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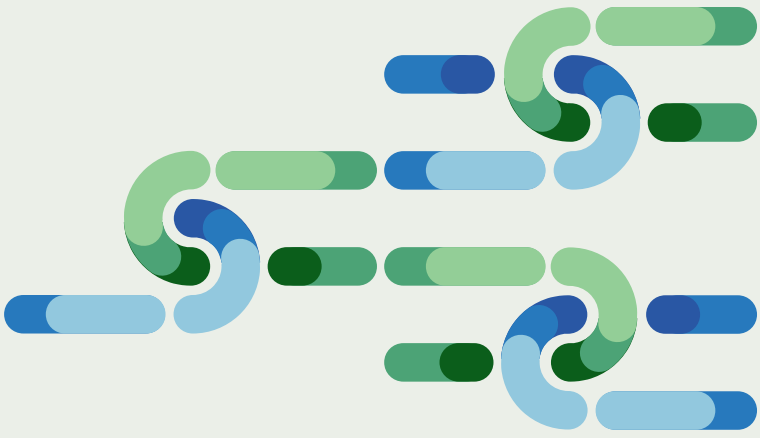
D.2.5.1 Technical proposal for implementing GBI connectivity networks in spatial plans and sector instruments

Pilot region: Illertal

Reference in AF: D2.5.1 including outcomes of D2.2.1, D2.2.2, D2.3.1, D2.4.1



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Case Studies 4th step: Draft a technical proposal integrating the project for a GBI connectivity network into planning tools/sector plans in pilot areas. A2.2, A2.3 and A2.4 deliverables are parts of it.

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Executive summary

The report presents a technical proposal for implementing Green and Blue Infrastructure (GBI) connectivity networks within spatial planning and sectoral instruments, focusing on the Illertal pilot region south of Kempten in Oberallgäu County. The pilot area, spanning approximately 16,000 hectares, features a dynamic and irregular terrain. The primary objective is to establish a semi-open connectivity corridor for biodiversity, emphasizing both conservation and restoration of priority habitats, particularly wetlands and moors, while also considering dry habitats for landscape diversity.

The project adopts a habitat-centric approach, in line with the Bavarian Habitat Network, the German Federal Nature Conservation Act (BNatSchG), and the Bavarian Nature Conservation Act (BayNatSchG), as well as the Federal Green Infrastructure Concept (Heiland et al. 2017) and the area-based biodiversity conservation principles (Riva et al. 2024). The strategy prioritizes structural connectivity over species-specific targets, aiming for a wide ecological network that protects and restores both large and small habitat patches.

Key Components of the Technical Proposal

1. Core Areas and Expansion Areas

- **Core Areas** are areas of high nature conservation value identified through mapping and expert evaluation.
- **Expansion areas** serve to enlarge and thus optimise existing core areas. They have a high potential for habitat restoration because they have a close functional connection to the core areas, i.e. an exchange of individual plants and animals is highly likely. To define expansion areas, the core areas were buffered with 100 m for wetland habitats and 250 m for dryland habitats (distance classes taken from Heiland et al. 2017). Soil moisture was additionally considered.
- **Stepping Stones** are additional and usually smaller habitat patches between core and expansion areas. They can reduce isolation of habitats and support ecological connectivity, especially in landscapes with intensive land use.

2. Pressures and Threats

A survey of experts identified the main anthropogenic pressures in the Illertal region:

- **Agriculture:** Intensive grazing or overgrazing by livestock, the use of plant protection chemicals in agricultural land and drainage for use of agricultural land
- **Transport Infrastructure:** Roads, highways and related infrastructure were evaluated as very strong pressures. Only Railways are considered as a moderate pressure.
- **Urban Development:** urban development construction or modification in existing built-up areas as well as conversion from other land uses to built-up areas (including tourism and industrial structures), represent strong anthropogenic pressure.

3. Energy Production and Land Use

Renewable energy development, particularly photovoltaics and hydropower, is significant in Oberallgäu, with renewables accounting for over 50% of the district's electricity consumption. The expansion of solar and wind energy is ongoing, but no large wind farms currently exist in the pilot region.

Connectivity Measures and Governance

1. Action Plan

- **Protection and Optimization:** Existing core areas should be preserved and legally protected, with special attention to improving and enlarging small or degraded patches.
- **Buffer Zones:** Expansion areas around the core areas should provide diverse site conditions (e.g. altitude, exposure, humidity) to increase resilience to climate change and allow species to adapt to changing environmental conditions.
- **Stepping Stones:** Enhancing connectivity through a network of smaller habitat patches is recommended, especially where land acquisition for continuous corridors is challenging.

2. Restoration Measures

The following measures are recommended for wetland conservation and restoration within the pilot region:

- **Restoration of Moor and Wetland Conditions:** Preventing afforestation on moorland sites, suppressing shrub encroachment, and keeping hydromorphic sites free from development
- **Grassland Management:** Mowing abandoned grassland and promoting sustainable management practices to maintain habitat quality.

3. Governance and Stakeholders

The report outlines a proposed regional governance structure for ecological connectivity in Illertal, involving key stakeholders from government, planning, conservation, and land management sectors. The governance model emphasizes collaboration and integration of connectivity measures into existing planning and sectoral instruments.

Conclusions and Outlook

The technical proposal for the Illertal pilot region presents a comprehensive approach to enhancing ecological connectivity through the creation of a semi-open GBI network. The plan is grounded in robust scientific principles, expert evaluation, and existing legal frameworks. It addresses the most important pressures - agriculture, urban development, and infrastructure - while also considering the challenges posed by land use change and climate change. By focusing on core areas, expansion areas, and stepping stones, the proposal aims to create a resilient and adaptive habitat network that supports biodiversity conservation and restoration in the face of ongoing environmental and societal change.

1 GBI network project

The pilot region “Illertal” is located south of Kempten in the *Oberallgäu* county. The size of the pilot area is about 16.000 ha (total length of about 23 km, width of about 6 km[1]). The area is characterized by a strongly moving and irregular relief.

The objective in the pilot region is to design a GBI network focusing on creating a semi-open connectivity corridor and to identify priority areas for conservation and restoration efforts (spatially and thematically). The focus in the pilot region is on structural connectivity. No specific target species has been chosen. The approach is based on the

- Bavarian Habitat network (“*Biotopverbund Bayern*”[2]) implementing the specifications from the Federal Nature Conservation Act (*Bundesnaturschutzgesetz – BNatSchG*) and the Bavarian Nature Conservation Act (*Bayerisches Naturschutzgesetz – BayNatSchG*),
- Federal Green Infrastructure Concept (“*Bundeskonzept Grüne Infrastruktur*”, Heiland et al. 2017) and the
- principles for area-based biodiversity conservation by Riva et al 2024.

Ecological connectivity in the pilot region is not considered in the sense of an uninterrupted corridor with directly adjacent habitats, but rather as a wide ecological network protecting and restoring both smaller and larger patches. That is why a rather wide corridor has been chosen.

The following measures for the habitat network in the pilot region are recommended:

- Protection and optimisation of existing core areas
- Enlargement of existing core areas (“Expansion areas”) providing diverse site conditions
- Increasing habitat connectivity with stepping stones (reducing distances between the core areas)

Because the majority of the areas with high nature conservation value (core areas) have moist soil conditions, the maintenance and restoration of wetlands and moors is a priority of the proposed habitat network. Nevertheless, dry habitats should not be completely neglected. In the few suitable areas, dry habitats should be preserved and expanded in order to increase the diversity in the landscape.

The suitable and unsuitable areas for conservation and restoration can be identified from the two following maps (see D.2.3.1). In these maps, the identified core areas (areas of high

[1] The size of the pilot area is based on a buffer around the so called “Least Cost Path”. See D.3.2.1)

[2] https://www.lfu.bayern.de/natur/bayaz/biotopverbund/index.htm

nature conservation value) were intersected with the soil map, for wetlands and dry habitats respectively. For wetlands the core areas were buffered and dissolved with a distance of 100 m. For dry habitats the core areas were buffered and dissolved with a distance of 250 m (Distance classes taken from 'Federal Concept for Green Infrastructure', Heiland et al. 2017). The narrow buffer zones around the core areas represent the "expansion areas". These areas of neighbouring habitats are particularly worthy of protection and restoration because they are in close functional relation to the core areas, i.e. an exchange of individuals is possible. The moist or dry soil conditions outside the buffer zones are suitable for stepping stones. Since there are only a few areas with soil condition classified as "dry," the core areas for dry habitats coincide with nearly all areas that have a "dry" soil condition (see Figure 2).

Table 1: Overview – Size of Core Areas, Expansion Areas and additional areas suitable for stepping stones

Soil condition	Core Areas (ha)	Expansion Areas (ha)	Areas suitable for stepping stones (ha)
moist	2.737	4.838	2.625
dry	36	639	15
∑	2.773	5.477	2.640

The specific buffer dimensions (100 m for wetlands, 250 m for dry habitats) imply that different ecosystem types require tailored protection approaches based on their ecological characteristics and sensitivity to edge effects. This acknowledges that a one-size-fits-all approach to habitat protection is insufficient.

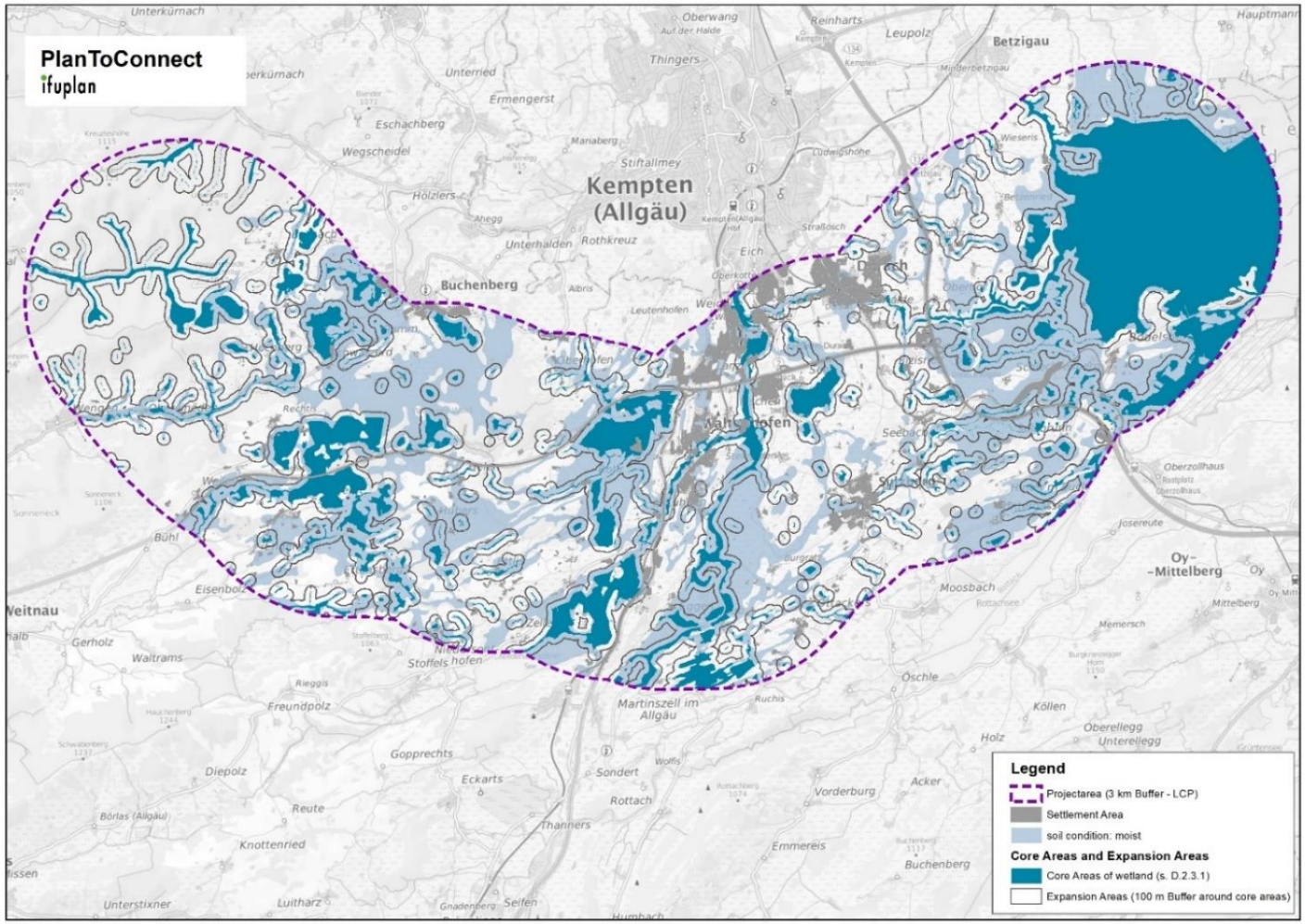

Figure 1: Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m and moist soil conditions

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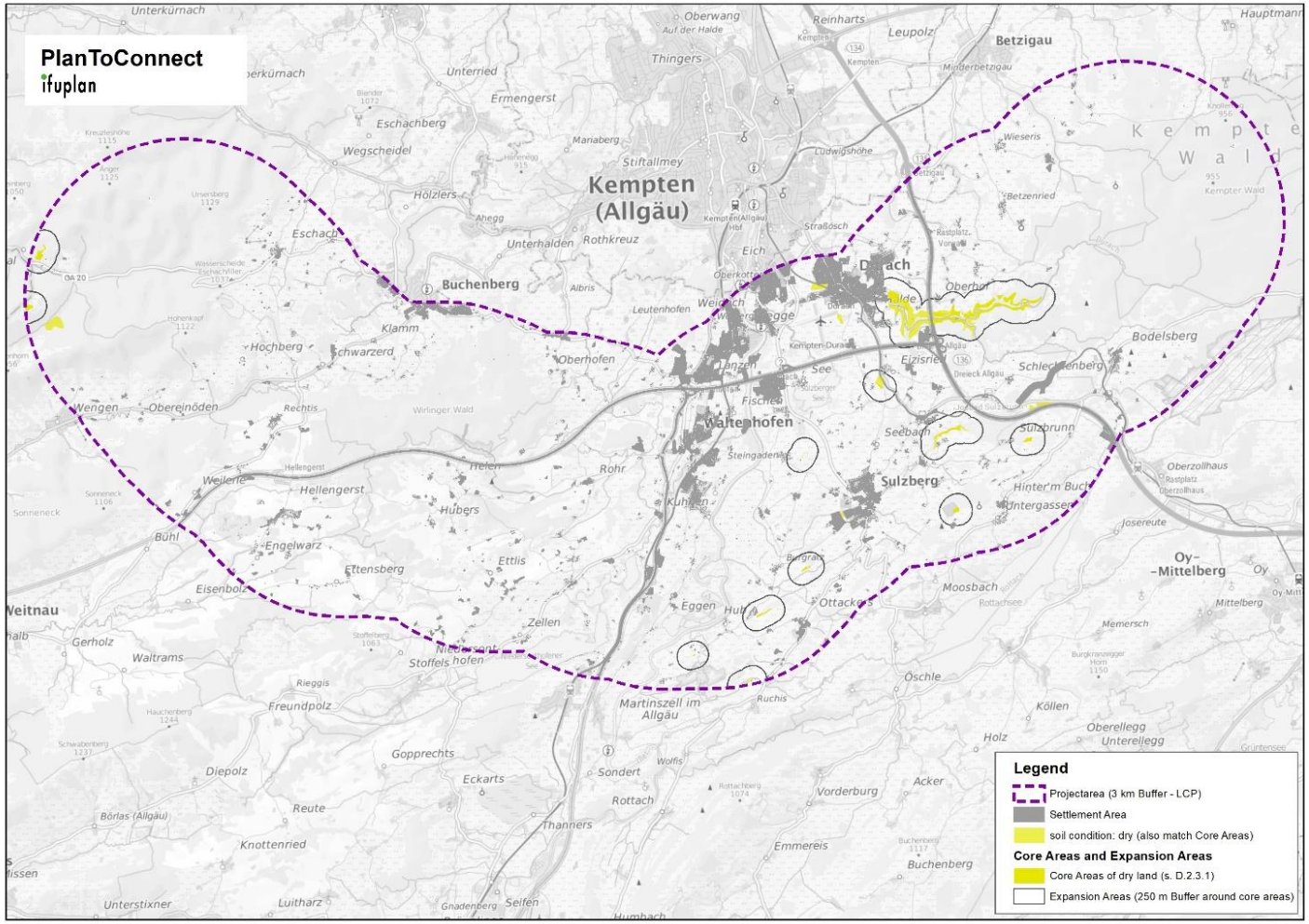

Figure 2: Core areas of dry habitats buffered and dissolved with a distance of 250 m and dry soil conditions

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2 Pressures and Threats to connectivity conservation and restoration areas

2.1 Main pressures

An exploratory expert opinion evaluation on the most important anthropogenic pressures and conflicting uses was conducted by an online survey in all pilot sites. The survey results are not representative but can be seen as exploratory evaluation of tendencies (see D.1.2.1).

A comparison between the general categories of anthropogenic pressures shows that transport infrastructure, urban development and agricultural practices are the top three most important anthropogenic pressures in the pilot sites (see D.1.2.1). This overall result is also reflected in the pilot region Illertal, south of Kempten. Nine persons were interviewed as part of the survey (working in the field biology, wildlife management, environmental sciences, landscape planning, urban planning, regional planning or other fields).

The following figures show the results of the survey: Figure 3 gives an overview of the general categories. Figure 4 shows the detailed results (see D.1.2.1).

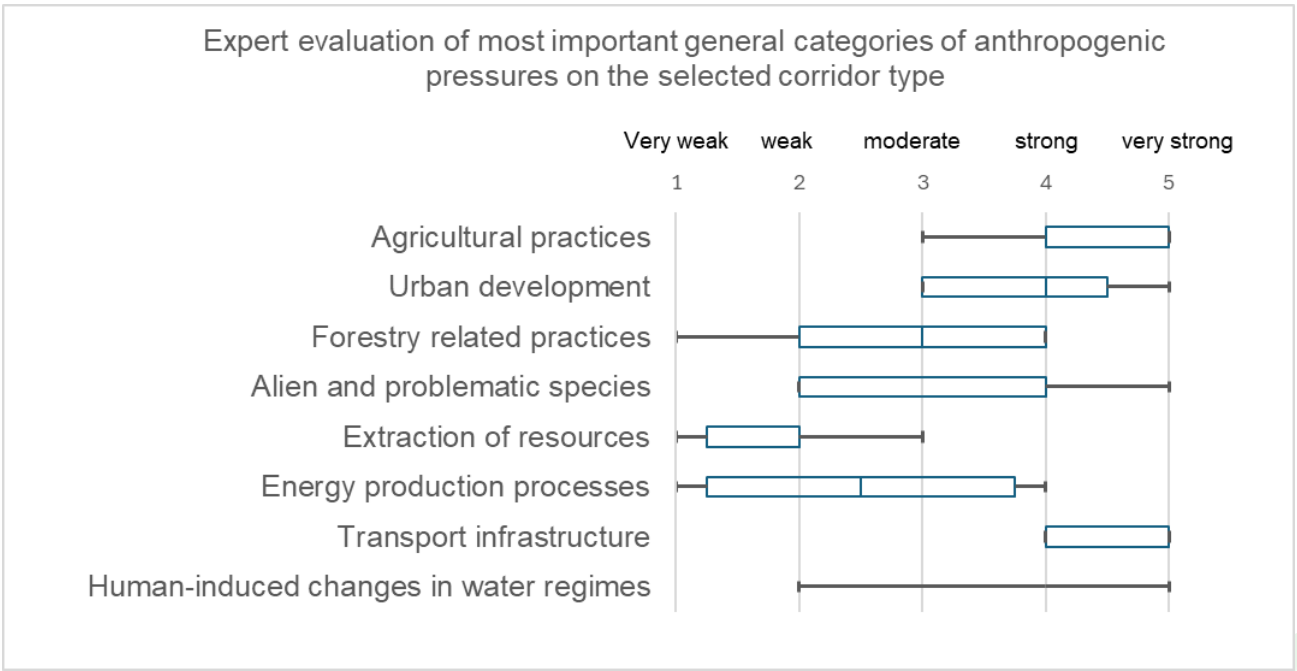


Figure 3: Overview of the expert evaluation in the pilot region Illertal (black line represents minimum/maximum reply, blue box range of 2/3 of replies)

Agricultural practices were rated as very strong, followed by transport infrastructure and urban development.

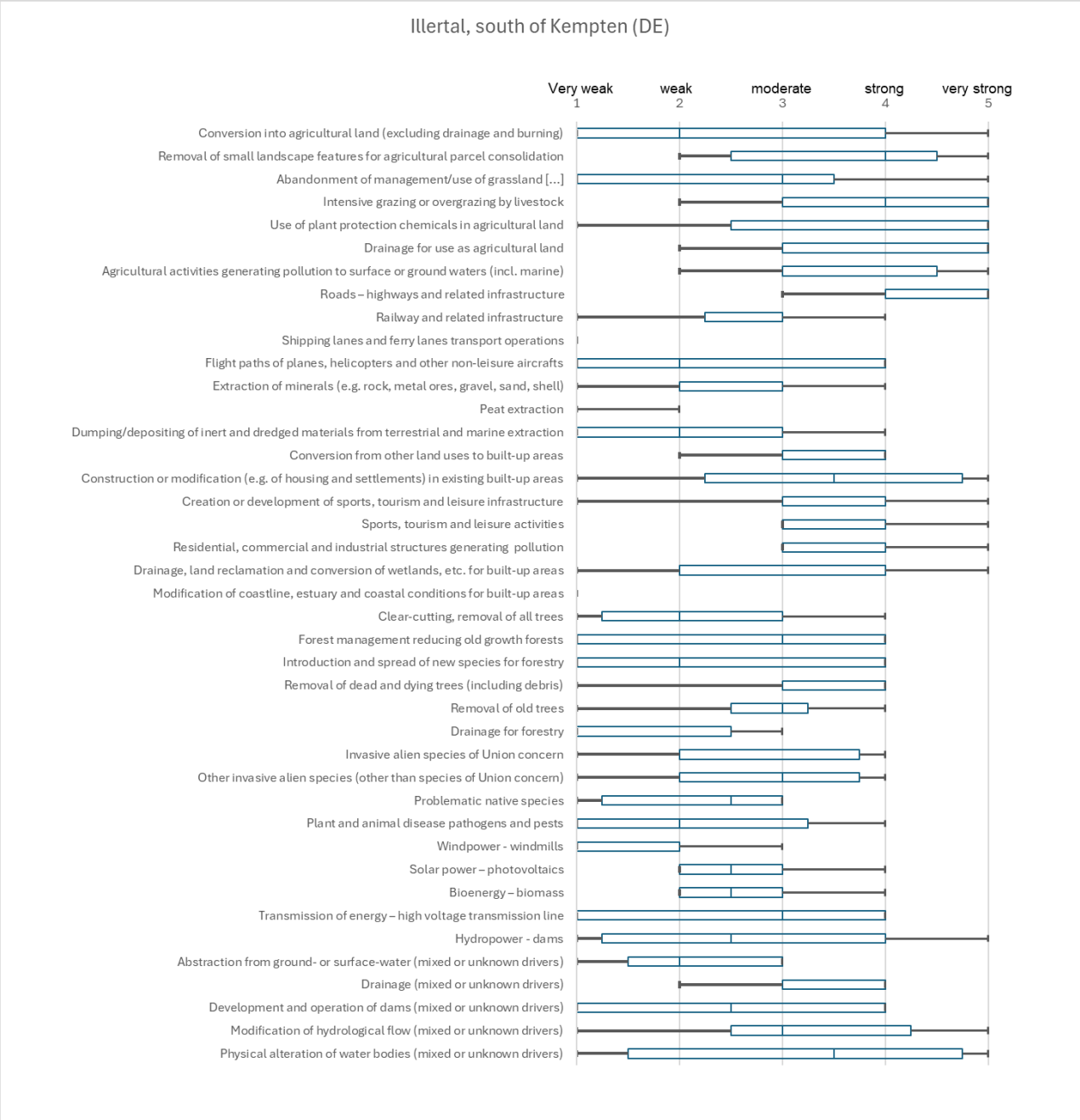


Figure 4: Expert evaluation of specific pressures in the pilot region Illertal (black line represents minimum/ maximum reply, blue box range of 2/3 of replies)

Intensive grazing or overgrazing by livestock, the use of plant protection chemicals in agricultural land and drainage for use of agricultural land were rated as ”very strong” pressures in the pilot site.. Removal of small landscape features for agricultural parcel consolidation and agricultural activities generating pollution to surface and ground waters were rated as strong.

As part of the transport infrastructure, roads, highways and related infrastructure were evaluated as very strong pressure. Only Railways are considered as a moderate pressure.

With regard to urban development construction or modification in existing built-up areas as well as conversion from other land uses to built-up areas (including tourism and industrial structures), represent strong anthropogenic pressures.

In terms of human-induced change in water regimes, drainage, modification of hydrological flow and the physical alteration of water bodies were rated between moderate and strong.

2.2 Threats to connectivity conservation and restoration areas

The following table lists all projects with spatial relevance in the pilot region (see D.2.4.1, Chapter 4.3 – Existing pressures and expected major threats in the pilot region). A distinction is made between existing infrastructure (pressures) and planned projects (threats).

Table 2: Overview – Existing pressures and expected major threats in the pilot region Illertal

Type of infrastructure/ Land use	Existing (= pressures)	Expected (= threats)	Description
Hydropower Hydroelectric reservoir (dam)	-	-	No existing or planned dam
Hydropower - Run-off-River power plant	Waltenhofen: Running power plant (Laufkraftwerk): 1.000 bis 4.999 kW (Graben/Hegge); 500 - 999 kW (Au)	-	No planned major river power plant
Windpower – wind turbines	-	-	Site-search for windpower project in Buchenberg. General site search for windpower installations

Type of infrastructure/ Land use	Existing (= pressures)	Expected (= threats)	Description
			with at least a size of 8 ha in the district “Oberallgäu”
Solar Power - Photovoltaics: Ground-mounted solar panels	“Solarpark Schlechtenberg“ (12,5 ha), along the railway Schlechtenberg-Bodelsberg “Photovoltaik-Anlage Herzmanns” (1,4 ha), between Herzmanns and Greith east of the Federal road B19	Expansion of “Solarpark Schlechtenberg“ (approx. 6 ha) „Solarpark Nägeleried“ (5.5 ha), between Nägelried and Schlechtenberg	-
Bioenergy - Biomass	-	-	No existing or planned major biogas plant
Transmission of electricity - High voltage transmission line	-	-	No major transmission lines are existing or planned
Roads/ Highways	Motorway A7 and A970, Federal roads B12 and B19	-	4-lane roadways are existing throughout the whole corridor No further major roads or highways are planned
Railway	-	Presumably at some point “Illertalbahn” Expansion/ Electrification	Possible expansion and rail electrification of the Illertalbahn. No detailed plan existing yet
Urban/ industrial development	-	Commercial area Herzmanns Süd, south of the ground-mounted solar field Herzmanns (Waltenhofen)	Mostly expansions of settlements that do not pose a threat One big commercial development of the company “Herzmanns Süd” expected

Electricity production from renewable energies in the district of Oberallgäu has been very dynamic since 2006, particularly in the area of photovoltaics. With a 23% share of total electricity consumption in the district, photovoltaics has now become the most important source of energy. Hydropower accounts for 18% of electricity consumption. Wind power and biogas are all between 5 and 7%. Overall, the share of renewable energies in the district of

Oberallgäu was 50.2% in the electricity sector in 2020. At national level, this share was 45.4% (2020). The current focus in the region is on the expansion of solar energy. Wind power is also becoming an emerging topic in the region. Therefore, the following remarks focus on wind and solar energy.

Wind Power

So far, there are no large wind farms in the pilot region.

Solar Power

There are a few existing and planned ground-mounted solar panels (see Table 2).

3 Connectivity measures and governance settings

3.1 Connectivity measures / action plan

As defined in D.2.3.1 (chapter 4.3) the action plan for the pilot region “Illertal” focuses on creating a semi-open connectivity corridor primarily for moors and wetlands, while also preserving dry habitats where appropriate. It establishes a hierarchical approach with three main components:

- Protecting and optimizing existing core areas of high conservation value
- Creating buffer zones (“Expansion areas”) around these core areas (100 m for wetlands, 250 m for dry habitats)
- Enhancing connectivity through stepping stones between core areas

This approach mirrors fundamental connectivity conservation principles found elsewhere. It emphasizes habitat restoration as a key strategy. Unlike some plans that focus primarily on single species, the approach applied in the Illertal takes a habitat-centric view. It doesn't explicitly address infrastructure barriers, focusing instead on natural landscape elements. The habitat network in the pilot region should take into account as many different habitats as possible (see “area-based biodiversity conservation”, Riva et al 2024).

Climate change is accelerating habitat loss and fragmentation, creating additional urgency and complexity for connectivity conservation implementation. Static conservation approaches are insufficient in the face of climate change. Therefore, climate resilience is explicitly addressed through measures that create habitat gradients and structural diversity to help species adapt to changing environmental conditions.

Land is a finite resource and is therefore often a limiting factor for network structures. The plan acknowledges that in intensively used landscapes, where land acquisition is difficult, creating smaller stepping stone habitats may be more feasible than continuous corridors while still maintaining ecological functionality for various species.

The restoration measures should be prioritised within the focus areas (“Schwerpunktgebiete”) identified in the Bavarian Species and Biotope Conservation Programme (“Arten- und Biotopschutzprogramm Landkreis Oberallgäu – ABSP 2017”). The following figures show an overlay of the contents of Figure 5 and Figure 2 with the focus areas (“*Schwerpunktgebiete*”) of the ABSP 2017.

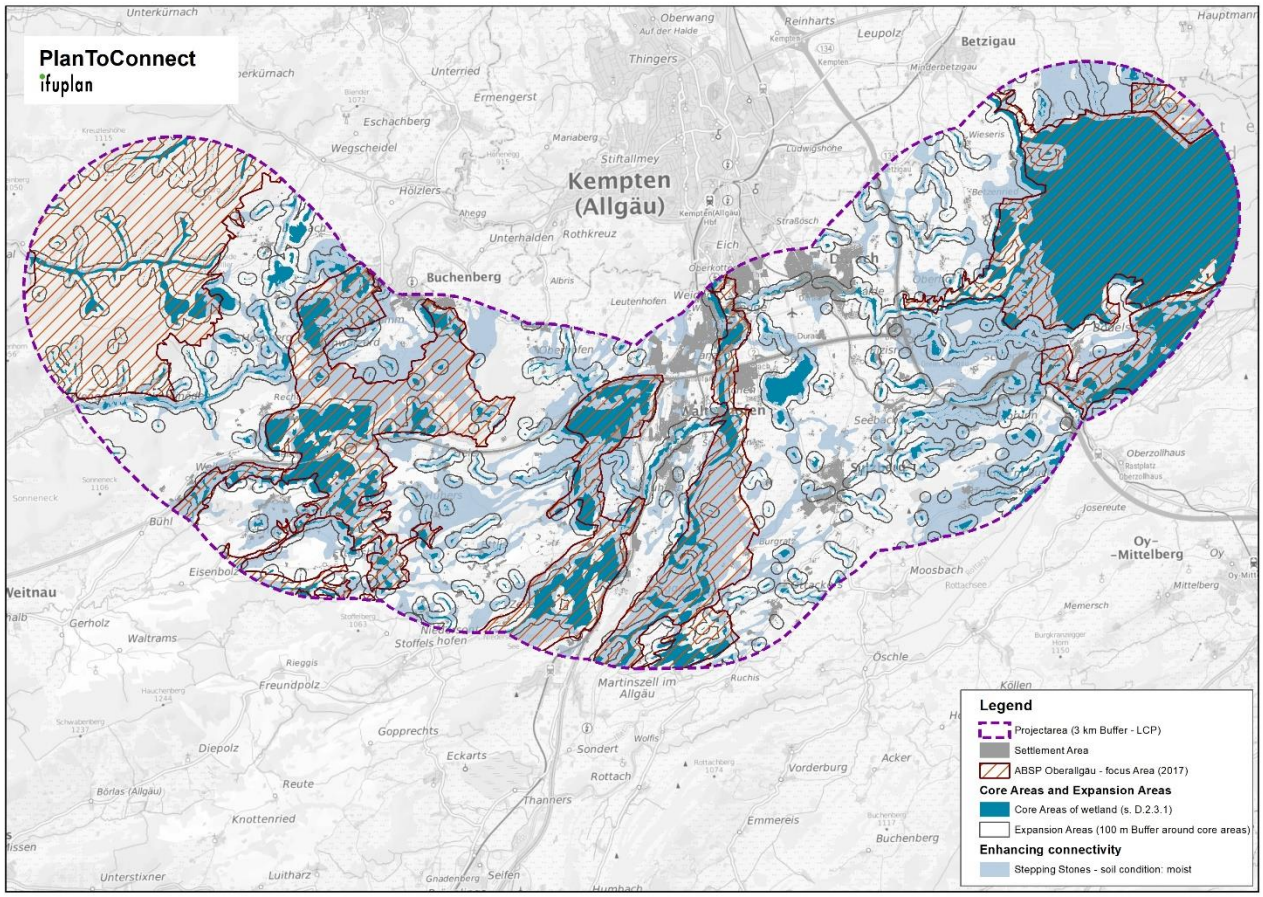


Figure 5: Overlay of core areas of wet habitats with focus areas ("*Schwerpunktgebiete*") identified in the ABSP 2017

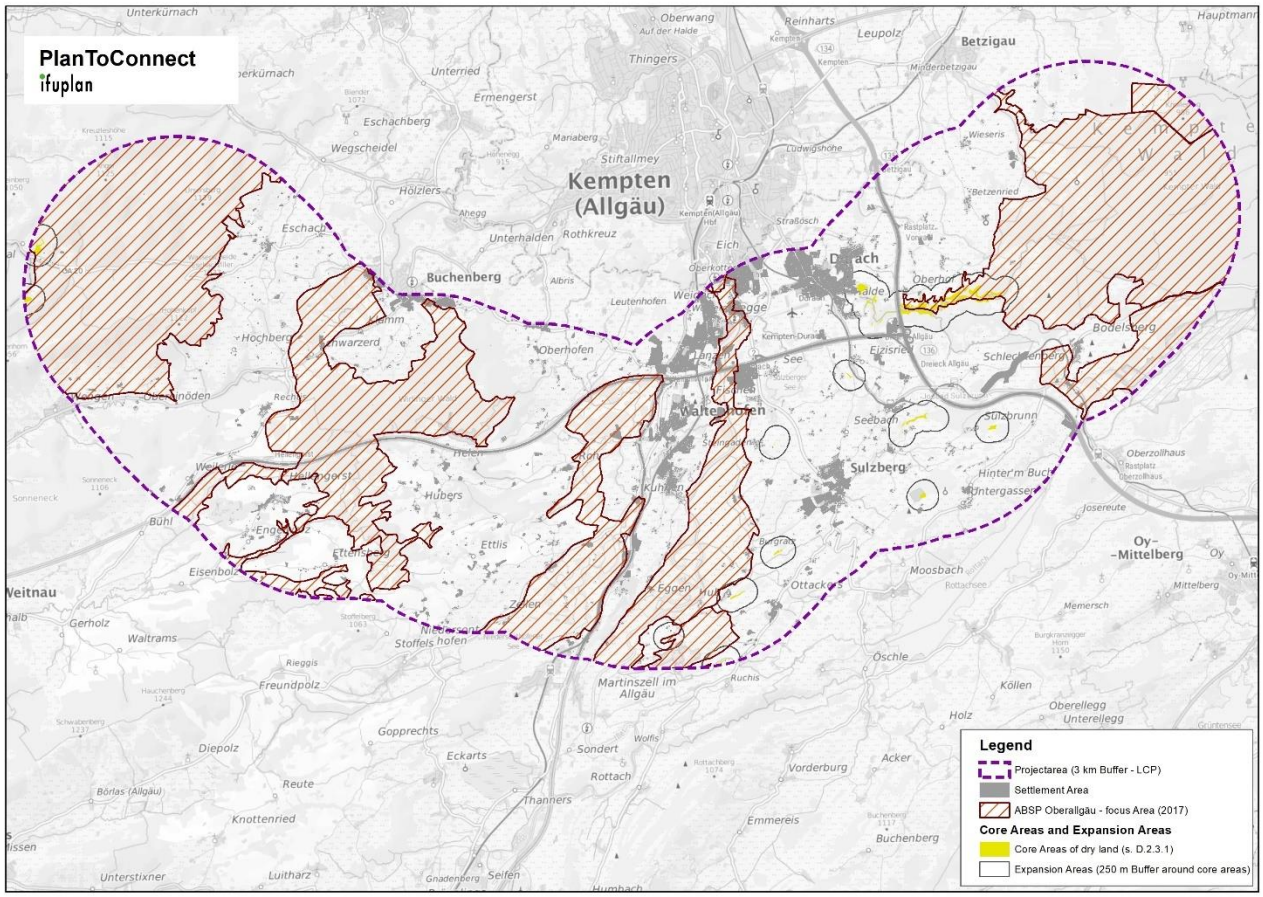


Figure 6: Overlay of core areas of dry habitats with focus areas ("*Schwerpunktgebiete*") identified in the ABSP 2017

Protecting and optimizing existing core areas of high conservation value

Existing areas with high nature conservation value (core areas) should be preserved and legally protected, for example through nature protection or spatial planning instruments.

Creating buffer zones ("Expansion areas") around the core areas

To ensure the long-term survival of species populations, the protection of existing core areas is not sufficient. Many core areas in the pilot region are very small and often not in good condition due to the edge effects (e.g. high nutrient input, scrub encroachment). Therefore, these small core areas have to be improved and enlarged (expansion area).

It is also important to increase the resilience of existing core areas to the effects of climate change. The sensitivity of grassland habitats to climate change is highly dependent on land use. Moist grassland habitats are more strongly influenced by climate change than dry ones (Heiland et al 2017). The species should have the option of moving to neighbouring habitats

if conditions become unfavourable (e.g. too dry or too wet). In order to provide species with these alternative options, the expansion areas should have gradients of diverse site conditions such as altitude, exposure, shading conditions, humidity and vegetation structure. Gradients providing high structural diversity are particularly useful in the expansion areas because they represent areas that are well connected to the core areas (distances less than 100 m or 250 m). This means that in case of conditions becoming increasingly unfavourable, species can move within the expansion areas and can find suitable replacement habitats. If the distances between suitable habitats remain too large, there is a risk of species loss. The chances that such heterogeneous conditions are available increase with the size of the area.

Enhancing connectivity through stepping stones

In addition to the protection and enlargement of core areas, the habitat network should be supplemented by stepping stones. Stepping stones are a network of smaller habitat patches between large protected areas. They facilitate the movement of species and help maintaining connection between larger habitat areas without direct structural connection. Studies have shown the importance that even small habitat patches can have on maintaining ecological connectivity for some species (for example for birds, plants and aerial insects). (Moreira et al 2024)

Land is a finite resource and is therefore often a limiting factor for network structures. Stepping stones can be more feasible to implement in intensively used landscape where land acquisition is difficult.

Options for restoration measures

For all the above mentioned approaches the following restoration measures are suggested for priority areas for wetland conservation and restoration between “Hohentanner-, Kürnacher- und Buchenberger Wald” in the west and „Kempter Wald” in the east. The aim is the conservation and optimization of moors and wetlands as habitats for endangered species. Detailed descriptions of possible restoration measures can be found in the ABSP 2017:

- restoration of site conditions typical of moors/ wetlands,
- preventing afforestation on moorland sites
- suppressing shrub encroachment
- Keeping hydromorphic sites free from afforestation and development
- mowing of abandoned grassland
- Promoting sustainable grassland management

The following Picture 1 shows a typical case of an existing core area (peatland) that is, however, increasingly threatened by woody growth. This scrubby peatland area can be preserved and improved by appropriate maintenance measures, e.g. by removing woody plants from the sides and regular maintenance of the core area.

Picture 1: Example of scrub-covered peatlands

Picture 2 shows a typical example of a very small isolated habitat area surrounded by intensively used grassland. In order to reduce the edge effects (e.g. high nutrient input), such areas should be enlarged (expansion area), e.g. by a surrounding buffer zone that is only extensively used.

Picture 2: Example of an isolated small habitat area

3.2 Key Stakeholders

The key stakeholders in the pilot region can be categorized as follows:

Table 3: Overview – key stakeholders in the pilot region

	Stakeholder	Responsibilities resp. fields of activities
Authorities and state agencies	Lower Nature Conservation Authority at the Office of the County Oberallgäu Biodiversity advisory services	Ensures that the nature conservation laws of the European Union and the federal and state governments are implemented and enforced. In addition, the nature conservation authorities receive scientific and technical advice from voluntary nature conservation advisory boards and are supported by members of the nature conservation guards. In 2020, the role of biodiversity consultants has been established and incorporated in county offices. As part of the lower nature conservation authorities, the employees in the biodiversity advisory service thus contribute to the joint task of safeguarding endangered animal and plant species, maintaining and further developing high-quality protected areas and implementing the state-wide biotope network. The central task of biodiversity advisory services is to advise interested landowners, land managers, municipalities, associations and other stakeholders on nature conservation measures and state funding programs (contractual nature conservation program and landscape conservation directive).
	Higher Nature Conservation Authority at the Government of Swabia	The nature conservation department performs a variety of tasks to preserve and further develop the diversity of species and habitats as well as the recreational quality of the landscape (implementation of the Bavarian Biodiversity Strategy, landscape management, peatland restoration, Natura2000 management plans, establishing nature protection areas (NSG)) As the higher nature conservation authority, the department draws up protection, maintenance and development concepts and coordinates and supports nature conservation projects. The department comments on impact planning and issues nature conservation exemptions. In addition, the higher nature conservation authority initiates measures that are necessary for the protection and care of endangered animal and plant species. It also supports landscape conservation measures that are financed by EU and state funding programs.

	Regional planning authority at the Government of Swabia	The higher state planning authority is responsible for the legal and technical supervision of the regional planning associations in its area of responsibility. It also appoints the regional commissioners who provide technical support to the regional planning associations. Furthermore, it is in charge of carrying out procedures to assess the spatial compatibility of projects of considerable supra-local spatial significance.
	Regional planning association Allgäu	The Allgäu Regional Planning Association is formed in accordance with the Bayer. Landesplanungsgesetz (BayLplG) by merging the municipalities, markets, towns and districts of the Allgäu region (16) (= association members of the Allgäu region). The association is active in its delegated sphere of activity. It decides on the regional plan and its amendments (e.g. acceleration areas for renewable energie) and coordinates the interests of the association members within the framework of regional planning. In doing so, it must comply with the planning objectives set by the state within the framework of the Bayer. State Development Program (LEP). It is involved in the preparation of land use plans and development plans, the coordination of individual projects by specialist planning bodies and the implementation of regional planning and planning approval procedures. The regional representative at the government of Swabia acts as an expert advisor.
	Office for Food, Agriculture and Forestry Kempten (AELF Kempten)	The AELF Kempten is responsible for the districts of Oberallgäu, Lindau (Lake Constance) and the independent town of Kempten (Allgäu) for state agricultural advice, education and administration as well as the tasks of the lower forestry authority. In the latter responsibility, the AELF is drafting and supervising Natura2000 management plans for forested areas.
	Municipalities of Weitnau, Buchenberg, Waltenhofen, Sulzberg, and Durach	Elaborate landscape plans and integrate them in their land use plans and wield sovereignty over communal statutes, including those affecting the protection of natural features such as tree protection. Additionally, municipalities are land-owners and hold roughly 1/3 of the Bavarian territory.
	State Construction Authorities (Federal Construction Authority Kempten responsible for B12/B19 / Federal Motorway Authority Southern Bavaria responsible for A7/A980 motorways)	As road infrastructure is playing a relevant fragmenting role in the pilot region, road construction departments at the state construction authority are important stakeholders. It is responsible for the planning, construction, operation and maintenance of the federal and state roads in the districts of Oberallgäu, Unterallgäu, Ostallgäu and Lindau as well as for the district roads in the district of Lindau. The road maintenance depots in Kempten, Marktoberdorf, Mindelheim and the cooperative road maintenance depots in Sonthofen and

		Lindenberg are responsible for operational and winter road maintenance. In addition to the planning, construction, operation and management of roads and engineering structures as well as footpaths and cycle paths, land acquisition and the planning and implementation of landscape conservation measures are an important part of their duties.
Landowners / users	Bavarian Farmers Association	Lobby organisation for agricultural enterprises in Bavaria with subchapters in each county and representatives in each municipality
	Bavarian State Forest	Adopting tasks of the former state forest administration, the Bayerische Staatsforsten (BaySF) was founded as a public law institution on July 1, 2005. Its mission is the sustainable management of the Bavarian state forest. It is profit-oriented, but also pursues ecological/biodiversity[3] and social objectives (recreation) laid out in the Bavarian Forest Law. Roughly 1/3 of Bavarian forests are managed by the BaySF
	Allgäuer Moorallianz	Special purpose association established in 2009 to implement regional measures in the framework of the federal programme chance.natur in the counties of Oberallgäu and Ostallgäu. The measures and objectives are outlined in a maintenance and development plan (PEPL). A “moor inventory” was carried out for the PEPL, i.e. an inventory (of species, water balance, etc.) in the core areas. Possible measures were then planned and implementation priorities defined. The PEPL forms the basis for renaturation measures in the chance.natur project. However, individual measures can only be implemented after consultation with all stakeholders in the region (e.g. landowners). The project funds can be used to purchase moorland, compensate for loss of value and finance the measures. The planning content is presented to the stakeholders at so-called “moor tables” and measures are only implemented with the consent of the landowners
	Landscape Maintenance Association (Landschaftspflegeverband (LPV) Oberallgäu/Kempten)	Landscape Maintenance Associations coordinate upcoming nature conservation measures, obtain cost estimates, apply for funding and check that maintenance measures are carried out professionally on site. It performs its duties in close coordination with landowners, municipalities, responsible authorities, nature conservation associations and other stakeholders. The actual

[3] See Regional Nature Protection Concept for the BaySF section Sonthofen, to which the pilot region belongs: https://www.baysf.de/fileadmin/user_upload/01-ueber_uns/05-standorte/FB_Sonthofen/220609_NSK_FB_Sonthofen_01.pdf

		landscape conservation work is mainly carried out by local farmers or landscape conservation groups.
	Bavarian Chapter of the German Association for landscape maintenance (DVL Bavaria)	The German Association for Landcare (DVL) has been the nationwide umbrella organization for around 200 Landscape Maintenance Association in Germany. It promotes voluntary cooperation between agriculture, nature conservation, and local authorities. The DVL represents the interests of its members, provides platforms for exchange, and contributes expert knowledge to agricultural and regional policy. Key topics include biodiversity, climate protection, water protection, and soil conservation. The main goals are the cooperative implementation of Natura 2000, federal and state biodiversity strategies, and the European Water Framework Directive, for which the DVL initiates model projects.
NGOs	Federation for Nature Conservation in Bavaria (BN), county chapter Oberallgäu	The BN is the largest nature conservation NGO in Bavaria. Its county chapters serve as contact point for information, get critically involved in local policy decisions affecting nature and environment, offer events, carry out public relations work and nature conservation projects. In the local groups, BN members are primarily concerned with traditional species protection, the maintenance and purchase of biotopes. In addition, children's and youth groups are active in every district group.
	Association for Bird Protection Bavaria (LBV), county chapter Kempten/Oberallgäu	County chapters carry out a range of nature and species conservation projects, purchase important biotope areas on an ongoing basis and carry out educational work throughout Bavaria.

3.3 Governance settings

Governance describes the cooperation of different actors (e.g. government, companies, civil society) in the management and regulation of common affairs. In contrast to “government”, governance refers not only to state action, but also to non-state actors and their influence on decision-making processes.

3.3.1 Existing governance setting

The existing governance setting for ecological connectivity in the pilot region Illertal can be described as follows:

3.3.1.1 Existing governance setting

The above-mentioned “Responsibilities resp. fields of activities” are forming the background but are not guiding the actions of the regional stakeholder institutions.

The core authority is the Lower Nature Conservation Authority (Untere Natuschutzbehörde) at the Office of the County of Oberallgäu. Within its resources and capacities, it assesses impacts of infrastructural developments also on ecological connectivity as one aspect of a broader range of ecological protected assets.

The five municipalities are partly active in the field of promoting biodiversity on municipally-owned properties (extensive, biodiversity-friendly management).

The regional Landscape Maintenance Association (LPV) cooperates with farmers participating in Agricultural Environmental Measures (Agrarumweltmaßnahmen). Hence, it promotes ecological connectivity through its diverse activities. It is not in charge of implementing a spatially coherent network with the purpose of facilitating local, regional and supra-regional exchange and migration of species.

A key active player with beneficial effects for ecological connectivity is the Allgäuer Moorallianz. It carries out projects e.g. to promote litter meadows and their low-impact agricultural use and restoration of degraded peatland forests.

The Bavarian Farmers Association, through its regional chapter, is providing information on ecological aspects of farming (agrobiodiversity, water protection), but is often lobbying for watered-down environmental standards and regulations, e.g. it opposed the ultimately successful referendum on biodiversity promotion in Bavaria. So currently it is not an active player promoting ecological connectivity in the agricultural sector – but potentially could adopt this role.

Summing up, the existing governance structure is characterized as follows:

- Several institutions (agencies, landscape maintenance association, NGOs) are active in the field of nature conservation and ecological connectivity, but a coordinating role that is mandated to plan and implement an ecological network is missing; no institution holds a mandate to establish supra-local linkages (e.g. Federal Green Infrastructure Concept)
- The Peatland Alliance (Allgäuer Moorallianz) is a unique supra-local institution that sets the pilot region apart from neighboring regions
- Areas relevant for ecological connectivity only partly delineated (aspect of ABSP[4], Regional Plan Allgäu (regional level), Landscape Plans (municipality level))

[4] ABSP: The ABSP (species and biotope protection program) is a specialist nature conservation concept that records, evaluates and documents important areas and species in a region. It serves as the basis for measures to protect and develop biodiversity and habitats. The program is not legally binding but is a central technical orientation for authorities and planning.

3.3.2 Proposed governance setting

Based on the existing governance setting, the following governance structure to plan and implement ecological connectivity in the pilot region Illertal is being proposed.

Planning and monitoring

The key role for planning and monitoring of a regional network would be assigned to the Lower Nature Conservation Authority at the county administration of Upper Allgäu (UNB Untere Naturschutzbehörde am Landratsamt Oberallgäu) in its capacity as authority performing sovereign tasks (“hoheitliche Aufgaben”). Horizontally, the UNB would need to coordinate with the county-level Agency for Agriculture, Food and Forestry (AELF Amt für Ernährung, Landwirtschaft und Forsten) in regard to its area of responsibility (organic farming).

Supra-local interfaces of regional linkages with neighboring counties will be addressed through reciprocal arrangements with the respective Lower Nature Conservation Authorities of the neighboring county administrations Lindau, East Allgäu (Ostallgäu) and Lower Allgäu (Unterallgäu) as well as the city administration of Kempten.

The supra-local and regional integration of local networks, e.g. into the Bavarian-wide Biotope Network or the Federal Green Infrastructure Concept, would be the task of the Regional Planning Association Allgäu (Regionaler Planungsverband Allgäu) in close coordination with the Higher Nature Conservation Authority of the Regional Government of Swabia (Höhere Naturschutzbehörde an der Regierung von Schwaben)[5].

The Regional Planning Association Allgäu would be in charge of incorporating the regional ecological connectivity network into the Regional Plan Allgäu in the form of objectives, principles and representations in the thematic map 3 “Nature and Landscape”, using the available instruments[6].

For strategic questions and support, the lower and higher nature conservations authorities should establish links to the Bavarian Agency for Species Protection (BayAZ Bayerisches Artenschutzzentrum), a sub-division of the Bavarian State Agency for the Environment.

[5] There are three different levels of Nature Conervation Authoritys. At municipality level is the “Lower Nature Conservation Authority”, at regional level is the “Higher Nature Conservation Authority” and the highest level is the “Top Nature Conservation Authority”, at State Ministry level.

[6] Such as regional green corridors, landscape maintenance measures (for nature protection and landscape maintenance, natural vegetation development, continuation of current use for landscape maintenance), restoration of degraded landscapes for biotope development, biotope connectivity axes. See Catalogue of Planning Symbols (Planzeichenkatalog) https://www.stmwi.bayern.de/fileadmin/user_upload/stmwi/Landesentwicklung/Dokumente/Instrumente/Regionalplaene/Planzeichenkatalog.pdf

Both administrative levels – the county level with the Lower Nature Conservation Authority and the regional level with the Higher Nature Conservation Authority – are being supported by Nature Protection Advisory Boards (Naturschutzbeirat). Representing nature conservation, landscape management, biology and agriculture and forestry, these boards could act as multipliers. The legal basis for these advisory boards is Art. 48 of the Bavarian Nature Protection Law (BayNatSchG). They need to be informed by the respective nature protection authority about legal regulations, permitting procedures of general relevance and declarations of consent with other departments. If these advisory boards are to play a more active role in the planning, reflection and communication of regional ecological connectivity (e.g. expansion towards a “Nature Protection and Connectivity Board”), their composition and mandate would have to be reviewed accordingly.

The core group of institutions for planning and monitoring a regional network for ecological connectivity would therefore include the Lower Nature Conservation Authority and the Regional Planning Association, with support from the Higher Nature Conservation Authority and the Bavarian Agency for Species Protection.

Implementation and management tasks

For measures to implement and manage the regional network, the key role is assigned to the existing Landscape Maintenance Association Upper Allgäu. Since its establishment in 1996, it gathered extensive experience in the coordination, procurement, application for funding and quality control of measures for nature conservation and landscape maintenance and related training and awareness-raising activities. For the additional task of implementing and managing the regional ecological connectivity network, funds focusing specifically on related tasks and corridors, need to be made available.

The Landscape Maintenance Association largely depends on farmers carrying out maintenance tasks with their expertise and machinery. Therefore, a reliable, long-term arrangement with farmers is of highest importance, outlining

- the types of measures necessary for implementing and improving the regional network
- funds set aside for a mid-term period of 5-10 years
- support being provided by the Landscape Maintenance Association.

Raising awareness and winning the support of key agricultural representatives from the pilot region and the county as a whole is of crucial importance for raising awareness and creating a positive climate among land users for the topic and requirements of ecological connectivity. Farmers need to be considered as allies and efforts should focus on meeting their specific needs when expanding connectivity-related measures (financial support, know-how, societal recognition).

Besides the core partners of Bavarian Farmers’ Association and State Forest, the Landscape Maintenance Association would also be coordinating with the Bavarian Chapter of the German Association for landscape maintenance (DVL Bavaria) and with

environmental NGOs active in the pilot region (local chapters of Bund Naturschutz in Bayern e.V. and Landesbund für Vogelschutz e.V.) in regard to voluntary work and communication outreach. Additionally, the NGOs would have a watchdog role for the implementation and management process.

Additionally, sectoral stakeholders would be responsible for contributions to the regional network in their respective fields, e.g.:

- Municipalities: Measures on communal lands (either through municipal depot (Bauhof) or through formulating cultivation requirements for tenants), municipal decrees (e.g. near-natural gardens, limitation of sealing)
- State forest (BaySF): Measures in operation of state forests, protected “nature forests”
- Water management (WWA Kempten): Incorporation of connectivity needs in the Iller Water Body Development Concept (GEK)[7] and the Iller Implementation Concept[8] for the EU Water Framework Directive
- State Building Agencies (StBA Kempten): Inclusion of compensation and mitigation measures in regional road construction and renewal projects
- Tourism: Recreational offers and visitor management along regional linkages to promote acceptance and functionality of the network.

Until 2030, the Allgäu Peatland Alliance (Allgäuer Moorallianz) has secured funding under the federal BfN-programme “chance.natur – Bundesförderung Naturschutz”. In a mid- to long-term perspective and in case of expiring funds, the Peatland Alliance could merge with the Landscape Maintenance Associations of the counties it currently operates (Oberallgäu, Unterallgäu).

[7] See https://www.wwa-ke.bayern.de/themen/fluesse_seen/gewaesserentwicklungskonzepte/index.htm, river kilometer 106-110

[8] https://www.wwa-ke.bayern.de/themen/fluesse_seen/umsetzungskonzepte_wrrl/index.htm

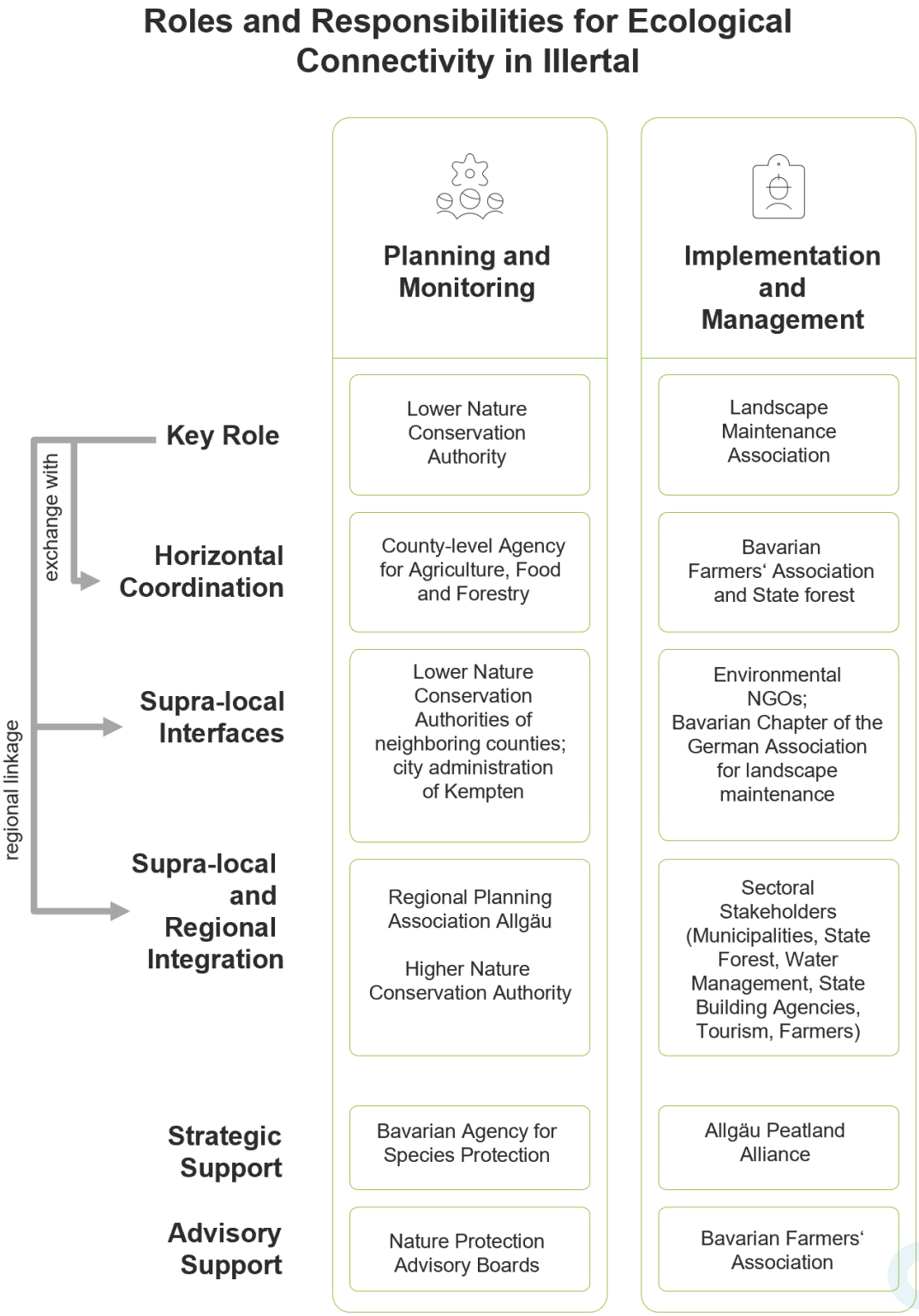


Figure 7: Proposed regional governance structure for ecological connectivity Illertal

Table 4: Existing setting and proposal

Existing setting	Proposal
Supra-local linkages / embedding is missing	Pro-actively implement imminent Bavarian-wide Biotope Network Concept
Several active institutions, but no one is „in charge“ and mandated to plan and implement an ecological network	No new institutions: Equip Lower Nature Protection Authority with EC planning and coordination task Equip Landscape Maintenance Association with EC implementation task
Unique supra-local institution of Peatland Alliance (Allgäuer Moorallianz)	Close cooperation with Landscape Maintenance Association as short-term, merger as mid-term perspective
Areas relevant for ecological connectivity only partly delineated (ABSP, Regional Plan Allgäu, Landscape Plans)	Elaborate ABSP Action Plan for implementation of measures Use existing spatial planning instruments (biotope connectivity axes, regional green corridors)

3.4 Funding instruments

The following range of funding programmes and initiatives is available in Bavaria to support measures for biotope connectivity, habitat networking, nature conservation, and the promotion of low-intensity agricultural and forestry practices. These programmes are primarily coordinated by the Bavarian State Ministry for the Environment and Consumer Protection, often in cooperation with the European Union and other national and regional partners.

Key Funding Programs and Initiatives

- Bavarian Contractual Nature Conservation Program (Vertragsnaturschutzprogramm, VNP): The VNP is a cornerstone of Bavaria’s cooperative approach to nature conservation. It rewards farmers and land managers for voluntarily adopting environmentally friendly practices on ecologically valuable meadows, pastures, arable land, and ponds. Contracts typically run for five years and compensate for both additional costs and income losses resulting from nature-friendly management. Measures include late mowing, reduced use of fertilizers and pesticides, and specialized mowing techniques. The program is closely linked to the implementation of the European Natura 2000 network and the Bavarian Biodiversity Strategy. In 2023,

approximately 160,000 hectares were managed under VNP contracts, with an annual funding volume of around €90 million, benefiting about 28,000 farms[9] [10]

- Rural Development Programme for Bavaria (RDP): The RDP is co-financed by the EU, Germany, and Bavaria, with a focus on restoring, preserving, and enhancing ecosystems related to agriculture and forestry. About 16.4% of Bavarian farmland is under contracts aimed at improving biodiversity, water, and soil management. The program also supports innovation, organic farming, and resource efficiency. Measures are tailored to address specific regional and ecological challenges, including the maintenance and development of biotope networks[11] [12].

- Landscape Conservation and Nature Parks Funding (LNPR): The Guidelines for Landscape Conservation and Nature Parks (Landschaftspflege- und Naturparkrichtlinien) provide targeted funding for projects that protect habitats and species, particularly within Natura 2000 sites and the Bavarian biotope network. These guidelines support a variety of conservation measures and are funded by the state of Bavaria[13].

- LIFE Living Natura 2000 Project: Funded by the EU's LIFE program, this project focuses on improving public perception and stakeholder engagement regarding the Natura 2000 network in Bavaria. While primarily a communication and awareness campaign, it also supports the cooperative planning and implementation of conservation measures across the region. The project budget is approximately €3 million, with 60% financed by the EU and the remainder by Bavarian and German partners[14].

- Bavarian Nature Protection Fund[15]: As a non-profit foundation, the Nature Conservation Fund promotes measures to protect, maintain and develop nature and landscapes in Bavaria. Its most important objectives are to safeguard biodiversity - in particular the

[9] https://erlangen.de/en/service/135

[10] https://www.stmuv.bayern.de/themen/naturschutz/naturschutzfoerderung/vertragsnaturschutzprogramm/index.htm

[11] https://agriculture.ec.europa.eu/document/download/297d3831-8a2c-412f-a2be-099ee3a9a60b_en?filename=rdp-factsheet-bavaria_en.pdf

[12] https://epub.uni-bayreuth.de/id/eprint/7546/1/s00267-023-01922-w.pdf

[13] https://verwaltung.bund.de/leistungsverzeichnis/EN/leistung/99090009027000/herausgeber/BY-133/region/09

[14] https://www.anl.bayern.de/english/cooperation/life_projekt.htm

[15] https://www.naturschutzfonds.bayern.de/

protection of highly endangered species and biotic communities, the establishment of a state-wide biotope network, the promotion of natural dynamics and the preservation of historical cultural landscapes typical of the region. To this end, the foundation supports the purchase or long-term lease of ecologically valuable areas, biotope optimization measures, project management, the management of ecologically sensitive areas, regional biotope network partnerships, application-oriented nature conservation research and specialist publications, public relations work, the establishment of nature conservation-oriented use and acceptance-promoting measures. In addition, the Nature Conservation Fund manages the compensation funds of the lower nature conservation authorities and ecologically valuable areas of the Free State of Bavaria with the objective of nature conservation. Every two years, the foundation awards the Bavarian Biodiversity Prize “Natur.Vielfalt.Bayern”.

- Federal Nature Conservation Fund[16]: The Federal Nature Conservation Fund expands and bundles project funding for nature conservation and landscape management. The aim is to implement effective, targeted approaches that directly or indirectly strengthen biodiversity. It combines the existing programmes Federal Biological Diversity Programme, Germany’s Blue Belt Programme, chance.natur (large-scale nature conservation projects) and testing and development projects, as well as the Wilderness Fund. In addition, the new National Species Recovery Programme has been in place since 2022.

- EFRE-Funds Bayern 2021-2027[17]: Targeted investments in green infrastructure in the EFRE-framework are intended to restore important key biotopes, close gaps between biotopes and optimize grey infrastructure ecologically. The “Promotion of biodiversity” type of measure therefore focuses on technically and regionally adapted projects in rural areas of Bavaria which, due to their spatial extent, specific objectives, stepping stone function and scope, make an important contribution to the conservation of biodiversity and at the same time improve the quality of life for people. These include, in particular, ecosystem-based conservation and restoration measures, the creation or optimization of green or blue biotope network structures, the ecological transformation of human-influenced landscape structures, as well as advisory activities, communication with relevant stakeholders, project-specific management tasks and public relations work. The renaturation of moors is an important sub-measure for the reduction of harmful greenhouse gas emissions and for other positive aspects in relation to water and soil protection. The type of measure fits into the legal and strategic framework at regional, national and European level. It improves the conservation of endangered or typical

[16] https://www.bfn.de/en/topic/federal-nature-conservation-fund

[17] https://www.efre-bayern.de/foerderung/foerderbereich-2-klima-und-umweltschutz/verbesserung-der-gruenen-infrastruktur/

habitats or species and thus increases the effectiveness and implementation of the Habitats Directive 92/43/EEC and the Birds Directive 2009/147/EC. It also supports the EU Biodiversity Strategy 2030.
Eligible recipients include local authorities and their associations as well as associations, clubs and organizations that are dedicated to nature conservation and landscape conservation in accordance with their statutes, e.g. landscape conservation associations.

Eligible Applicants and Application Process

- Eligible applicants include farmers, land managers, recognized nature conservation associations, and landscape conservation associations.
- Applications are typically submitted to the relevant Office for Food, Agriculture, and Forestry during a set annual period (usually January to February).
- A consultation with local conservation authorities is required to tailor measures to the specific ecological context and needs of each site.

Programme Impact and Flexibility

- The programs are designed to be modular, allowing for the combination of basic and additional measures to address the unique requirements of different habitats and species.
- Funding is intended to both compensate for economic disadvantages and incentivize the adoption of sustainable, biodiversity-friendly land use practices.
- Success monitoring indicates a significant increase in biodiversity and the presence of Red List species on funded areas[18].

For connectivity restoration measures outline in 3.1, the following funding options would be applicable (see Table 5).

[18] https://www.stmuv.bayern.de/themen/naturschutz/naturschutzfoerderung/vertragsnaturschutzprogramm/index.htm

Table 5: Funding instruments for connectivity measures (examples)

Connectivity measure	Funding Instrument	EU, National, Innovative	Description
Restoration of site conditions typical of moors / wetlands	Federal Nature Conservation Fund	National	Funding can be facilitated in the framework of the Allgäu Peatland Alliance, an initiative funded through the chance.natur-initiative.
Preventing afforestation on moorland sites	Bavarian Peatland farmer programme (“Moorbauernprogramm”)	State	Cultivation of wet pastures, funding of 600 - 900 €/ha
Suppressing shrub encroachment	Bavarian Contractual Nature Conservation Programme		E.g. through litter mowing and utilization and grazing concepts with highly adapted species, funding of 340 - 590 €/ha
Keeping hydromorphic sites free from afforestation and development		State	
Promoting sustainable grassland management / Mowing of abandoned grassland		State	Biotope type “Meadows”, basic service G/D/E 19, 21-26), 260 - 450 €/ha, depending on mowing time

4 Proposal for the implementation of the GBI network plan into spatial and sector planning tools

4.1 State of the art of connectivity planning and implementation in the pilot area

4.1.1 Objectives and measures for ecological connectivity

Conceptual stipulations for ecological connectivity in the pilot region exist mainly in the form of objectives and spatial categories outlined in the Regional Plan Allgäu, FFH management plans and the Species and Biotope Protection Programme for the County of Oberallgäu.

Regional Plan Allgäu

Non-sectoral objectives and principles (Part A)

Ecological requirements for the development of sub-regions in the Allgäu planning region include

- the goal of permanently preserving the diverse, ecologically significant natural areas of the functions and connecting them with each other as far as possible (Principle 2.1)
- The Alpine region, the Iller [...] foreland, the western Allgäu, [...] and the Iller and Wertach valleys should be preserved in terms of their ecological importance and recreational quality (Objective 2.2)

These ecological requirements are formulated as follows in the explanatory memorandum to the objectives and principles of the regional plan (ad 2.1):

The establishment of a biotope network system in accordance with the principles of the species and biotope protection program serves to preserve and develop endangered habitats for animal and plant species, especially along relatively natural areas such as flowing and still waters and riparian forests, but also in wetlands and meadow areas as well as meadow valleys.

Closer connectivity can be achieved by integrating forest edges, near-natural forest plots, rough grassland and hedge structures as well as former quarry areas.

Landscape reservation areas

According to the Bavarian regional development program, areas of particular importance for nature conservation and landscape management are to be designated as “landscape reserve areas” in the regional plans (LEP, Chapter 7.1.2).

Priority areas for the landscape reservation areas in the pilot region are

- 9 Illerschlucht north of Kempten (Allgäu) and Illertal valley between Kempten (Allgäu) and Oberstdorf
- 10 Kürnach Forest (Adelegg)
- 13 Illervorberge (Kempter Forest)
- 15 Rottachberg and surroundings of the Rottach lake
- 19 Uplands of the Faltenmolasse between Buchenberg and Oberstaufen

The explanatory memorandum explains the need to designate priority landscape areas for the conservation of characteristic landscapes whose use, character, diversity and structure are of particular importance for the ecosystem, landscape protection, the landscape and recreational use. The ecological significance of these areas beyond the boundaries of the natural area and the region must also be taken into account - an indication of their potential networking function.

Regional green corridors

Regional green corridors are a spatial planning instrument for structuring settlements, improving local climatic conditions and creating recreational opportunities. Their inclusion in the regional plans is an objective of the Bavarian State Development Program (LEP, see chapter 7.1.4 of the LEP in the version dated 01.01.2020).

In the pilot region, there is a green corridor of regional importance to the east of Kempten (see Figure 6 below, vertical double lines), the preservation of which is an objective of the regional plan. The cartographic representation of the green corridors is not precise in terms of area.

NATURA 2000 management plans

With the help of management plans, the necessary local measures for the European relevant protected assets are identified in order to preserve or restore them. The protected assets include certain habitat types, animal and plant species and their habitats, insofar as these are defined in the Bavarian Ordinance on Natura 2000 sites as conservation objectives for the respective FFH and bird sanctuaries.

The management plans drawn up by the authority as binding are prepared by the nature conservation and forestry administration with the involvement of the authorities, managers, owners, associations and site experts in a transparent process.

The following FFH-management plans exist in the pilot region, from west to east.

- Kürnacher Wald (8227-373)[19]
- Allgäuer Molassetobel (8326-371)
- Moore im Wirlinger Wald (8327-301)
- Kempter Wald mit Oberem Rottaltal (8228-301)

4.2 Key spatial (and urban) planning instruments

The overall focus in the project area lies primarily on a “network of green infrastructure” in the open land, considering all areas that are suitable for improving biodiversity. This is in line with Art. 19 Section 1 of the Bavarian Nature Conservation Law, which foresees the creation of a network of spatially and functionally connected biotopes on at least 15% of the total open land area of the state.

To implement this for Bavaria, a thematic state-wide plan for biotope connectivity – using the example of Baden-Württemberg[20] - could form the basis for expanding the biotope network. In line with the spatial analysis conducted in PlanToConnect, it could differentiate objectives and measures into dry, medium and wet site conditions.

Apart from the integration of regional connectivity elements into the Regional Plan Allgäu outlined below, the drafting of a Landscape Development Plan[21] for the Allgäu region would be an opportunity to identify and delineate more differentiated elements and measures of a comprehensive regional GBI network.

Table 6 outlines key spatial planning instruments that could be applied to spatially secure and strengthen ecological connectivity functions in the pilot region.

19 https://www.lfu.bayern.de/natur/natura2000_managementplaene/8027_8672/doc/8227_373/texte/de8227373_t_ge_nfin_ffin.pdf

20 https://um.baden-wuerttemberg.de/de/umwelt-natur/biologische-vielfalt-und-mensch/biotopverbund

21 Currently, this planning document that is in theory foreseen for every Bavarian Planning Region, has only been drafted as a pilot for the Donau-Wald planning region 12.

Table 6: Overview of textual amendments to the regional plan and summary of technical proposal

Instrument	Level	Relevance for connectivity in pilot area. Gaps or inconsistency	Technical proposal to … and content
Regional Plan Allgäu (Part B)	**Regional**		
		2 Securing, protection and development of nature and landscape	➔ Besides the "Landscape reservation areas" and "Regional Green Corridors", add references and locations to additional signatures outlined in ➔ Table 7 Particularly biotope connectivity axes, but also landscape maintenance measure, natural vegetation development, continuation of current use.
		Bogs and wetlands 2.3.2.1 (G) "The preservation and development of the biotope network between the numerous moors of the Alpine foothills through streams, stream valleys and wetland structures is to be striven for."	➔ Convert to principle (Z) ➔ Supplement with: "[…] biotope network at a local and regional scale, considering/including even small and isolated patches/areas, between the numerous moors […]"; ➔ "Every area that is suitable for improving biodiversity is to be preserved and functioned as stepping stone. Suitable areas - around the existing and protected habitats - are to be classified and outlined by the municipalities."
		Nutrient-poor and dry locations 2.3.2.4 (G) Biotope complexes and the biotope network should be *preserved as far as possible* and restored if necessary	➔ Convert to principle (Z)
		Still and flowing waters 2.3.2.11 (Z) The river valleys of the foothills of the Alps, in particular the Lech, Wertach and Iller, should be strengthened in their function as important habitats and biotope networks and biotope axes should be strengthened, insofar as this is possible for reasons of flood protection. In doing so, the near-natural areas are to be preserved, the continuity improved and watercourse	➔ Supplement with: "Every area that is suitable for improving biodiversity is to be preserved and functioned as stepping stone. Suitable areas - around the existing and protected habitats - are to be classified and outlined by the municipalities."

Instrument	Level	Relevance for connectivity in pilot area. Gaps or inconsistency	Technical proposal to … and content
		dynamics promoted. Of particular importance are the slope areas of the rivers mentioned with their diversity of sites.	

In map 3 of the Regional Plan Allgäu, the objectives of spatial planning are currently limited to the categories reserved area landscape and regional green corridors. Compared to priority areas, reserved areas represent a weaker protection status as they are fully subject to the weighing of interests in the course of planning procedures against other land uses, while priority areas are already the result of such a weighing process.

The Catalogue of Planning Signatures for Bavarian Regional Planning (Oberste Landesplanungsbehörde 2006), however, optionally allows a significantly broader range of signatures for integration and illustration of planning objectives in regional plans.

The proposal for the implementation of the GBI network plan in the pilot region includes a broad application of planning signatures to illustrate the relevance and potential of specific areas for the regional linkage of ecological connectivity (see Table 7).

Table 7: Overview of mapping signature amendments to the regional plan and summary of technical proposal

Instrument	Level	The following optionally available planning signatures are not applied to delineate and secure connectivity across the Iller valley:		
Regional Plan Allgäu / Map 3 Nature and Landscape	regional		landscape maintenance measures: Keeping sites open whose agricultural use has been abandoned or is in the process of being abandoned	➔ designate marginal yield areas in danger of natural succession that are of importance for open-land-connectivity as areas for landscape maintenance measures
			natural vegetation development	➔ delineate marginal yield areas where abandonment of agricultural use would benefit ecological connectivity
			continuation of current use for landscape maintenance	➔ delineate low-yield areas where a continuation of agricultural use for landscape maintenance should be specifically supported

Instrument	Level	The following optionally available planning signatures are not applied to delineate and secure connectivity across the Iller valley:		
			biotope connectivity axes	➔ integrate the role of the Iller valley as regional linkage for ecological connectivity through a spatially not concretised biotope connectivity axes.
		AVAVA	Separating green stretch (Trenngrün)	➔ Establish borders for settlement enlargement in north-south direction along the railway line in the Iller valley.

An example how the mapping signature amendments to the map of the regional plan could look like - adjusted to the pilot area - is shown in the following figure:

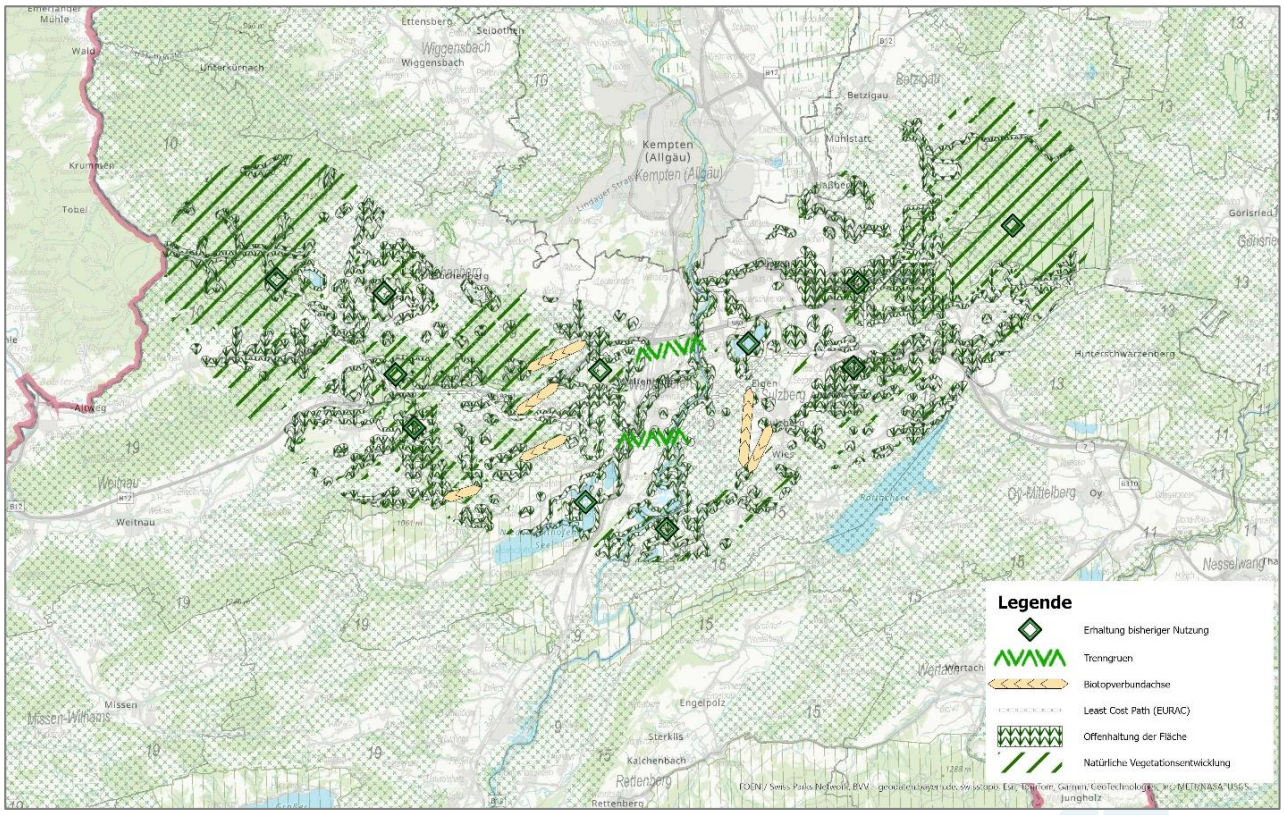


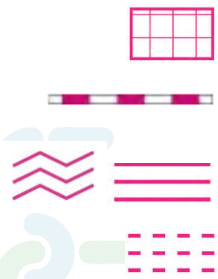
Figure 8: Proposed mapping signature amendments for the regional plan, focus Illertal

For landscape planning at municipal level, the importance of the pilot area should be reflected in a harmonised target concept (Zielkonzept) that differentiates areas and structural elements (Hoheisel/Mengel/Heiland et al. 2017a:140f) …

- …that are already in good condition in regard to the objective and should be preserved and secured (target-conform areas and elements)
- …that already contain valuable elements, but are primarily to be developed or restored (areas with development potential)

The habitats and biotopes with relevance for ecological connectivity (see 3.1) should be delineated with the according signature in municipal land use plans (see Table 8) proposed by Hoheisl et al. 2017b:81ff):

Table 8: Potential categories and symbology for habitats and biotopes in municipal landscape plans

Type	Category	Significance	Symbology
Habitats and biotopes – Status and evaluation	Pastures	High to outstanding significance	
	Pastures on wet to moist conditions		
	Pasture fallow		
	Peatlands		
	Forest edge and perennial meadow		
	Coniferous forest on wet to moist locations		
Habitats and biotopes – Negative impacts and risks	Areas with high degree of sealing > 5 ha Roads with high DTV Railway with high frequency Recreational use with conflict potential Agricultural/forestry use with conflict potential (currently or future)		

In the municipal land use plans, the following options to spatially identify and safeguard areas of importance for ecological connectivity should be supplemented in existing plans. In regard to future urban development outside of already built-up areas, the provisions of the Federal Building Code (BauGB) § 1a (3) for avoiding and compensating negative effects on – among others – the efficiency and functionality of the natural environment need to be applied. This includes the assessment, planning and localization of compensation measures.

In the balancing of interests, the avoidance should take connectivity functions of parts of the pilot area duly into account. Compensation measures should be used and located to strategically strengthen areas of importance for ecological connectivity, particularly those with an assigned development potential resp. buffers around protected areas. This includes also contractual arrangements (§ 11 BauGB Urban Development Contract). The BauGB (§ 1a (3)) as well as the Bavarian Compensation Decree (BayKomV) allows for compensation measures to be taken outside of the area of impact.

Measures to “reconnect habitats or management and maintenance measures for permanently upgrading nature and landscapes” are to be given priority in order to avoid abandonments of use on agricultural and forestry plots. Annex 4.1 BayKomV outlines appropriate compensation measures for species and habitats, including “technical measures to reconnect habitats such as green bridges, green underpasses, animal passages including hinterland connections”.

Table 9: Overview of proposals at the urban planning level and summary of technical proposal

Type	Level	Category	Adjustment
Non-binding land use plan (Flächen-nutzungsplan)	Municipal	Catalog § 5 Abs. 2 BauGB has an exemplary list of presentation possibilities.	§ 5 Abs. 2 Nr. 5 (green areas related to built-up areas) and Nr. 10 (areas for measures to protect, maintain and develop soil, nature and landscape) BauGB can be extended: Supplement “Multifunctional areas”: which potentially address biodiversity promotion issues
		Securing Areas In accordance with § 5 Abs. 2 Nr. 10 BauGB, the land use plan may in include areas for measures to protect, maintain and develop the soil, nature and landscape. This applies both to	Addition of a representation (hatch) of a change of use, which can create the planning basis for new stepping stones between two protected habitats.

Type	Level	Category	Adjustment
		areas to be preserved as well as areas to be developed.	
		Renaturation of areas The renaturation of areas can be prepared by designating areas for measures to protect, maintain and development of soil, nature and landscape in accordance with § 5 Abs. 2, Nr. 10 BauGB. According to § 5 Abs. 2a BauGB areas for compensation (including renaturation measures) within the meaning of the impact regulation under the Federal Nature Conservation Act (BNatSchG) can be allocated in whole or in part to areas where interventions in nature and the landscape are to be expected	Designation of specific areas to be identified by the municipalities, which should be prioritized
		Consideration of regulating ecosystem services § 5 Abs. 2 Nr. 2c BauGB: the land use plan can also depict, among other things, the provision of the municipal area with other measures that serve to adapt to climate change.	Municipalities are asked to designate areas that are to be developed to adapt to climate change and at the same time promote biodiversity
Landscape Plan (Landschafts-plan)	Municipal	Weitnau (1984)	Updating the landscape plan with signatures outlined in Table 7 and including proposals for securing areas for a “network Green Infrastructure”
		Buchenberg (1998)	
		Waltenhofen (2002)	
		Sulzberg (2000)	
		Durach (1986)	
Binding land use plan (Bebauungs-plan)	Municipal	The binding land use plan may include provisions on specific areas or measures for the protection, maintenance and development of soil, nature and landscape (§ 9 Abs. 2 Nr. 20 BauGB)	Could be used to include areas close to urban development to save up areas for development for habitats/networks of green infrastructure Future compensation measures (Ausgleichsflächen) should be used

Type	Level	Category	Adjustment
			to strengthen the local and regional ecological network
		In the case of compensation measures in the course of municipal settlement or infrastructural development, focus on the following types of measures (BayKomV, Annex 4.1): • Development and restoration of peatlands • Development of perennial shrubs • Development of ecologically valuable embankements • Development of low-intensity pastures Development and management of wood and forest structures of importance for species and biotope protection (groups of old-growth trees to enrich valuable age segments)	Identify potential areas for these compensation measures

4.3 Other sector instruments to be coordinated or upgraded

In general, improved interdisciplinary cooperation in the form of a closer cooperation between nature conservation, water management, agriculture and municipal development can create synergies and improve the quality of green.

4.3.1 Rural development / land consolidation

The joint decree by the Bavarian State Ministries for Food, Agriculture and Forestry and Regional Development and Environmental Affairs (7815-L, December 12 1988) outlines how impacts on nature and landscape should be handled in the course of land consolidation procedures and which compensation and substitute measures contribute to the maintenance and improvement of the natural environment. Land consolidation can also support contractual arrangements with land users by allocating appropriate sites of ecological relevance to land users willing to perform voluntary services e.g. under the meadow breeder programme.

Landscape maintenance measures in the course of land consolidation procedures also include an ecologically effective network of landscape elements (biotope network).

Compensation measures should be oriented towards also benefitting ecological connectivity in the form of stepping stones or linear elements such as hedgerows. The BayKomV-Implementation Guidelines Rural Development (Bayerisches Staatsministerium für Umwelt und Verbraucherschutz 2015) stipulate that compensation measures outlined in Annex 4.1 of the BayKomV can be used to reduce project-related compensation requirements.

In the course of planning the core ways network for agricultural purposes, functional habitat connections including biotope connection axes, migration corridors are to be addressed in the course of assessing potential impacts (Bayerische Verwaltung für Ländliche Entwicklung 2022), using information provided in ABSPs.

4.3.2 Water management

The Water Body Development Concept (GEK) for the Iller river, section river kilometers 106-110 km contains measures to ecologically develop the river course, taking into consideration sectoral plans such as Natura2000. For the pilot region section, the concept could be amended with a localized reference to the regional linkage crossing the Iller at this point.

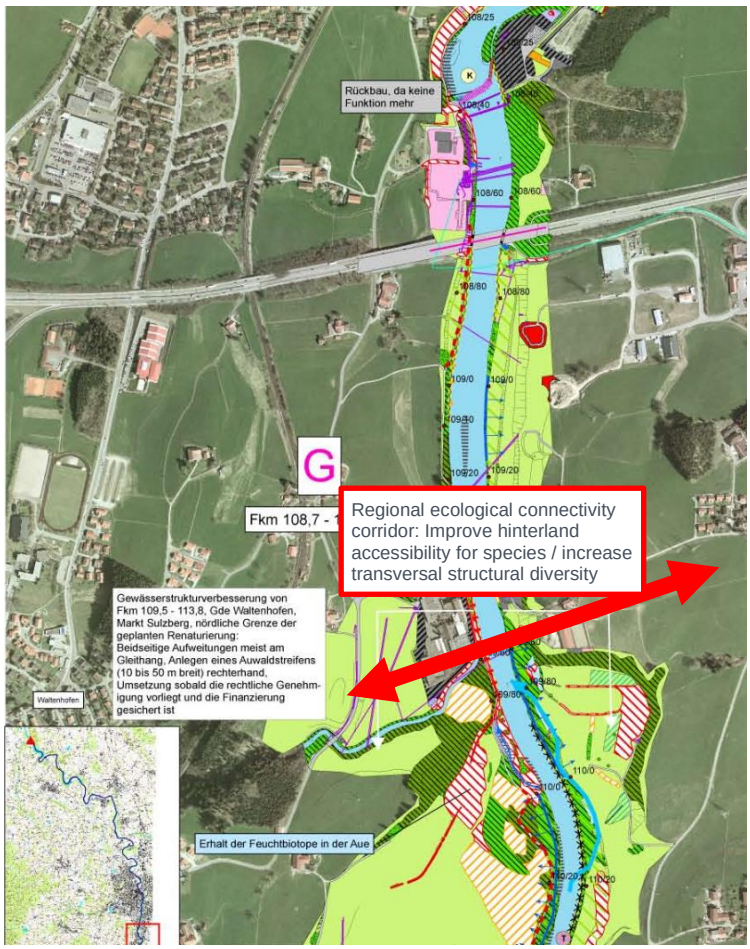


Figure 9: Proposal for river development concept Iller

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Annex

Annex 1 Technical proposal for the pilot region Illertal in local language

Zusammenfassung des Vorschlags zur Umsetzung von GBI-Netzwerken im Illertal

Einleitung und Zielsetzung

Das vorliegende Dokument stellt einen Vorschlag zur Integration von Grüner und Blauer Infrastruktur (GBI) als Netzwerk ökologischer Verbundachsen in die Raumplanung und sektoralen Instrumente im Pilotgebiet Illertal südlich von Kempten im Landkreis Oberallgäu dar. Die Pilotregion umfasst etwa 16.000 Hektar mit einem stark bewegten und unregelmäßigen Relief. Ziel ist es, einen halboffenen Verbundkorridor zu schaffen, der sowohl den Schutz als auch die Wiederherstellung naturschutzfachlich hochwertiger Lebensräume – insbesondere Feuchtgebiete und Moore – fördert, aber auch Trockenstandorte zur Landschaftsdiversität berücksichtigt.

Methodischer Ansatz

Der Ansatz konzentriert sich auf Lebensräume. Er orientiert sich am „Biotopverbund Bayern“ (https://www.lfu.bayern.de/natur/bayaz/biotopverbund/index.htm), am Bundesnaturschutzgesetz (BNatSchG), am Bayerischen Naturschutzgesetz (BayNatSchG), am „Bundeskonzept Grüne Infrastruktur” (Heiland et al 2017) sowie an den Prinzipien der flächenbasierten Biodiversitätserhaltung nach Riva et al. (2024). Im Vordergrund steht die strukturelle Konnektivität, nicht der Schutz einzelner Zielarten. Es wird ein breites ökologisches Netzwerk angestrebt, das sowohl große als auch kleine Lebensräume schützt und wiederherstellt.

Kernflächen, Erweiterungsflächen und Trittsteine

- **Kernflächen:** Kernflächen sind Gebiete mit hohem naturschutzfachlichem Wert, die durch Kartierung und Experteneinschätzung identifiziert wurden.
- **Erweiterungsflächen:** Erweiterungsflächen dienen der Vergrößerung und somit Optimierung von bestehenden Kernflächen. Sie besitzen ein hohes Potenzial für die Wiederherstellung von Lebensräumen, weil sie in enger funktionaler Beziehung zu den Kernflächen stehen, d.h. ein Austausch von Pflanzen und Tieren mit hoher Wahrscheinlichkeit möglich ist. Zur Abgrenzung von Erweiterungsflächen wurden die Kernflächen für Feuchtlebensräume mit 100 m gepuffert, für Trockenlebensräume mit 250 m (Distanzklassen aus „Bundeskonzepts für Grüne Infrastruktur“, Heiland et al. 2017 entnommen).
- **Trittsteine:** Weitere Flächen zwischen den Kern- und Erweiterungsflächen dienen als Trittsteine, um die Isolation von Habitaten zu verringern und die ökologische Konnektivität insbesondere in Landschaften mit intensiver Nutzung zu stärken (Verringerung der Abstände zwischen den Kernflächen).

Die für die Erhaltung und Wiederherstellung geeigneten und ungeeigneten Bereiche sind in den beiden folgenden Karten dargestellt. Hierbei wurden auch die Bodenverhältnisse berücksichtigt.

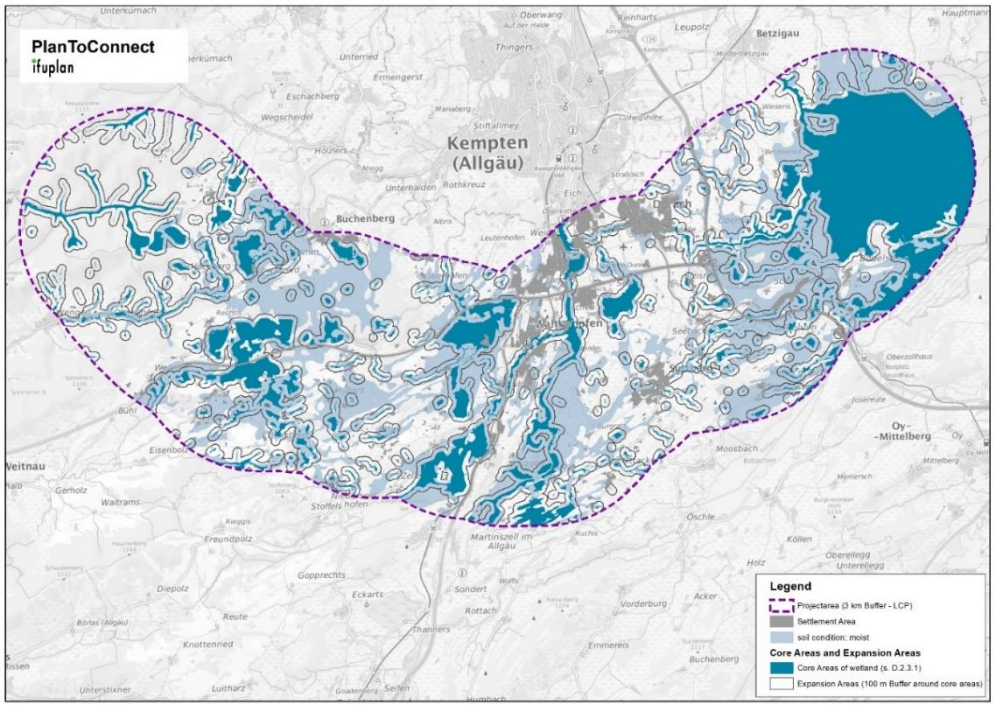

Abbildung 1 Kernflächen von Feuchtbiotopen mit möglichen Erweiterungsflächen auf Feuchtstandorten

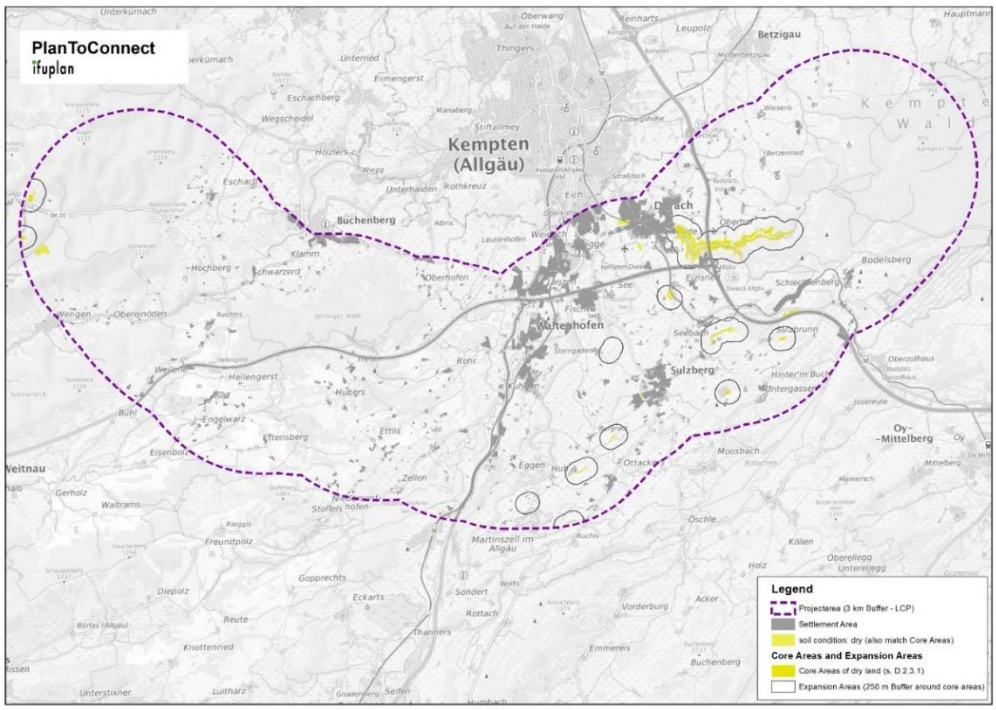

Abbildung 2 Kernflächen von Trockenbiotopen mit mögliche Erweiterungsflächen auf Trockenstandorten

Auf Feuchtstandorten umfassen die vorgeschlagenen Kernflächen ca. 668 ha, zuzüglich ca. 4.839 ha Erweiterungsflächen und ca. 2.625 ha geeignete Flächen mit feuchten Bodenverhältnissen für Trittsteine. Auf Trockenstandorten entfallen ca. 36 ha auf Kernflächen, ca. 639 ha auf Erweiterungsflächen. Insgesamt eignen sich somit rund 7.464 ha des 16.000 ha großen Pilotgebiets als potenzielle Flächen zur Optimierung und Renaturierung.

Nutzungen mit möglichen Beeinträchtigungen für die Biodiversität

Eine Befragung von Expertinnen und Experten identifizierte die wichtigsten anthropogenen Nutzungen mit möglichen Beeinträchtigungen für die Biodiversität im Illertal:

- **Landwirtschaft:** Intensive Beweidung oder Überweidung durch Vieh, der Einsatz von Pflanzenschutzmitteln auf landwirtschaftlichen Flächen sowie die Entwässerung zur Nutzung landwirtschaftlicher Flächen.
- **Infrastruktur:** Straßen, Autobahnen und damit verbundene Infrastrukturen wurden als sehr starke Beeinträchtigungen bewertet. Nur Bahnstrecken gelten als mittlere Beeinträchtigung.
- **Siedlungsentwicklung:** Städtische Entwicklung, der Bau oder die Veränderung bestehender Siedlungsgebiete sowie die Umwandlung anderer Nutzungsarten in Siedlungsgebiete (einschließlich touristischer und industrieller Bauten) stellen eine starke anthropogene Beeinträchtigung dar.

Energieerzeugung und Flächennutzung

Der Ausbau erneuerbarer Energien, insbesondere Photovoltaik und Wasserkraft, ist im Landkreis Oberallgäu sehr dynamisch. Photovoltaik deckt 23 % des Strombedarfs, Wasserkraft 18 %. Windenergie und Biogas liegen jeweils bei 5–7 %. Im Jahr 2020 stammten insgesamt über 50 % des erzeugten Stroms im Landkreis aus erneuerbaren Quellen. Der Fokus liegt aktuell auf dem Ausbau der Solarenergie; Windkraft wird zunehmend relevant, ist aber im Pilotgebiet noch nicht durch große Windparks vertreten.

Tabelle 1 Überblick – Bestehende Infrastrukturen und geplante Projekte in der Pilotregion Illertal

Infrastrukturtyp/ Landnutzung	Bestehende Infrastrukturen	Geplante Projekte	Beschreibung
Wasserkraft – Stausee (Talsperre)	-	-	Kein bestehender oder geplanter Staudamm
Wasserkraft – Laufwasserkraftwerk	Waltenhofen: Kraftwerk (Laufkraftwerk): 1) 1.000 bis 4.999 kW (Graben/Hegge);	-	Kein größeres Flusskraftwerk ist geplant

Infrastrukturtyp/ Landnutzung	Bestehende Infrastrukturen	Geplante Projekte	Beschreibung
	2) 500–999 kW (Au)		
Windkraft – Windräder	-	-	Standortsuche für Windkraftprojekt in Buchenberg.
			Allgemeine Standortsuche für Windkraftanlagen mit mindestens 8 ha Größe im Landkreis „Oberallgäu“
Solarenergie – Photovoltaik: Freiflächenanlagen	„Solarpark Schlechtenberg“ (12,5 ha), entlang der Bahnlinie Schlechtenberg-Bodelsberg „Photovoltaik-Anlage Herzmanns“ (1,4 ha), zwischen Herzmanns und Greith östlich der Bundesstraße B19	Erweiterung des „Solarpark Schlechtenberg“ (ca. 6 ha) „Solarpark Nägeleried“ (5,5 ha), zwischen Nägelried und Schlechtenberg	-
Bioenergie – Biomasse	-	-	Kein bestehendes oder geplantes größeres Biogaswerk
Stromübertragung – Hochspannungsleitung	-	-	Keine größeren, bestehenden oder geplanten Hochspannungsleitungen
Straßen/Autobahnen	Autobahn A7 und A970, Bundesstraßen B12 und B19	-	Vierspurige Straßen bestehen im gesamten Korridor; keine weiteren größeren Straßen oder Autobahnen geplant
Schiene	-	Voraussichtlich irgendwann „Illertalbahn“: Ausbau/Elektrifizierung	Mögliche Erweiterung und Elektrifizierung der Illertalbahn (noch kein detaillierter Plan vorhanden)
Siedlungs-/Gewerbeentwicklung	-	Gewerbegebiet Herzmanns Süd, südlich des	Meist Erweiterungen von Siedlungen, die keine Bedrohung darstellen.

Infrastrukturtyp/ Landnutzung	Bestehende Infrastrukturen	Geplante Projekte	Beschreibung
		Freiflächensolarfelds Herzmanns (Waltenhofen)	Eine große gewerbliche Entwicklung des Unternehmens „Herzmanns Süd“ wird erwartet

Maßnahmen zur Konnektivität und Governance

- **Schutz und Optimierung:** Bestehende Kernbereiche sollen erhalten und rechtlich gesichert werden, wobei kleine oder degradierte Flächen verbessert und vergrößert werden.
- **Erweiterungsflächen:** Diese sollen möglichst vielfältige Standortbedingungen (z.B. Höhenlage, Exposition, Feuchtigkeit) bieten, um die Resilienz gegenüber dem Klimawandel zu erhöhen und Arten die Anpassung an veränderte Umweltbedingungen zu ermöglichen.
- **Trittsteine:** Die Vernetzung soll durch Trittsteine verbessert werden, insbesondere dort, wo die Schaffung durchgehender Korridore aufgrund von hohem Landnutzungsdruck schwierig ist.

Wiederherstellungsmaßnahmen

Folgende Maßnahmen werden für die Erhaltung und Wiederherstellung von Feuchtgebieten in der Pilotregion empfohlen:

- **Wiederherstellung von Moor- und Feuchtgebieten:** Verhinderung von Aufforstung auf Moorstandorten, Zurückdrängen von Gehölzaufwuchs und Freihaltung von hydromorphen Standorten vor Bebauung.
- **Grünlandmanagement:** Mahd von brachgefallenem Grünland und Förderung nachhaltiger Bewirtschaftungspraktiken, um die Habitatqualität zu erhalten.

Governance und Akteursstruktur

Das Dokument skizziert eine regionale Governance-Struktur für die ökologische Konnektivität im Illertal, die wichtigen Akteure aus Verwaltung, Planung, Naturschutz und Landnutzung einbindet. Momentan umfasst diese seitens der Behörden die Höhere und Untere Naturschutzbehörde (LRA Oberallgäu bzw. Regierung von Schwaben), die Obere Landesplanungsbehörde an der Regierung von Schwaben mit dem Regionalen Planungsverband, das Amt für Ernährung, Landwirtschaft und Forsten Kempten, die Gemeinden sowie das Staatliche Bauamt Kempten. Schlüsselakteure seitens der Landnutzer sind der Bayerische Bauernverband als Vertretung der Landwirtschaft, die Bayerischen Staatsforsten, die Allgäuer Moorallianz sowie der Landschaftspflegeverband Oberallgäu/Kempten sowie seitens der Umweltverbände die Bund Naturschutz-Kreisgruppe Oberallgäu sowie die Kreisgruppe Kempten/Oberallgäu des Landesbundes für Vogelschutz.

Im Hinblick auf eine künftige Planung und Umsetzung eines regionalen Netzwerkes Grüner Infrastruktur wird folgende Struktur (Abbildung 3, in englischer Sprache) vorgeschlagen, die weitgehend auf bestehenden Institutionen aufbaut:

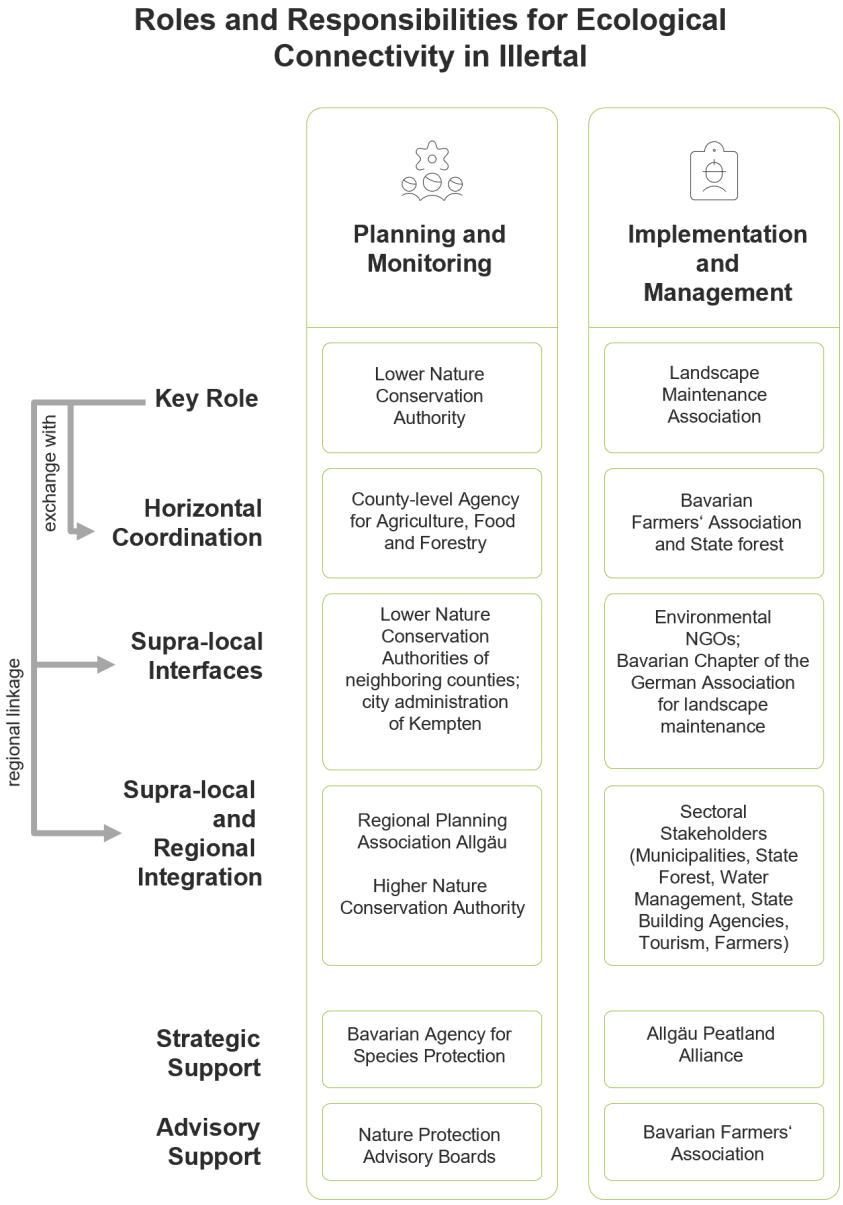

Abbildung 3 Vorgeschlagene regionale Governance-Struktur für den ökologischen Verbund Illertal

Planungsinstrumente und rechtliche Verankerung

- **Regionalplan:** Vorschläge für textliche und kartografische Anpassungen des Regionalplans, um die Kernflächen, mögliche Erweiterungsflächen und Trittsteine verbindlich zu verankern. Dies umfasst insbesondere eine deutlich stärkere Anwendung biodiversitäts- und vernetzungsbezogener Planzeichen wie beispielsweise der Biotopverbundachsen aus dem Planzeichenkatalog der Obersten Landesplanungsbehörde.
- **Landschaftspläne:** Vorschläge für Kategorien und Signaturen zur Darstellung von Lebensräumen und Biotopen in kommunalen Landschaftsplänen.
- **Stadtplanung und Fachplanungen:** Empfehlungen zur Integration der GBI-Netzwerke auf städtebaulicher und fachplanerischer Ebene, insbesondere im Hinblick auf die Entwicklung von Fließgewässern (z.B. Iller).

Tabelle 2 Überblick über Planungssignaturen

Instrument	**Level**	**Die folgenden optional verfügbaren Planungssignaturen werden zur Abgrenzung und Sicherung der Konnektivität im Illertal nicht angewendet**		
Regionalplan Allgäu / Karte 3 Natur und Landschaft	**regional**		Landschaftspflegemaßnahmen: Offenhalten von Flächen, deren landwirtschaftliche Nutzung aufgegeben wurde oder im Begriff ist, aufgegeben zu werden	➔ Ausweisung von Grenzertragsflächen, die von natürlicher Sukzession bedroht sind und für die Offenlandkonnektivität von Bedeutung sind, als Flächen für Landschaftspflegemaßnahmen
			Natürliche Vegetationsentwicklung	➔ Abgrenzung von Grenzertragsflächen, bei denen das Aufgeben der landwirtschaftlichen Nutzung die ökologische Konnektivität fördern würde
			Fortführung der bisherigen Nutzung zur Landschaftspflege	➔ Abgrenzung von Grenzertragsflächen, bei denen die Fortführung der landwirtschaftlichen Nutzung zur Landschaftspflege gezielt unterstützt werden sollte
			Biotopverbundachsen	➔ Integration der Rolle des Illertals als regionaler Verbindungskorridor für ökologische Konnektivität

Instrument	Level	Die folgenden optional verfügbaren Planungssignaturen werden zur Abgrenzung und Sicherung der Konnektivität im Illertal nicht angewendet		
				durch eine räumlich nicht konkretisierte Biotopverbundachse.
		AVAVA	Trenngrün	➔ Festlegung von Siedlungsrandzonen für die Siedlungserweiterung in Nord-Süd-Richtung entlang der Bahnlinie im Illertal.

Ein Beispiel dafür, wie die ergänzenden Planungssignaturen in den Karten des Regionalplans – begrenzt auf das Pilotgebiet – dargestellt werden könnten, ist in der folgenden Abbildung aufgezeigt:

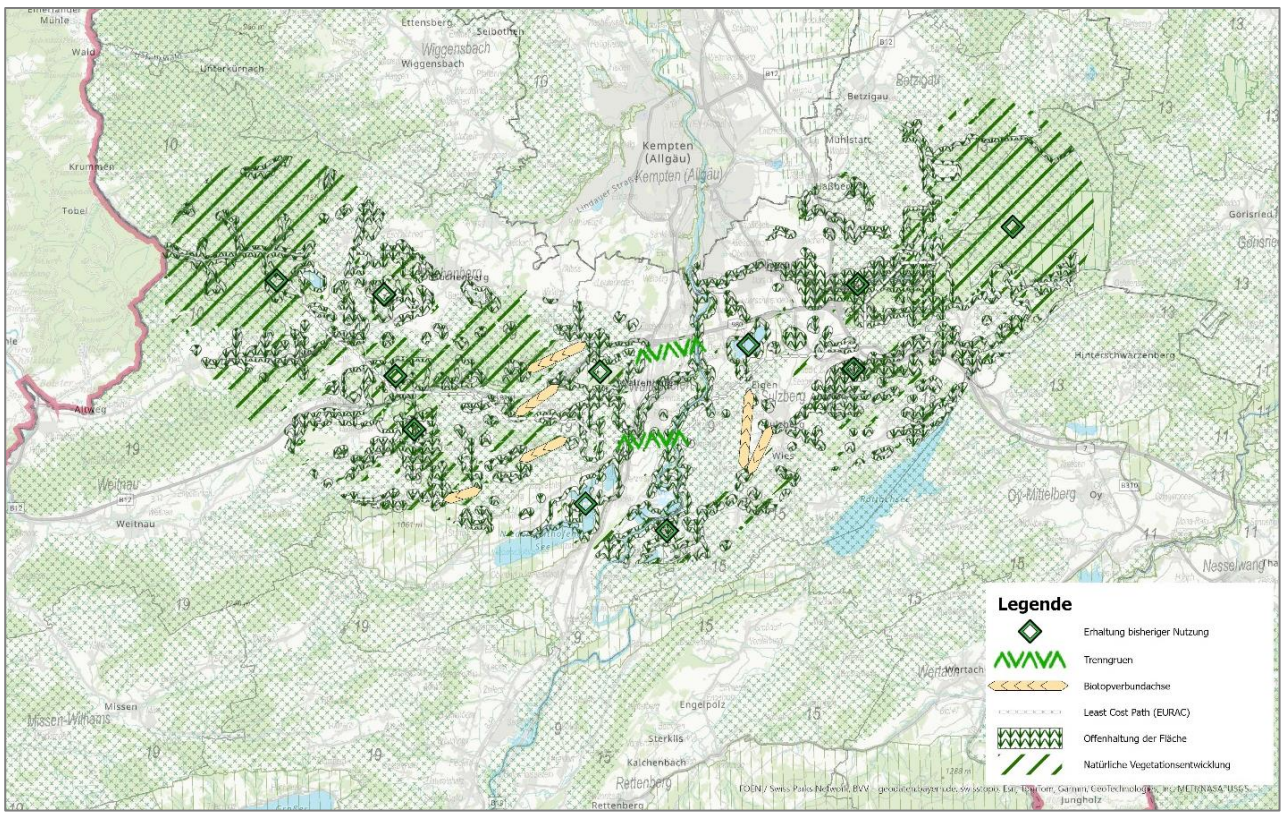

Abbildung 4 Vorschlag zur Umsetzung in der Karte 3 des Regionalplans

Finanzierung und Förderinstrumente

Das Dokument listet verschiedene Förderinstrumente für Konnektivitätsmaßnahmen auf, darunter Agrarumweltprogramme, Naturschutzförderung und Maßnahmen zur Landschaftspflege. Diese können für die vorgeschlagenen Maßnahmentypen eingesetzt werden.

Fazit und Ausblick

Der Vorschlag für das Pilotgebiet Illertal bietet einen umfassenden Ansatz zur Stärkung der ökologischen Konnektivität durch die Schaffung eines halboffenen GBI-Netzwerks. Die Planung basiert auf wissenschaftlichen Prinzipien, Experteneinschätzungen und bestehenden rechtlichen Rahmenbedingungen. Sie behandelt die wichtigsten Belastungen und Herausforderungen durch Landwirtschaft, Siedlungsentwicklung und Infrastruktur sowie durch den Klimawandel. Mit den Kernflächen, Erweiterungsflächen und Trittsteinen soll ein resilientes und anpassungsfähiges Lebensraumnetzwerk entstehen, das den Schutz und die Wiederherstellung der Biodiversität in einer sich verändernden Umwelt sicherstellt.

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Salzburg Institute for Regional Planning and Housing (AT)
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Document / report title

Case Studies 4th step: Draft a technical proposal integrating the project for a GBI connectivity network into planning tools/sector plans in pilot areas

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ifuplan