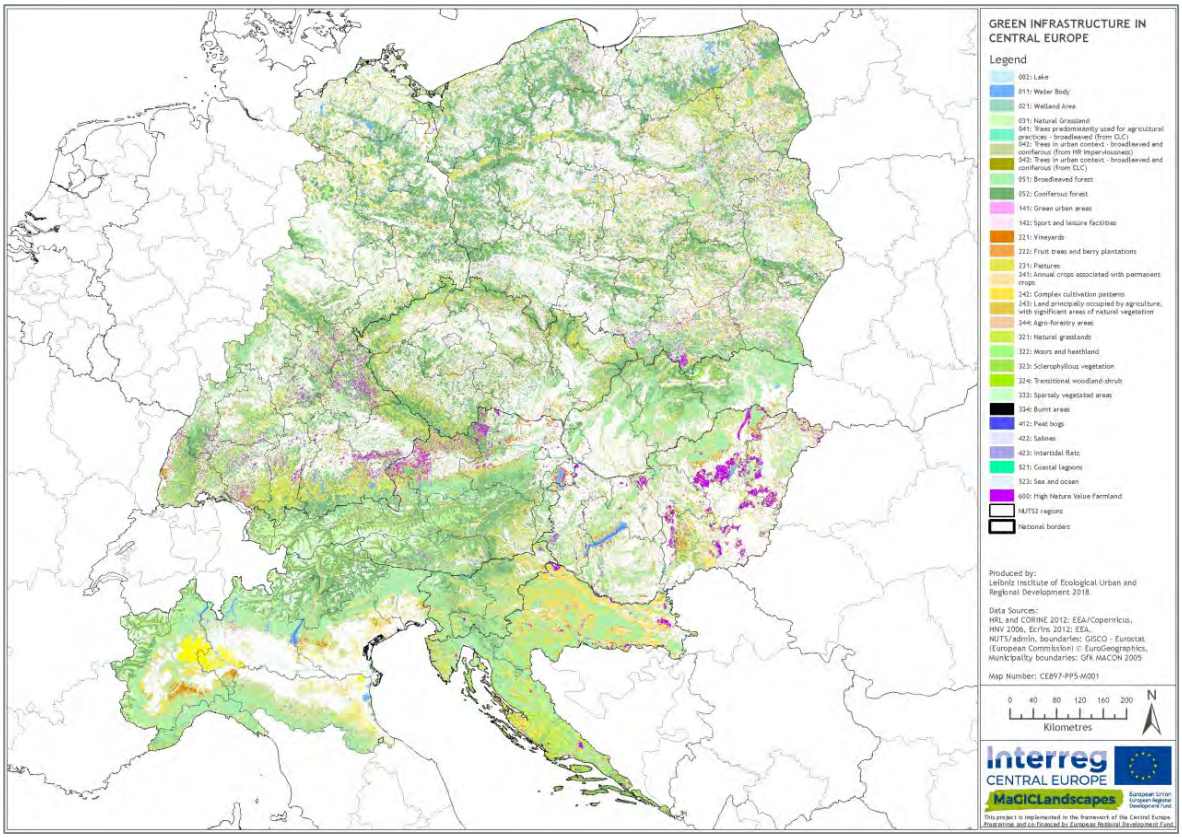

Figure 2: Second draft map of GI in Central Europe developed using selected classes of CORINE Land Cover (CLC), High Resolution Layers (HRL), High Nature Value Farmland (HNVF) and European catchments and Rivers network system (Ecrins)

Table 1: GI classification scheme used for the second draft GI map (status December 2017)

Code	Description *(Comments)*	Source layer
0	Unclassified *(e.g. HRL class unclassifiable: no satellite image available, clouds, shadows or snow)*	
001*	Rivers	Ecrins
002	Lakes	Ecrins
011	Water bodies	PWB
021	Wetland	WET
031	Natural grasslands	NGR
041	Trees predominantly used for agricultural practices – broadleaved (from CLC classes 2.2.2 and 2.2.3) *(extend is different from CLC 222 and 223)*	FAD
042	Trees in urban context – broadleaved and coniferous (from HR Imperviousness Layer context)	FAD
043	Trees in urban context – broadleaved and coniferous (from CLC class 1.4.1) *(extend is different from CLC 141)*	FAD
051	Broadleaved forest	FTY
052	Coniferous forest	FTY
141	Green urban areas	CLC
142	Sport and leisure facilities *(contains allotment gardens, problematic: also contains buildings, sealed surfaces etc. from sports facilities)*	CLC
213**	Rice fields	CLC
221	Vineyards	CLC
222	Fruit trees and berry plantations	CLC
223**	Olive groves	CLC
231	Pastures	CLC
241	Annual crops associated with permanent crops	CLC
242	Complex cultivation patterns	CLC
243	Land principally occupied by agriculture, with significant areas of natural vegetation	CLC
244	Agro-forestry areas	CLC
321	Natural grasslands	CLC
322	Moors and heathland	CLC
323	Sclerophyllous vegetation	CLC
324	Transitional woodland-shrub	CLC
333	Sparsely vegetated areas	CLC
334	Burnt areas	CLC
335**	Glaciers and perpetual snow	CLC
412	Peat bogs	CLC
421**	Salt marshes	CLC
422	Salines	CLC
423	Intertidal flats	CLC
521	Coastal lagoons *(overlaps with HRL PWB, but not fully covered)*	CLC
523	Sea and ocean *(seen as part of Blue Infrastructure)*	CLC
600	total cell is High Nature Value Farmland (HNVF)	HNVF

* Rivers are not included for display reasons.
** These classes do not appear in the map section.
Remarks: CLC class 112 ‘discontinuous urban fabric’ are not contained, since it is covered in HRL FAD ‘urban trees’. CLC class 331 ‘beaches, dunes, sands’ are not contained, since this class only covers bare dunes and beaches. CLC class 332 ‘bare rocks’ are not contained since these areas are covered with vegetation up to max. 10 % only. The CLC class 411 ‘inland marshes’ is covered by HRL wetlands. CLC class 522 ‘estuaries’ is covered by HRL PWB. CLC classes 111 ‘continuous urban fabric’, 121 ‘industrial or commercial units’, 122 ‘road and rail networks’, 123 ‘port areas’, 124 ‘airports’, 131 ‘mineral extraction sites’, 132 ‘dump sites’, 133 ‘construction sites’, 211 ‘non-irrigated arable land’, and 212 ‘permanently irrigated land’ are thought to be not GI.
For explanation of the source layer abbreviations see Table 2.

2.2 Data sets available for Central Europe

Table 2 provides an overview about available datasets in Central Europe for transnational GI and BI mapping fulfilling the following criteria: a) data comparable for all countries involved, b) classification systems applicable to all Central European countries, and c) free/open data access and usability.

Table 2: Datasets available for transnational GI and BI mapping (status: end of 2017)

Title	Source	Data Type	Reference Year	Publication Date	Remarks
Layers of GI and BI elements					
Permanent Water Bodies (PWB)	The datasets of Pan-European High Resolution Layers (HRL) are not available anymore, please see **https://land.copernicus.eu/pan-european/high-resolution-layers** for new alternative datasets.	Original in raster format, transformed to polygons by IOER	2012	23/03/2016	Resolution: 20 m Minimum Mapping Unit (MMU): no Minimum Mapping Width (MMW): [unknown]
Wetlands (WET)				23/03/2016	Minimum Mapping Unit (MMU): no Minimum Mapping Width (MMW): 20 m
Natural Grasslands (NGR)				10/05/2016	Minimum Mapping Unit (MMU): 0.16 ha Minimum Mapping Width (MMW): 20 m Included Classes: Natural and semi-natural grasslands are characterized by low human influence. Evidence of cultivation i.e. parcel structure is usually not visible: Semi-natural grassland (extensive managed) within forest, and grass covered surfaces within transitional woodland with low fraction (<10 %) of scattered trees and shrubs. Natural grassland in any environment. Grassy areas with low fraction (<10 %) of scattered trees and shrubs. Alpine meadows with low fraction (<30 %) of bare rock/gravel or shrubs.
Forest Additional support layer (FAD)				[unknown]	Downloaded on 30.11.2017, dataset now removed from the website Minimum Mapping Unit (MMU): 0.5 ha (minimum number of pixels to form a patch), Minimum Mapping Width (MMW): 20m Included Classes:: trees predominantly used for agricultural practices – broadleaved (from CLC classes 2.2.2 and 2.2.3) trees in urban context – broadleaved and coniferous (from HR Imperviousness Layer context) trees in urban context – broadleaved and coniferous (from CLC class 1.4.1)

Forest Type (FTY)				31/03/2016	Minimum Mapping Unit (MMU): 0.5 ha (minimum number of pixels to form a patch) Minimum Mapping Width (MMW): 20m Classes: broadleaved and coniferous forest
CORINE Land Cover (CLC)	**http://land.copernicus.eu/pan-european/corine-land-cover**	Vector → Polygons	2012	19/09/2016	Version 18, for downloading files a free user account has to be created Available classes: 44 classes in the hierarchical 3-level CORINE nomenclature, class descriptions see **https://land.copernicus.eu/user-corner/technical-library/corine-land-cover-nomenclature-guidelines/docs/pdf/CLC2018_Nomenclature_illustrated_guide_20190510.pdf** Minimum Mapping Unit (MMU): 25 ha Minimum Mapping Width (MMW): 100 m
High Nature Value Farmland (HNVF)	**https://www.eea.europa.eu/data-and-maps/data/high-nature-value-farmland**	Raster		06/10/2015	Resolution: 100 m Based on CORINE Land Cover 2006!, seems to be especially useful in parts of AT, HR, HU, LS Available classes: 0 (total cell is no HNV), 1 (total cell is HNV)
European catchments and Rivers network system	**https://www.eea.europa.eu/data-and-maps/data/european-catchments-and-rivers-network#tab-gis-data**	Vector: Polygons/ Lines	1990-2006	13/06/2012	"lake polygons are derived from the latest CLC, just checking if the CLC water masses are identified as lakes or not" **http://www.eea.europa.eu/publications/eea-catchments-and-rivers-network.1/at_download/file**
EU-Hydro River Network	The dataset is not available anymore. A more recent dataset is available at: **https://land.copernicus.eu/imagery-in-situ/eu-hydro/eu-hydro-river-network-database?tab=metadata**	Vector: Lines	2012	20/04/2016	EU-Hydro public beta version, however not validated yet, made publicly available on the Copernicus Land portal and are open for comments at **copernicus.land@eea.europa.eu**
European Settlement Map (ESM)	**http://land.copernicus.eu/pan-european/GHSL/european-settlement-map/esm-2012-release-2017-urban-green?tab=mapview**	Raster	2012	09/11/2017	Contains no information about the type and quality of green area, resolution: 2.5 m
USGS Global Land Cover data layers	The dataset is not available anymore: **https://archive.usgs.gov/archive/sites/landcover.usgs.gov/globallandcover.html**	Raster	ca. 2010	Unknown	Resolution: 30 m, Highlight tree and bare soil cover per pixel in percentage of cover (1-100) and also provide a (persistent surface) water layer
Supportive layers					
NUTS Boundaries	**http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts#nuts13**	Vector: Polygons (Scale: 1:1 Mio)	2013	03/12/2015	**N**omenclature des **u**nités **t**erritoriales **s**tatistiques (French)

Based on these existing data sets the transnational map of GI and BI was drafted and amended iteratively (see section 2.1). The quality was checked using ground-truthing (see section 2.3)

2.3 Qualitative Evaluation

2.3.1 Questionnaire

For a first general two-level ground-truthing a questionnaire was designed (see Annex). It contains questions regarding the specific country as well as case study area level. The regional experts were asked regarding the assignment of land cover classes to GI, general impressions of the classification scheme, the occurrence of any mapping errors (position, classification), known large scale land use changes after 2012 (time of data acquisition), useful scale of application as well as known further datasets. The experts answered the questionnaire prior the subsequent accuracy assessment (see section 2.3.2). To answer some of the questions, they needed to get a first impression of the data (draft maps).

2.3.2 Accuracy Assessment of Draft GI Map - Methodology of Ground-Truthing

In general, the truthing can be done by a desk-based checking by comparing the GI classes (i.e. second draft map, see section 2.1) to 2.5 m spatial resolution GIOLand 2012 remote sensing data (since it has the same time status ~2012). It is also possible to compare the classification result with other current aerial imagery or remote sensing data if available (i.e. to detect changes between 2012 and today). It is also possible to conduct field-based ground-truthing. In case of field-based ground-truthing, a documentation should be prepared (what points/areas have been accessed, photo documentation etc.).

For a more detailed evaluation of the quality/accuracy of datasets a method using accuracy assessment points has been applied. These points can be generated using ArcGIS tools (Data Management > Sampling > Generate Sampling Points). For the ground-truthing **GIOLand 2012 remote sensing data**, available as Web Map Service (WMS) „Very High Resolution Image 2012“:can be used.

To test this accuracy assessment method within the framework of the MaGICLandscapes project a number of 1,000 randomly distributed points was generated for each of the nine MaGICLandscapes project case study areas (see Figure 7). Furthermore, a transnational data collection describing GI (File Geodatabase) and ESRI ArcMap project (MXD) already including the layer order below and the layer legends was generated.

Layer order in the mapping project (MXD) was as follows:

- Accuracy Assessment Points
- Outlines of Case Study Areas
- European catchment areas and rivers network system (ECRINS) (lines and polygons)
- Sentinel High Resolution Layers (HRL)
  - Permanent Water Bodies (PWB)
  - Wetlands (WET)
  - Natural Grasslands (NGR)
  - Forest Additional support layer (FAD)
  - Forest Type (FTY)
- CORINE Land Cover (CLC)
- High Nature Value Farmland (HNVF)
- Administrative units (here: Central Europe area divided by using the respective NUTS regions)
- WMS “Very High Resolution Image 2012” (GIOLand 2012)

Figure 3 shows an example how the second draft GI map looks like for a specific region. In addition, Figure 4 demonstrates the distribution of accuracy assessment points for the same region.

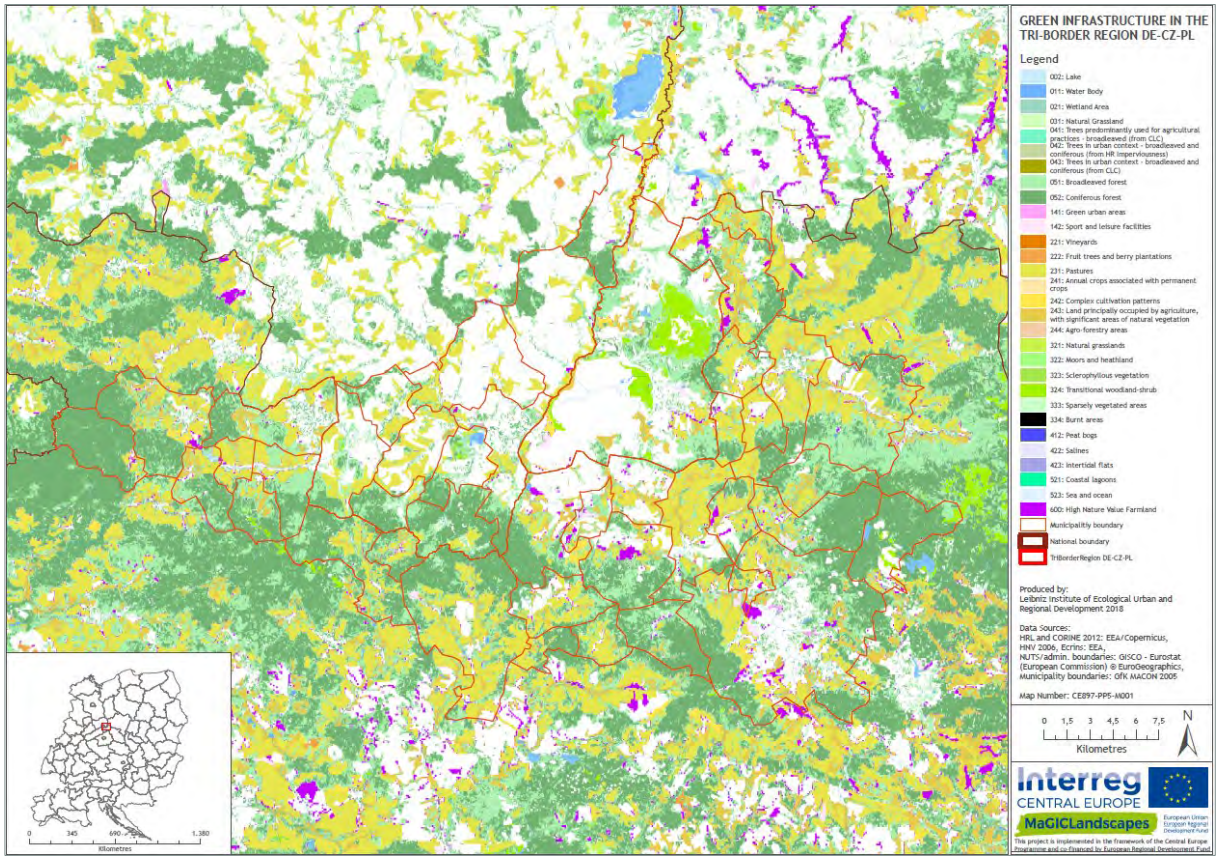

Figure 3: Second draft GI map for the case study area "Tri Border Area DE-CZ-PL"

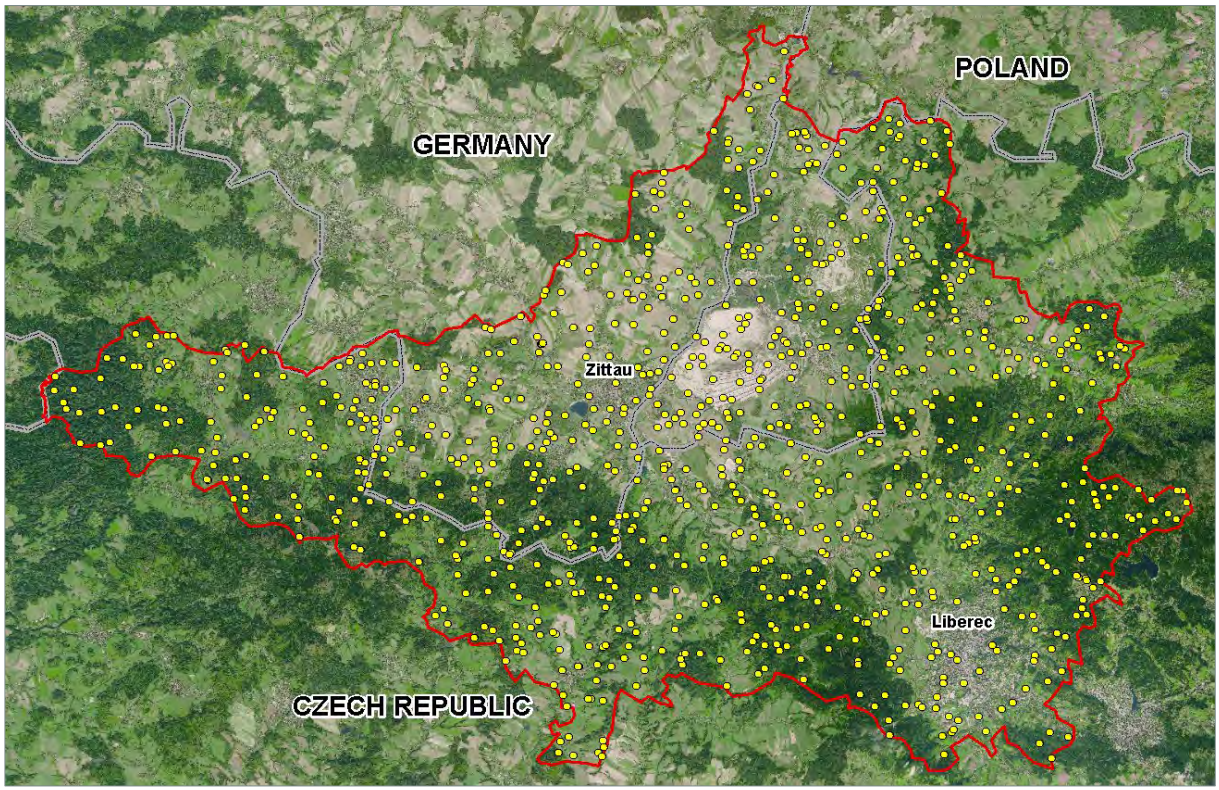

Figure 4: Case study tri-border area DE-CZ-PL (red line) including 1,000 control points (yellow dots) and national boundaries (grey/black line) overlaid on GIOLand/Very High Resolution 2012 (data source: EEA)

2.3.3 General Findings

Following the questionnaire based ground-truthing and the examination of the accuracy assessment points the used datasets can be evaluated as follows:

- The water dataset from ECRINS was found to be generalised and outdated in some cases. Thus, using this dataset is not recommended.
- CORINE data quality can be rated as good in terms of the transnational scale. The classification was satisfactory and sufficient for the transnational application. The amount of misclassifications was low. The full coverage is another advantage of this dataset
- High Resolution Layers have a high amount of misclassification and turned out to be not useful compared to CORINE. Using these layers would lead to an incomplete (not full coverage) land use layer compared to CLC (wall-to-wall classification). In addition, these layers contains some gaps or unclassifiable areas (i.e. covered by clouds in the underlying satellite images).
- High Nature Value Farmland layer has a low spatial resolution and turned out to be not useful compared to CORINE. Using this layer would lead to an incomplete (not full coverage) land use layer compared to CLC (wall-to-wall classification). This layer illustrates a high variability of mapping HNVF by presenting enormous national differences.

Due to this evaluation results, using CORINE data as the only source for mapping of GI at the transnational scale will be sufficient.

At the transnational scale of Green Infrastructure assessment the shortcomings of CORINE data (scale, large Minimum Mapping Unit, generalised boundaries, broad classifications (generality)/occurrence of mixed/fuzzy classes, subjectivity of class assignment) are not such an important issue, however it demonstrates the need for a finer-scale of data when assessing GI at the regional or local level. Thus, for analysing a specific area, we recommend mapping GI using national or regional data - if existing and suitable.

2.3.4 Specific Findings regarding CORINE Data

Mixed classes, i.e. land principally occupied by agriculture, with significant areas of natural vegetation (243) and complex cultivation patterns (242) are rather subjectively defined and delineated classes since they contain several land cover types. While both categories are vital for green infrastructure, because of their character they should represent biodiversity hotspots, especially in more intensively used monoculture landscapes, and it might be difficult to distinguish between them. For regional or local analyses these mixed classes should definitely be split in the land cover types they consist of. Since settlement areas also often consist of mixed land cover types, the same problem applies for these classes (e.g. Discontinuous urban fabric, 112).

Another issue is the differentiation of forest types (broad-leaved, coniferous and mixed). Especially the mixed category is very problematic as was confirmed both with the comparison to 2012 GIOLand dataset and regional aerial images. This type of error can stem mainly from subjective delineation of classes. Additionally, ground-truthing results from the Giant Mountains (CZ/PL) revealed a large number of incorrect classifications in mountainous forests. They were associated with changes between categories of forest types (311, 312, 313) and category 324 (transitional woodland-shrub). This is due to a typical character of mountain forest, especially near the timber line, where the category 312 was usually assigned by CLC as a transitional woodland-shrub.

A further issue with the CORINE classification is that it does not represent woodlots and woody strips in agricultural landscapes. These are essential elements of green infrastructure, especially in intensively used agricultural landscapes, such as Kyjovsko (CZ). This is another argument that the dataset can be used only on transnational scale and is not suitable for the regional scale.

Ground-truthing results from the Upper River Po Plains (IT) revealed, that rice fields (213) were not detected as such by CORINE. A separate reasoning was made regarding a typical and widespread crop in the Po Valley: the poplar plantations. Poplar cultivation can be attributed to an intensive form of arboriculture, but it is

not similar to forestry activities but rather to agricultural activities. It is in fact an agricultural production, conducted on bare soil and regularly ploughed, with relatively short cultivation cycles (less than ten years) and a form of crop rotation with other types of agricultural crops (e.g. corn, other herbaceous crops). For this reason, all land use maps in Italy introduced an additional type, called 224 (poplar plantation), which can still be considered, from the point of view of the analysis of green infrastructures, equivalent to the types that are considered extraneous to GI. Poplar plantations are classified in CLC data inconsistently partly as agricultural areas and partly as forest areas.

One open issue is that it is not possible to detect or to map the land use intensity by using CORINE. For example, an intensive vineyard without vegetated soil cover would be assigned to "not GI", whereas an extensive vineyard with grassy soil cover would be assigned to "GI" class. This issue arises especially in the wine growing regions Kyjovsko (CZ), Eastern Waldviertel and Western Weinviertel (AT), Po Hills around Chieri (IT) as well as Upper River Po Plains (IT). But the general question about land use intensity is transferable to most of the land cover types.

Such variations are very likely to also occur in other areas where specific land use characteristics cannot be comprehensively represented by a Europe-wide classification key. Therefore, such regional specifics should be assessed. This shows limitations of the currently available transnational data and their classifications.

2.4 Map of potential Green and Blue Infrastructure in Central Europe

Based on the findings of the qualitative evaluation (see section 3.3), a final transnational map of potential GI and BI, containing only the CLC data, has been produced for Central Europe (Figure 5). Based on the results of the first part of the questionnaire (see Annex) the CLC classification scheme (44 classes at Level 3) has been discussed amongst the MaGICLandscapes regional experts and decisions for a coordinated GI classification scheme/legend were agreed. Due to generalisation according to the minimum mapping unit of 25 ha on the one hand and under consideration of possible differences in land use intensity within areas classified as the same land cover type or broader classes containing at least partially GI on the other hand a clear distinction between "GI/BI" and "not GI/BI" was not possible for all classes. Therefore, the group "GI according to specific circumstances" was formed. For example extensively managed "Vineyards" or "Fruit trees and berry plantations" can be considered as GI, whereas their intensively managed relatives, where high amounts of pesticides are used, are not. Beside those management related aspects also classes partially containing GI were assigned to this group, like "Discontinuous urban fabric" or "Road and rail networks and associated land" (see Table 3).

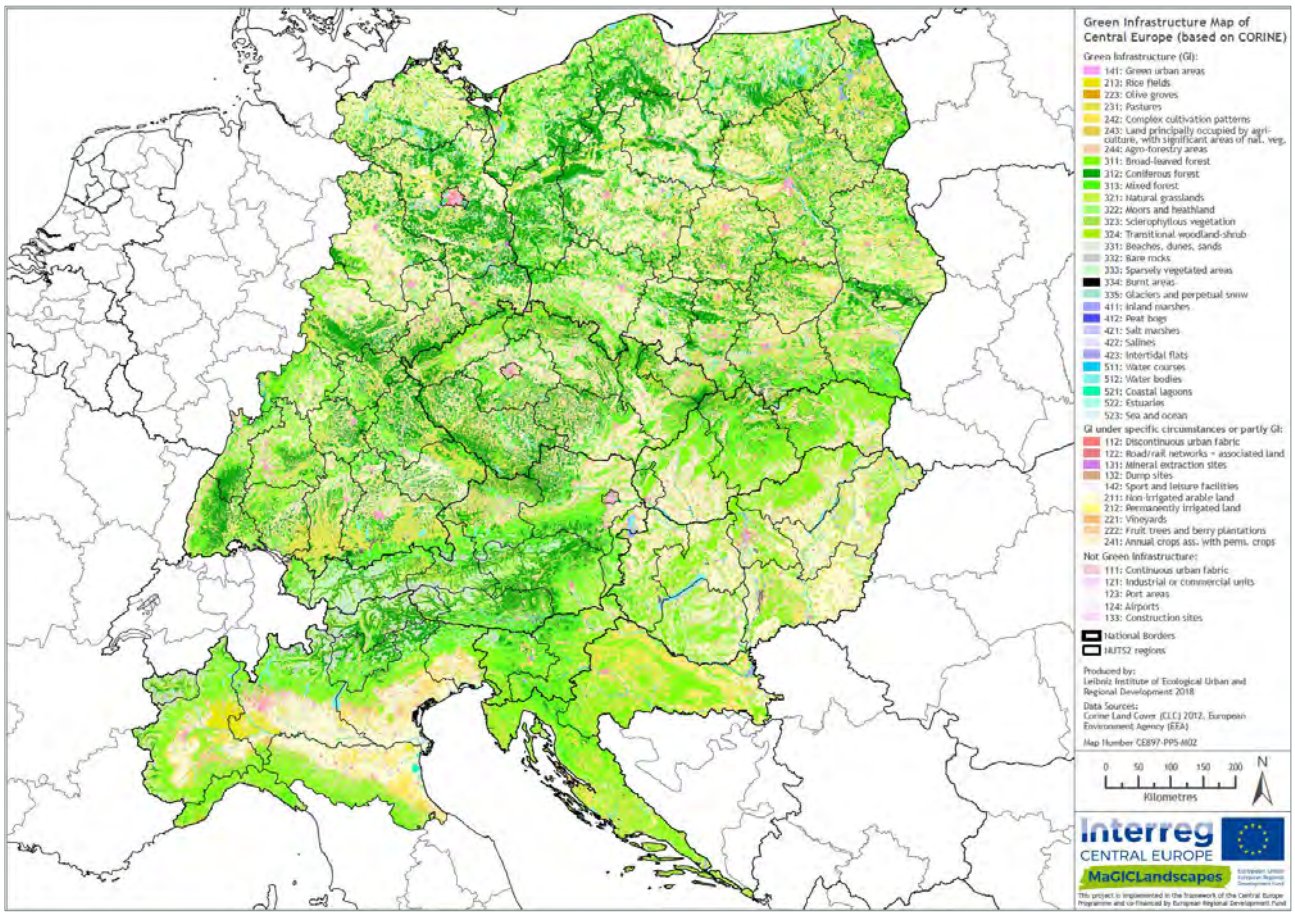

Figure 5: Map of green infrastructure for the Central Europe programme area based on the transnational legend using CORINE land cover data from 2012

In addition to this Transnational Map for the whole Central Europe programme area, larger scale maps for the MaGICLandscapes case study areas have been produced, illustrating further the limitations of applicability of the transnational data at regional scale (see sections 3.1-3.9). At this regional scale the recently published dataset EU-Hydro River Network (public beta version, see Table 2) should be included as additional layer to better represent blue infrastructure.

To get a better overview about the spatial distribution of GI/BI a simplified map has been generated (Figure 5) with the following three groups:

- GI/BI,
- GI according to specific circumstances and
- Not GI/BI

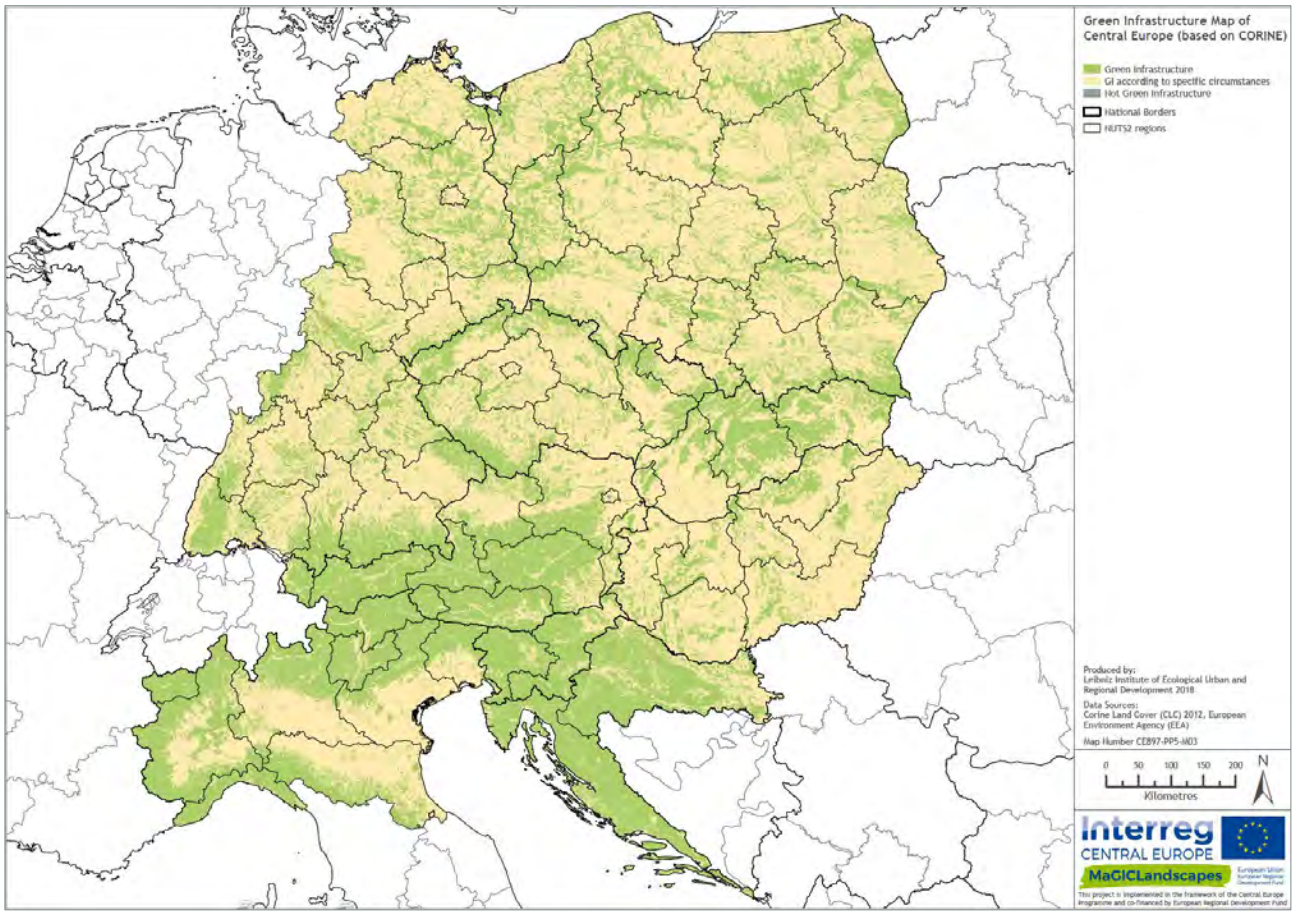

Figure 6: Map of green infrastructure for the Central Europe programme area based on the transnational legend using CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see Table 3)

Table 3: Final GI classification scheme used for transnational mapping

Group	CLC Code	Description
Green Infrastructure (GI)	141	Green urban areas
	213	Rice fields
	223	Olive groves
	231	Pastures
	242	Complex cultivation patterns
	243	Land principally occupied by agriculture, with significant areas of natural vegetation
	244	Agro-forestry areas
	311	Broad-leaved forest
	312	Coniferous forest
	313	Mixed forest
	321	Natural grasslands
	322	Moors and heathland
	323	Sclerophyllous vegetation
	324	Transitional woodland-shrub
	331	Beaches, dunes, sands
	332	Bare rocks
	333	Sparsely vegetated areas
	334	Burnt areas
	335	Glaciers and perpetual snow
	411	Inland marshes
	412	Peat bogs
	421	Salt marshes
	422	Salines
	423	Intertidal flats
	511	Water courses
	512	Water bodies
	521	Coastal lagoons
	522	Estuaries
	523	Sea and ocean
GI according to specific circumstances	112	Discontinuous urban fabric
	122	Road and rail networks and associated land
	131	Mineral extraction sites
	132	Dump sites
	142	Sport and leisure facilities
	211	Non-irrigated arable land
	212	Permanently irrigated land
	221	Vineyards
	222	Fruit trees and berry plantations
	241	Annual crops associated with permanent crops
Not GI	111	Continuous urban fabric
	121	Industrial or commercial units
	123	Port areas
	124	Airports
	133	Construction sites

2.5 Conclusions on Transnational Mapping Method and Usability

Following the questionnaire based ground-truthing and the examination of the accuracy assessment points it appears that the developed mapping procedure (with its iterations) is useful and provides acceptable results at the transnational scale by using solely CORINE land cover data. Further developments in terms of CLC quality as well as the repeated provision of data - currently CORINE 2018 is processed - argues for using this data as transnational GI mapping basis. There may also be new products from the Copernicus programme available that can further support or assist the GI mapping helping to overcome the shortcomings of CLC data.

The mainly underlying CORINE land cover data was found to be very suitable for the transnational and maybe the national level (if the national states consist of larger territories) but it is unsuitable for local or even regional maps of GI. The analysed classification accuracy within the case study areas was found to be between 72.9 % and 96.2 % correct. Nevertheless, at the transnational level a CORINE based map contains misclassifications (due to generalisation according to large Minimum Mapping Units, scale, generalised boundaries, broad classifications (generality/occurrence of mixed/fuzzy classes, subjectivity of class assignment), and this has to be considered when using those maps for further analysis.

The method of mapping GI including the evaluation process is applicable at different scales if using datasets of the same specific scale. Users that wish to map GI for a specific area/scale should apply ground-truthing to evaluate the quality of the data used and to identify shortcomings.

To overcome most of the shortcomings on regional and local scale, GI mapping using more detailed regional data is proposed (see Section 4). If this procedure is combined with a coordinated classification scheme the resulting maps are inter-regionally comparable to a large extent.

3 Generating Regional Green Infrastructure Maps

Due to some shortcomings regarding transnational data, such as their spatial resolution, accuracy or the type and scope of the classified elements, the mapping was refined at the national/regional level. This section is meant to present the resulting maps and used datasets as advice for similar mapping projects on regional level.

This was done for the nine case study areas of the project MaGICLandscapes (Figure 7). They represent a broad variety of different landscape features and habitats as well as different cultural or socio-economic characteristics. There are for example protected areas such as the Karkonosze (Polish Giant Mountains)/Krkonoše (Czech Giant Mountains) and Thayatal (Austria) National Parks or the Dübener Heide Nature Park (Germany), areas characterised by large rivers like the Upper Po Plain (Italy), areas dominated by agricultural use like Kyjovsko region (Czech Republic) or Eastern Waldviertel and Western Weinviertel (Austria) as well as areas containing larger cities with more than 100,000 inhabitants like the tri-border area Czech Republic-Germany-Poland with the city of Liberec up to the Po Hills around Chieri with the Metropolitan City of Turin (Italy). More information on the project case study area can be found in the MaGICLandscapes Green Infrastructure Handbook - Conceptual & Theoretical Background, Terms and Definitions (John et al. 2019).

The regional GI Maps were produced using freely available or low cost national/regional data, e.g. biotope or land use maps. The following sections present the case study area maps of GI as examples - how to refine the transnational GI maps. To compare the differences between the transnational (CLC based) and national/regional data for most of the case study areas both maps are included. Furthermore, the used national/regional data in the specific case study area is given.
For all case study areas regional maps using CORINE land cover data as well a regional data are provided. Compared visually, the regional maps of GI usually have a better spatial resolution, level of detail and accuracy. Furthermore, the national/regional datasets provided information on regional characteristics, for

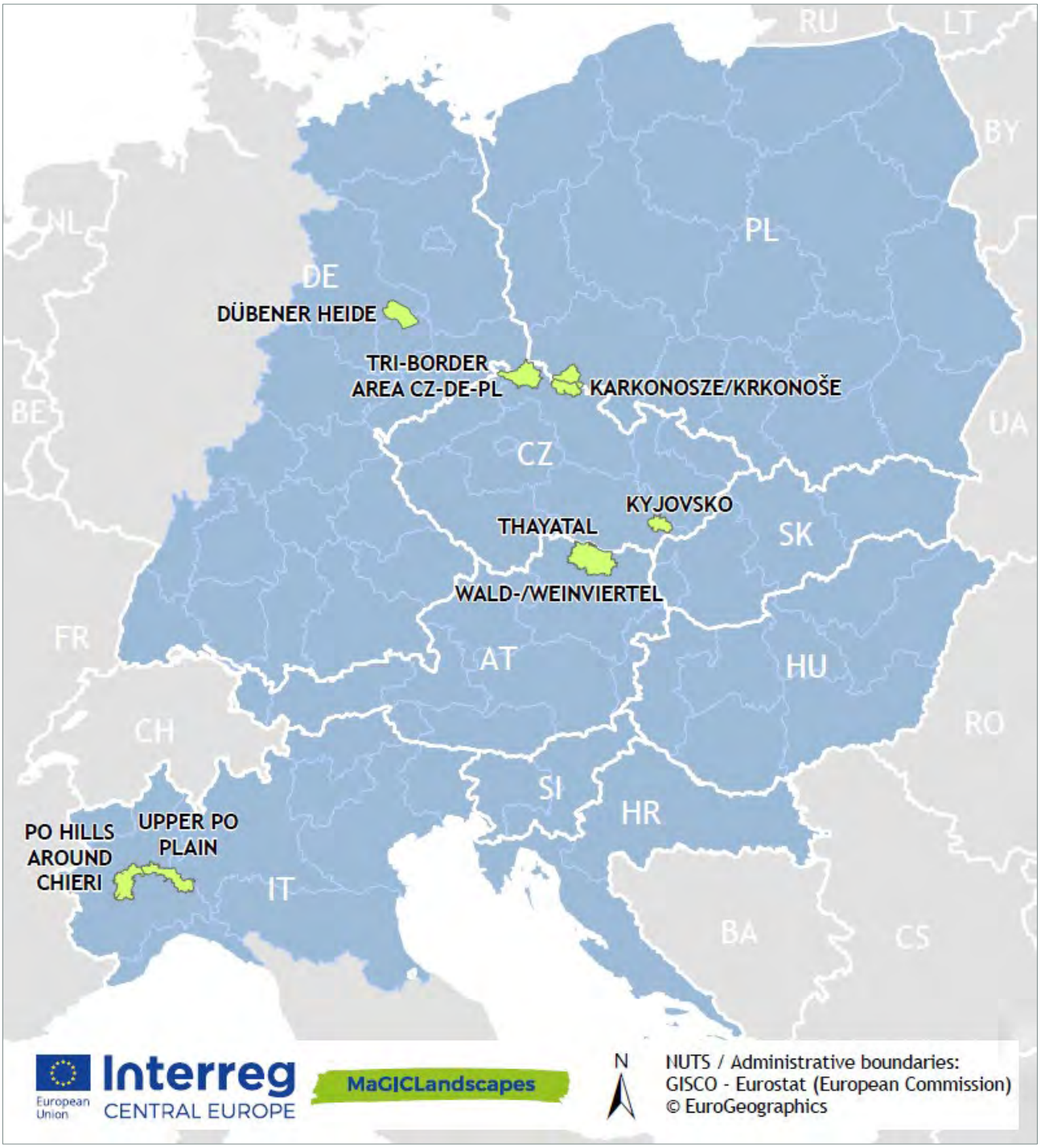

Figure 7: Map of Central Europe programme area (blue) with the nine case study areas (green) of MaGICLandscapes project

example regarding specific biotope types not common to other countries/regions and therefore not represented in the transnational classification scheme (e.g. poplar plantations in Italy). The coordinated GI classification scheme for these regional maps is based on the CLC and allows for inter-regional comparability, but in most cases the classification scheme is refined due to the regional particularities. Regional data in general allows for a more detailed classification scheme, some of datasets are using a classification scheme based on CLC on a fourth level (Feranec et al. 2016), or allow for reclassification and provide interfaces to other European classification schemes (e.g. European Nature Information System (EUNIS) habitat classification).

The most important difference between both map types, especially when thinking about further analyses of landscape functionality, ecosystem services or connectivity, is that they are spatially more detailed, contain

small elements (e.g. hedgerows, groups of trees) and are more differentiated in complex land cover classes, i.e. settlements and agricultural areas.

The facts mentioned above lead to a higher qualitative and trustworthy result and make the maps more useful for regional applications.

3.1 Case Study Eastern Waldviertel and Western Weinviertel, Austria

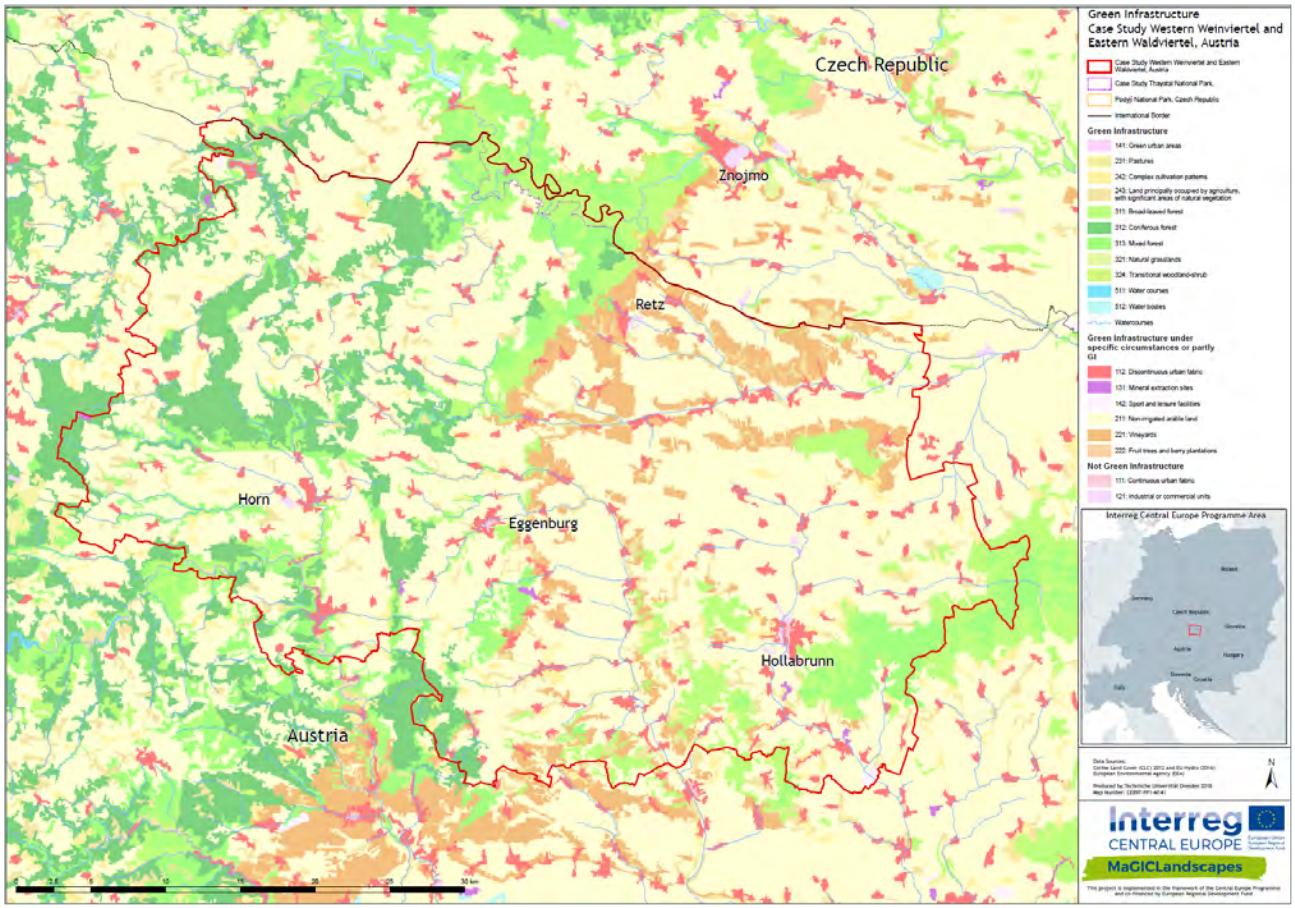

Figure 8: Map of green infrastructure for the Austrian case study area Western Eastern Waldviertel and Western Weinviertel based on the transnational legend using CORINE land cover data from 2012.

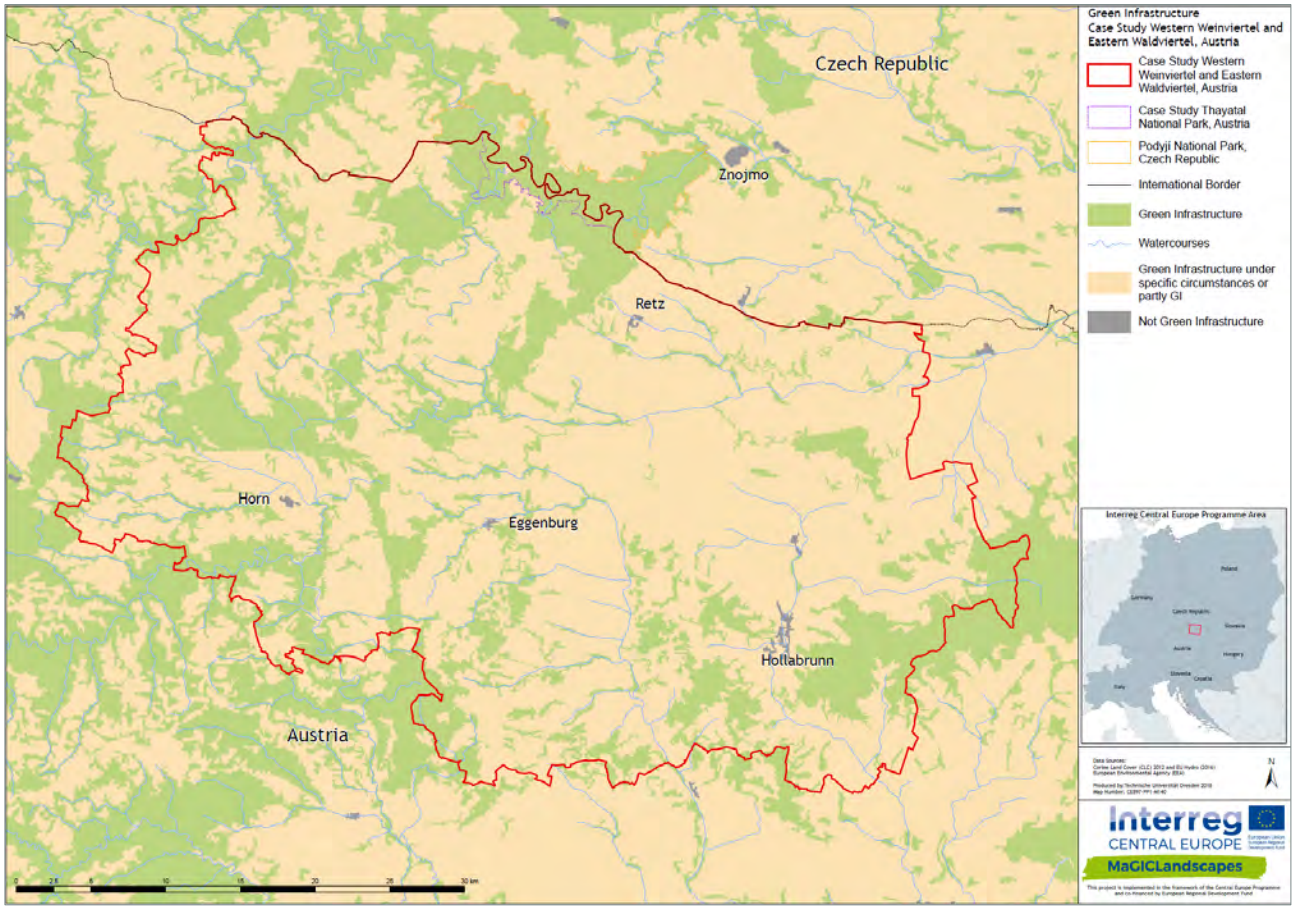

Figure 9: Map of green infrastructure for the Austrian case study area Eastern Waldviertel and Western Weinviertel based on the CORINE data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

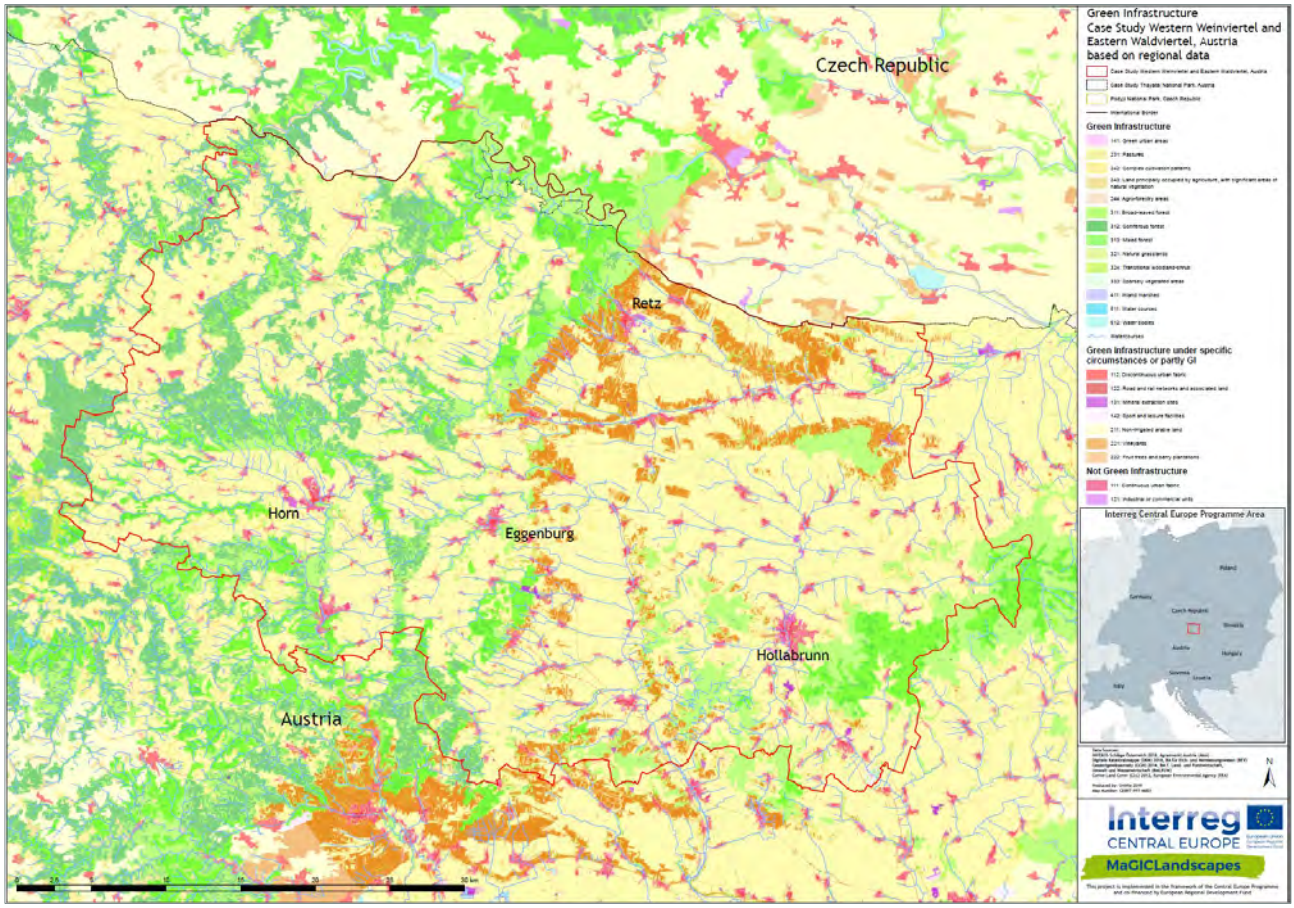

Figure 10: Map of green infrastructure for the Austrian case study area Eastern Waldviertel and Western Weinviertel based on the transnational legend using regional agricultural data (INVEKOS Schläge Österreich 2018, Agrarmarkt Austria) and forest data (Waldflächen in Niederösterreich 2019, Land Niederösterreich) in addition to CORINE land cover data from 2012.

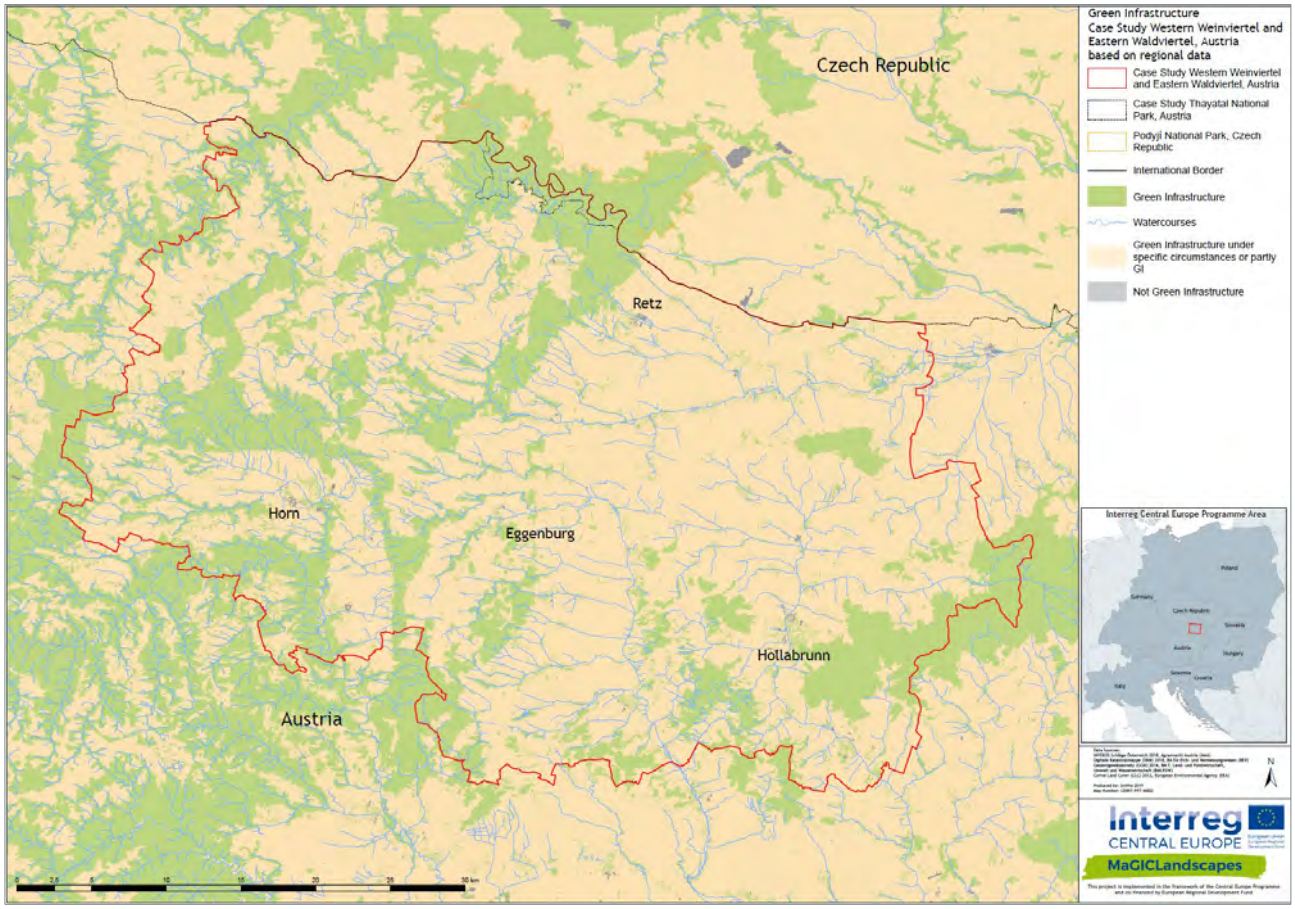

Figure 11: Map of green infrastructure for the Austrian case study area Eastern Waldviertel and Western Weinviertel based on regional agricultural data (INVEKOS Schläge Österreich 2018, Agrarmarkt Austria) and forest data (Waldflächen in Niederösterreich 2019, Land Niederösterreich) in addition to CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

Table 4: Datasets used for the regional map of Green Infrastructure of the case study area Eastern Waldviertel and Western Weinviertel

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
INVEKOS Schläge Österreich	Agrarmarkt Austria	vector	n/a	full	2018	Available for free
Waldflächen in Niederösterreich	Land Nieder-österreich	vector	n/a	full	2018	Available for free
HRL Waldtypen	Umweltbundes-amt GmbH	raster	20*20m	full	2012	Available for free
HRL Versiegelung	Umweltbundes-amt GmbH	raster	20*20m	full	2012	Available for free
Intermodales Verkehrsreferenz-system Österreich	**geoland.at**	vector	n/a	full	2018	Available for free

3.2 Case Study Thayatal National Park, Austria

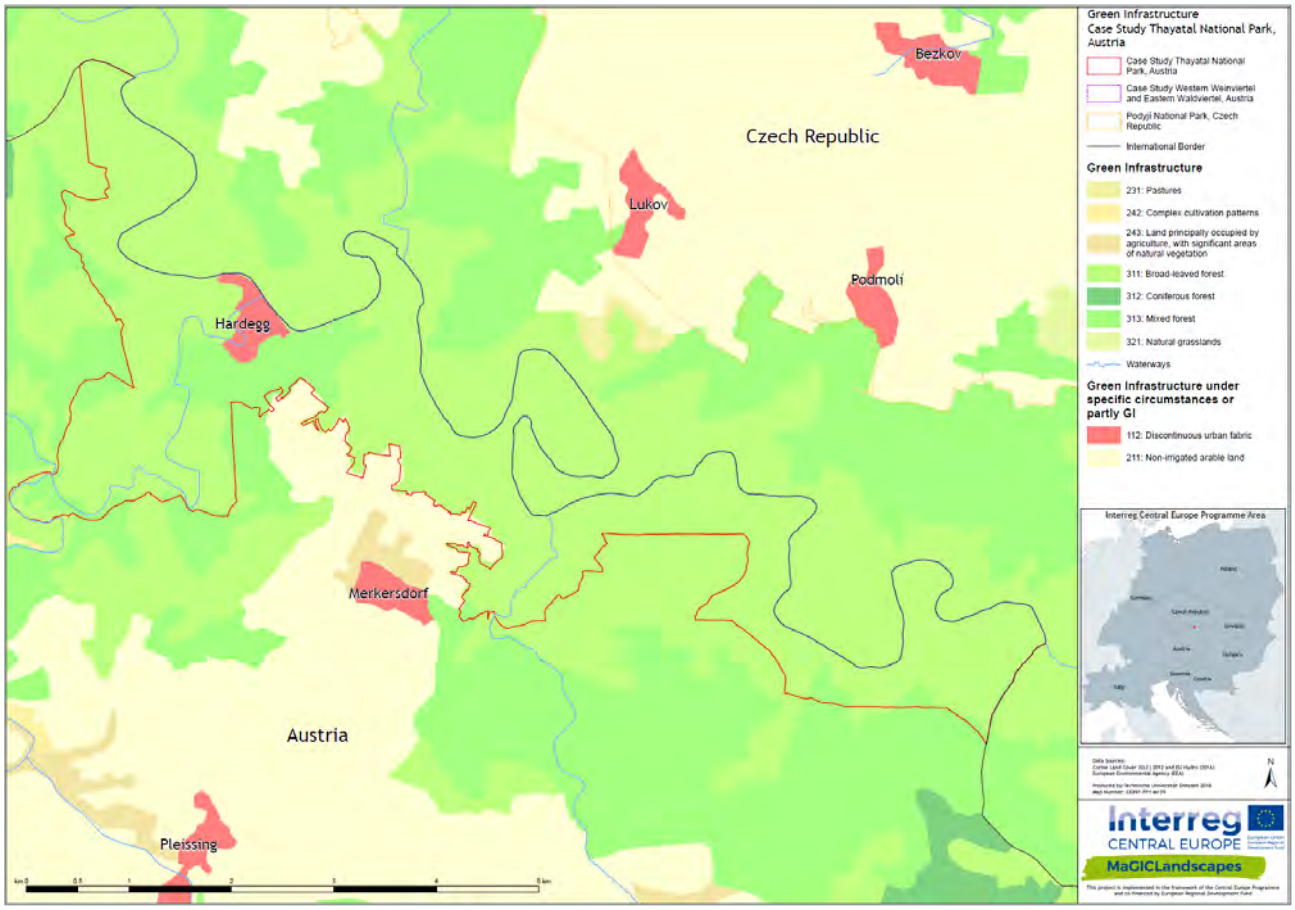

Figure 12: Map of green infrastructure for the Austrian case study area Thayatal National Park based on the transnational legend using CORINE land cover data from 2012

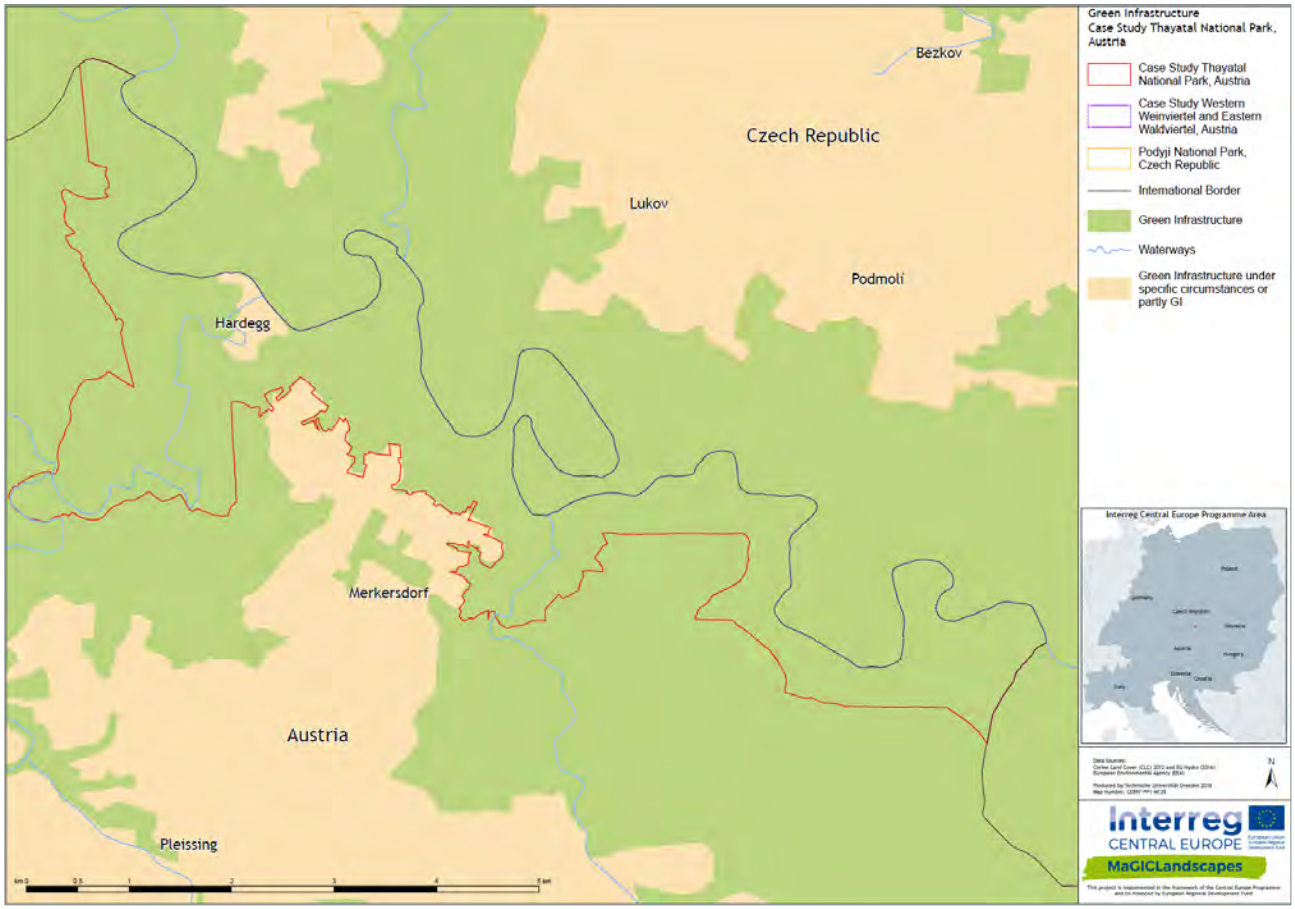

Figure 13: Map of green infrastructure for the Austrian case study area Thayatal National Park based on CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4)

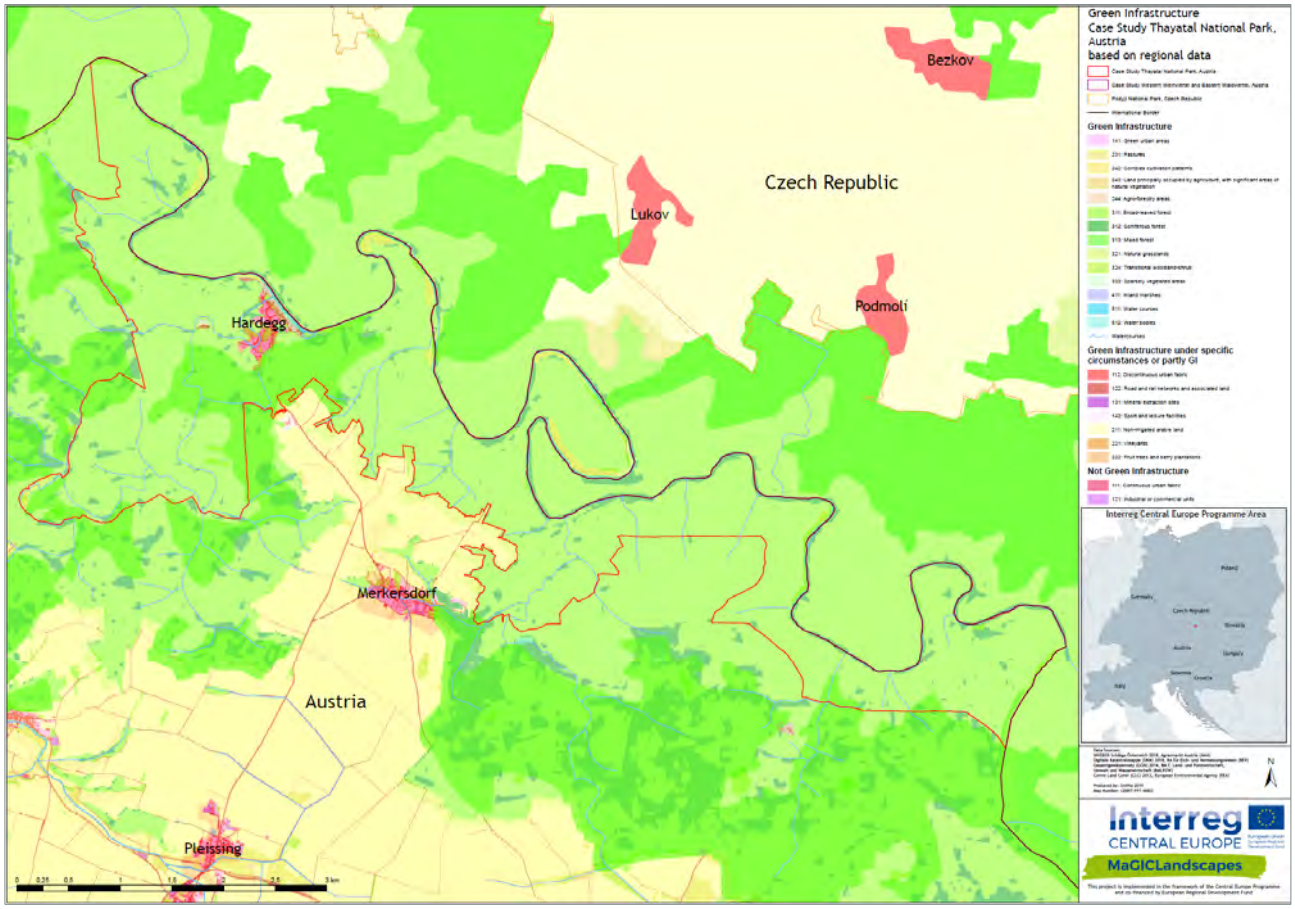

Figure 14: Map of green infrastructure for the Austrian case study area Thayatal National Park based on the transnational legend using regional agricultural data (INVEKOS Schläge Österreich 2018, Agrarmarkt Austria) and forest data (Waldflächen in Niederösterreich 2019, Land Niederösterreich) in addition to CORINE land cover data from 2012

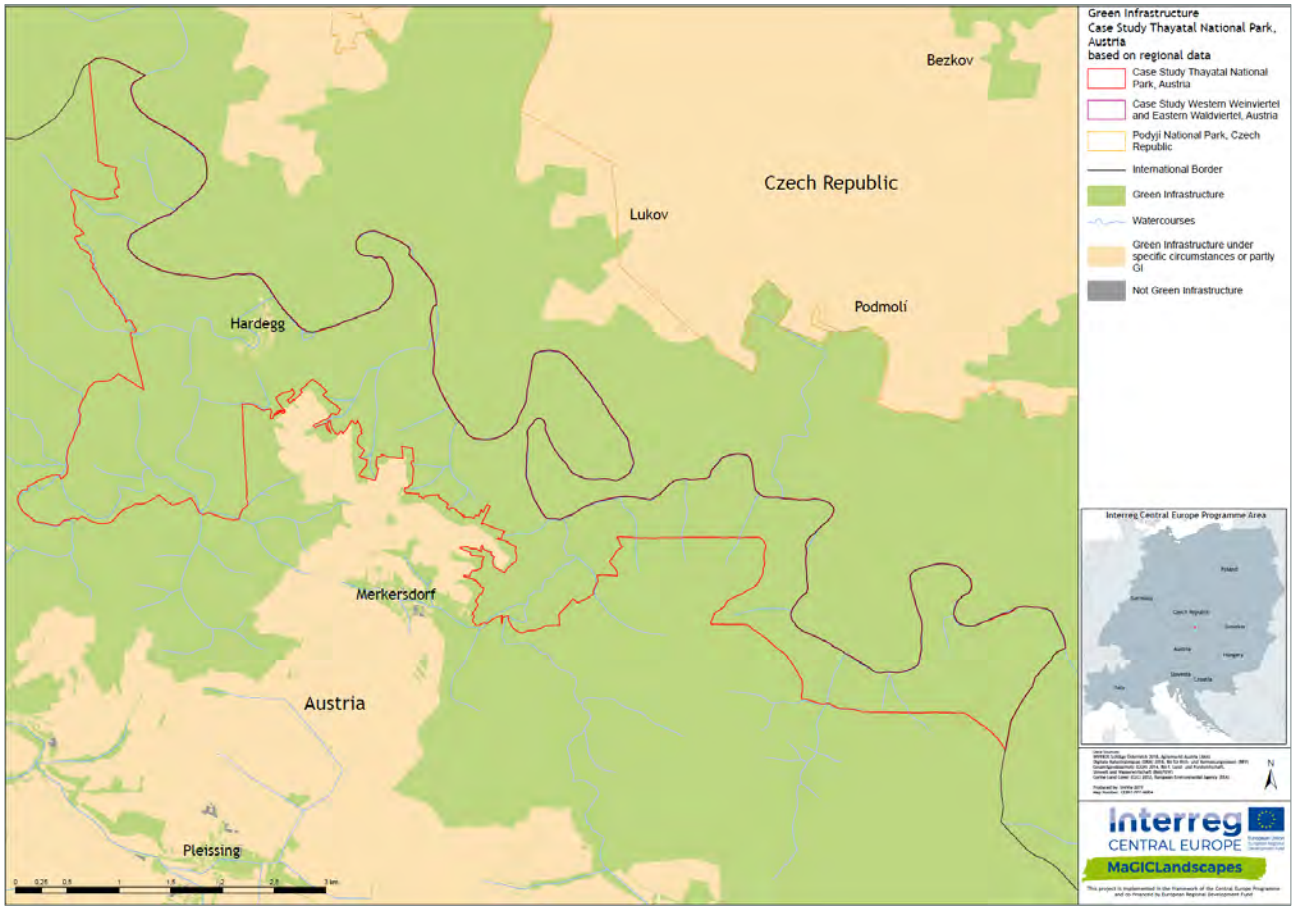

Figure 15: Map of green infrastructure for the Austrian case study area Thayatal National Park based on regional agricultural data (INVEKOS Schläge Österreich 2018, Agrarmarkt Austria) and forest data (Waldflächen in Niederösterreich 2019, Land Niederösterreich) in addition to CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4)

Table 5: Datasets used for the regional map of Green Infrastructure of the case study area Thayatal National Park

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
INVEKOS Schläge Österreich	Agrarmarkt Austria	vector	n/a	full	2018	Available for free
Waldflächen in Niederösterreich	Land Niederösterreich	vector	n/a	full	2018	Available for free
HRL Waldtypen	Umweltbundesamt GmbH	raster	20*20m	full	2012	Available for free
HRL Versiegelung	Umweltbundesamt GmbH	raster	20*20m	full	2012	Available for free
Intermodales Verkehrsreferenz-system Österreich	**geoland.at**	vector	n/a	full	2018	Available for free

3.3 Case Study Kyjovsko, Czech Republic

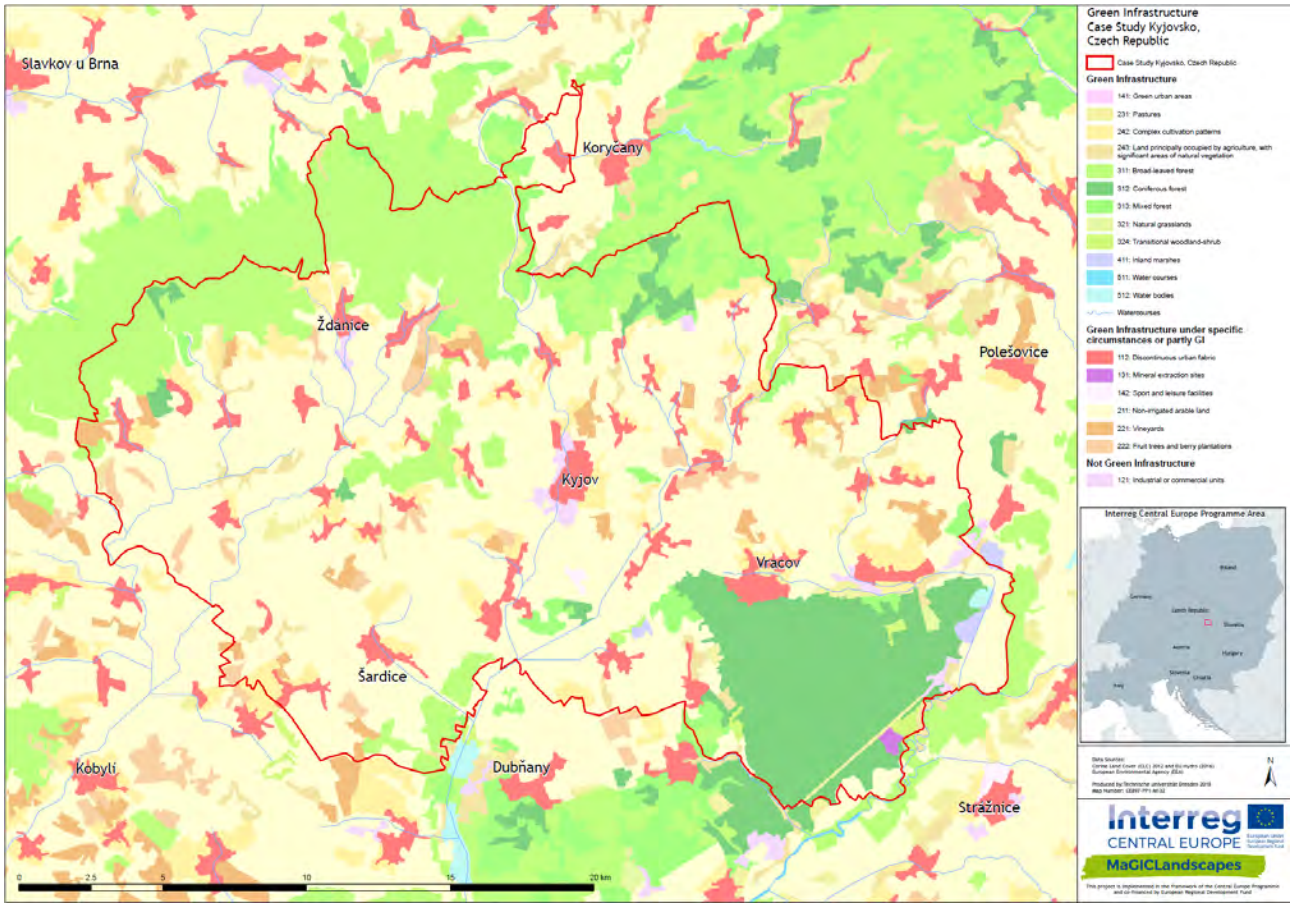

Figure 16: Map of green infrastructure for the Czech case study area Kyjovsko based on the transnational legend using CORINE land cover data from 2012.

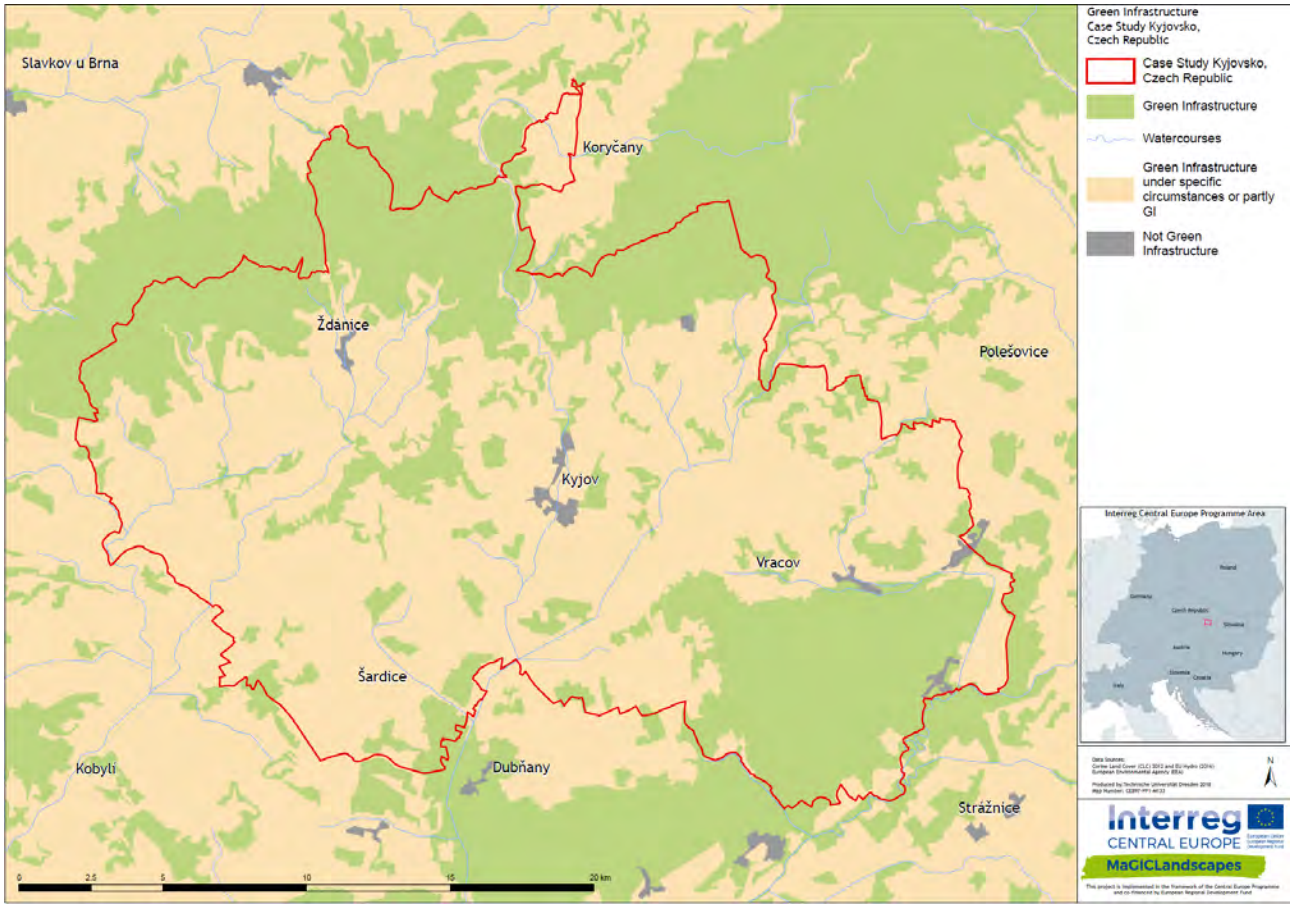

Figure 17: Map of green infrastructure for the Czech case study area Kyjovsko based on CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

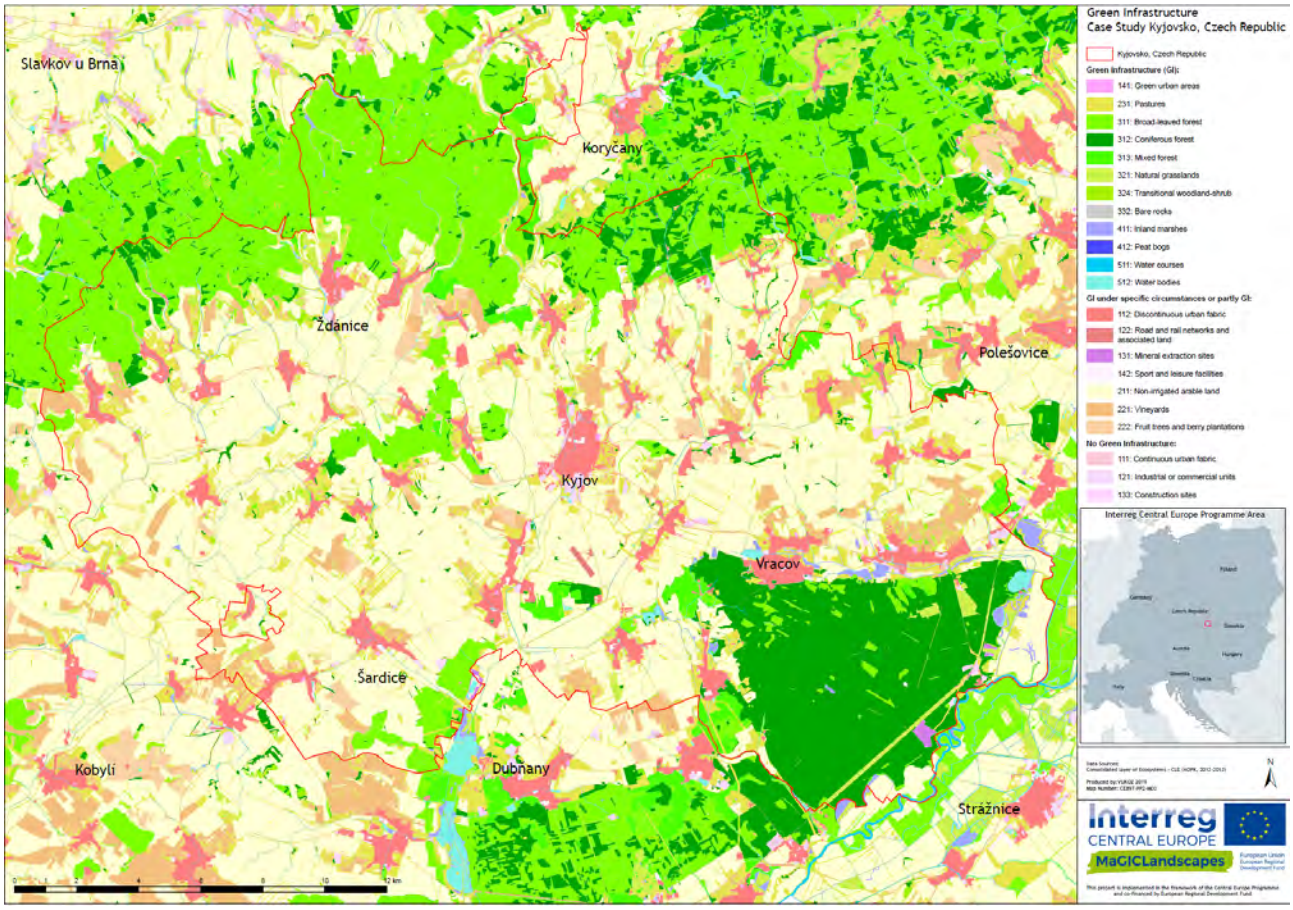

Figure 18: Map of green infrastructure for the Czech case study area Kyjovsko based on the transnational legend using data from consolidated layer of ecosystems (KVES). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

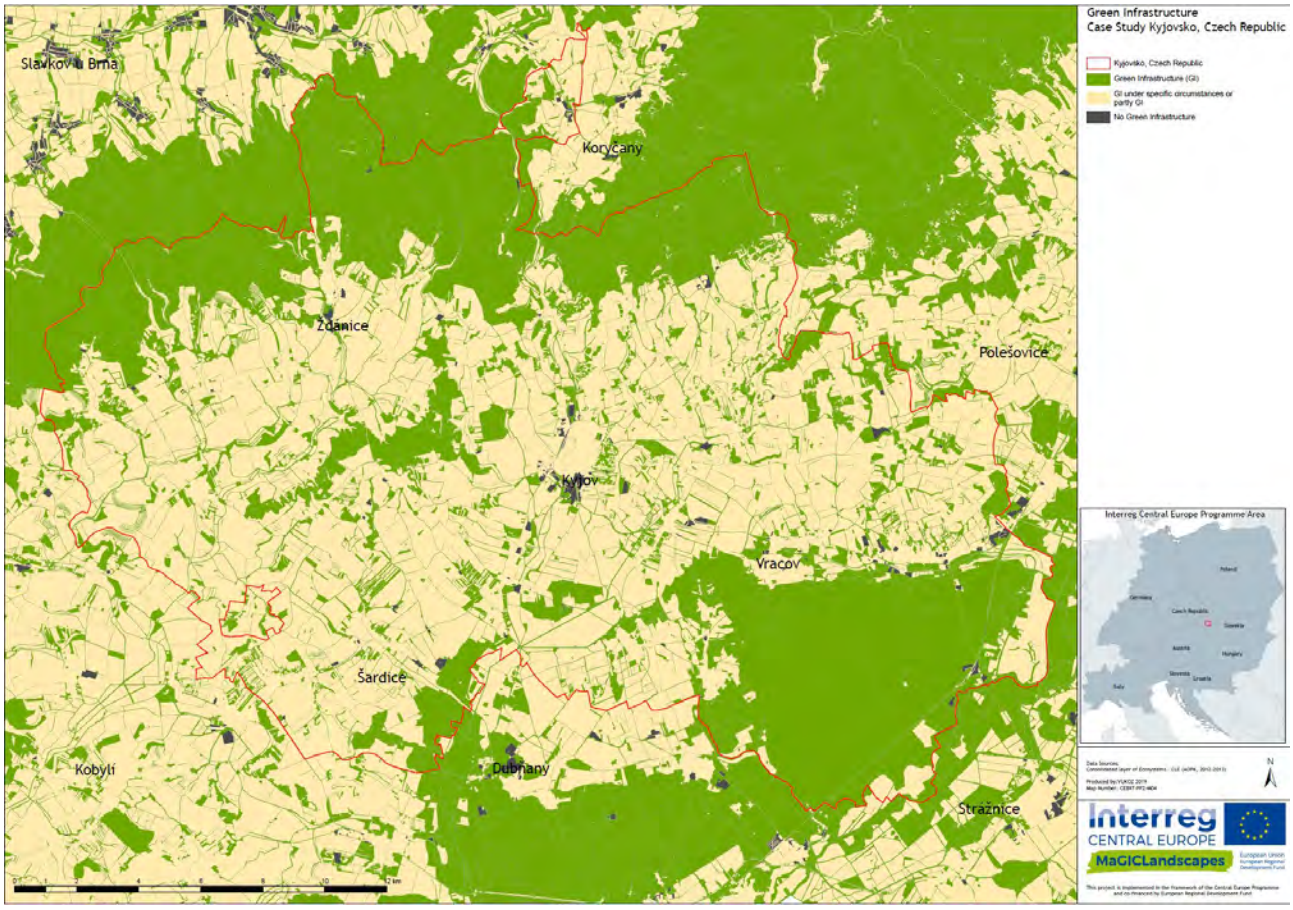

Figure 19: Map of green infrastructure for the Czech case study area Kyjovsko based on data from consolidated layer of ecosystems (KVES). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

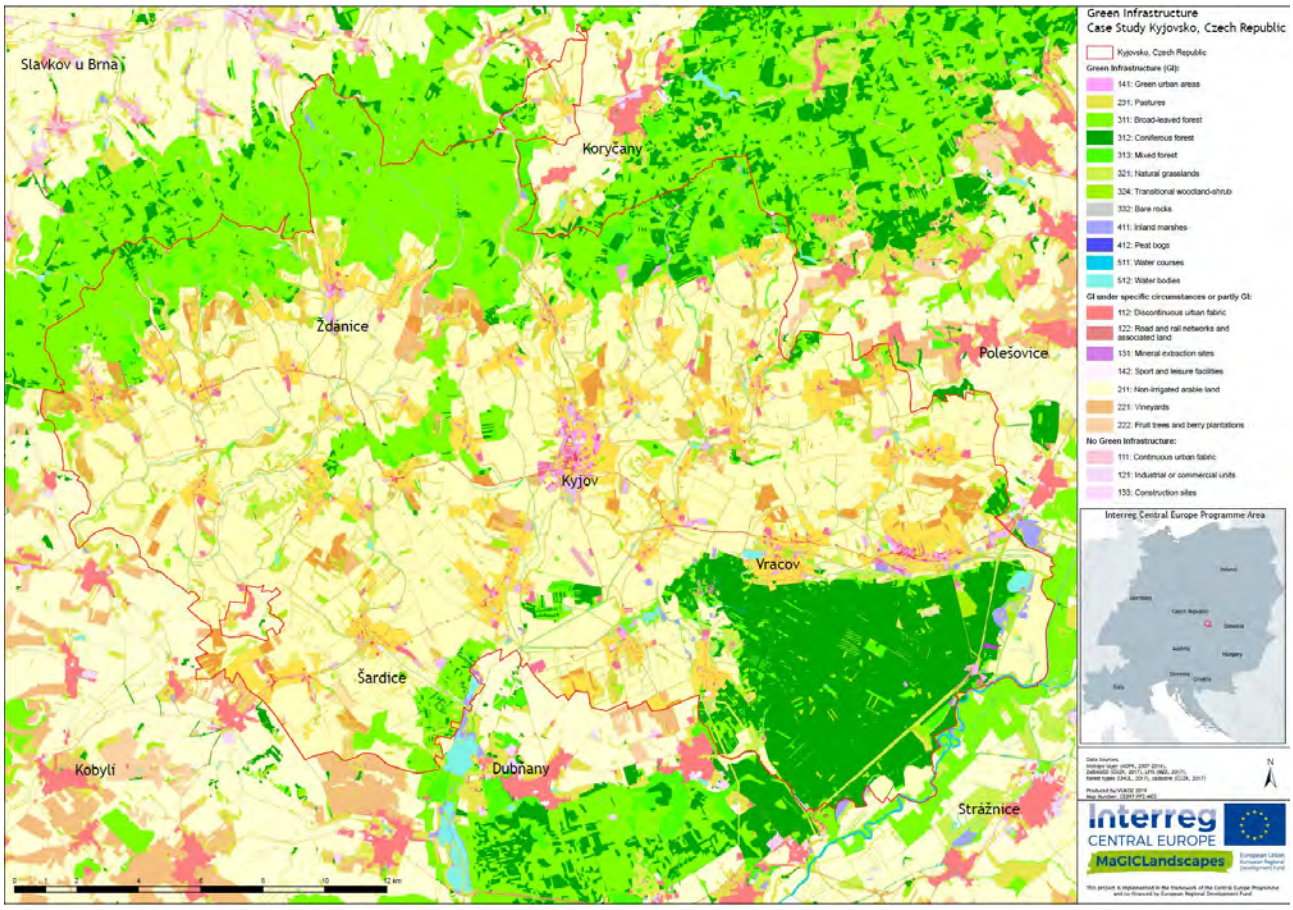

Figure 20: Map of green infrastructure for the Czech case study area Kyjovsko based on the transnational legend using several regional data from AOPK ČR (biotope layer), ČUZK (ZABAGED, cadastre, orthophotos from 2018), UHUL (Forest type map), and Ministry of Agriculture (LPIS).

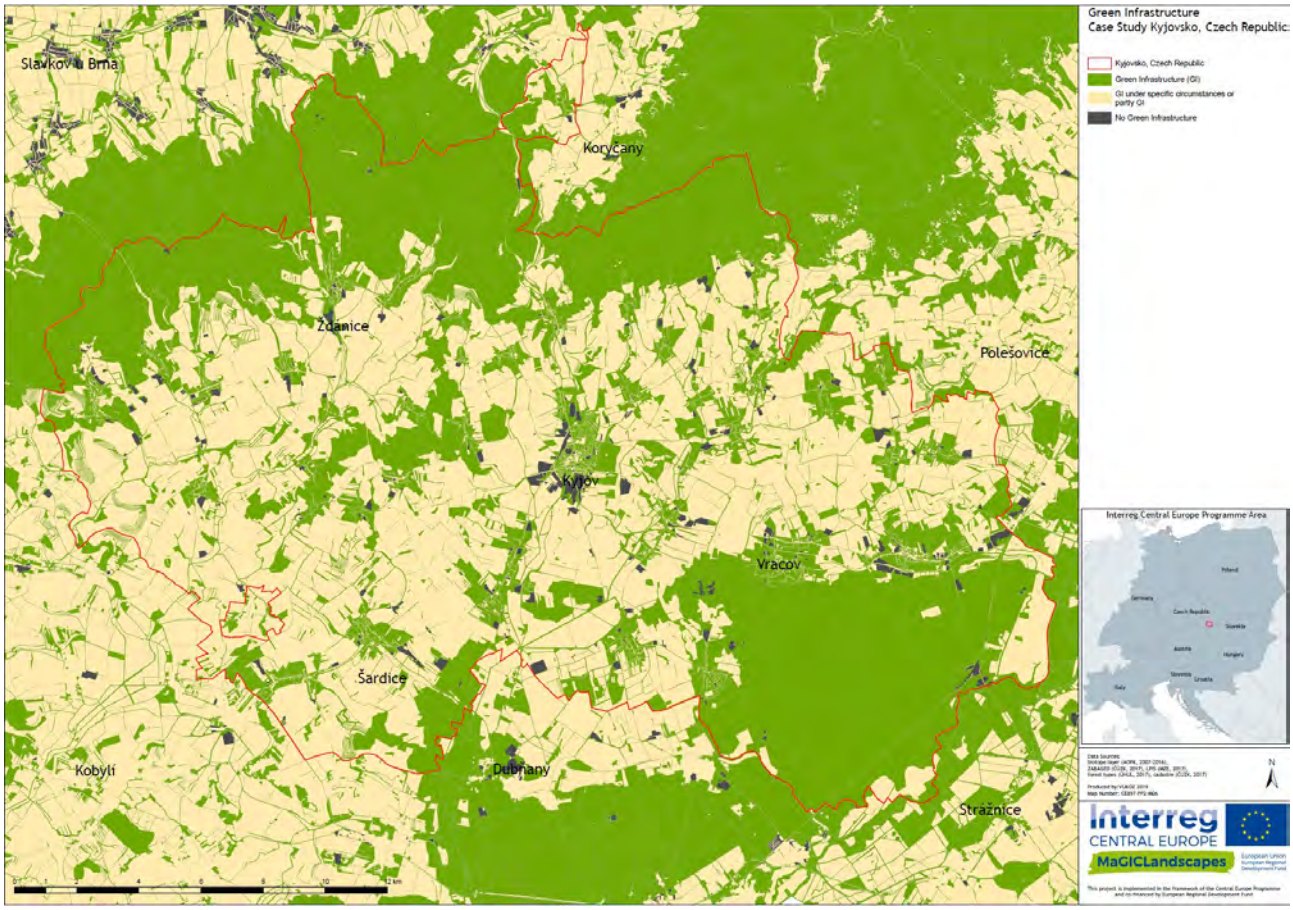

Figure 21: Map of green infrastructure for the Czech case study area Kyjovsko based on several regional data from AOPK ČR (biotope layer), ČUZK (ZABAGED, cadastre, orthophotos from 2018), UHUL (Forest type map), and Ministry of Agriculture (LPIS). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

Table 6: Datasets used for the regional map of Green Infrastructure of the case study area Kyjovsko

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Cadastre data	ČUZK - – Czech State Administration of Land Surveying and Cadastre, **http://services.cuzk.cz/shp/ku/epsg-5514/** **http://geoportal.cuzk.cz/(S(g0514m4lupibv42li4rbo4zu))/Default.aspx?lng=CZ&mode=TextMeta&side=INSPIRE_dSady&metadataID=CZ-00025712-CUZK_WFS-MD_CP&metadataXSL=metadata.sluzba&menu=416&head_tab=sekce-04-gp**	vector	parcel level	full	weekly updated (data used for GI assessment downloaded 09/03/2018)	freely available; some cadastres still not in digital form
LPIS (Land Parcel Information System)	Ministry of Agriculture of the Czech Republic **http://eagri.cz/public/app/lpisext/lpis/verejny2/plpis/** wms: **http://eagri.cz/public/app/wms/plpis.fcgi** wfs: **http://eagri.cz/public/app/wms/plpis_wfs.fcgi?** Download of individual cadastres: **http://eagri.cz/public/app/eagriapp/lpisdata/**	vector	parcel level	not full	continuously updated (data used for GI assessment downloaded 20/11/2017)	freely available, only for parcel under subsidies
Biotope layer	AOPK ČR – Nature Conservation Agency of the Czech Republic	vector	based on 1:10000 mapping – MMU 1500-2500 m^2	not full	2007-2017	available on request (no fee), coverage only for natural biotopes/protected areas
Forest type map	ÚHÚL – Czech Forest Management Institute	vector	based on forest plots	not full	updated yearly	available for fee, for information about species structure, agreement from every owner is needed; it is possible to get aggregated data regarding forest type (broad-leaved, coniferous, mixed, clear-cut); only for forested land

ZABAGED	ČUZK	vector	based on 1:10 000, MMU not set	full	updated every three years	available for fee, consists of 122 types of geographic objects (settlements, communications, utility networks & pipelines, hydrology, administrative units, protected areas, vegetation & surface, terrain relief)
KVES (konsolidovaná vrstva ekosystémů)	AOPK ČR	vector	unknown	full	2012-2013	available on request (no fee), MMU stated vaguely as "detail recognizable during field mapping"
Orthophoto	ČUZK; wms server: **http://geoportal.cuzk.cz/WMS_ORTOFOTO_PUB/WMService.aspx**	raster	20 cm pixel	full	2018	available for fee, freely from wms, served for manual vectorization of gaps not covered by available data

3.4 Case Study Krkonoše Mountains National Park, Czech Republic

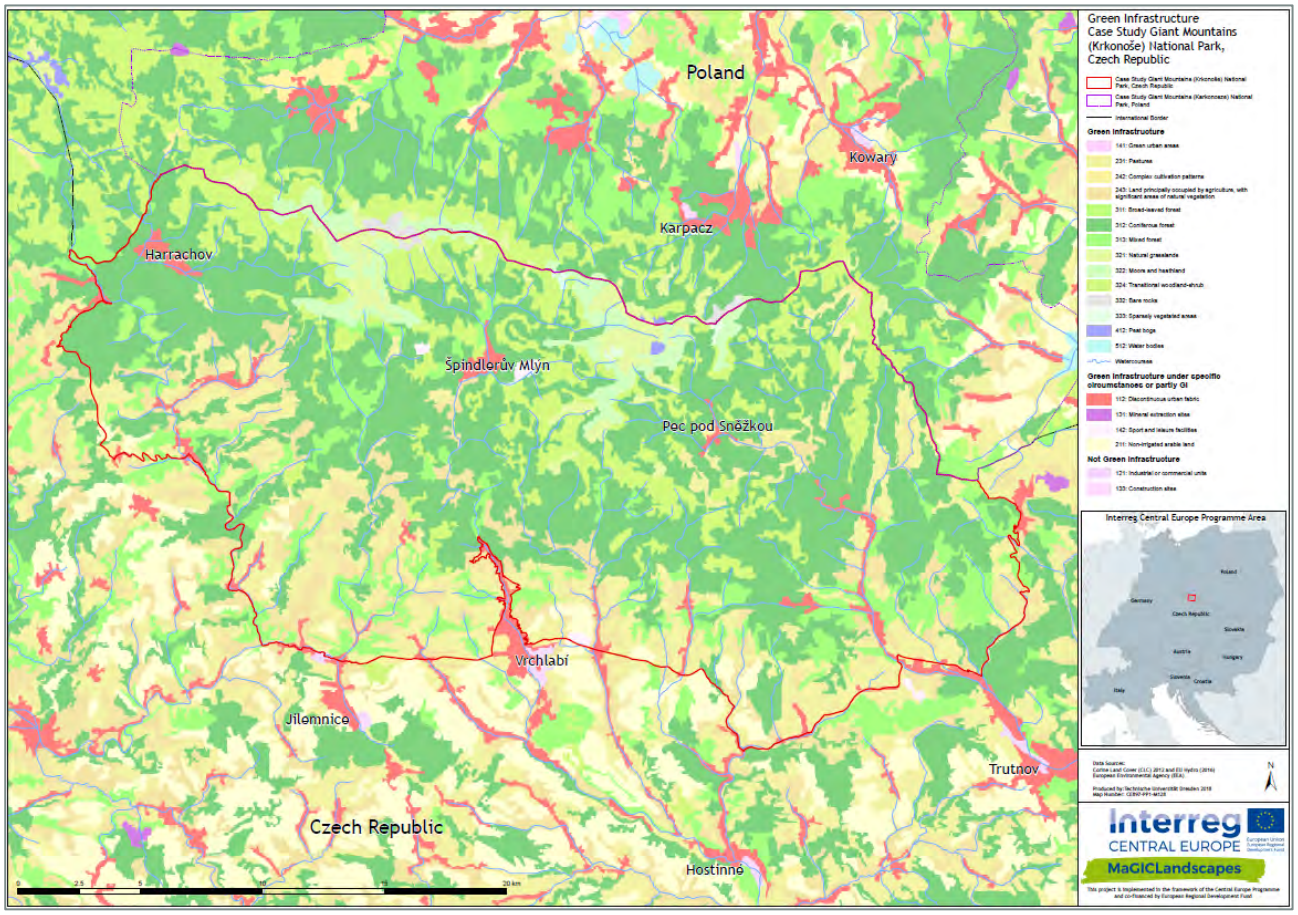

Figure 22: Map of green infrastructure for the Czech case study area Krkonoše Mountains National Park based on the transnational legend using regional biotope data from CORINE land cover data from 2012 and EU-Hydro River Network 2016.

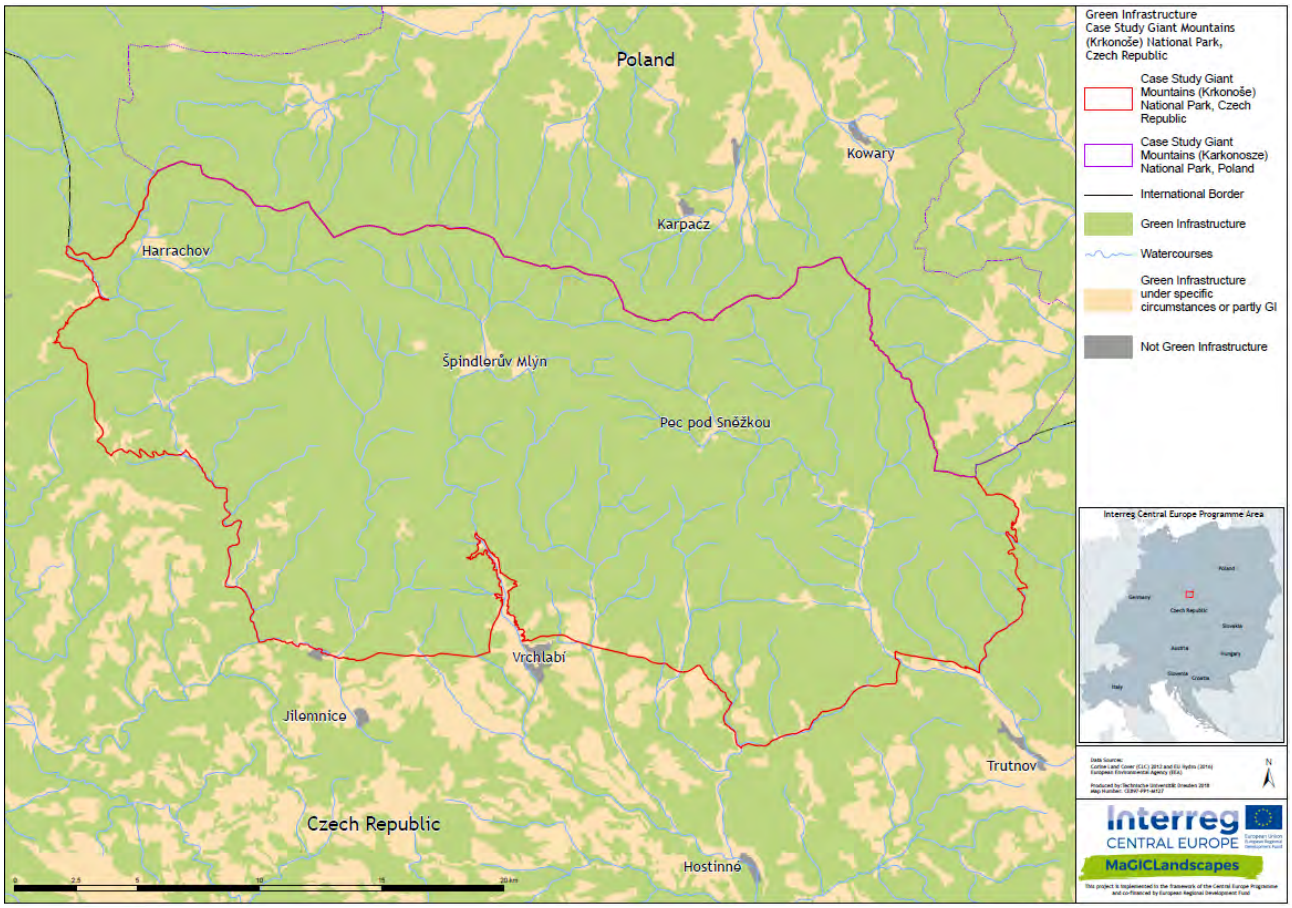

Figure 23: Map of green infrastructure for the Czech case study area Krkonoše Mountains National Park based on regional biotope data from CORINE land cover data from 2012 and EU-Hydro River Network 2016. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

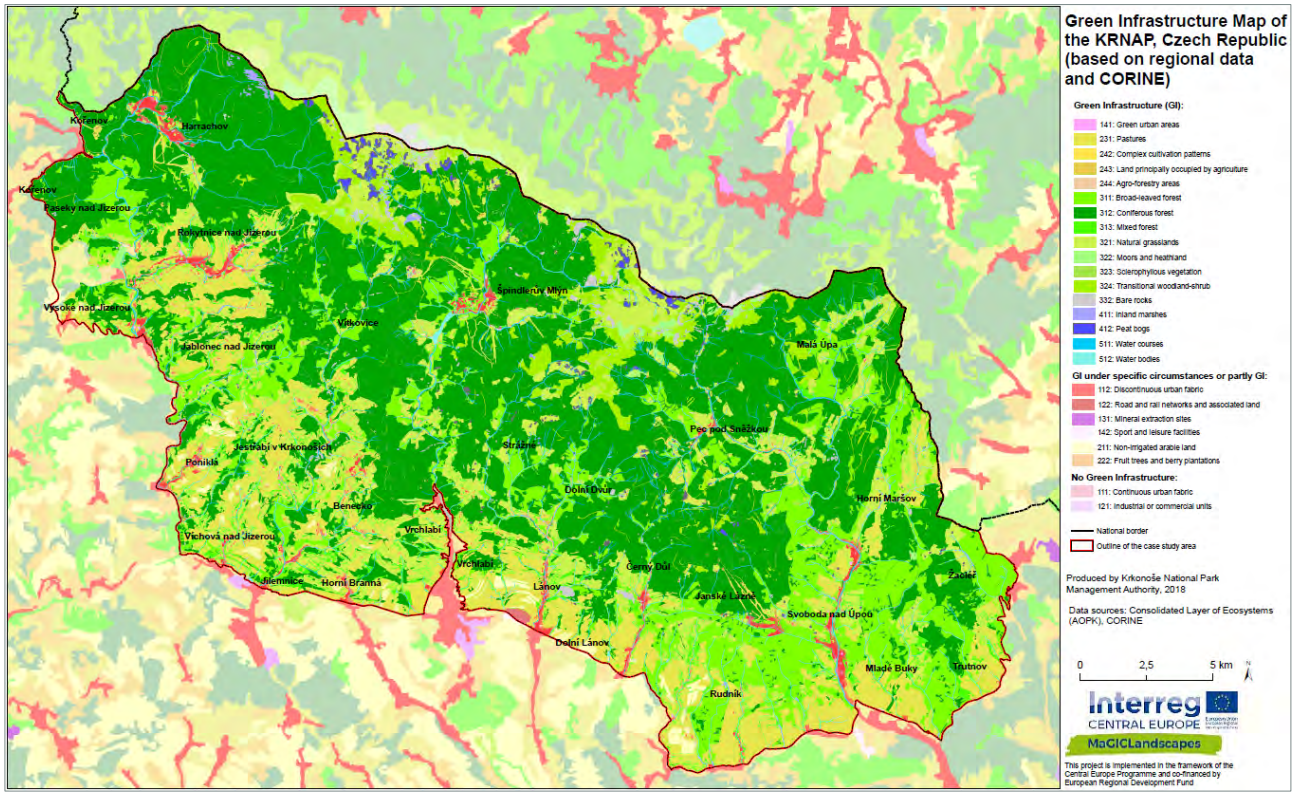

Figure 24: Map of green infrastructure for the Czech case study area Krkonoše Mountains National Park based on the transnational legend using regional biotope data from consolidated layer of ecosystems (KVES).

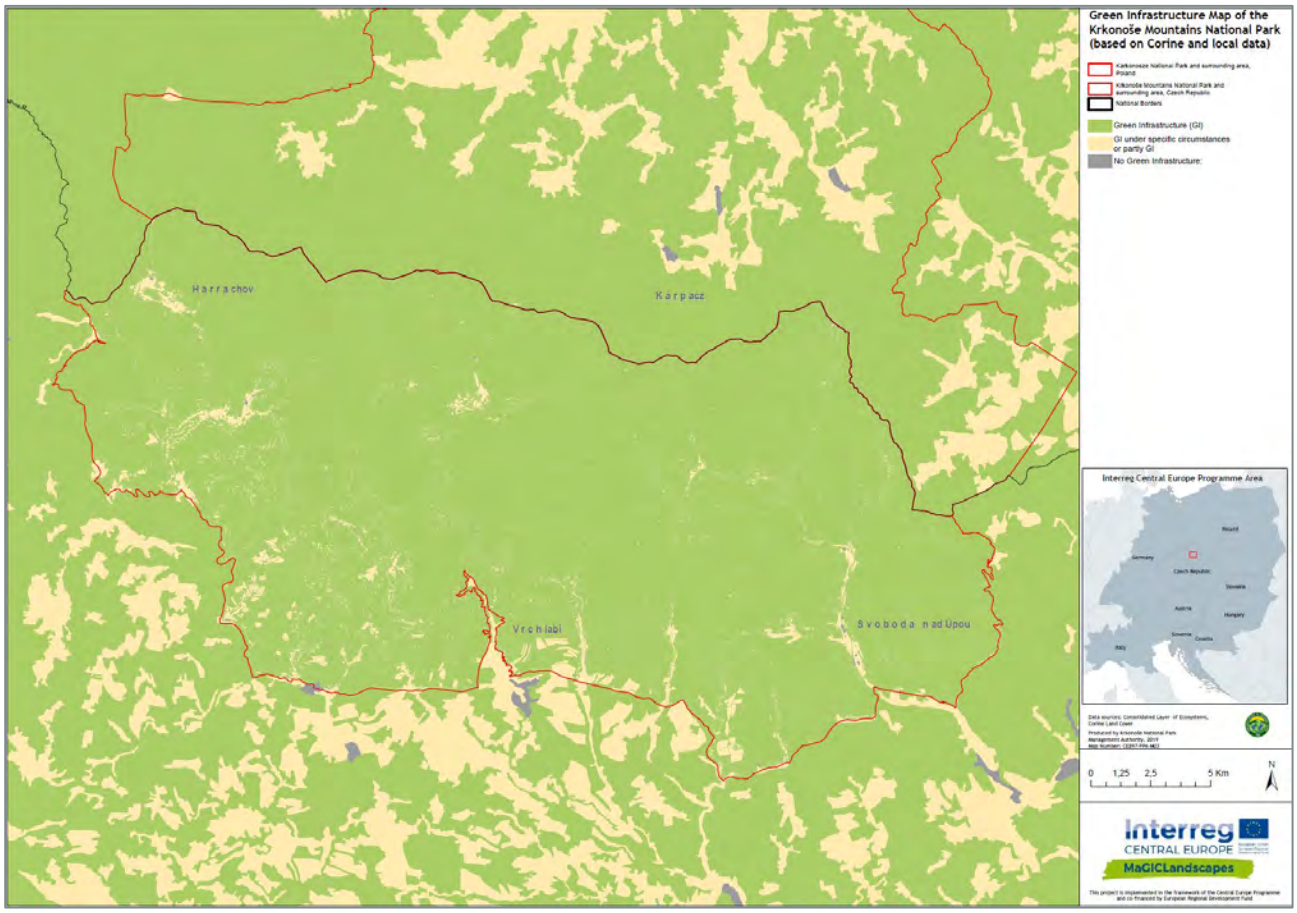

Figure 25: Map of green infrastructure for the Czech case study area Krkonoše Mountains National Park based on the transnational legend using regional biotope data from consolidated layer of ecosystems (KVES). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

Table 7: Datasets used for the regional map of Green Infrastructure of the Czech case study area Krkonoše Mountains National Park

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Konsolidovaná vrstva ekosystémů (KVES)	CzechGlobe, AOPK ČR (2013)	vector	n/a	full	2006 to 2013	Czech part; available on request (no fee)
EU-Hydro River Network	**https://land.copernicus.eu/pan-european/satellite-derived-products/eu-hydro/eu-hydro-public-beta/eu-hydro-river-network?tab=download**	vector	n/a	not full, just waters	2012	Available for free

3.5 Case Study Tri-border area Czech Republic-Germany-Poland

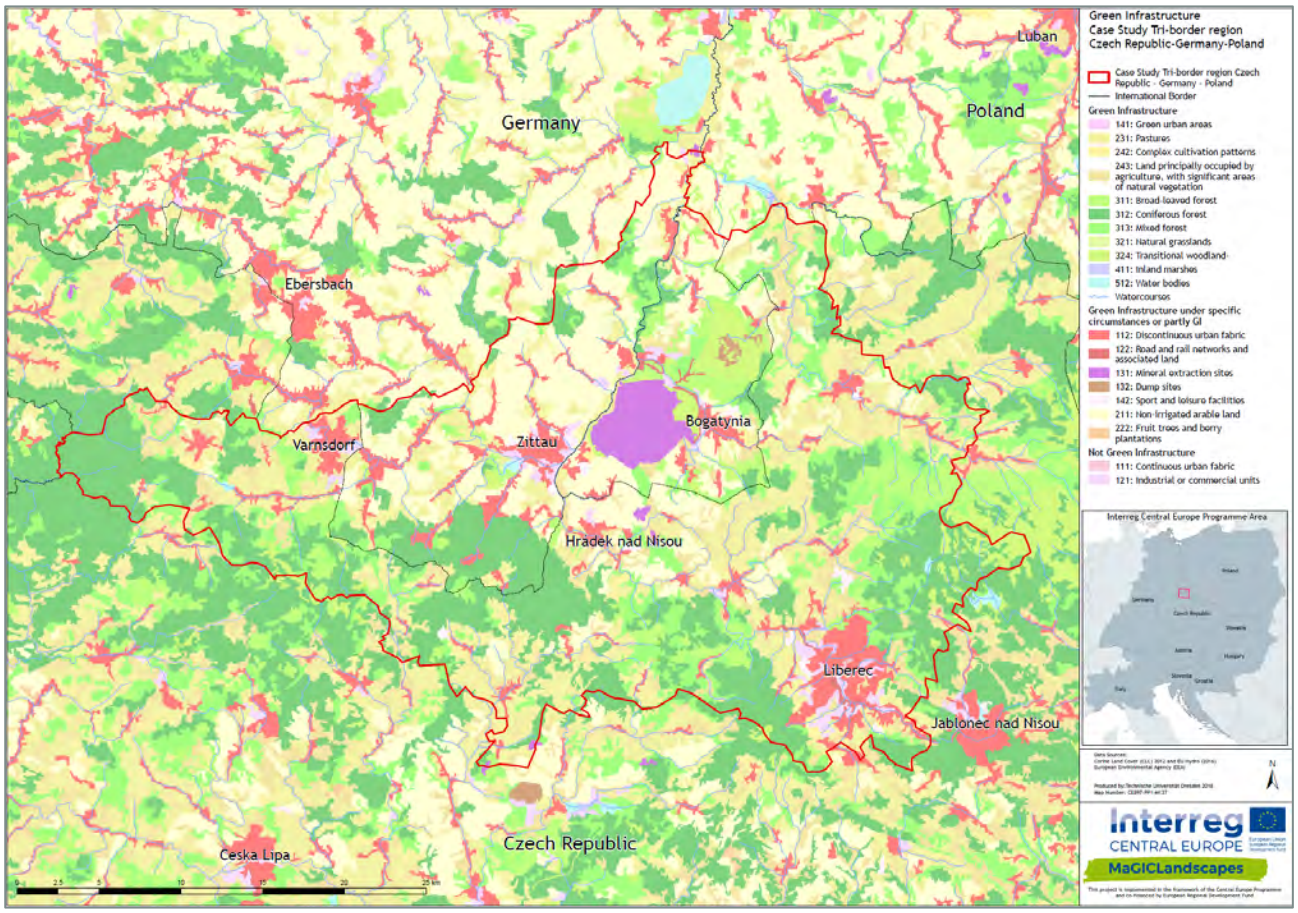

Figure 26: Map of green infrastructure for the case study area tri-border area Czech Republic-Germany-Poland based on the transnational legend using CORINE land cover data from 2012.

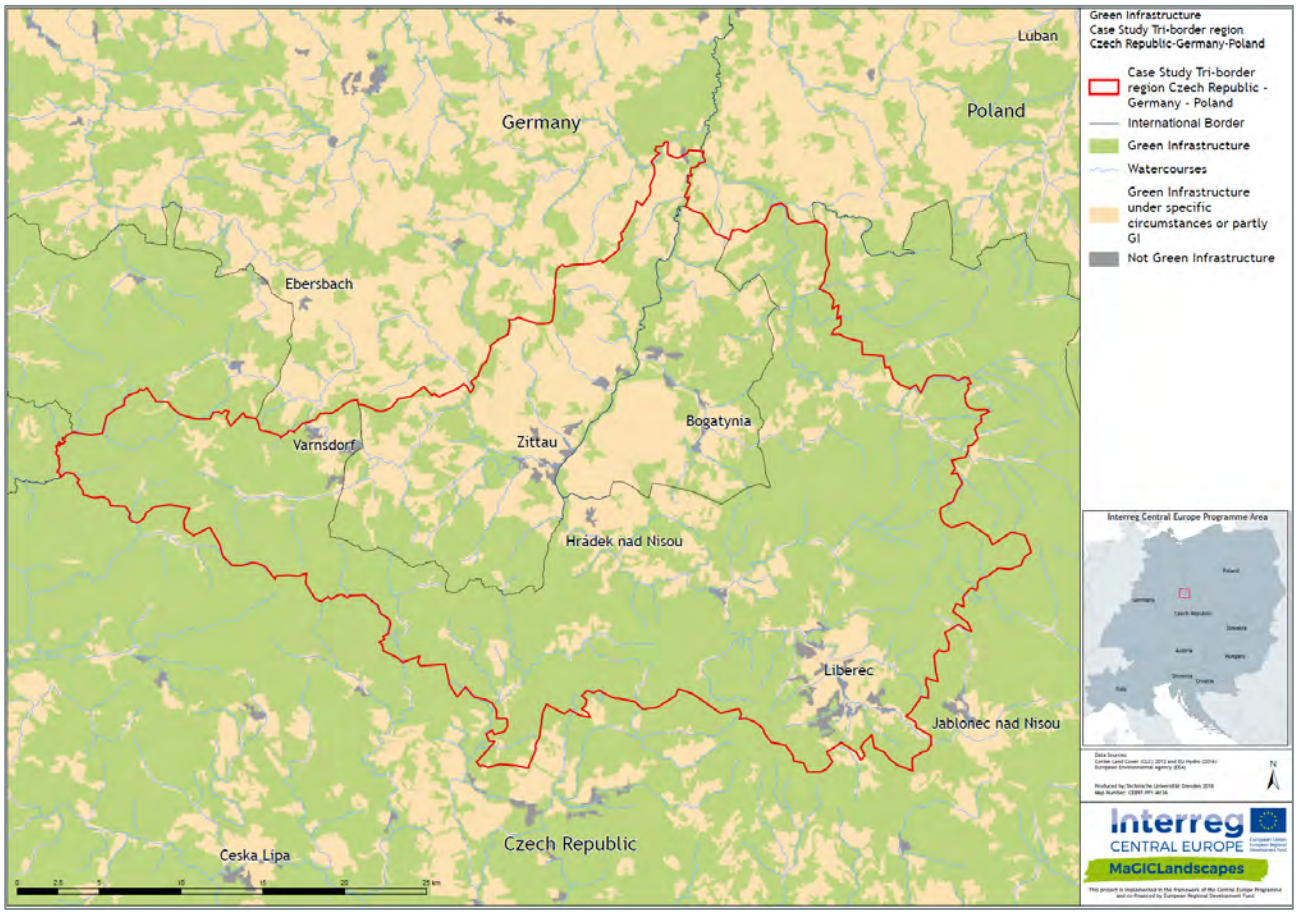

Figure 27: Map of green infrastructure for the case study area tri-border area Czech Republic-Germany-Poland based on the transnational CORINE data. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

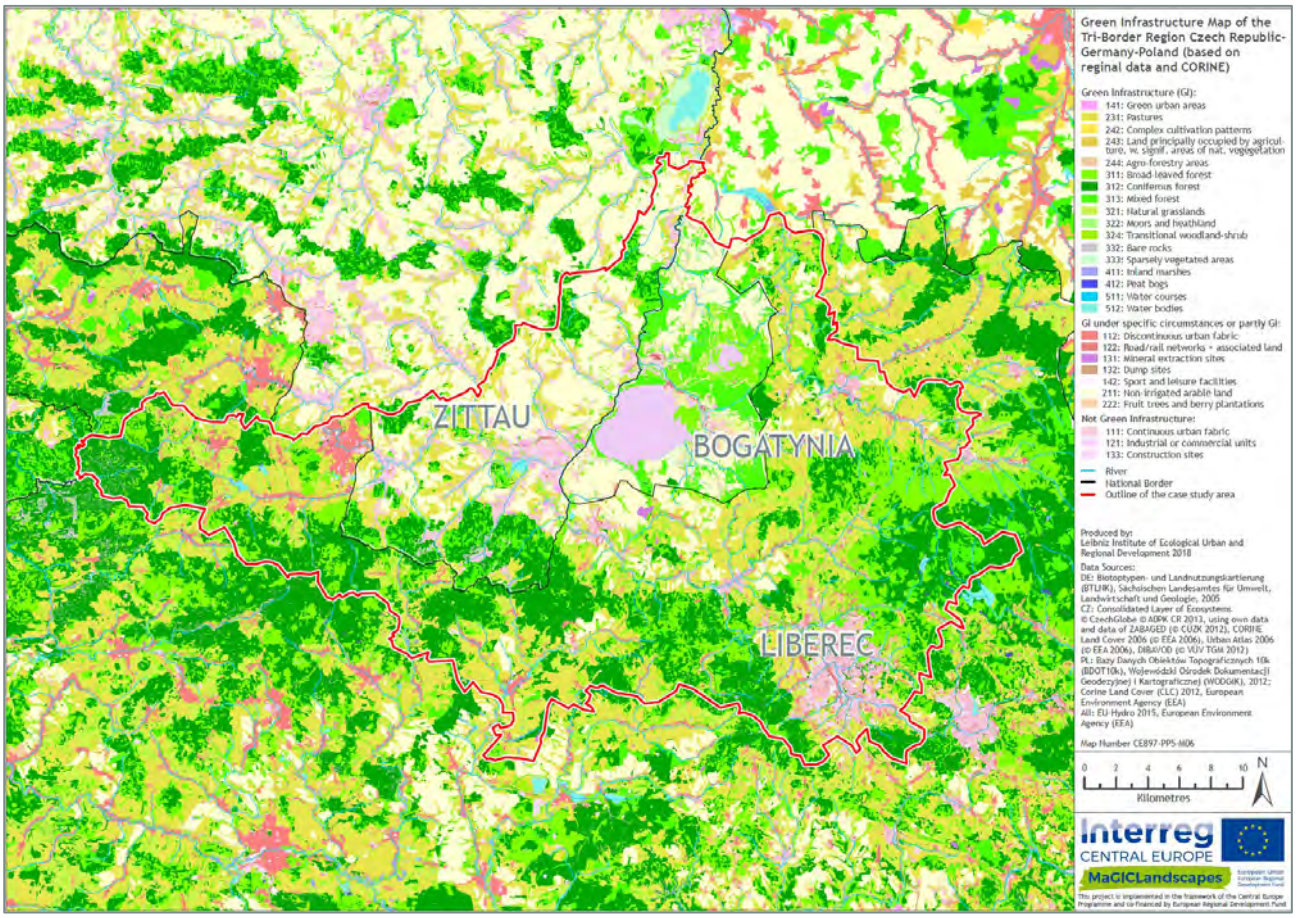

Figure 28: Map of green infrastructure for the case study area tri-border area Czech Republic-Germany-Poland based on the transnational legend using biotope data from CZ (consolidated layer of ecosystems (KVES) from 2013), DE (biotope type and land use mapping (BTLNK) from 2005) and PL (database of topographic objects (BDOT10k) from 2012; CORINE land cover data from 2012).

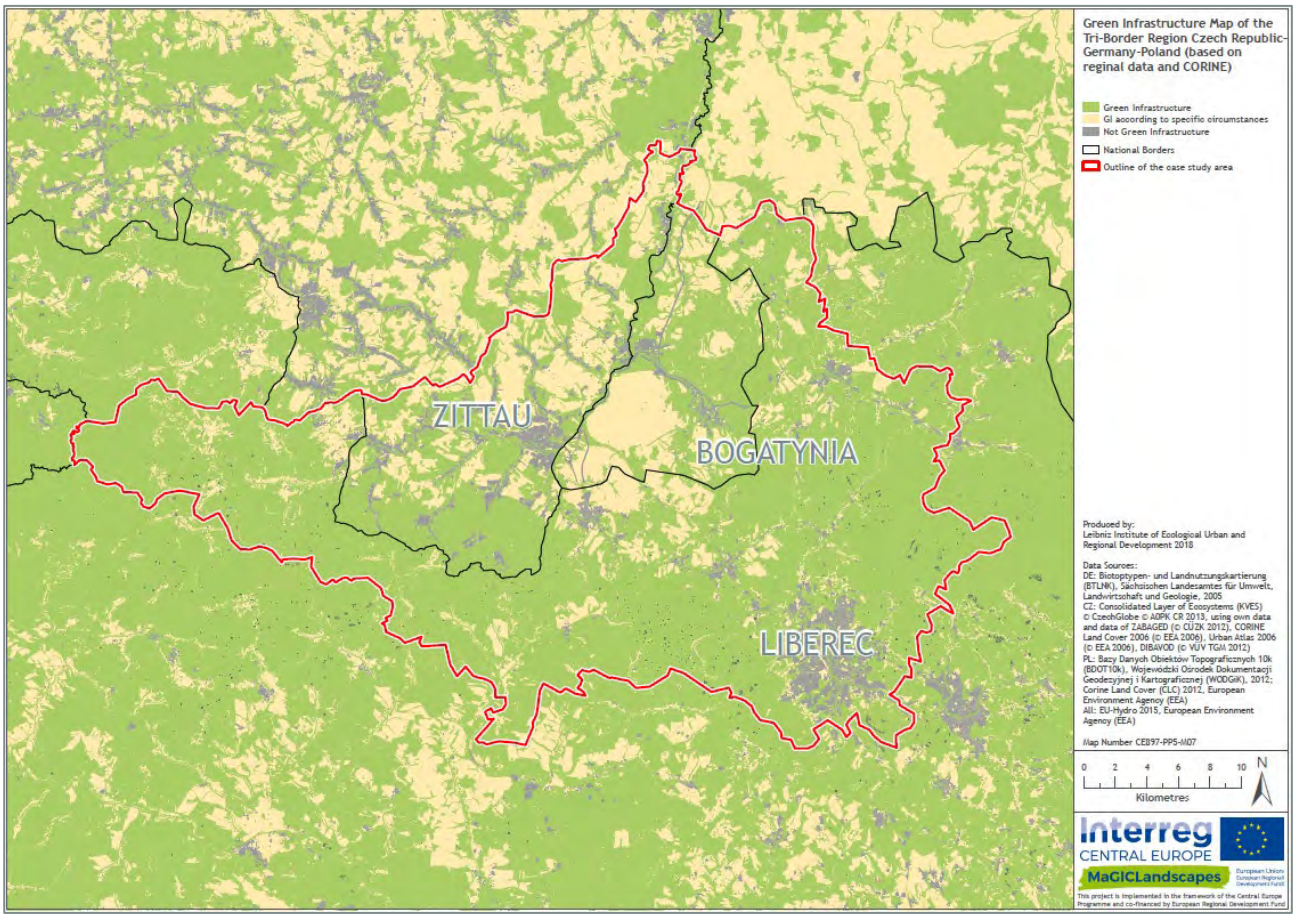

Figure 29: Map of green infrastructure for the case study area tri-border area Czech Republic-Germany-Poland based on biotope data from CZ (consolidated layer of ecosystems (KVES) from 2013), DE (biotope type and land use mapping (BTLNK) from 2005) and PL (database of topographic objects (BDOT10k) from 2012; CORINE land cover data from 2012). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

Table 8: Datasets used for the regional map of Green Infrastructure of the case study area Tri-border area Czech Republic-Germany-Poland

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Biotoptypen- und Landnutzungs-kartierung (BTLNK)	**https://www.umwelt.sachsen.de/umwelt/natur/25140.htm** (web links to WMS or WFS) shape file can be ordered from: Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie; Referat 61: Landschaftsökologie, Flächennaturschutz	vector	n/a	full	2005	German part; Available for free
Konsolidovaná vrstva ekosystémů (KVES)	CzechGlobe, AOPK ČR (2013)	vector	n/a	full	2006 to 2013	Czech part; available on request (no fee)
Topographic data (BDOT)	Geodatabase ordered in Wojewódzki Ośrodek Dokumentacji Geodezyjnej i Kartograficznej (Wrocław) **http://wgik.dolnyslask.pl/web/start/wodgik/do-pobrania**	vector	1:10 000	full	2012	Polish part; Free for public institutions
EU-Hydro River Network	**https://land.copernicus.eu/pan-european/satellite-derived-products/eu-hydro/eu-hydro-public-beta/eu-hydro-river-network?tab=download**	vector	n/a	not full, just waters	2012	Available for free

3.6 Case Study Dübener Heide Nature Park, Germany

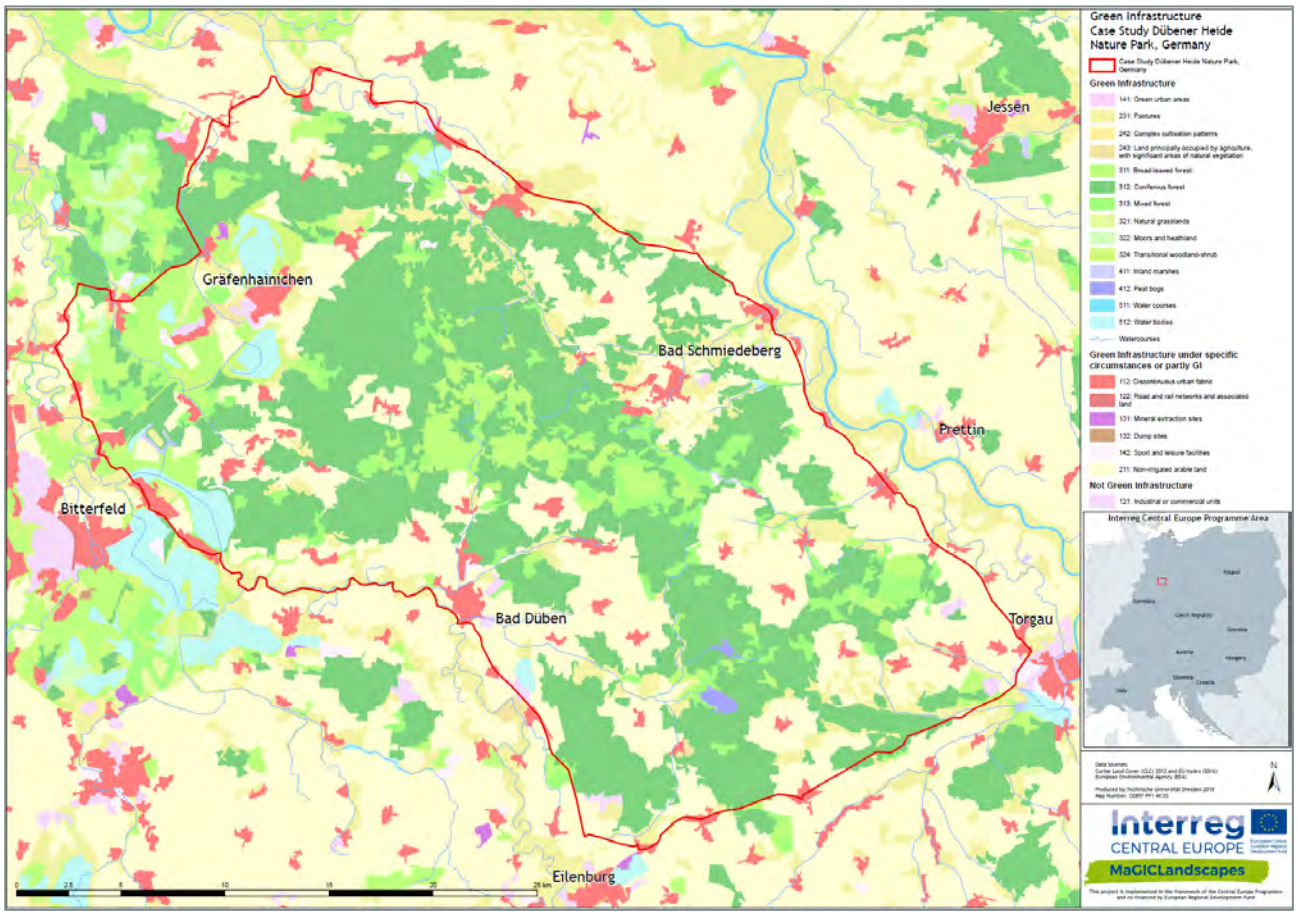

Figure 30: Map of green infrastructure for the German case study area Dübener Heide Nature Park based on the transnational legend using CORINE land cover data from 2012.

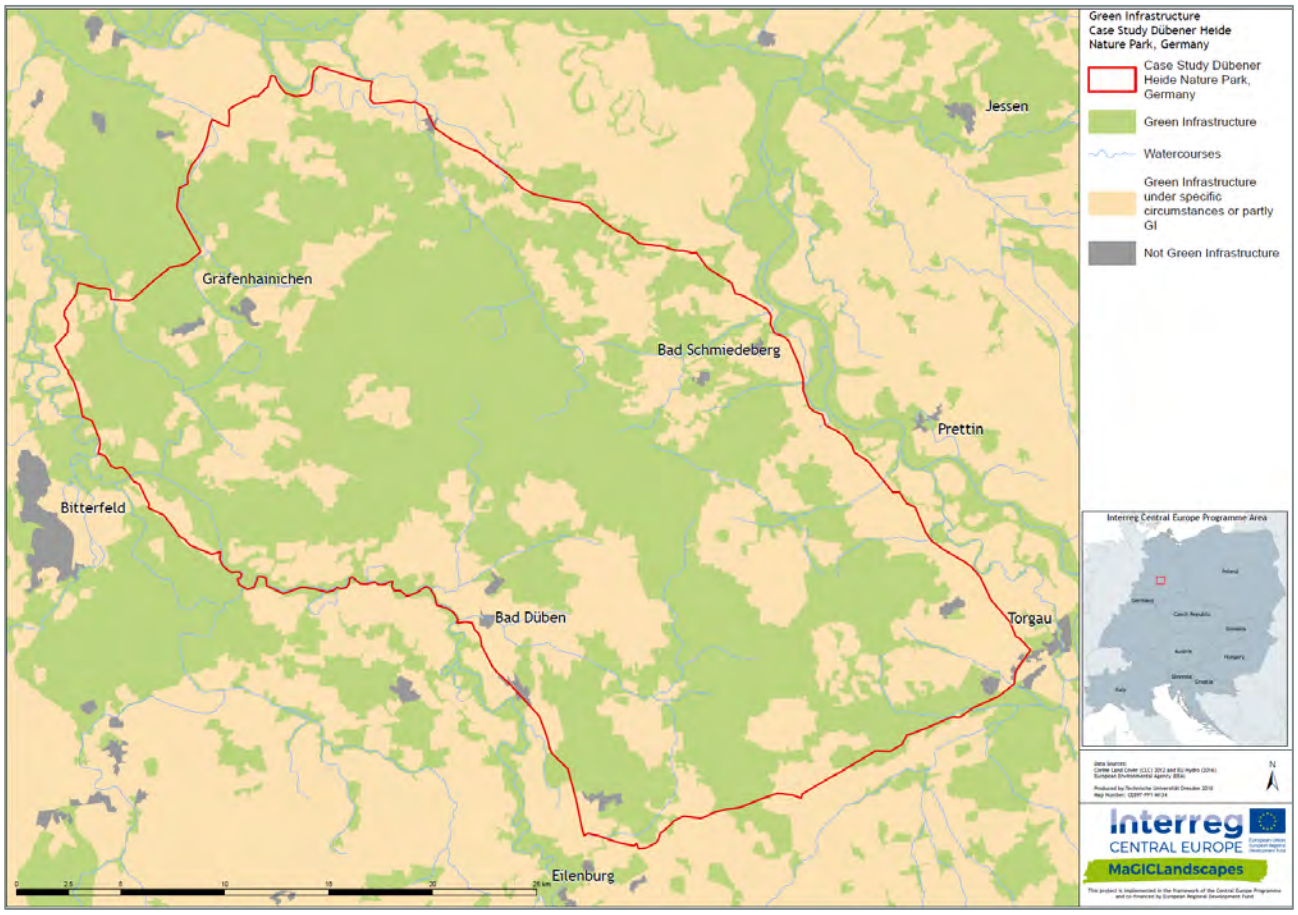

Figure 31: Map of green infrastructure for the German case study area Dübener Heide Nature Park based on CORINE land cover data from 2012. The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

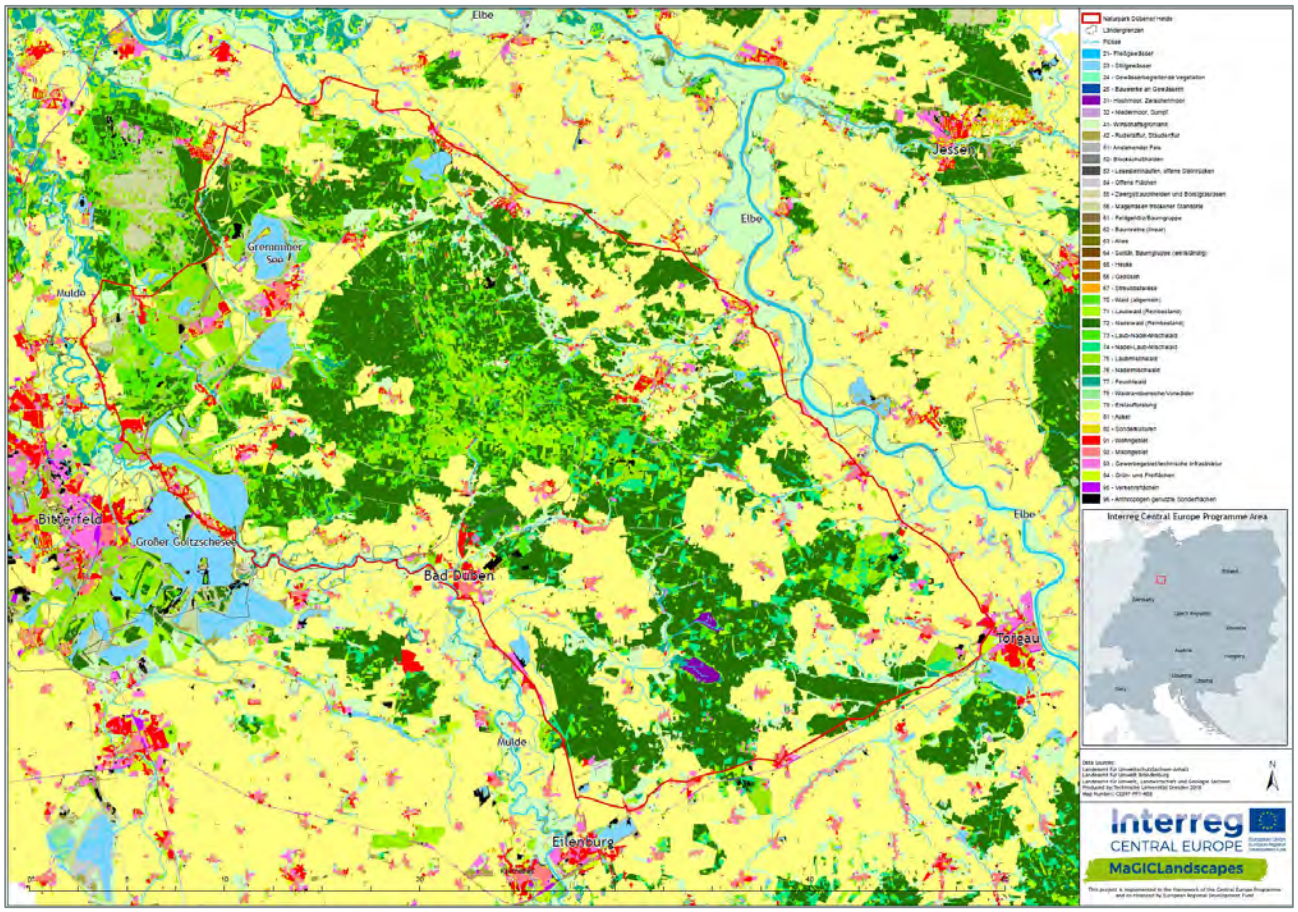

Figure 32: Map of green infrastructure for the German case study area Dübener Heide Nature Park based on the transnational legend using regional biotope and land use data from Saxony, Saxony-Anhalt and Brandenburg (BTLNK, BTNT and BTLN).

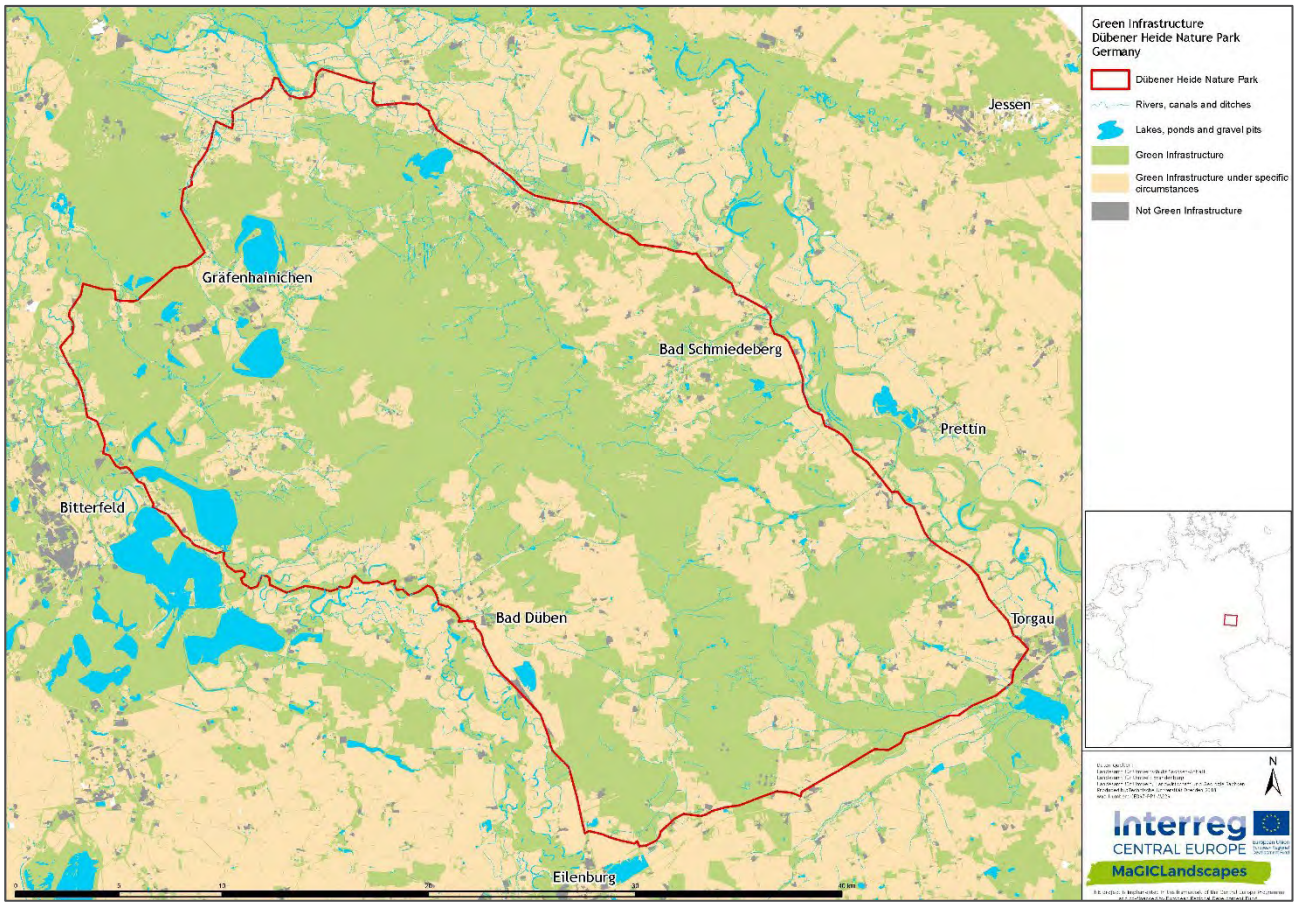

Figure 33: Map of green infrastructure for the German case study area Dübener Heide Nature Park based on regional biotope and land use data from Saxony, Saxony-Anhalt and Brandenburg (BTLNK, BTNT and BTLN). The CORINE classes are classified in a simplified transnational legend just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the coordinated legend (see section 2.4).

Table 9: Datasets used for the regional map of Green Infrastructure of the German case study area Dübener Heide Nature Park

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Biotoptypen- und Landnutzungs-kartierung (BTLNK)	**https://www.umwelt.sachsen.de/umwelt/natur/25140.htm** (web links to WMS or WFS) shape file can be ordered from: Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie; Referat 61: Landschaftsökologie, Flächennaturschutz	vector	n/a	full	2005	Saxony
Biotop- und Nutzungs-typen-kartierung (BTNT)	-	vector	n/a	full	2009	Saxony-Anhalt
Biotop- und Landnutzungs-kartierung (BTLN)	-	vector	n/a	full	2009	Brandenburg (not part of the case study area, but close by)
European catchments and Rivers network system (Ecrins)	**https://www.eea.europa.eu/data-and-maps/data/european-catchments-and-rivers-network#tab-gis-data**	vector	n/a	Not full, just waters	1990-2006	

3.7 Case Study Upper River Po Plain, Italy

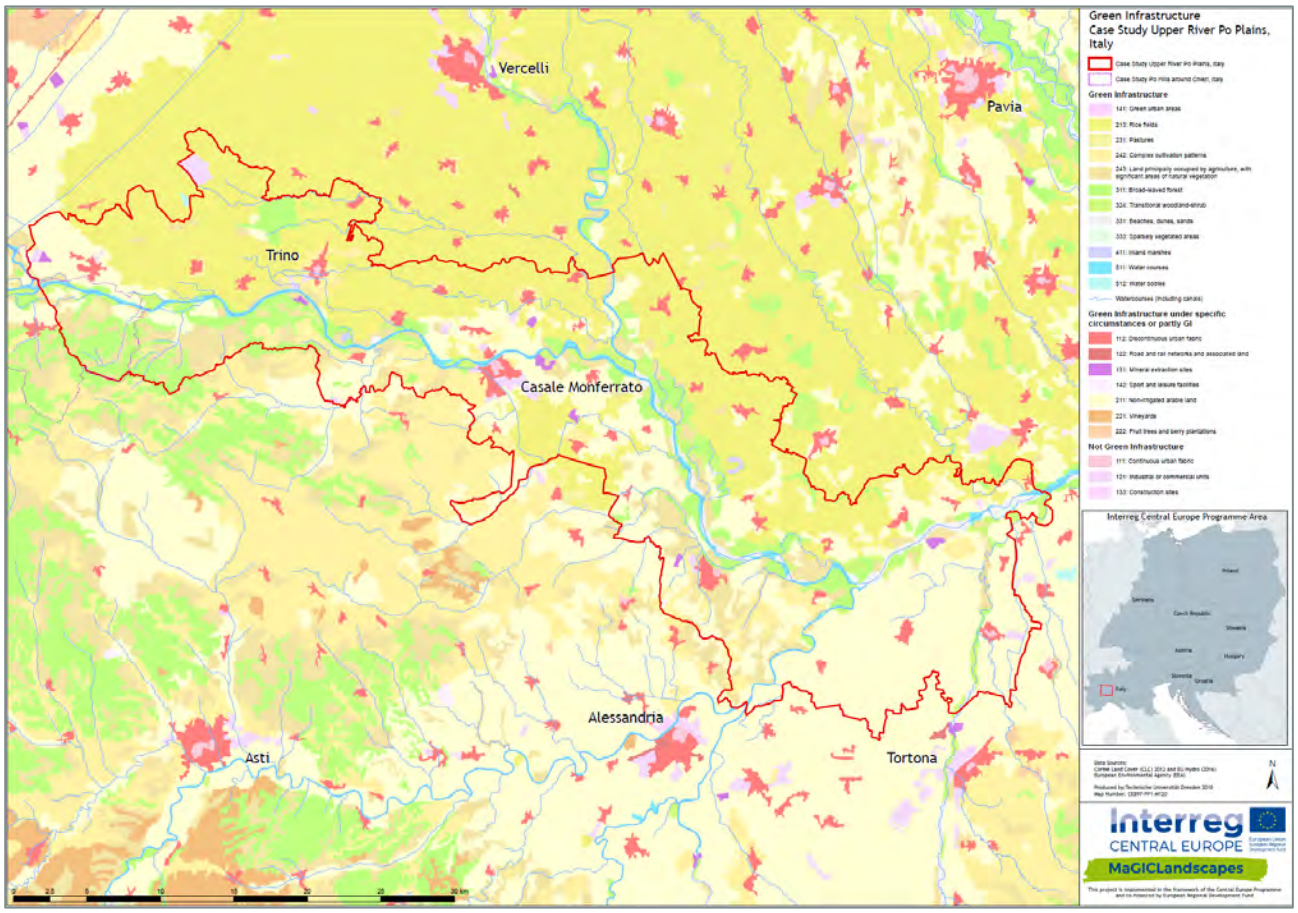

Figure 34: Map of green infrastructure for the Italian case study area Upper Po Plain based on the transnational legend using CORINE land cover data from 2012.

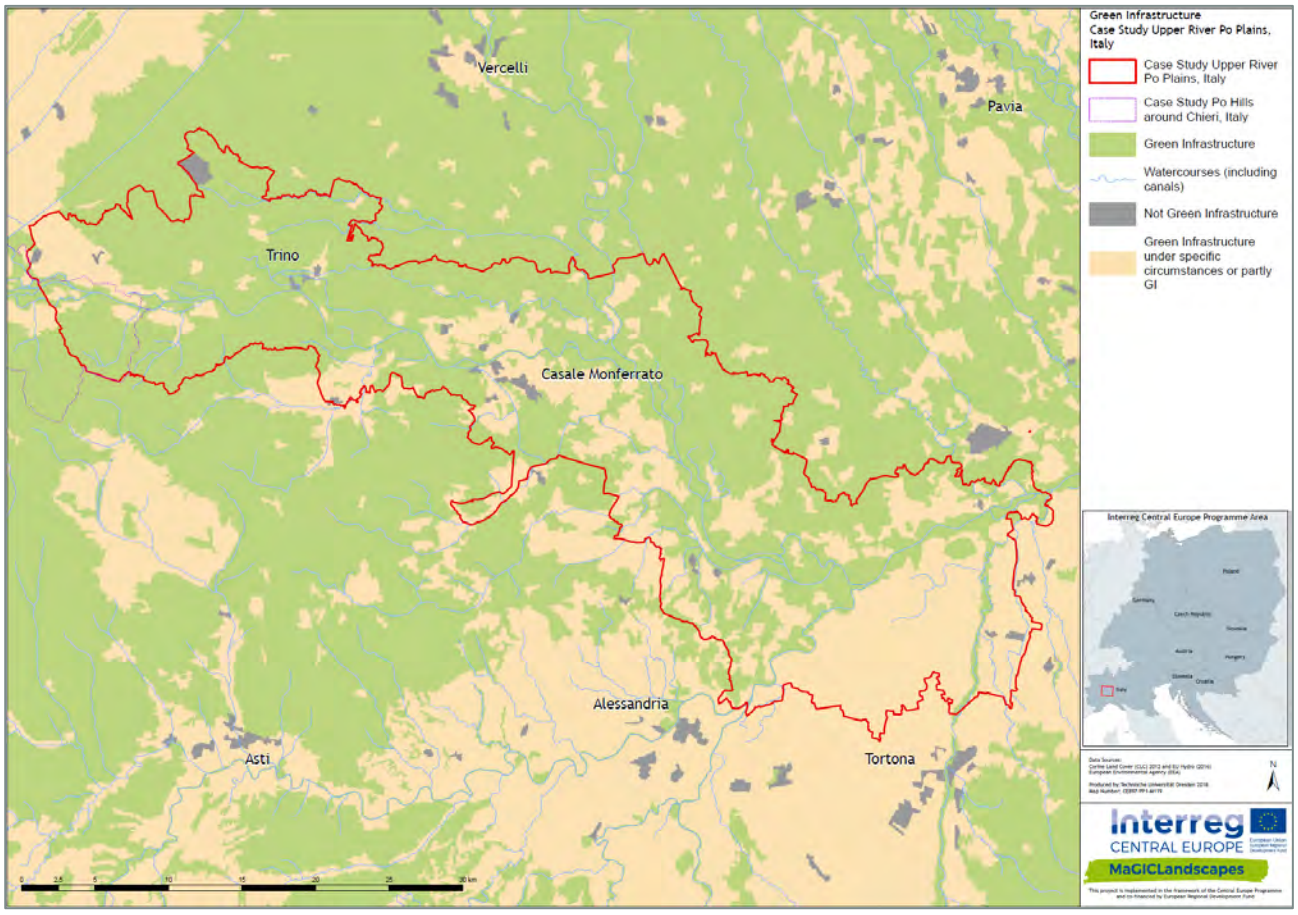

Figure 35: Map of green infrastructure for the Italian case study area Upper Po Plain based on the transnational legend using CORINE land cover data from 2012. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

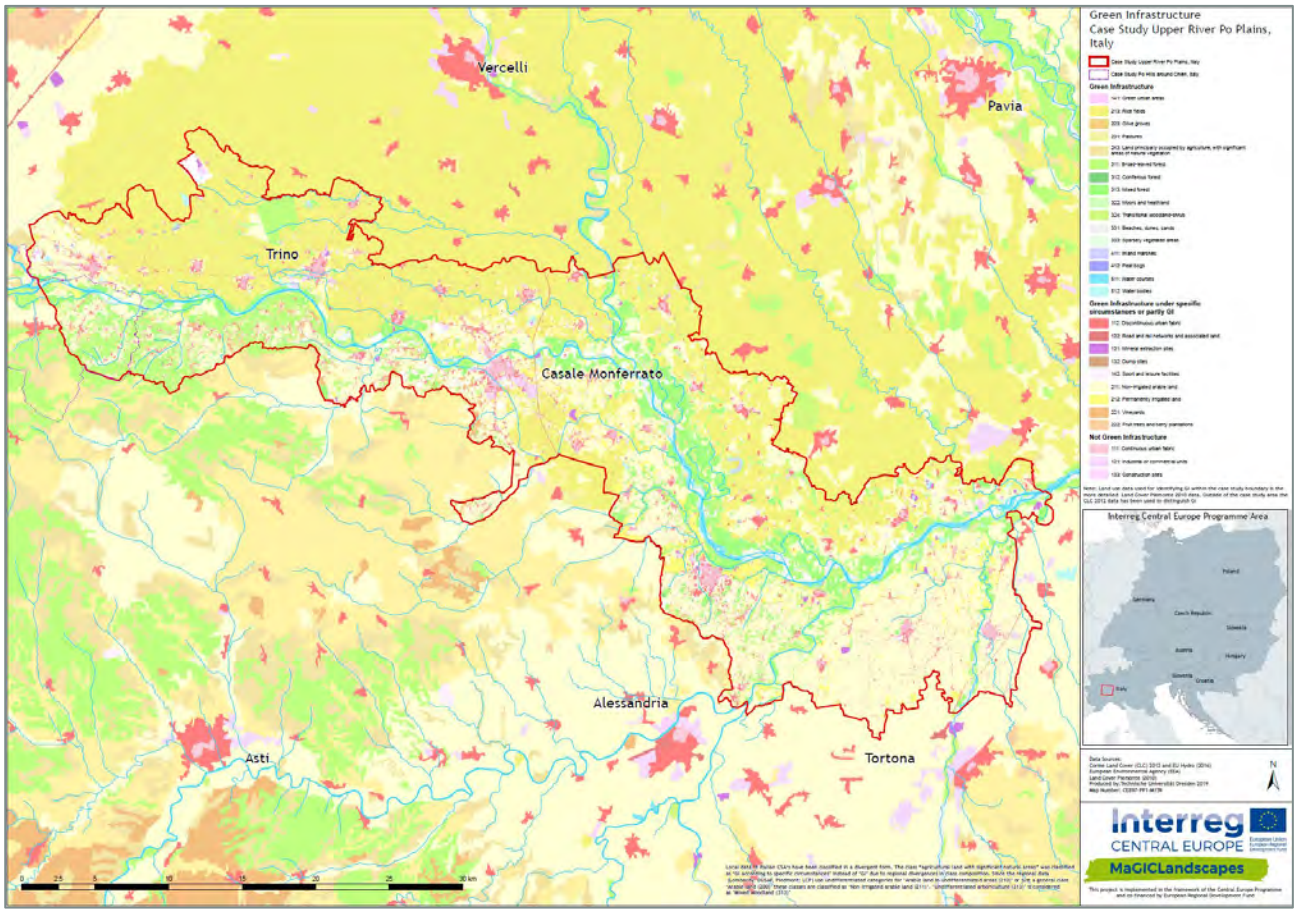

Figure 36: Map of green infrastructure for the Italian case study area Upper Po Plain based on the transnational legend using Land Cover Piedmont data from 2010 and DUSAF 4.0 from 2012.

Remark:

Local data of Italian case study areas have been classified in a divergent form. The class “Agricultural land with significant natural areas” was classified as ‘GI according to specific circumstances’ instead of ‘GI’ due to regional divergences in class composition. Since the regional data (Lombardia: DUSAF, Piedmont: LCP) use undifferentiated categories for ‘Arable land in undifferentiated areas (210)’ or just a general class ‘Arable land (200)’ these classes are classified as ‘Non-irrigated arable land (211)’. ‘Undifferentiated arboriculture (313)’ is considered as ‘Mixed woodland (313)’.

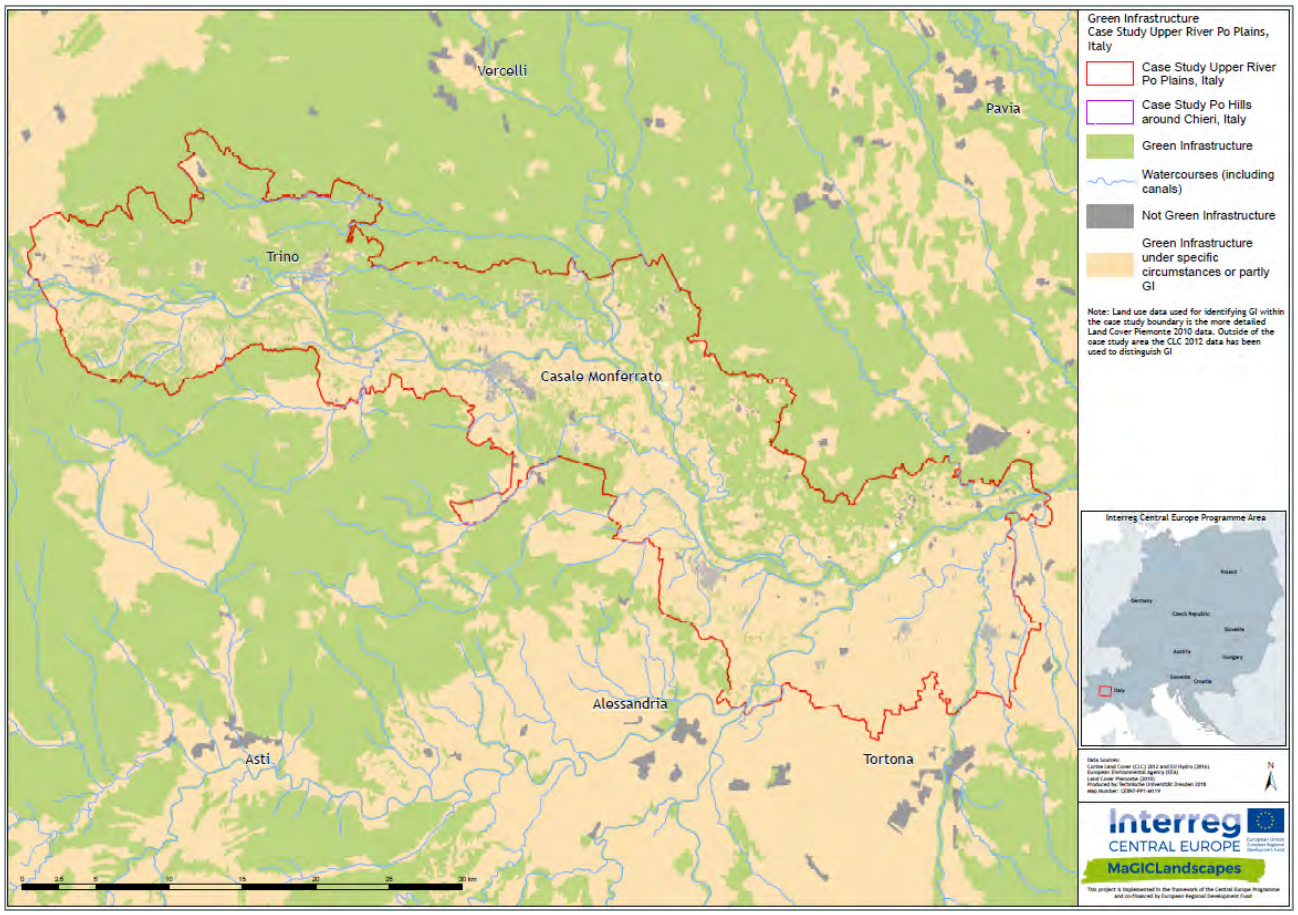

Figure 37: Map of green infrastructure for the Italian case study area Upper Po Plain based on the transnational legend using Land Cover Piedmont data from 2010 and DUSAF 4.0 from 2012. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

Table 10: Datasets used for the regional map of Green Infrastructure of the Italian case study area Upper Po Plain

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Land Cover Piedmont	Regione Piemonte **http://www.geoportale.piemonte.it/geocatalogorp/**	vector	n/a	Piedmont Region	2010	Free download
DUSAF 4.0 (Use of Agricultural and Forest Soils)	Regione Lombardia **https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioServizio/servizi-e-informazioni/Enti-e-Operatori/Territorio/sistema-informativo-territoriale-sit/uso-suolo-dusaf/uso-suolo-dusaf**	vector	n/a	Lombardy Region	2012	Free download

3.8 Case Study Po Hills around Chieri, Italy

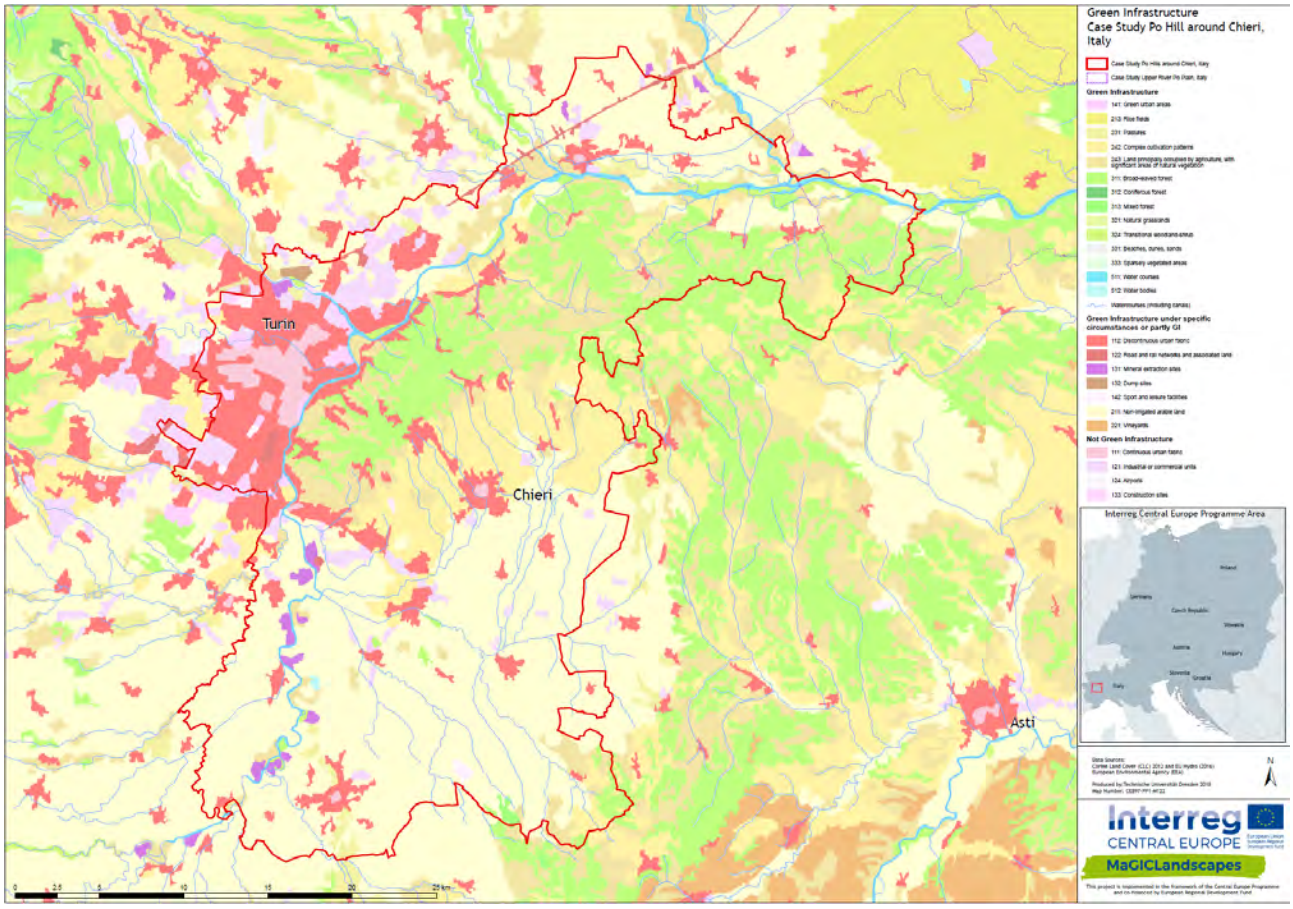

Figure 38: Map of green infrastructure for the Italian case study area Po Hills around Chieri based on the transnational legend using CORINE land cover data from 2012.

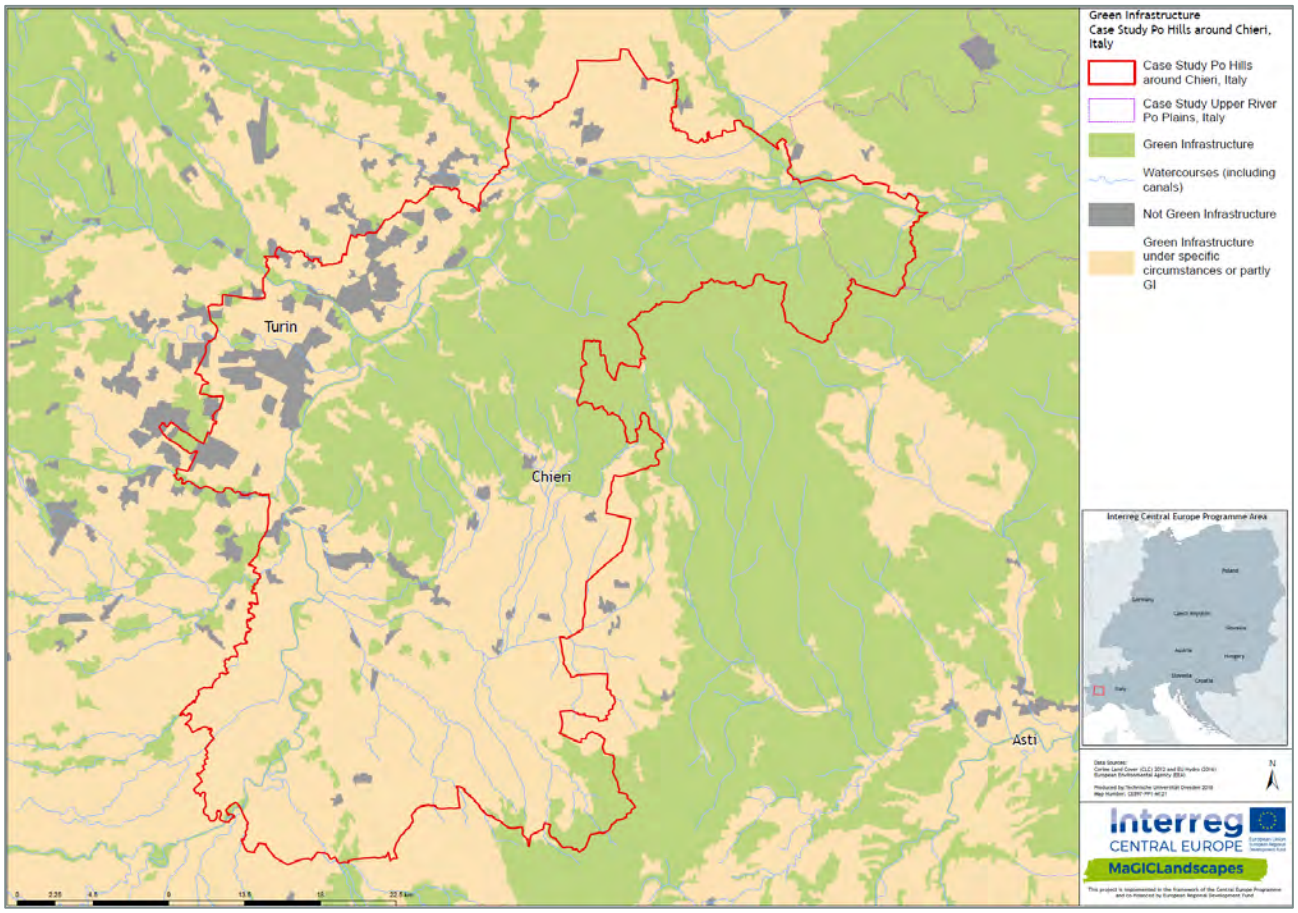

Figure 39: Map of green infrastructure for the Italian case study area Po Hills around Chieri based on the transnational legend using CORINE land cover data from 2012. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

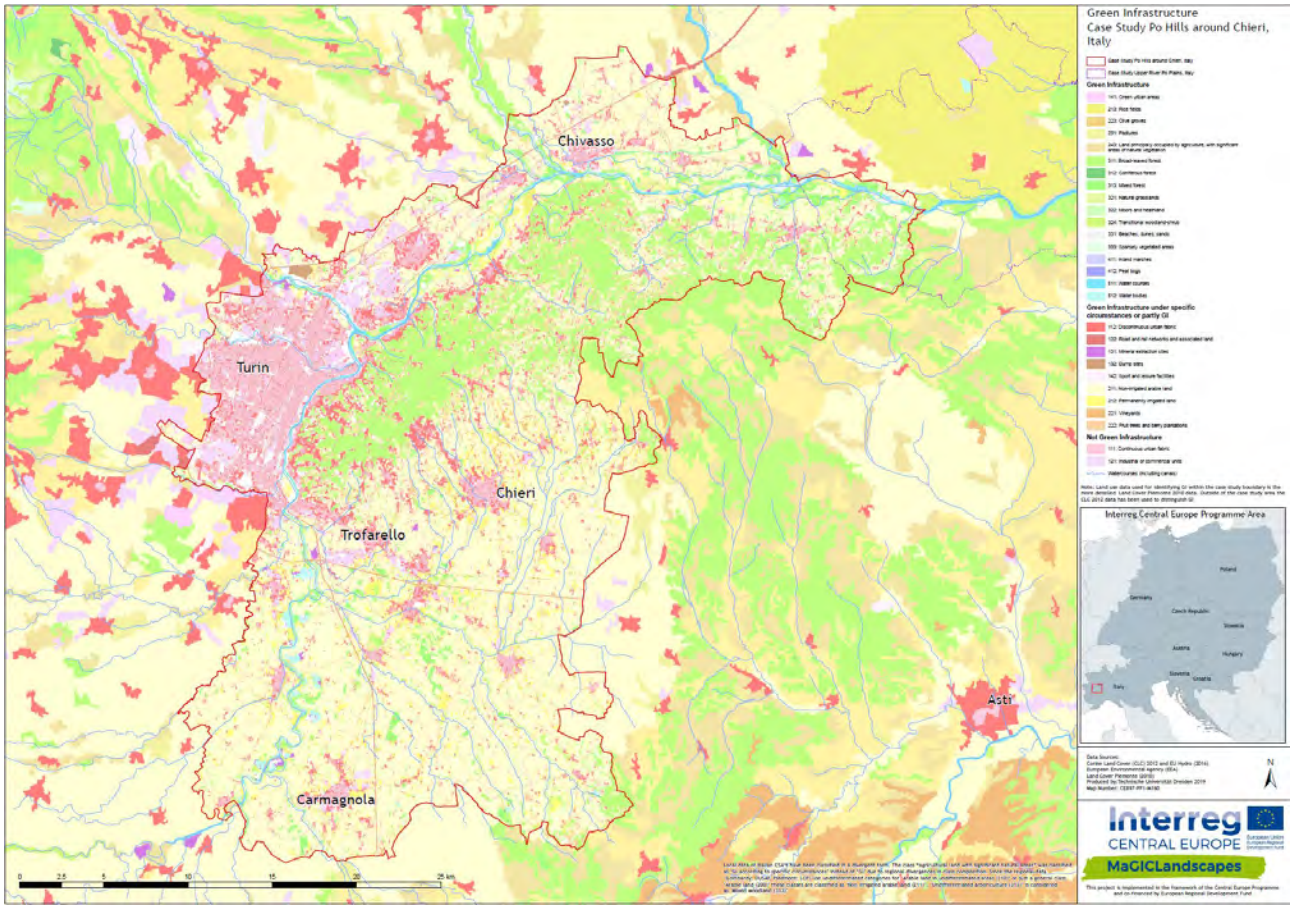

Figure 40: Map of green infrastructure for the Italian case study area Po Hills around Chieri based on the transnational legend using Land Cover Piedmont data from 2010.

Remark:

Local data of Italian case study areas have been classified in a divergent form. The class "Agricultural land with significant natural areas" was classified as 'GI according to specific circumstances' instead of 'GI' due to regional divergences in class composition. Since the regional data (Lombardia: DUSAF, Piedmont: LCP) use undifferentiated categories for 'Arable land in undifferentiated areas (210)' or just a general class 'Arable land (200)' these classes are classified as 'Non-irrigated arable land (211)'. 'Undifferentiated arboriculture (313)' is considered as 'Mixed woodland (313)'.

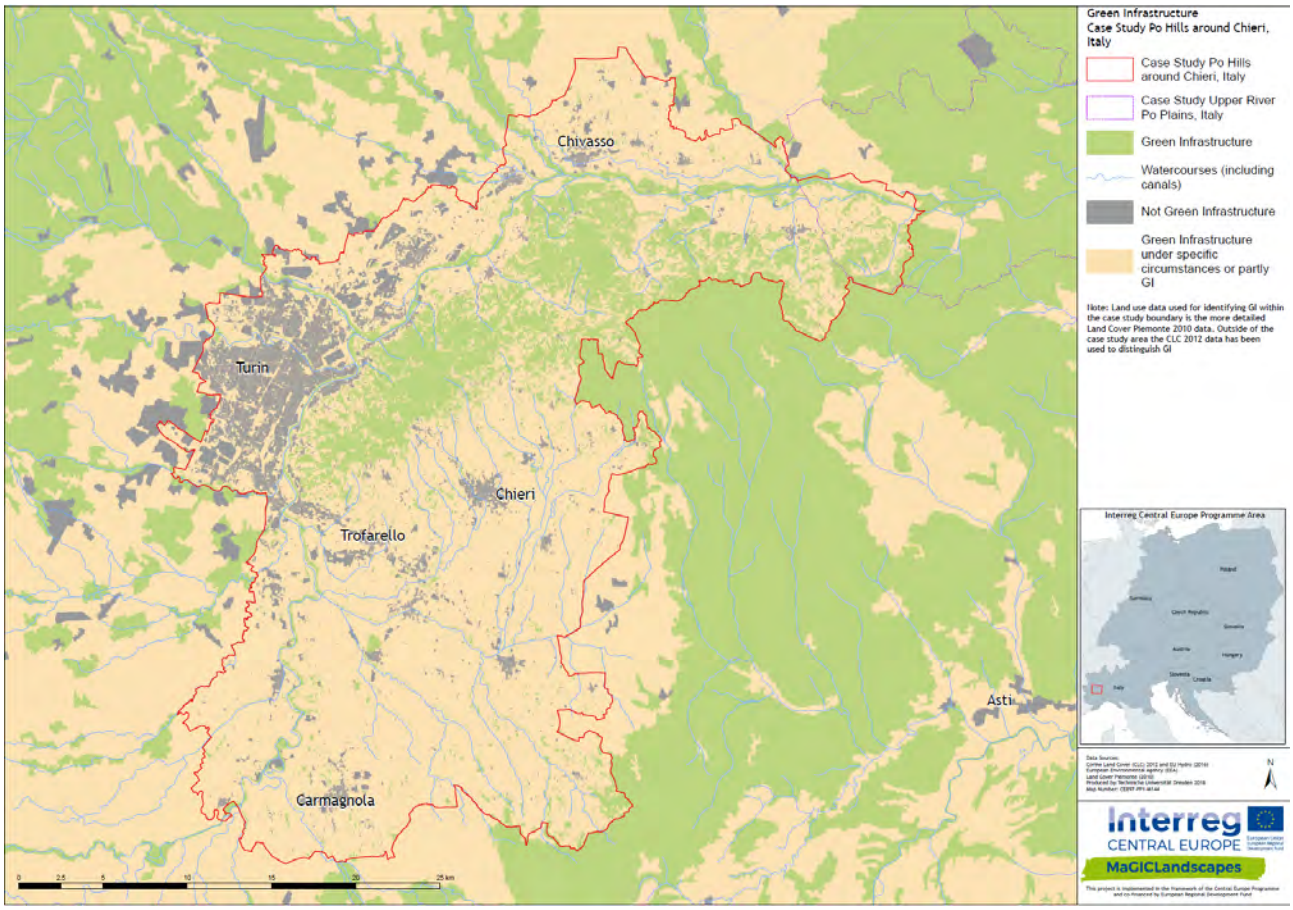

Figure 41: Map of green infrastructure for the Italian case study area Po Hills around Chieri based on the transnational legend using Land Cover Piedmont data from 2010. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

Table 11: Datasets used for the regional map of Green Infrastructure of the Italian case study area Po Hills around Chieri

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Land Cover Piedmont	Regione Piemonte **http://www.geoportale.piemonte.it/geocatalogorp/**	raster/ vector	Scale 1:100.000. Mapping unit minimum (MMU): 25 hectares (ha) per area phenomena and width 100 m for linear phenomena.	full	2010	Free download
BDTRE	Regione Piemonte **http://www.geoportale.piemonte.it/geocatalogorp/**	vector	Scale 1:50.000	full	2018	Free download
Protected areas	Regione Piemonte **http://www.geoportale.piemonte.it/geocatalogorp/**	vector	Scale 1:10.000	not full	2007	Free download
Rivers	Regione Piemonte **http://www.geoportale.piemonte.it/geocatalogorp/**	vector	Scale 1:10.000	not full	2014	Free download
Urban area	Città Metropolitana di Torino	vector	Scale 1:10.000	not full	2008	Free download

3.9 Case Study Karkonosze National Park, Poland

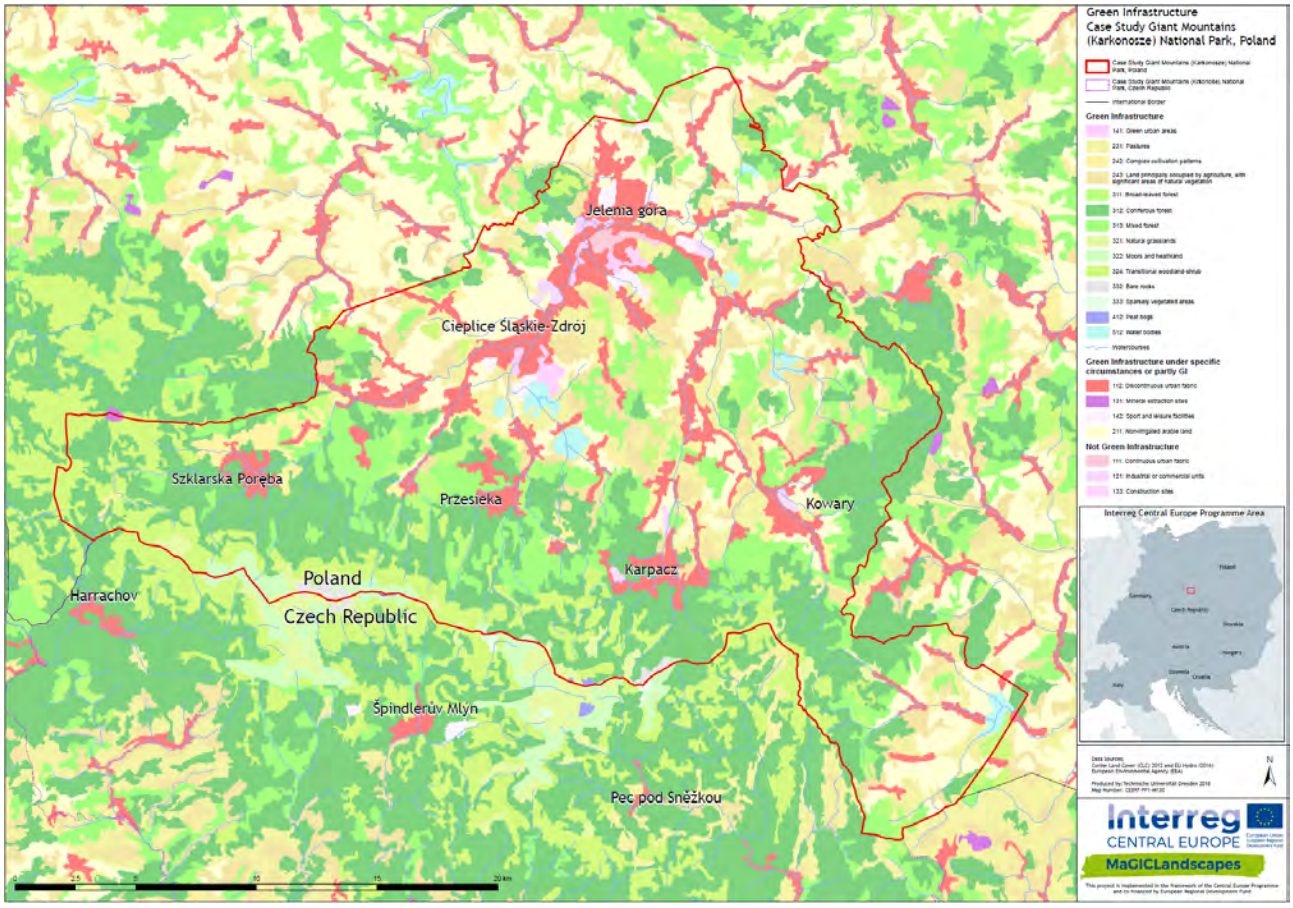

Figure 42: Map of green infrastructure for the Polish case study area Karkonosze National Park based on the transnational legend using CORINE land cover data from 2012.

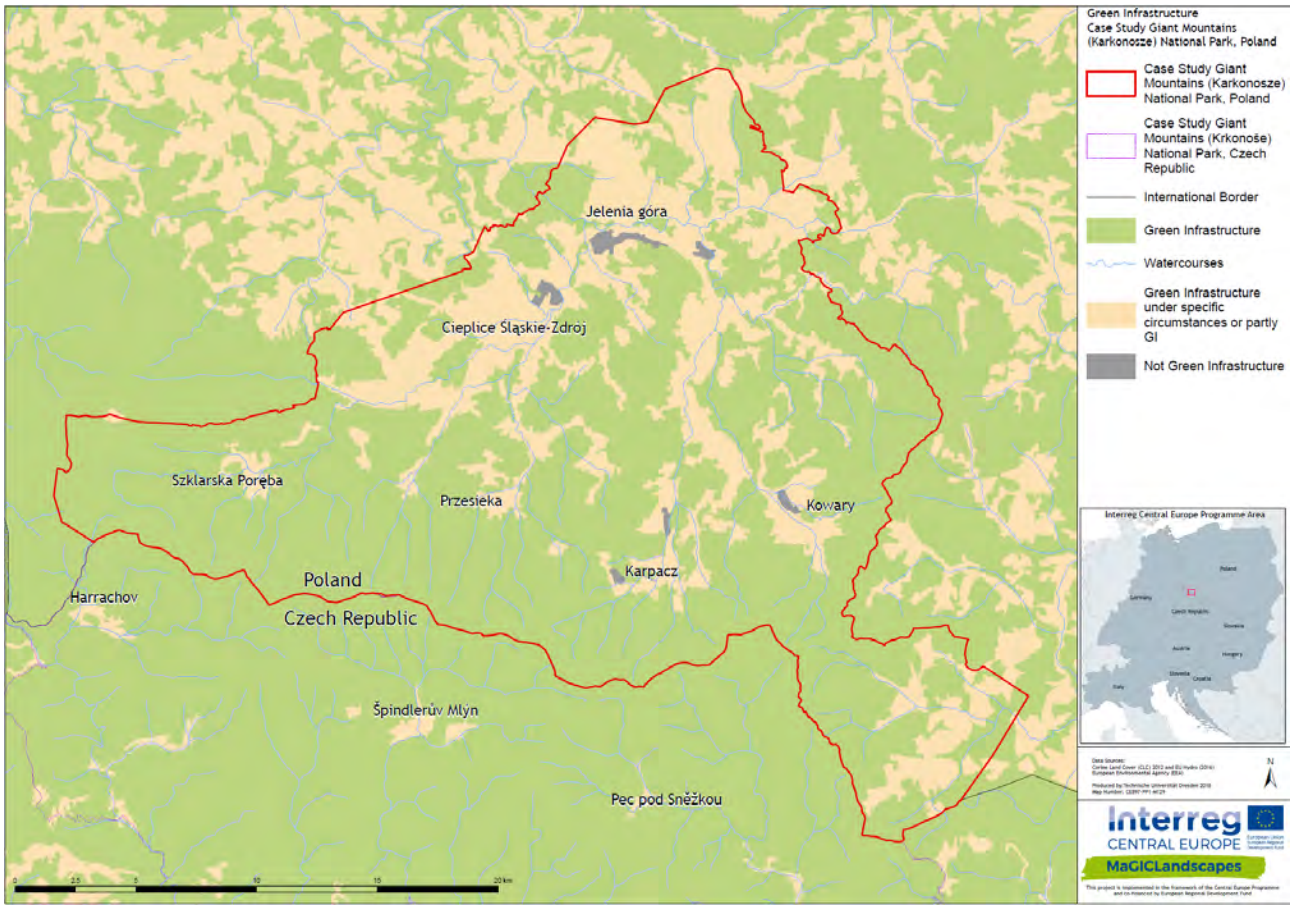

Figure 43: Map of green infrastructure for the Polish case study area Karkonosze National Park based on the transnational legend using CORINE land cover data from 2012. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

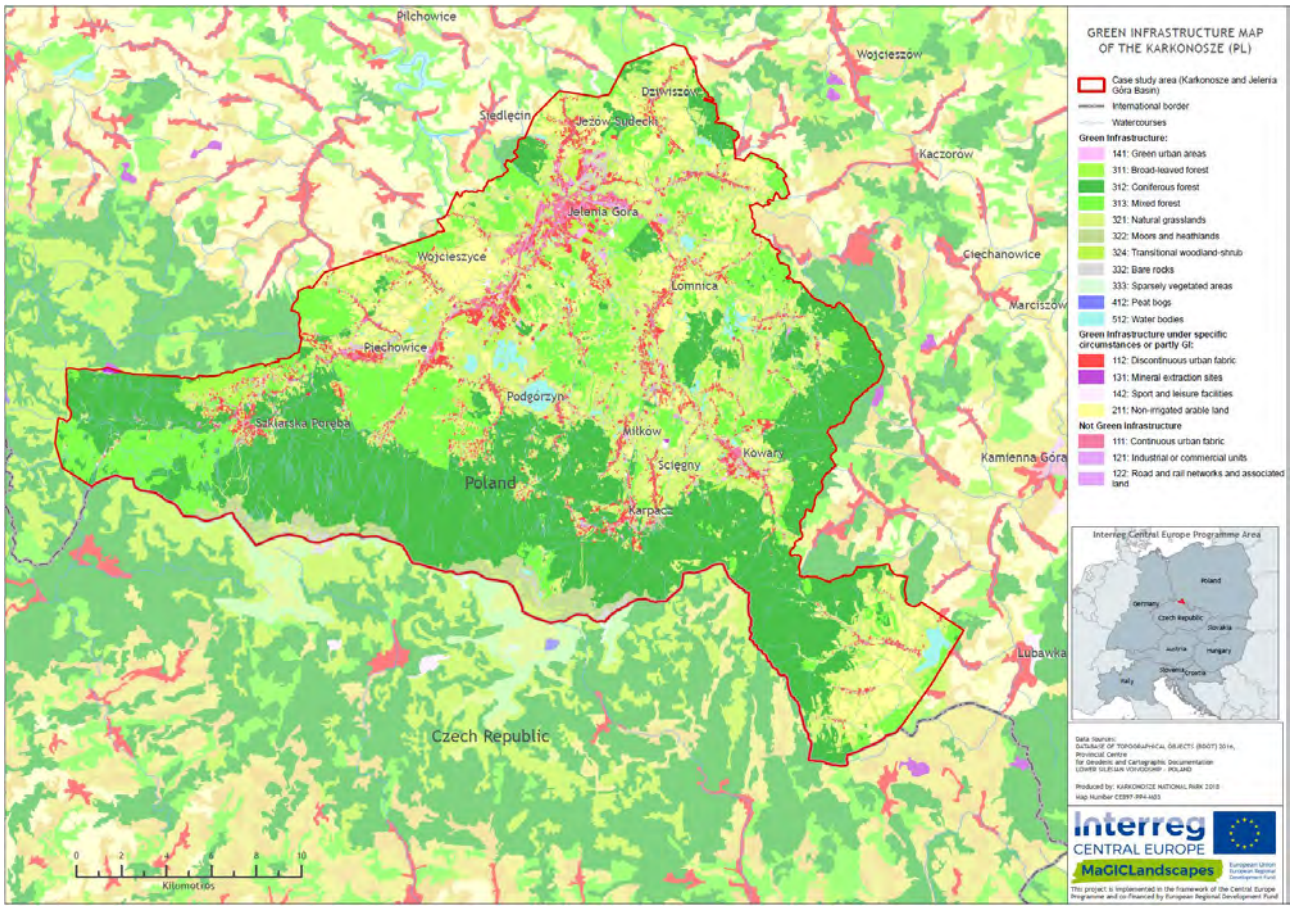

Figure 44: Map of green infrastructure for the Polish case study area Karkonosze National Park based on regional topographic data (BDOT) and CORINE data for the surroundings.

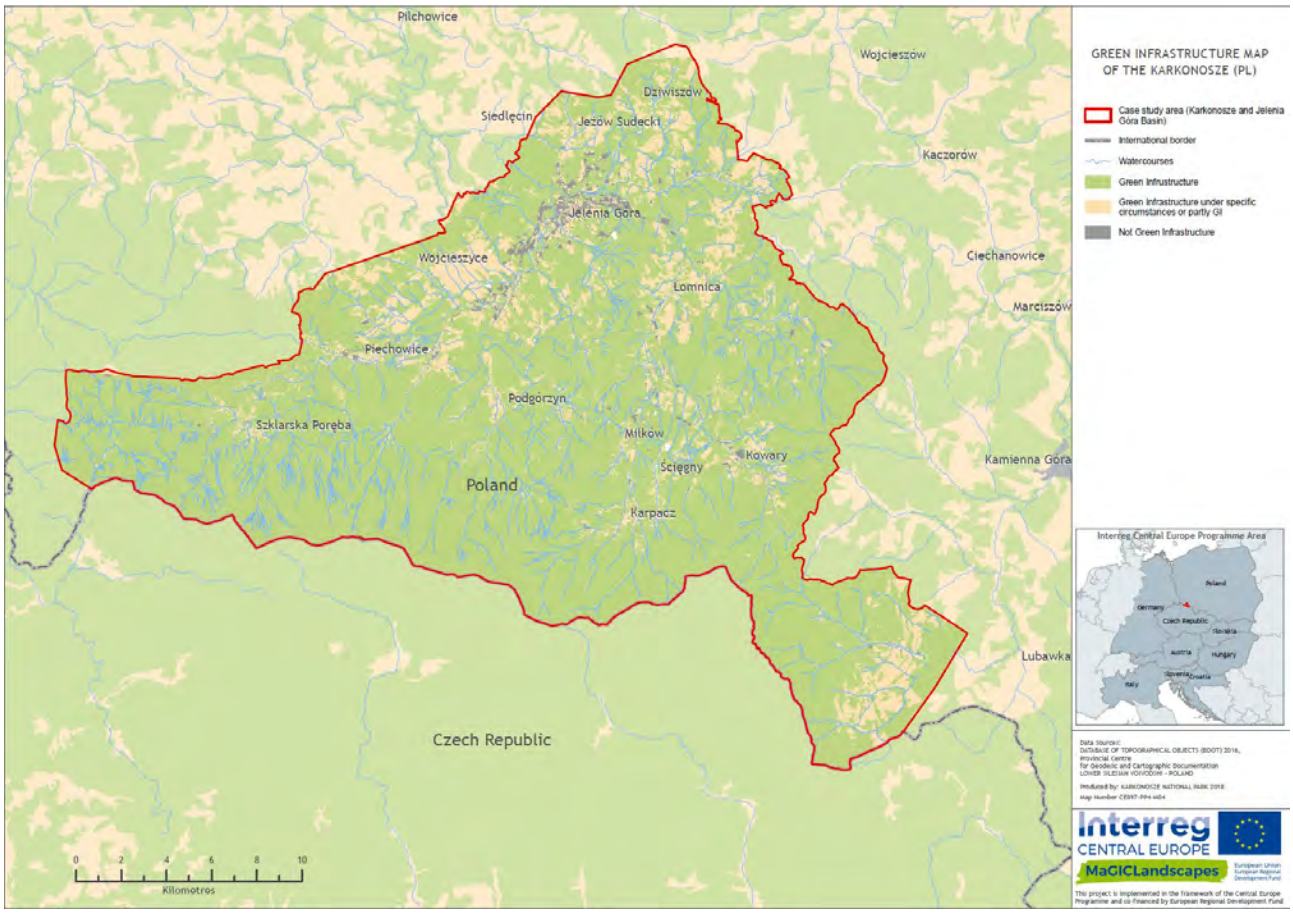

Figure 45: Map of green infrastructure for Karkonosze National Park based on regional topographic data (BDOT) and CORINE data for the surroundings. The classification follows a simplified transnational legend containing just three classes (GI, GI under specific circumstances or partly GI, not GI) based on the concerted legend (see section 2.4).

Table 12: Datasets used for the regional map of Green Infrastructure of the Polish case study area Karkonosze National Park

Dataset	Source	Data Type	Resolution/ MMU	Coverage	Reference Year	Remarks/ Availability
Topographic data (BDOT)	Geodatabase ordered in Wojewódzki Ośrodek Dokumentacji Geodezyjnej i Kartograficznej (Wrocław) **http://wgik.dolnyslask.pl/web/start/wodgik/do-pobrania**	vector	1:10,000	Full	2012	Free for public institutions
Hydrographic Division in Poland	Shape file downloaded from **https://dane.gov.pl/dataset/869**	vector	1:50,000	Full	2014	Free download

References

EC - European Commission (2016): Green Infrastructure. Published online: **http://ec.europa.eu/environment/nature/ ecosystems/index_en.htm** (last accessed 12.08.2018)

EEA - European Environment Agency (2014): Spatial analysis of green infrastructure in Europe. EEA Technical report, No 2/2014, Publications Office of the European Union, Luxembourg. Published online: **https://www.eea.europa.eu/publications/spatial-analysis-of-green-infrastructure/at_download/file** (last accessed 22.11.2018)

EEA - European Environment Agency – Copernicus Land Monitoring Services (2016): GIOLand (GMES/Copernicus initial operations land) High Resolution Layers (HRLs) - summary of product specifications. Published online: **https://cws-download.eea.europa.eu/pan-european/hrl/HRL_Summary_for_publication_ v14.pdf** (accessed 2.11.2017)

Feranec, J.; Soukup, T.; Hazeu, G.; Jaffrain, G. (2016): European Landscape Dynamics: CORINE Land Cover Data. CRC Press, Boca Raton, 337 p.

John, H, Marrs, C., Neubert, M. (ed., 2019): Green Infrastructure Handbook - Conceptual and Theoretical Background, Terms and Definitions. Interreg Central Europe Project MaGICLandscapes. Output O.T1.1, Dresden. With contributions from: H. John, C. Marrs, M. Neubert, S. Alberico, G. Bovo, S. Ciadamidaro, F. Danzinger, M. Erlebach, D. Freudl, S. Grasso, A. Hahn, Z. Jała, I. Lasala, M. Minciardi, G.L. Rossi, H. Skokanová, T. Slach, K. Uhlemann, P.Vayr, D. Wojnarowicz, T. Wrbka. Published online: **https://www.interreg-central.eu/Content.Node/MaGICLandscapes.html#Outputs**

Annex

Questionnaire for CE RS-based GI analysis ground/desk truthing

TWP1/D.T1.2.2 Feed-back report on ground-truthing/calibration in partner case study areas (issues, success etc.)

IOER, 26th March 2018

To add your comments regarding errors to the draft map we suggest providing us a shape file where you digitise the errors and add details in an attribute column.

Before you start working with the map please assess the following land cover classes, if they belong to green (GI) or blue infrastructure (BI) or not, or if you are unsure?				
GI	BI	Neither GI nor BI	I don't know	
				European catchments and Rivers network system (Ecrins)
☐	☐	☐	☐	001 Rivers
☐	☐	☐	☐	002 Lakes
				Pan-European High Resolution Layers (HRL)
☐	☐	☐	☐	011 Water body
☐	☐	☐	☐	021 Wetland
☐	☐	☐	☐	031 Natural grasslands
☐	☐	☐	☐	041 Trees predominantly used for agricultural practices – broadleaved
☐	☐	☐	☐	042/043 Trees in urban context – broadleaved and coniferous
☐	☐	☐	☐	051 Broadleaved forest
☐	☐	☐	☐	052 Coniferous forest
				CORINE Land Cover (CLC)
☐	☐	☐	☐	111 Continuous urban fabric
☐	☐	☐	☐	112 Discontinuous urban fabric
☐	☐	☐	☐	121 Industrial or commercial units
☐	☐	☐	☐	122 Road and rail networks and associated land
☐	☐	☐	☐	123 Port areas
☐	☐	☐	☐	124 Airports
☐	☐	☐	☐	131 Mineral extraction sites
☐	☐	☐	☐	132 Dump sites
☐	☐	☐	☐	133 Construction sites
☐	☐	☐	☐	141 Green urban areas
☐	☐	☐	☐	142 Sport and leisure facilities
☐	☐	☐	☐	211 Non-irrigated arable land
☐	☐	☐	☐	212 Permanently irrigated land
☐	☐	☐	☐	213 Rice fields
☐	☐	☐	☐	221 Vineyards
☐	☐	☐	☐	222 Fruit trees and berry plantations
☐	☐	☐	☐	223 Olive groves
☐	☐	☐	☐	231 Pastures
☐	☐	☐	☐	241 Annual crops associated with permanent crops

☐	☐	☐	☐	242 Complex cultivation patterns
☐	☐	☐	☐	243 Land principally occupied by agriculture, with significant areas of natural vegetation
☐	☐	☐	☐	244 Agro-forestry areas
☐	☐	☐	☐	311 Broad-leaved forest
☐	☐	☐	☐	312 Coniferous forest
☐	☐	☐	☐	313 Mixed forest
☐	☐	☐	☐	321 Natural grasslands
☐	☐	☐	☐	322 Moors and heathland
☐	☐	☐	☐	323 Sclerophyllous vegetation
☐	☐	☐	☐	324 Transitional woodland-shrub
☐	☐	☐	☐	331 Beaches, dunes, sands
☐	☐	☐	☐	332 Bare rocks
☐	☐	☐	☐	333 Sparsely vegetated areas
☐	☐	☐	☐	334 Burnt areas
☐	☐	☐	☐	335 Glaciers and perpetual snow
☐	☐	☐	☐	411 Inland marshes
☐	☐	☐	☐	412 Peat bogs
☐	☐	☐	☐	421 Salt marshes
☐	☐	☐	☐	422 Salines
☐	☐	☐	☐	423 Intertidal flats
☐	☐	☐	☐	511 Water courses
☐	☐	☐	☐	512 Water bodies
				521 Coastal lagoons
				522 Estuaries
				523 Sea and ocean
				High Nature Value Farmland (HNVF)
☐	☐	☐	☐	600 High Nature Value Farmland

Please comment the cases where you are unsure (I don't know):

Are these classifications sufficient or do you miss elements of GI or BI?

☐ Yes, they are sufficient.
☐ I miss the following elements of GI or BI not covered by the classifications above:

Are there any general issues/impressions that you want to share about the draft GI map of Central Europe?

Did you recognise any positional errors in the draft map?	
Case study area: ☐ No ☐ Yes, please provide details (i.e. offset):	National Level: ☐ No ☐ Yes, please provide details (i.e. offset):
Did you recognise any classification errors in the map?	
Case study area: ☐ No ☐ Yes, please provide details (i.e. coordinates and the correct classification):	National Level: ☐ No ☐ Yes, please provide details (i.e. coordinates and the correct classification):
Do you miss a land cover class from the list above in the draft map? *(Remark: Not all CLC-classes were used in the map. Some CLC classes are well covered by other layers, some are no elements of GI or BI in our opinion.)*	
Case study area: ☐ No ☐ Yes, please provide details (i.e. class names):	National Level: ☐ No ☐ Yes, please provide details (i.e. class names):
The data used for the transnational map is from 2012. Do you know of (large scale) changes that have taken place after 2012 (i.e. large-scale construction measures, changes in use such as the change from (semi-)natural grassland to arable land)?	
Case study area: ☐ No ☐ Yes, please provide details (i.e. coordinates of such areas):	National Level: ☐ No ☐ Yes, please provide details (i.e. coordinates of such areas):
Up to which scale the map is useful?	
Useful for ☐ Trans-national scale ☐ National scale ☐ Regional scale (Case study area level) ☐ Local Scale Comments:	
Does the size of raster resolution/Minimum Mapping Unit influence the quality?	
☐ No ☐ Yes, please provide details:	

Do you know additional transnational (Central European) datasets that may enhance the existing map?

☐ No
☐ Yes, please provide details (i.e. data sources):

What kind of remote sensing and additional data is available for the detailed GI analysis of your case study area?

☐ Aerial Imagery:
Acquisition date: …
Resolution: …
Bands: RGB/NIR, … …
☐ Satellite Imagery:
Acquisition date: …
Resolution: …
Bands: RGB/NIR, … …

Additional data:
☐ Biotope Map
☐ Land use map
☐ Natura 2000 mapping
☐ River network/waters
☐ Road network
☐ Others, please specify:

What kind of site-related data is available for the analysis of functionality and connectivity of GI elements of your case study area?

☐ Assessment of biotope status
☐ Map of biotope network (corridors, step-stone biotopes)
☐ Natura 2000 monitoring status of habitats (favourable, unfavourable – inadequate, unfavourable – bad)
☐ Hemeroby maps (naturalness)
☐ Protected areas (especially national categories (e.g. nature park) that are not part of European data sets (i.e. Common Database on Designated Areas (CDDA)/Nationally designated areas))
☐ Water quality maps
☐ Others, please specify: