TOOLKIT

for Ensuring Sustainable Use and Management of Green Infrastructure in Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA)

Part of SaveGREEN Output T1.3 “Capacity Building Programme”

Bucharest, 2022

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Toolkit for Ensuring Sustainable Use and Management of Green Infrastructure in Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA)

Part of Output T1.3 Capacity Building Programme

SaveGREEN Project "Safeguarding the functionality of transnationally important ecological corridors in the Danube basin"

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The Capacity Building Programme consists of the following parts:

» Toolkit » Handbook » Training package


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About SaveGREEN

The SaveGREEN project, funded by the Interreg Danube Transnational Programme is focused on the identification, collection, and promotion of the best solutions for safeguarding ecological corridors in the Carpathians and further mountain ranges in the Danube region. Currently, ecological corridors in the region are under threat due to the lack of adequate planning of economic development initiatives. Therefore, basing its work on integrated planning, SaveGREEN will monitor the impact of mitigation measures in 8 pilot areas and derive proper recommendations for follow-up actions and policy design.

www.interreg-danube.eu/savegreen

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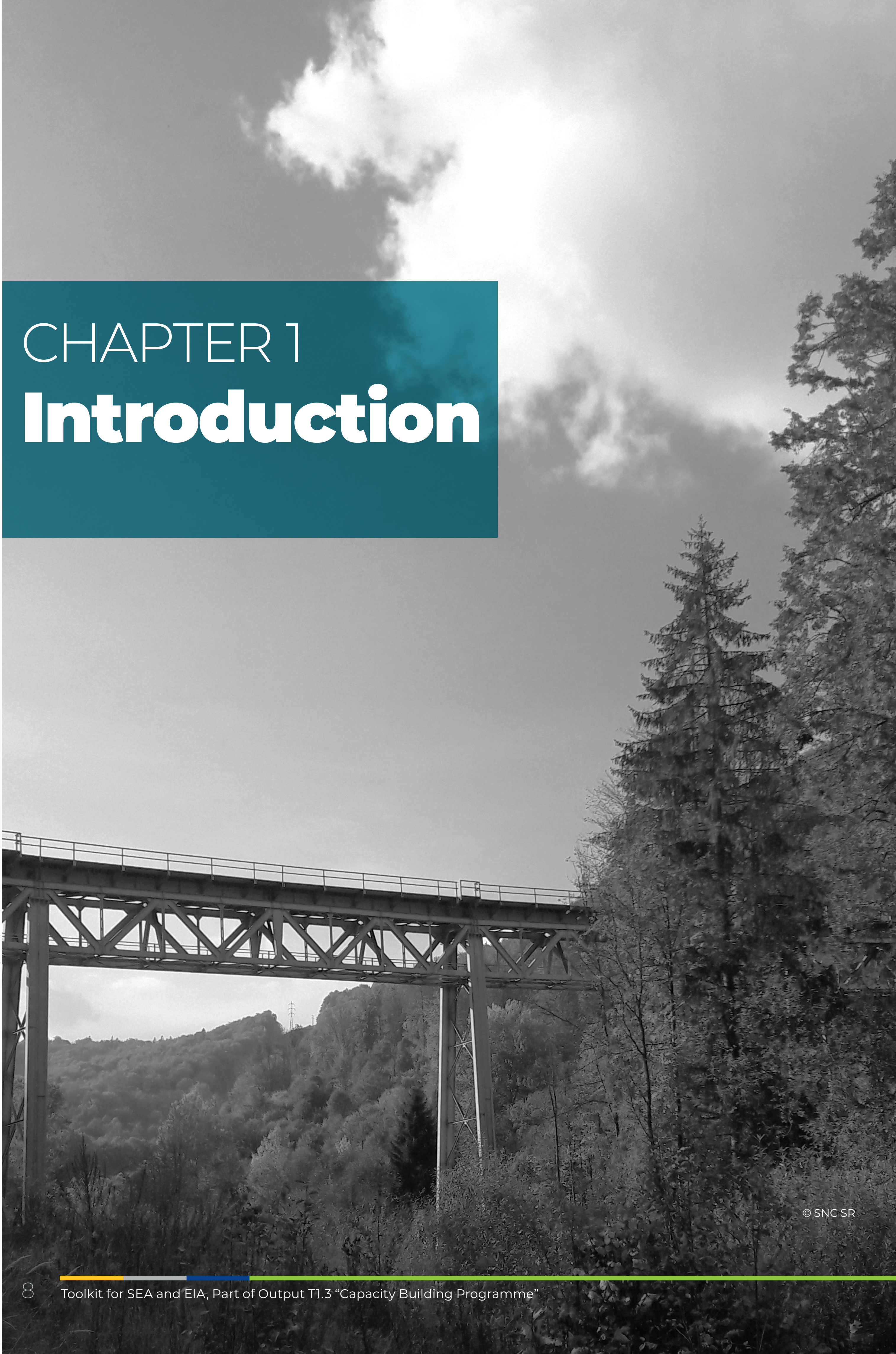
AA	Appropriate Assessment
CBA	Cost – Benefit Analysis
EC	European Commission
EIA	Environmental Impact Assessment
ER	Environmental Report
ESVD	Ecosystem Services Valuation Database
EU	European Union
GI	Green Infrastructure
GIS	Geographic Information System
MCA	Multi-Criteria Analysis
NGO	Non-Governmental Organisation
OI	Openness Index
SEA	Strategic Environmental Assessment
SSCO	Site Specific Conservation Objectives
TEEB	The Economics of Ecosystems and Biodiversity
LTI	Linear Transport Infrastructure
WFD	Water Framework Directive

CHAPTER 1

Introduction



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The **scope** of this deliverable is to propose a toolbox that can be used by SEA and EIA practitioners, environmental authorities, NGOs and other stakeholders when identifying and assessing, in a quantified manner, the impacts on GI caused by certain plans or projects, and when securing the maintenance of ecological connectivity in the area of implementation of these plans or projects. The final purpose of the toolkit is to ensure that future SEA or EIA will require the implementation of prevention, avoidance, mitigation or compensation measures, which adequately safeguard the maintenance or restoration of structural and functional ecological connectivity.

The **objectives** established for this deliverable are the following:

» **Obj. 1** Development of a SEA Toolkit, to be used by stakeholders for assessing the impacts on GI, generated by strategic documents such as plans (including large-scale development plans), programmes and strategies;

» **Obj. 2** Development of an EIA Toolkit focused on the identification and quantification of project impacts on GI.

Regarding the assessment methodologies proposed in this toolkit, it is important to mention that their application should follow the spirit of the precautionary principle. All of the information and data to be used in the methodologies should have a sound scientific basis, while any assumptions that need to be included should assume the most unfavourable situation.

Addressing ecological connectivity in SEA and EIA implementation is crucial. When developing transport and other linear infrastructure projects, the following basic concepts and challenges need to be considered to minimise the project's impact on ecosystem and landscape cohesion as described in the following table:

1) Problem: Genetic isolation and wildlife mortality;

2) Cause: Habitat fragmentation and land degradation;

3) Aim: Ecological and landscape connectivity;

4) Objective: Sustainability;

5) Conflict: Green and grey infrastructure; and,

6) Solution: Avoidance and mitigation as the main solutions.

SaveGREEN is a project funded through the Danube Transnational Programme, implemented in the period July 2020 – December 2022. It aims to demonstrate ways of designing appropriate mitigation measures and maintaining or improving the functionality of ecological corridors through integrated planning.

SaveGREEN includes detailed, on-site work in 8 pilot areas in Austria, the Czech Republic, Slovakia, Hungary, Ukraine, Romania and Bulgaria, and contains several important outputs, among which are:

» A Methodology for Standardised Monitoring of Ecological Connectivity -Guidelines for the analysis of structural and functional connectivity, to be used in the pilot areas for assessing already implemented connectivity-related measures or for

Table 1 **Basic concepts for ecological connectivity (Georgiadis *et al.* 2020)**

	Ecological connectivity related concepts	Main logical framework concepts	Description
1	Genetic isolation and wildlife mortality	Problem	The main environmental challenges related to Linear Transport Infrastructure (LTI) development are genetic isolation, wildlife mortality and the loss of ecosystem functions, which can cause significant changes in habitats, thus making it impossible for the original community of species to persist.
2	Habitat fragmentation	Cause of the problems	The lack of genetic exchange is caused by habitat fragmentation on both terrestrial and aquatic ecosystems.
3	Securing the ecological connectivity	Aim	The main aim is to secure the ecological connectivity in important natural areas when they are intersected by TLI.
4	Sustainability	Objective	Sustainability and quality must be achieved for three different perspectives: Social, Environmental and Economic.
5	Green and Grey Infrastructure	Crossing point and conflict areas	Adopting the concepts of Green Infrastructure, Natural Capital and Ecosystem Services and identifying the conflicts in the main "crossing points" where Grey Infrastructure such as LTI intersects Green Infrastructure/natural areas.
6	The hierarchy of priorities: Avoidance - Mitigation – Compensation	Solution	The achievement of sustainable coexistence of Green and Grey Infrastructure must focus on resolving conflict through specific measures following the hierarchy of priorities of Avoidance - Mitigation – Compensation.

collecting data for proposed infrastructure projects;

- A Technical Application Toolbox for monitoring ecological corridors, as well as monitoring activities, together with reports on monitoring and testing the application developed within the project;
- A Capacity Building Programme, including a Handbook on Best Practise Examples. The programme will provide a set of tools to allow for a better understanding of human impacts on Green Infrastructure and a better identification and implementation of measures to prevent and reduce these impacts;
- Local Cross Sectoral Operational Plans (CSOP), including concrete measures to safeguard, enhance and restore functionality of ecological connectivity in the pilot areas. The development of the CSOP includes stakeholder analyses and different meetings on the topic.

The full list of outputs as well as a more detailed description of the SaveGREEN project is available on the project's official website at https://www.interreg-danube.eu/approved-projects/savegreen.

The project builds on the results of the previous DTP projects TRANSGREEN, ConnectGREEN and HARMON, especially on the Decision Support System developed in ConnectGREEN[1] and the Wildlife and Traffic in the Carpathians Guidelines, developed in TRANSGREEN[2]. This deliverable is aimed at continuing the work done in the TRANSGREEN project, especially in deliverable 3.2. Keeping Nature Connected – Environmental Impact Assessment for Integrated Green Infrastructure Planning (Nistorescu *et al.* 2019).

The present deliverable was elaborated within activity A.T1.3 Develop Capacity Building Programme of the SaveGREEN project.

Considering the findings of deliverable D.T1.3.1 *Report on Collection and Gap Analysis of Existing Methodologies / Best practices / Training materials*, developed within the SaveGREEN project (the Gap Analysis), this deliverable is of particular importance. The Gap Analysis has shown that stakeholders' understanding of the Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures is insufficient. It has been observed that there are knowledge gaps in the stakeholders' understanding of SEA and EIA, particularly concerning procedures, legislative requirements, appropriate methodologies and the actual assessment of impacts. The results of a Gap Analysis also showed that in general, ecological connectivity (structural or functional) is either not assessed at all, or analysed very briefly, in the process of decision making and the assessment of impacts (for plans or projects) (Borlea *et al.* 2021).

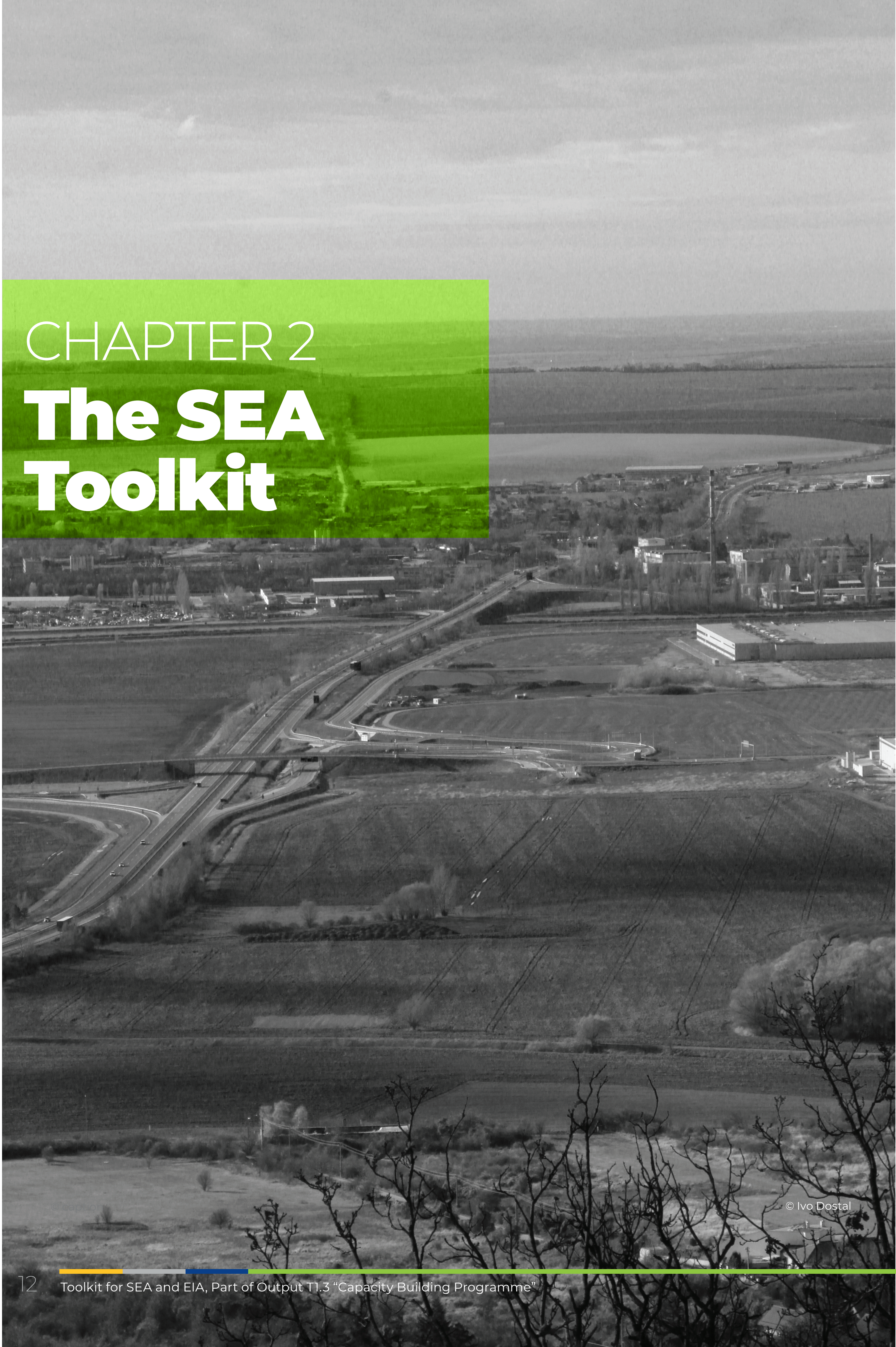
The SEA/EIA tools featured in this document, including aspects related to the cost-benefit analysis for ensuring sustainable use and management of Green Infrastructure (from here on referred to as *SEA/EIA Toolkits*, in short) will contribute to developing the stakeholders' understanding of SEA and EIA processes and will be important in the elaboration and further implementation of the Cross-Sectoral Operational Plans (CSOP), being developed within SaveGREEN.

1 Available here: http://connectgreen.patko.sk/index.php/decision-support-tool/.

2 The document is available here: https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/35/02caaafe3c-1c1365f76574e754ddbdc4e1af4a7a.pdf.

CHAPTER 2

The SEA Toolkit



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2.1 Overview of the Strategic Environmental Assessment

The nature of the Strategic Environmental Assessment (SEA) is defined within the framework of Directive 2001/42/EC (the SEA Directive). This Directive applies to plans and programmes prepared or adopted by an authority at a national, regional or local level and is mandatory for plans or programmes related to several domains, among which are transport, agriculture, forestry or spatial and regional development planning (European Commission 2001).

The main particularity of a SEA is that it is implemented strategically, with the input and participation of different stakeholders. Therefore, it is important to ensure that ecological connectivity is included in the assessment from the beginning of the procedure, as the SEA process can aid in the collaboration of different stakeholders from different backgrounds with the same aim: of maintaining or restoring ecological connectivity.

The SEA Directive requires that an **environmental report** be prepared as part of the SEA procedure, in which the "likely significant effects on the environment of implementing the plan or programme, and reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme, are identified, described and evaluated." (Art. 5, SEA Directive). To the extent possible, the assessments done in this environmental report should be based on clear, accurate data and should include quantification of the identified effects expected to occur due to the analysed plan or programme.

2.2 Proposed Toolkit for SEA

The SEA Toolkit included in this report mainly addresses strategies, plans and programmes related to transport infrastructure. The strategies, plans or programmes to which the tools presented in this chapter can be applied should include at least: general considerations on proposed types of linear infrastructure, a general idea on proposed routes, a set of clear objectives or measures proposed, etc.

It should be mentioned that the tools presented in this chapter are applicable to strategies, plans or programmes which address various spatial levels (e.g., national, regional, local). However, while the general idea of the tool can be applied, the details will require modifications, based on the particular aspects of each strategy, plan or programme.

2.2.1 Tool for selection of alternatives

The selection of the preferable alternative among the different variants of a plan or programme can be a very powerful and useful method for ensuring as small of an impact on the environment as possible.

A selection of alternatives can be done through a Multi-Criteria Analysis (MCA), taking into consideration the effects of the analysed alternatives on the relevant environmental aspects. The criteria used by the MCA must have the appropriate biodiversity weight value and be connected to the environmental aspects relevant to the analysed plan or programme. The environmental aspects to be taken into consideration in the MCA should be in accordance with Directive 2001/41/EC (SEA Directive)[3] and Directive 2014/52/EU (EIA Directive)[4]. Examples of environmental aspects that could be taken into consideration are:

3 Available at the following link: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32001L0042.
4 Available at the following link: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0052.

- **Population and human health**: This can include changes in noise levels, human health or changes in social aspects.

- **Biodiversity**: This includes aspects related to natural protected areas (such as Natura 2000 sites or other types of protected areas), areas of high importance for biodiversity (such as core habitats for species or areas with Priority Habitat Types located outside of Natura 2000 sites) and ecological corridors;

- **Land, soil, water, air and climate**: This can include aspects such as the ecological and / or chemical status of water bodies (surface and groundwater) as defined in the Water Framework Directive (WFD), land use, air quality and vulnerability to climate change;

- **Material assets, cultural heritage and the landscape**: This includes aspects such as presence of special cultural heritage elements, high value landscapes, economic considerations, etc.;

- Other relevant aspects in the context of the analysed strategy, plan or programme. The MCA should also take into consideration any interactions between the different elements included in the analysis.

Table 2 **Example of an assessment table for the analysis of alternatives proposed by a plan or programme based on environmental criteria**

Environmental criterion	Indicator
Noise level	Surface of settlements with increased noise levels
Social aspects	Number of administrative units intersected
	Number of economic epicentres connected
Natura 2000 sites	Affected surface of Natura 2000 sites / other Community designated sites (e.g. Emerald Sites)
Areas of high importance for biodiversity	Areas with Natura 2000 habitats located outside Natura 2000 sites, old-growth forests, etc.
Other nationally designated protected natural areas	Number of intersections with Parks
Ecological corridors	Intersections with ecological corridors
	Importance of ecological corridor
Core habitats	Intersections with core habitats
Water bodies	Number of intersections with water bodies
Air quality	Surface of areas with increased pollutant concentrations
Climate change	Exposure to flooding
	Exposure to landslides
Cultural heritage	Number of UNESCO WHS sites located at <5 km from the alternative
Land use	Surface requiring deforestation
...	...
Other relevant criteria	-
	Total score

* Please note that the environmental criteria, indicators, units of measurement, importance and alternative analysis presented here are only examples. They should be changed and adapted for each SEA developed by the respective SEA expert.

It is recommended that the Multi-Criteria Analysis is done quantitatively. This implies measurements and calculations of the predicted effects the individual plan or programme alternatives and the changes these can have on the selected environmental aspects.

The data to be used in the MCA can be publicly available data, obtained either from European institutions (such as the European Commission (EC) databases[5], the European Space Agency[6] or the EC Joint Research Centre[7]), international independent projects (including initiatives such as the ConnectGREEN project) or national institutions, if data is available at national level.

At the planning level, in-depth fieldwork data might be too difficult to obtain due to the large scale of the assessed plan. However, if the assessed plan is applicable to a local level, additional data from the field can be included in the assessment.

The environmental aspects selected to be used in the analysis should allow for the visualisation of differences between the analysed alternatives. For instance, if two alternative routes of a motorway intersect the same number of Natura 2000 sites, the indicator 'number of Natura 2000 sites intersected' is not useful for discerning the better alternative between the two of

5 Available at: https://www.eea.europa.eu/data-and-maps.
6 Data (including Copernicus satellite data) are available at: https://earth.esa.int/eogateway/catalog.
7 Available here: https://joint-research-centre.ec.europa.eu/index_en.

Unit of measurement	Importance	Alternative 1		Alternative 2		Alternative 3		---	Alternative X
		Input	Score	Input	Score	Input	Score		
ha	5%	256	**25,6**	430	**43**	390	**39**	...	-
Number	5%	13	**0,65**	25	**1,25**	28	**1,4**	...	-
Number	5%	2	**0,1**	3	**0,15**	3	**0,15**	...	-
ha	10%	5	**0,5**	2	**0,2**	2	**0,2**	...	-
ha	10%	5	**0,5**	2	**0,2**	2	**0,2**	...	-
Number	10%	2	**0,2**	0	**0**	0	**0**	...	-
Yes / No	10%	No	**0**	Yes	**10**	Yes	**10**	...	-
Category	10%	National	**10**	Regional	**5**	Local	**1**	-	-
Yes / No	10%	No	**0**	Yes	**10**	No	**0**	...	-
Number	10%	20	**2**	25	**2,5**	14	**1,4**	...	-
ha	5%	3	**0,3**	1	**0,1**	2	**0,2**	...	-
Yes / No	5%	No	**0**	Yes	**5**	No	**0**	...	-
Yes / No	5%	No	**0**	Yes	**5**	No	**0**	...	-
Number	5%	0	**0**	1	**0,05**	0	**0**	...	-
ha	5%	98	**4,9**	45	**2,25**	33	**1,65**	...	-
...	...	...	**...**	...	**...**	...	**...**	...	...
-	-	-	**-**	-	**-**	-	**-**	...	-
		-	**34,25**	**-**	**79,5**	**-**	**54**	**-**	-

them, although it can show a difference compared with a third alternative. However, the two alternatives which intersect a Natura 2000 site may show local differences, intersecting areas of different importance for biodiversity (one might intersect areas of high importance, the other areas of low importance). Therefore, the MCA should include an important component of spatial analysis of the proposed alternatives as well.

The Multi-Criteria Analysis can be performed using a table, with supportive explanations in a textual format. The purpose of the table is to analyse and compare the effects of the different alternatives on the selected environmental aspects. An example of such a table is presented below, showcasing examples of possible indicators and examples of the different importance and weight value represented by different percentages associated to each indicator. The purpose of the different percentages is to prioritize between the various indicators and should be established by each SEA expert in their assessment, based on the specific characteristics of the analysed area. In general, in Natura 2000 sites and important areas for biodiversity and threatened species areas, the importance and the weight value of biodiversity criteria must have greater value than the other environmental criteria.

It should be mentioned that it is possible to also include aspects such as "no-go" criteria in the analysis. These can, for instance, be related to irreplaceable natural heritage areas, where any development might threaten their existence. In such cases, there can be alternatives which should be excluded from the analysis based on their possible impacts on "no-go" areas.

In the context of a SEA, the table should be tailored to the particular situation at hand by the experts involved. It should reflect the characteristics of the analysed plan or programme and of the area in which this is proposed.

Establishing the "importance" component with different weight values should be done by the experts who elaborate the SEA. The percentages chosen should be based on the strategies, objectives and targets of the particular country / region in which the SEA is carried out (also taking into consideration European Community requirements, if applicable). For example, if a country has an objective in its national level strategy for "no new infrastructure in Natura 2000 sites", the 'Natura 2000' environmental aspect should be given a higher percentage (and therefore importance) than the rest in the MCA criteria.

In the example presented below, the alternative with the highest score is the least advantageous from an environmental standpoint. The importance of each indicator can be valued between 0 – 100% and the total sum of the importance of all indicators has to be 100%.

2.2.2 Tool for strategic assessment of impacts (SEA)

Following the selection of the most advantageous alternative proposed through the plan or programme, the chosen alternative will have to be analysed in an Environmental Report. The analysis requires a more in-depth look at the environmental criteria included in the analysis of alternatives, as well as an assessment from the point of view of the existing environmental problems.

The SEA should follow a series of steps, presented here in a simplified version as follows:

1. Description of the relevant environmental criteria, based on the specific situation in the region where the plan or project is proposed;

2. Analysis of the current situation related to the selected environmental criteria;

3. Analysis of the development and future perspectives concerning the selected environmental criteria (Alternative 0 – the expected development of the environmental criterion without the realisation of the plan/programme);

4. Identification of the main environmental problems in the area where the plan or programme is proposed;

5. Identification of the main environmental objectives related to the selected environmental criteria in the area where the plan or programme is proposed. These can be established through the use of already proposed strategies and plans developed at the international, national, regional or local level;

6. Assessment of the effects of the analysed plan or programme related to these environmental objectives and their targets. This should include the cumulative nature of the effects when added to those of other plans.

While the methodology for elaborating a SEA can be chosen by the expert or imposed by the national legislation of a certain country, in this report we opted to present an example of a method that could be adapted and used for SEA, if no other requirements exist regarding the methodology; which should be used. The relevant environmental criteria to be analysed should be established by the expert, while also taking into account the requirements of the relevant legislation at national and EU levels (including the requirements of the Habitats Directive and Birds Directive).

This method is based on an assessment table and it aims to present the information related to each environmental criterion in an orderly manner, which can allow the SEA expert to identify the potentially significant effects, which can appear due to the proposed plan. The degree of reversibility of impacts has to be assessed in a substantial manner in order to maximize the potential for decreasing the severity of these impacts to the lowest possible level. Especially in regards to transport projects, the reversibility of the impacts has to be added as the 4th sustainability pillar, after environmental, social and economic considerations (Joumard & Nicolas 2010). An example of a completed table is presented below.

Table 3 Example of a table for the Strategic Assessment of the selected alternatives

Environmental criteria	Baseline conditions		Perspectives in 'Do nothing' scenario	
	Current situation	Current indicator score for the criterion	Perspectives (Alternative "0")	Future indicator score for the criterion
Natura 2000 sites	A decrease in the population of brown bears has been observed	-1	Continuation of the decreasing trend for the population of brown bears	-2
Areas of high importance for biodiversity	A decreasing trend in the surface area of habitats of Community interest located outside Natura 2000 sites	-1	Continuation of the decreasing trend for habitat surfaces outside Natura 2000 sites	-2
Other nationally designated protected natural areas	The trend in the number of tourists in the National Parks in the area has been decreasing	-1	The trend in the number of tourists will continue to decrease	-2
Ecological corridors	The number of intersections of infrastructure with ecological corridors has been increasing	-1	The number of intersections will continue to increase	-2
Core habitats	A decreasing trend has been observed in the size of the core habitats for large mammals	-1	The size of core habitats for large mammals will continue to decrease	-2
Water bodies	The ecological status of most water bodies in the area is moderate	-1	The ecological status of the water bodies is expected to remain the same	-1
Noise level	The noise levels in the area are generally low due to the low amount of infrastructure	+1	The levels are expected to remain low in the future without the development of infrastructure in the area	+1
...	...	...	...	...
Other relevant criteria	-	-	-	-

* Please note that these environmental criteria and the information in the rest of the table are only examples. They should be changed and adapted for each developed SEA.

Environmental problems	Relevant environmental objective	Plan / Programme proposals	
		Effect of the selected alternative on the environmental objective	Proposed measures for impact avoidance or mitigation
There is a decreasing trend in the population of brown bears	Reverse the decreasing trend	The alternative will not significantly affect the population of brown bears. It will not intersect Natura 2000 sites designated for the protection of brown bear	-
There is a decreasing trend for Natura 2000 habitats outside Natura 2000 sites	Reverse the decreasing trend	The alternative has the potential to contribute to the decreasing trend in Natura 2000 surfaces outside Natura 2000 sites	Changes to the proposed implementation areas
There is a decreasing trend in the number of tourists in the National Parks of the area	Reverse the decreasing trend	The alternative will contribute to the environmental objective through the promotion and improvement of the ease of access for tourists to National Parks	-
Ecological connectivity has become significantly affected by fragmentation due to anthropic development	Re-establish ecological connectivity	The selected alternative will not contribute to the fragmentation of ecological corridors	-
There is an important loss of core habitats for large mammals	Reverse the decreasing trend and expand the size of core habitats for large mammals	The selected alternative will not contribute to the decrease of core habitats for large mammals (it will not intersect core areas)	-
The water bodies in the area do not fulfil the requirements of the Water Framework Directive	Achievement of a Good ecological status for all water bodies	The selected alternative has the potential to affect the ecological status of water bodies if specific measures are not taken	The plan must include requirements to ensure that none of its proposals will contribute to the degradation of the ecological status of water bodies
-	Maintain the noise levels at a similar value or decrease them further	The selected alternative has the potential to affect the environmental objective through the increase in noise levels due to traffic	The plan must include requirements for ensuring that its proposals do not lead to a significant increase in noise levels
...	...	...	...
-	-	-	-

The scores for the current and future indicators are based on the expert judgement of observed or known trends, and on the effects that the analysed plan can have on the relevant environmental objectives. They can be established based on the following interpretation.

Possible effect	Description
Significant negative effect	-2
Nonsignificant negative effect	-1
No effects	0
Nonsignificant positive effect	1
Significant positive effect	2

An effect can be considered to have a **significant negative level** if it is considered to threaten the relevant environmental objective and prevents it from being reached. The effect has a **nonsignificant negative level** if it affects the relevant environmental objective, but still allows it to be reached.

A **nonsignificant positive effect** contributes to reaching the relevant environmental objective in a small manner, while a **significant positive effect** addresses the relevant environmental objective directly, and will lead to its fulfilment.

In accordance with the precautionary principle, if it is unknown whether the assessed plan or programme will have a significant or non-significant effect, it is preferable to consider the most unfavourable situation.

2.2.3 Tool for SEA Monitoring

According to Article 10 of the SEA Directive[8], the SEA process should include aspects related to the monitoring of the identified significant effects of a plan or programme. The purpose of monitoring should be "to identify at an early stage unforeseen adverse effects and to be able to undertake appropriate remedial action" (Art. 10, SEA Directive).

The monitoring programme proposed in the SEA should include a few important aspects:

- It should focus on the environmental problems and significant effects identified previously within the assessment;
- It should address all the relevant environmental criteria for which significant effects have been identified;
- It should use data from various relevant institutions to allow for an overview of the environmental situation following the implementation of the analysed plan or programme;
- It should require complementary field research in order (i) to complete the existing data and information, especially if the data is older, and (ii) to update the current status of the landscape and land use in real time;
- It should take into consideration the relevant environmental objectives selected within the SEA. This will allow the monitoring not only of any significant effects on the environment but also of significant effects on the relevant environmental objectives.

The development of a monitoring programme should follow a series of stages:

- Establishment of the environmental criteria potentially significantly affected by the plan or programme. This list should be derived from the SEA;

8 Document available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0042&from=EN.

- Identification of the appropriate indicators for monitoring the effects of the analysed plan or programme. The indicators should be quantifiable and should allow for clear measurements of values reflecting the status of the environmental criterion;
- Identification of the appropriate targets for the indicators. These targets should establish the main milestone/s for ensuring the decrease in the severity of identified effects to a non-significant level;
- Identification of the potential data sources which could be used for monitoring. These can be any institution that can gather data, especially if done at a higher level (county / region / national levels).

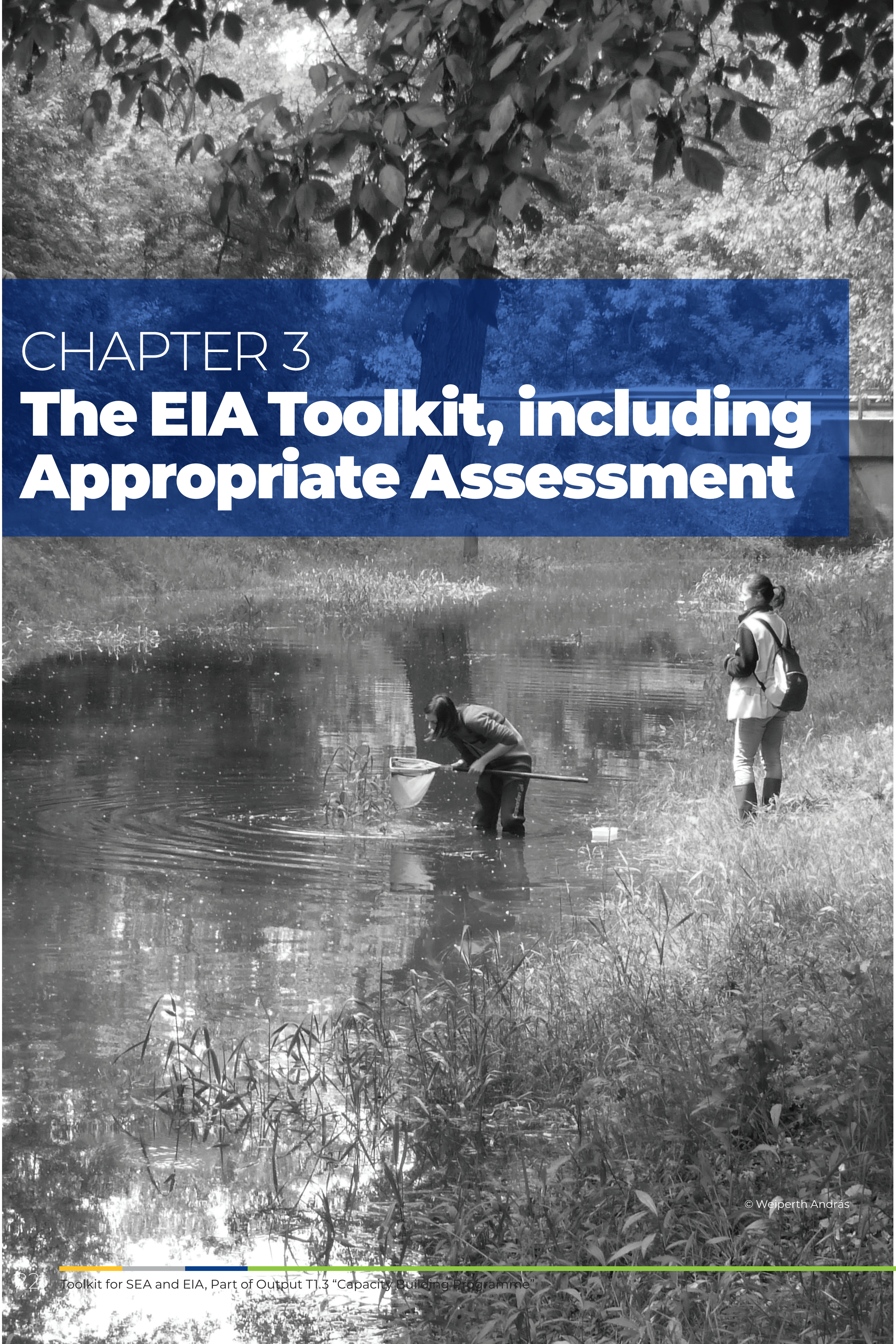
An example of a monitoring programme is presented in the table below. All of the information included in the table should be established by the experts involved in the SEA and adapted to the plan or programme under assessment and the country / region where it is proposed.

Table 4 **Example of a table to establish the monitoring programme proposed within the SEA process**

Environmental criteria	Monitoring programme		
	Indicator	Target	Institutions that can collect the data
Natura 2000 sites	Conservation status of habitats and species in Natura 2000 sites	The favourable conservation status for all habitats and species	National Agency for Natural Protected Areas
Areas of high importance for biodiversity	Surface (in ha) of habitats of Community interest outside Natura 2000 sites	At least 250 000 ha at a national level for habitat 91E0*	National Agency for Environmental Protection
Other nationally designated protected natural areas	Conservation status of habitats and species protected at national level	The favourable conservation status for all habitats and species	National Agency for Natural Protected Areas
Structural connectivity (for ecological corridors)	Degree of connectedness (or other connectivity indices)	Implementation of a system of wildlife crossings, which are permeable for the entire species spectrum, with appropriate land use arrangement in the surrounding areas	National Agency for Environmental Protection, NGOs
Functional connectivity (for ecological corridors)	Number of individuals passing through a particular corridor area	No significant difference in the number of sightings / crossings of wildlife compared to the period before the implementation of the plan	National Agency for Environmental Protection, NGOs
Core habitats	Size of the core habitat area	No significant reduction in the size of core habitats after the implementation of the plan	National Agency for Environmental Protection, NGOs
Water bodies	Degree of connectivity and ecological status of water bodies	No additional fragmentation of water bodies. No changes in the ecological status of the water bodies due to the implemented plan	National Water Management Authorities
...	...	...	...
Other relevant criteria	-	-	-

* Please note that these environmental criteria and the information in the rest of the table are only examples. They should be changed and adapted for each developed SEA.

CHAPTER 3
The EIA Toolkit, including Appropriate Assessment



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3.1 Overview of the EIA Procedure

The nature of an Environmental Impact Assessment (EIA) is defined within the framework of Directive 2014/52/EU, amending Directive 2011/92/EU (the EIA Directive).[9] The Directive applies to public and private projects, which are considered likely to have a significant effect on the environment.

Often, the EIA procedure also includes an Appropriate Assessment, if the project under analysis has the potential to generate a significant impact on the integrity of a Natura 2000 site. An Appropriate Assessment can also be done for the SEA procedure, but it is usually less likely to be required.

The Appropriate Assessment (sometimes called a Natura 2000 Impact Statement in certain countries) is performed according to the requirements set out in Directive 92/43/EEC (the Habitats Directive[10]) and Directive 2009/147/EC (the Birds Directive[11]). In addition to these directives, the European Commission released several guidelines for Appropriate Assessments, the most recent being the 'Revised methodological guidance on Article 6(3) and (4) of the Habitats Directive', developed in 2021[12].

More general details regarding the Appropriate Assessment are available in the TRANSGREEN deliverable 'Keeping Nature Connected – Environmental Impact Assessment (EIA) for Integrated Green Infrastructure Planning'.[13]

The EIA procedure includes the development of an **environmental impact assessment report**, which should include an analysis of alternatives (including a 'no project' alternative), a description of the baseline environmental conditions and their likely future trends, an assessment of the envisioned project impacts, as well as avoidance, mitigation and/or compensation measures, established to ensure no significant impact.

3.2 Proposed toolkit for EIA

3.2.1 Selection of alternatives at project level

For the alternative selection at project level, a more detailed version of the multi-criteria analysis (MCA) described above should be done.

For this version of the detailed MCA, a very solid set of data is required. This can include detailed publicly available data, as well as in-depth analysis in the field, where this is possible. The data has to clearly reflect the conditions existing in the proposed area of the project.

This MCA should include, among others, aspects related to the environmental impacts of the project, as well as aspects related to the estimated costs of the project (analysed through a cost-benefit analysis). Technical aspects related to the infrastructure can also be added to the analysis, but they shouldn't be considered as more important than the environmental criteria.

The environmental criteria selected for this MCA should be more detailed than the ones included

9 The consolidated version of the EIA Directive is available here: https://ec.europa.eu/environment/eia/pdf/EIA_Directive_informal.pdf.

10 Available here: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043.

11 Available at the following link: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147.

12 The Guideline is available here: https://ec.europa.eu/environment/nature/natura2000/management/pdf/methodological-guidance_2021-10/EN.pdf.

13 Deliverable available here: https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/35/f5374e0aee3813cfd352c8005b5ceb-0da52d52c5.pdf.

in the analysis done for SEA, considering that at project level more details are known in regards to the proposed works.

The criteria have to be selected taking into consideration the particularities of the analysed project and of the area in which the project is proposed, and should be able to indicate differences between the alternatives under analysis. They can be chosen in accordance with the factors established in the EIA Directive:

1. Population and human health;

2. Biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

3. Land, soil, water, air and climate;

4. Material assets, cultural heritage and the landscape;

5. The interaction between the factors mentioned above.

The chosen criteria should have corresponding indicators, to be used for quantification and for showcasing the differences between the analysed alternatives.

Table 5 **Example of criteria and indicators for the Multi-Criteria Analysis at the project stage**

Criteria	Indicator
Noise level	Surface area of settlements affected by increases in noise levels
Social aspects	Number of residential buildings requiring demolition
	Number of settlements separated by the infrastructure alignment
Biodiversity	Surface affected in Natura 2000 sites
	Surfaces of Priority habitats affected outside Natura 2000 sites
	Surfaces of habitats of strictly protected species intersected
	Surfaces of breeding habitats for Natura 2000 species, affected inside and outside Natura 2000 sites
	Length of the proposed infrastructure that can be considered permeable (large bridges, tunnels, etc.)
	Number of intersections with priority habitat areas
	Number of intersections with key umbrella species' habitats
	Number of ecological corridors potentially interrupted by the proposed infrastructure (for each relevant species)
Air quality	Surface of settlements with increased levels of air pollution intersected by alternative (considered at risk of lowering air quality)
Water bodies	Number of intersections with water bodies with Very good and Good ecological status
	Length of the intersection of riparian vegetation near water bodies
	Total volume of hydro-technical works
Soil	Volume of ground to be taken from borrow pits
Climate change	Length of the project subject to the risk of flooding or fire
Cultural values	Number of intersections with important archaeological, historic and cultural areas
Landscape	Total volume of excavations
	Number of touristic trails from which the structure is visible
...	...
Other relevant criteria	-
	Total score

In the first analysis of the proposed alternatives at project level, situations can also arise in which a specific alterative should be rejected due to possible unmitigable impacts on very important features (natural or cultural heritage). These can be considered as 'no-go' areas, in which the analysed type of project should not be implemented. The analysis of these situations at this level of the assessment allows for the elimination of non-feasible alternatives and can ease up the further assessment process.

The importance and the differences of the weight value of each indicator should be established by each EIA expert, based on the particular details related to each analysed project. The level of importance given to each indicator should reflect the country's strategies, plans and intentions in regards to each environmental factor, as well as the requirements existing at the level of the European Union (if applicable). In general, as described in the SEA toolkit the importance of biodiversity criteria should have greater value than the other environmental criteria.

An example of criteria that could be used, together with their indicators and an example of values is presented in the table below.

* Please note that these criteria, indicators and the information in the rest of the table are only examples. They should be changed and adapted to each EIA.

	Unit of measurement	Importance	Alternative 1		Alternative 2		Alternative 3		---	Alternative X
			Input	Score	Input	Score	Input	Score		
	ha	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	ha	...	...	...	...	...	...	...	...	...
	ha	...	...	...	...	...	...	...	...	...
	ha	---	---	---	---	---	---	---	---	---
	ha	...	...	...	...	...	...	...	...	...
	km	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	ha	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	m	...	...	...	...	...	...	...	...	...
	m^3	...	...	...	...	...	...	...	...	...
	m^3	...	...	...	...	...	...	...	...	...
	km	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	mil. m^3	...	...	...	...	...	...	...	...	...
	Number	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...
	-	-	-	-	-	-	-	-	...	-
			-	0	-	0	-	0	-	-

3.2.2 Assessment of baseline conditions

The assessment of baseline conditions has to be completed for all of the environmental factors analysed in the EIA report and potentially impacted by the project (established based on the requirements of the EIA Directive). The assessment of baseline conditions should include field measurements and observations as well as a detailed analysis of the status of the habitats or species under consideration. This assessment needs to include and present an evaluation of the sensitivity of the environmental aspects under analysis (for instance, the sensitivity of the habitats).

An important component in the assessment of baseline conditions for biodiversity is represented by the analysis of ecological corridors and appropriate areas for the movement of fauna. Depending on the situation, this analysis can be carried out with the use of existing information related to ecological corridors. If there is insufficient information related to ecological corridors in the area, it is recommended to undertake modelling to identify the local corridors and to confirm its results through fieldwork. The modelling of local corridors should follow a series of steps, presented in more detail in Output T1.1 'A Methodology for Standardised Monitoring of Ecological Connectivity - Guidelines for the analysis of structural and functional connectivity' of the SaveGREEN project.

The assessment of the baseline conditions must also include monitoring activities, for ensuring as much as possible the avoidance and mitigation of possible impacts of new infrastructure.

For infrastructure projects, it is preferable to include a three-stage monitoring programme. This type of programme, detailed in Hlaváč *et al.* 2019, proposes a framework based on monitoring during the three main stages of a project:

1. Before construction;
2. During construction;
3. After construction.

More details related to monitoring are presented in section 3.7.

3.2.3 Assessment of effects and impacts

For the assessment of effects and impacts, it is necessary to use all the data and information gathered through the monitoring done during the pre-construction phase. For the methodology presented in this output, it is proposed that the concepts of 'effect' and 'impact' are differentiated as follows:

- **Effects** refer to the changes caused in the physical environment as a direct consequence of activities in the project (in the construction and operation phases). Effects mainly include the change of topography, pollutant emissions, the generation of waste (i.e. changes in the structural connectivity).
- **Impacts** include changes at the level of the analysed environmental parameters and can be represented by changes in the population size and structure, changes in human health, degradation of habitats and disturbance of fauna, etc. (i.e. changes in functional connectivity).

The assessment of effects and impacts can be done by following a series of steps as described in detail in the next section of the chapter:

- Identification of effects;
- Quantification of effects;
- Identification of impacts;
- Quantification of impacts;
- Assessment of the impact significance.

3.2.3.1 Identification of effects

The identification of effects can be done by following these steps:

1. Analysis of all the interventions proposed by the project. The interventions should be the broad themes of the analysed project (e.g. for a new road, one intervention can be 'Construction of bridges');

2. Identification of all the activities resulting from the construction and the operation of the project. The activities are the detailed list of tasks necessary for implementing the interventions (e.g. for the 'Construction of bridges' the list of activities could include: removal of riparian vegetation, removal of bank substrate, temporary deviation of the river, construction of a foundation, construction of support structure, construction of bridge deck, etc.);

3. Identification of all the changes (effects) which take place in the physical and socio-economic environment following the construction and operation of the project.

The identification of effects can be performed through the use of a table, showcasing the project interventions, their main activities as well as the likely effects of these interventions. An example of such a table is presented below.

Table 6 Example of a table for the identification of the likely effects of the project interventions

Phase	Intervention code	Intervention	Main activities	Effects of the intervention
Construction	I.C.1	Ground clearing	Removal of vegetation, ground levelling	Reduction of vegetated area, disturbance of soil, soil surplus
Construction	I.C.2	Creation of access roads	Removal of vegetation, ground levelling, excavations, fillings	Elimination of vegetation, increased dust emissions, fragmentation of natural habitats
Construction	I.C.3	Construction works	Excavations, ground levelling, fillings	Occupation of land, elimination of vegetation, increase in dust emissions, increase in noise levels
Construction	I.C.4	Construction of bridges	Temporary working platforms, temporary river deviation, excavations, concrete levelling, drilling	Occupation of land, changes in riparian vegetation, increased turbidity in water, changes in hydrological conditions, increase in noise levels
Operation	I.O.1	Road traffic	Facilitation of the road traffic on the new infrastructure	Increase of mortality of fauna
Operation			Spread of invasive plant species	Changes in the natural vegetation in the area of the project (decrease of structural connectivity)
Operation	I.O.2	Water management	Evacuation of rainwater, snow management, de-icing	Accidental pollution, changes in water quality in rivers, increase in salt levels in the soil
Operation	I.O.3	Service space activity	Operation of activities in service spaces, waste management, rainwater management	Accidental pollution risk, potential attraction of fauna
...	...	...	...	...

* Please note that these interventions, activities and the information in the rest of the table are only examples. They should be changed and adapted to each EIA.

3.2.3.2 Quantification of the effects

For the impact assessment in the next step, it is important to take into consideration the effects which can be quantified and which will likely generate an impact.

The quantification of effects can be done through:

» Measurements of the project proposals (e.g. surfaces affected by various project components, spatial siting of the components, volumes of materials necessary for the construction, etc.);

» Assessment of the permeability of the proposed infrastructure (especially, but not only, in areas of ecological connectivity);

» Numerical estimations and calculations for air emissions or other components where this is required;

» Modelling of projected changes, such as noise levels during the operation phase of the project;

» Other estimations based on the existing knowledge or outcomes of similar projects.

A specific indicator has to be established for each quantified effect. Examples of effects and indices which could be used in the case of linear infrastructure projects are presented in the table below.

3.2.3.3 Identification of impacts

The identification of impacts has to be carried out based on the previously identified effects. This stage should identify the likely changes at the level of the analysed environmental parameters, following the appearance of an effect.

This stage should aim to identify all of the impacts likely to occur due to the implementation of the project as thoroughly as possible. It should not include quantifications of the impacts. The quantification of impacts is presented in detail in chapter 3.2.3.4 of this Toolkit.

Table 7 Examples of effects and indices

Types of effects (examples)	Indices for calculation	Measurement units
Natural surface occupied	Calculations	km^2 or ha
Interruption of ecological corridors	Calculations	Number of corridors
Soil compaction	Calculations	m^2 or ha
Soil contamination	Numeric modelling	m^3
Removal of vegetation	Spatial analysis	m^2 or ha
Pollutant emissions	Calculations	mg/s
The concentration of atmospheric pollutants	Numeric modelling	mg/m^3
Noise level	Numeric modelling	dB(A)
Risk of landslides	Spatial analysis / Numeric modelling	ha
Collision of fauna with traffic	Calculations	Number of individuals
Changes in the river banks	Spatial analysis	m^2 or ha

* Please note that the effects, indices and the information in the rest of the table are only examples. They should be changed and adapted to each EIA.

3.2.3.3.1 Impact on abiotic components

The identification of impacts should follow a process of identifying the cause – effect – impact relationship.

The types of impacts are specific to each environmental component, but the main difference between the impacts and the effects is that impacts imply changes to the specific sensitive environmental parameters. For instance, an effect might be the emission of pollutants into the air. From this effect, several impacts can appear on sensitive environmental parameters such as a change in air quality, human health issues or changes in the flora of the area.

Following the cause – effect – impact approach, it is necessary to list all of the proposed project interventions, as well as the main activities related to them. Based on these, their expected effects can be identified, followed by the expected impacts on the environmental components (including biodiversity, detailed in the following section of this Toolkit). One of the most important components in the assessment of impacts is making the correct and complete connection between the project proposals and the potential impacts they might generate on all the considered environmental parameters. This can be done through a thorough analysis of all of the project proposals (during both the construction and operation phases), in order to identify all of the effects and potential impacts each intervention can generate on each environmental parameter.

Effects vs. impacts - conceptual differences

For the purposes of this Toolkit, a differentiation between the concepts of effects and impacts is proposed. This helps to ensure that a rigorous and complete identification of the possible effects that an infrastructure project might generate, as well as a complete assessment of the probable impacts which might be caused by the project.

In this understanding, **effects** refer to changes generated in the physical environment, as a direct consequence of the causes (interventions) generated by the analysed project, in all of its phases of implementation. **Impacts** can include, either at a structural level, or at a functional level, changes on the sensitive analysed environmental parameters (things such as Natura 2000 sites, ecological corridors, habitats and species or even human health and well-being).

The following figure shows the relationship between causes, effects and impacts, as they are proposed to be used within this Toolkit.

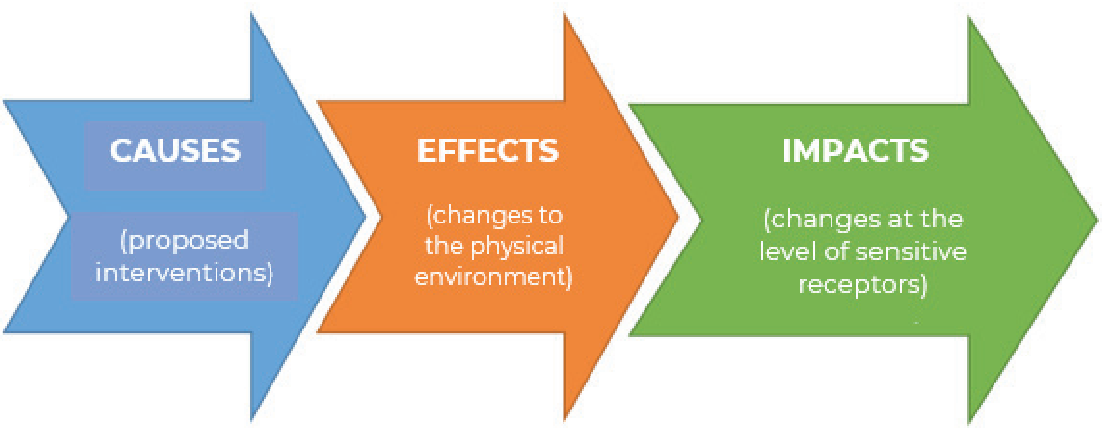

Figure 1 The relationship between causes, effects and impacts, as they are understood in this Toolkit

The next table presents an example of such an analysis of a proposed new motorway. It shows examples of the application of the cause – effect – impact framework for multiple environmental components, as well as examples of effects and impacts generated by linear infrastructure projects (in particular road projects).

The impacts to be included in the analysis of abiotic components can be related to issues such as:

» Fulfilling certain targets related to the ecological or chemical status of water bodies (in accordance with the requirements of the Water Framework Directive);

Table 8 **Example of a table used for the identification of the impacts likely to occur due to a new motorway project. This table also includes 'biodiversity' as an environmental factor, but the potential impacts on biodiversity are discussed in more detail in the following section**

Type of intervention		Causes (Activities)	Environmental factors
I.C.1	Developing construction site	Temporary facilities	Soil
		Temporary facilities	Biodiversity
		Platform-building	Soil
		Platform-building	Biodiversity
		Groundwater supply	Groundwater
		Preparing concrete and asphalt mixtures	Air quality
		Material/waste storage	Groundwater
		Material/waste storage	Air quality
		Material/waste storage	Biodiversity
		Material/waste storage	Soil
		Accidental discharge of pollutants into the ground	Groundwater
		Accidental discharge of pollutants into the ground	Soil
		Accidental discharge of pollutants into the ground	Surface water
		Rainwater drainage from construction site	Surface water
		Employment	Population
		Employment	Material goods
I.C.2	Temporary access roads	Earthworks	Air quality
		Earthworks	Soil
		Earthworks	Biodiversity
		Earthworks	Surface water
		Earthworks	Biodiversity
		Fertile soil storage	Biodiversity
		Accidental discharge of pollutants into the ground	Groundwater
		Accidental discharge of pollutants into the ground	Soil
		Site traffic	Air quality
		Site traffic	Biodiversity
		Site traffic	Human health
		Site traffic	Material goods
		Site traffic	Material goods
		Site traffic	Cultural heritage
		Site traffic	Landscape

- Legislative thresholds for certain pollutant concentrations (e.g. air quality, soil quality, etc.);
- Fulfilling the conservation objectives established for natural protected areas (either Natura 2000 sites or other types of protected areas);
- Loss of financial resources or any other material assets;
- Threats to human health, well-being or cultural heritage.

These types of impacts on the environment need to be analysed and defined corresponding to the specific conditions of each project and each country of interest. The identification of impacts can be done through the use of a table (an example of a table is presented below).

	Effects/Risks	Direct impacts
	Soil compaction	Altering the productive capacity of the soil
	Reducing vegetation cover	Altering habitats
	Soil insulation	Loss of soil's productive capacity
	Removal of vegetation	Loss of habitats
	Change in groundwater quality	Quantitative alterations of groundwater
	Emission of air pollutants	Modification of air quality
	Introduction of pollutants into the groundwater	Altering groundwater quality
	Emission of air pollutants	Changing air quality
	Covering vegetation with soil and other materials	Habitat alteration
	Infiltration of pollutants into the soil	Soil quality alteration
	Infiltration of pollutants into the groundwater	Groundwater quality alteration
	Infiltration of pollutants into the soil	Soil quality alteration
	Infiltration of pollutants into surface waters	Surface water quality alteration
	Infiltration of pollutants into surface waters	Surface water quality alteration
	Temporary settlements within project area	Human population structure changes
	Temporary employment of locals in construction activities	Financial gains
	Emission of air pollutants	Changes in water quality
	Soil compaction	Altering the soil's productive capacity
	Removal of vegetation	Habitat loss
	Substrate and river bank alteration	Ecological status decline for water bodies
	Longitudinal connectivity fragmentation	Habitat fragmentation
	Covering vegetation with soil and other materials	Habitat alteration
	Infiltration of pollutants into the groundwater	Groundwater quality alteration
	Infiltration of pollutants into the soil	Soil quality alteration
	Emission of air pollutants	Changes in water quality
	Raising noise levels	Disruption of species activity
	Raising noise levels	Noise-generated discomfort
	Vibrations	Impairment of real estate
	Increasing the level of traffic on public roads	Financial losses
	Vibrations	Affecting the cultural heritage
	Increasing heavy traffic	Reducing the aesthetic value of the landscape

Type of intervention		Causes (Activities)	Environmental factors
I.C.3	Relocation of utility networks	Earthworks	Air quality
		Earthworks	Soil
		Earthworks	Biodiversity
		Earthworks	Biodiversity
		Land storage	Biodiversity
		Foundation construction	Soil
		Foundation construction	Biodiversity
		Welding and assembly operations	Air quality
		Accidental discharge of pollutants into the ground	Groundwater
		Accidental discharge of pollutants into the ground	Soil
		Temporary disconnection of utilities	Material goods
I.C.4	Road relocation	Earthworks	Air quality
		Earthworks	Soil
		Earthworks	Biodiversity
		Fertile soil storage	Biodiversity
		Accidental discharge of pollutants into the ground	Groundwater
		Accidental discharge of pollutants into the ground	Soil
		Pouring asphalt mixtures	Air quality
		Car traffic diversion	Air quality
		Car traffic diversion	Material goods
I.C.5	Earthworks	Expropriations	Material goods
		Expropriations	Biodiversity
		Expropriations	Biodiversity
		Excavations / fillings / borrow pits	Human health
		Excavations / fillings / borrow pits	Population
		Excavations / fillings / borrow pits	Human health
		Excavations / fillings / borrow pits	Air quality
		Excavations / fillings / borrow pits	Soil
		Excavations / fillings / borrow pits	Soil
		Excavations / fillings / borrow pits	Soil
		Excavations / fillings / borrow pits	Soil
		Excavations / fillings / borrow pits	Geology
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Cultural heritage
		Excavations / fillings / borrow pits	Landscape
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Biodiversity
		Excavations / fillings / borrow pits	Biodiversity
		Accidental discharge of pollutants into the ground	Groundwater
		Accidental discharge of pollutants into the ground	Soil

Effects/Risks	Direct impacts
Emission of air pollutants	Changes in air quality
Soil compaction	Altering the soil's productive capacity
Removal of vegetation	Habitat alteration
Removal of vegetation	Habitat loss
Removal of vegetation	Habitat alteration
Removal of soil	Quantitative soil losses
Removal of vegetation	Habitat loss
Emission of air pollutants	Changes in air quality
Infiltration of pollutants into the groundwater	Alteration of groundwater quality
Infiltration of pollutants into the soil	Alteration of soil quality
Temporary disconnection of utilities	Financial losses
Emission of air pollutants	Changes in air quality
Soil compaction	Losing the soils' productive capacity
Removal of vegetation	Habitat loss
Covering vegetation with soil and other materials	Habitat alteration
Infiltration of pollutants into the groundwater	Groundwater quality alteration
Infiltration of pollutants into the groundwater	Groundwater quality alteration
Emission of air pollutants	Changes in air quality
Emission of air pollutants	Changes in air quality
Increasing the level of traffic on public roads	Financial losses
Differences between the value of compensation and the market value of real estate	Financial losses
Destruction of shelters and nests	Habitat loss
Destruction of shelters and nests	Reduction of population
Raising noise levels	Noise-generated discomfort
Vibrations	Financial losses
Emission of air pollutants	Increasing the risk of diseases
Emission of air pollutants	Changes in air quality
Removal of soil	Quantitative soil losses
Changing the topography of the land by storing land	Altering soil quality
Contaminated soil handling (identification of contaminated sites)	Altering soil quality
Causing landslides	Losing the soils' productive capacity
Structural changes due to excavations	Geological substrate losses
Causing landslides	Habitat alteration
Construction works inside archaeological sites	Affecting the cultural heritage
Causing landslides	Reducing the aesthetic value of the landscape
Removal of vegetations	Habitat loss
Destruction of shelters and nests	Habitat loss
Wildlife collision with site traffic	Reduction of population
Increasing the noise level	Disruption of species activity
Presence of non-native species	Habitat alteration
The emergence of physical barriers for wildlife	Habitat fragmentation
Infiltration of pollutants into the groundwater	Altering groundwater quality
Infiltration of pollutants into the soil	Altering soil quality

Type of intervention		Causes (Activities)	Environmental factors
I.C.6	Bridges, viaducts, tunnels	Construction of bridges and viaducts	Surface water
		Construction of bridges, viaducts and passages	Surface water
		Construction of bridges, viaducts and passages	Surface water
		Construction of bridges, viaducts and passages	Soil
		Construction of bridges, viaducts and passages	Soil
		Construction of bridges, viaducts and passages	Geology
		Construction of bridges, viaducts and passages	Biodiversity
		Construction of bridges, viaducts and passages	Biodiversity
		Construction of bridges, viaducts and passages	Human health
		Construction of bridges, viaducts and passages	Human health
		Construction of bridges, viaducts and passages	Human health
		Construction of bridges, viaducts and passages	Cultural heritage
		Construction of bridges, viaducts and passages	Landscape
I.C.7	Consolidation works	Construction of retaining walls	Groundwater
		Construction of retaining walls	Surface water
		Construction of retaining walls	Surface water
		Construction of retaining walls	Soil
		Construction of retaining walls	Geology
		Construction of retaining walls	Biodiversity
		Construction of retaining walls	Human health
		Construction of retaining walls	Material goods
		Construction of retaining walls	Landscape
I.C.8	Hydro-technical works	Temporary watercourse diversion	Surface water
		Temporary watercourse diversion	Biodiversity
		Temporary watercourse diversion	Soil
		Protection with gabion wall	Surface water
		Protection with gabion wall	Biodiversity
		Arrangement with gabion walls	Surface water
		Arrangement with gabion walls	Biodiversity
		Hydro-technical arrangements for bridges	Biodiversity
		Hydro-technical arrangements for bridges	Biodiversity
I.C.9	Highway works	Constructing the road structure	Groundwater
		Constructing the road structure	Air quality
		Constructing the road structure	Human health
		Installation of fences on the highway edges	Biodiversity
		Installation of fences on the highway edges	Biodiversity
		Installation of fences on the highway edges	Human health
		Building underpasses / overpasses for wildlife	Soil
		Building underpasses / overpasses for wildlife	Geology
		Building underpasses / overpasses for wildlife	Biodiversity
		Building underpasses / overpasses for wildlife	Biodiversity

Effects/Risks	Direct impacts
Removal of riparian vegetation	Ecological status decline for water bodies
Hydro-morphological changes due to the construction of piles in the minor riverbed	Ecological status decline for water bodies
Partial temporal deviation of the watercourse	Ecological status decline for water bodies
Soil compaction	Altering the soil's productive capacity
Soil removal	Losing the soils' productive capacity
Structural changes due to the construction of foundations	Alteration of the geological substrate
Removal of riparian vegetation	Habitat loss
Emergence of physical barriers for wildlife (only during construction)	Habitat fragmentation
Increasing the noise level	Noise-generated discomfort
Emission of air pollutants	Increasing the risk of diseases
Vibrations	Impact on real estate
Construction works inside archaeological sites	Affecting the cultural heritage
Creating massive artificial structures	Reducing the aesthetic value of the landscape
Fragmentation of groundwater connectivity	Lowering the groundwater level
Riverbanks alteration	Ecological status decline for water bodies
Removal of riparian vegetation	Ecological status decline for water bodies
Soil removal	Losing the soils' productive capacity
Substrate structural changes	Alteration of the geological substrate
Emergence of physical barriers for wildlife	Habitat fragmentation
Disaster prevention (landslides)	Avoiding the loss of human life
Disaster prevention (landslides)	Avoiding economic losses
Creating massive artificial structures	Reducing the aesthetic value of the landscape
Creating artificial stream bed	Major water body changes
Creating artificial stream bed	Habitat loss
Removal of soil	Losing the soils' productive capacity
Riverbank alteration	Ecological status decline for water bodies
Riverbank alteration	Habitat loss
Riverbank and substrate alteration	Ecological status decline for water bodies
Riverbank alteration	Habitat loss
Changes in favourable amphibian habitats	Habitat loss
Fragmentation of longitudinal connectivity	Habitat fragmentation
Disrupting the supply of groundwater with rainfall	Altering groundwater quantity
Emission of air pollutants	Changes in air quality
Emission of air pollutants	Increasing the risk of diseases
Disruption of ecological connectivity for terrestrial wildlife	Habitat fragmentation
Preventing access of wildlife to the road	Maintaining population numbers
Preventing access of wildlife to the road	Avoiding the loss of human life
Soil removal	Losing the soils' productive capacity
Structural changes due to the construction of foundations	Alteration of the geological substrate
Removal of vegetation	Habitat loss
Restoring ecological connectivity for terrestrial wildlife	Defragmenting existing barriers

Type of intervention		Causes (Activities)	Environmental factors
I.C.10	Restoration work	Grassing and restoration works	Biodiversity
		Grassing and restoration works	Landscape
I.O.1	Car traffic	Highway car traffic	Air quality
		Highway car traffic	Air quality
		Highway car traffic	Soil
		Highway car traffic	Biodiversity
		Highway car traffic	Biodiversity
		Highway car traffic	Biodiversity
		Highway car traffic	Biodiversity
		Highway car traffic	Climate conditions
		Highway car traffic	Population
		Highway car traffic	Material goods
		Highway car traffic	Human health
		Highway car traffic	Human health
		Highway car traffic	Cultural heritage
		Highway car traffic	Cultural heritage
		Highway car traffic	Cultural heritage
		Highway car traffic	Landscape
		Highway car traffic	Landscape
		Highway car traffic	Air quality
		Highway car traffic	Biodiversity
		Highway car traffic	Human health
		Highway car traffic	Material goods
		Highway car traffic	Human health
		Highway car traffic	Material goods
		Highway car traffic	Material goods
I.O.2	Rainfall management	Evacuation of pre-treated rainwater into outflows	Surface water
		Evacuation of pre-treated rainwater into outflows	Biodiversity
		Snow removal and frost prevention activities (including snow storage)	Surface water
		Snow removal and frost prevention activities (including snow storage)	Biodiversity
		Snow removal and frost prevention activities (including snow storage)	Soil
		Snow removal and frost prevention activities (including snow storage)	Groundwater
I.O.3	Maintenance and upkeep work	Road resurfacing / repair works	Air quality
		Road resurfacing / repair works	Human health
I.O.4	Service space and maintenance centre activity	Material / waste storage	Biodiversity
		Groundwater supply	Groundwater

* Please note that the interventions, activities and the information in the rest of the table are only examples. They should be changed and adapted to each EIA.

Effects/Risks	Direct impacts
Invasion of non-native and invasive species	Habitat alteration
Landscape restoration of temporarily affected areas	Maintaining the aesthetic value of the landscape
Emission of air pollutants	Changes in air quality
Emission of air pollutants	Reducing the mass flows of emitted air pollutants
Introduction of pollutants into the ground	Altering soil quality
Facilitating the spread of non-native and invasive species	Habitat alteration
Emission of air pollutants	Habitat alteration
Raising noise levels	Disrupting species activity
Wildlife collision with car traffic	Reduction of population
Reducing greenhouse gas emissions	Reducing contributions to climate change
New housing facilities established in the project area	Changes in human population structure
Economic development of highway proximity areas	Financial gains
Emission of air pollutants	Increasing the risk of diseases
Raising noise levels	Noise-generated discomfort
Emission of air pollutants	Affecting the cultural heritage
Vibrations	Affecting the cultural heritage
Increasing the number of tourists	Capitalizing on cultural heritage
Increasing the number of tourists	Capitalizing on cultural heritage
Increasing road traffic (including at night)	Reducing the aesthetic value of the landscape
The emergence of fires	Changes in air quality
The emergence of fires	Habitat alteration
The emergence of fires	Loss of human life
The emergence of fires	Financial losses
Prevention of road accidents	Avoiding the loss of human life
Prevention of road accidents	Avoiding economic losses
Reducing traffic times	Avoiding economic losses
Infiltration of pollutants into surface water	Altering surface water quality
Infiltration of pollutants into surface water	Habitat alteration
Infiltration of pollutants into surface water	Altering surface water quality
Infiltration of pollutants into surface water	Habitat alteration
Infiltration of pollutants into soil	Altering soil quality
Pollutants infiltration into groundwater	Altering groundwater quality
Emission of air pollutants	Changes in air quality
Emission of air pollutants	Increasing the risk of diseases
Attracting wildlife to household waste storage areas	Disrupting species activity
Infiltration of pollutants into the groundwater	Altering groundwater quantity

3.2.3.3.2 Impacts on biodiversity

An example of the five main potential impacts on biodiversity, that are associated with transport infrastructure are presented in the guidelines developed during the TRANSGREEN project – 'Wildlife and Traffic in the Carpathians. Guidelines how to minimize the impact of transport infrastructure development on nature in the Carpathian countries.' (Hlaváč *et al.* 2019). They are presented in short in the following image and are detailed in the TRANSGREEN Guidelines.[14]

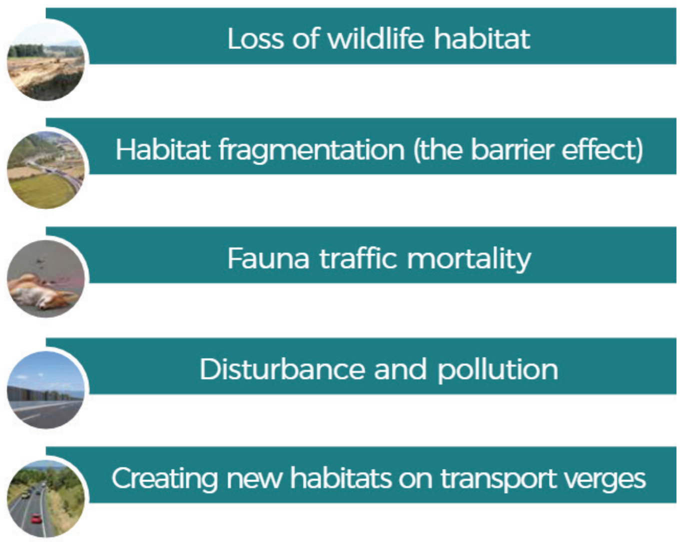

Figure 2 The main types of impacts that are associated with infrastructure projects (© Hlaváč *et al.* 2019)

The identification of impacts on biodiversity can be done with the same identification table presented above. Biodiversity has been highlighted as a separate component due to its importance and because the types of impacts which can occur are more general and widely applicable than the impacts on other environmental components.

When looking at the previous table (Table 8), it can be noted that multiple interventions and multiple effects can lead to the same type of impact. This aspect is very important in the quantification of impacts process, described in detail in the following section.

In the case of biodiversity, it is important to note that impacts might occur on protected areas (such as Natura 2000 sites) or on protected habitats and species outside Natura 2000 sites. These differences are highlighted in this document in sections 3.3 (assessment of impacts on Natura 2000 sites) and 3.4 (requirements for impact assessment of habitats and species of Community interest, outside Natura 2000 sites).

3.2.3.4 Quantification of impacts

A quantification of impacts should be performed to the greatest extent possible for all of the environmental components analysed and for all of the project phases. In this Toolkit, the focus will be on the biodiversity component, and the quantification methods for this component will be more detailed.
In the case of the other environmental components, quantifications should be based on spatial analysis (e.g. mapping of areas with increased noise levels, mapping of the spread of potential pollution, etc.) or statistical analysis (e.g. analysis of social and economic changes expected due to the project).

The quantification of impacts on biodiversity has to be based on the previously identified causes and effects and grouped in (a) habitat degradation and (b) species disturbance impacts.

A. Quantification of habitat degradation

A.1 Quantifying habitat loss and habitat alteration

The quantification of habitat loss and habitat alteration should be carried out with the use of a spatial (GIS) analysis. The areas where the project proposes permanent interventions should be considered as habitat loss. Areas

14 The Guidelines are available on the Interreg Danube Transnational Programme TRANSGREEN project website at: https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/35/02caaafe3c1c1365f76574e754ddbdc4e1af4a7a.pdf.

where it is likely that the structure of the habitats will be affected (e.g. through the spread of invasive plant species or changes in water quality, etc.) can be considered as 'altered'. The levels of noise caused by the project should also be analysed. They can lead to a loss of habitat (through species displacement) or the alteration of habitat (through disturbance).

An example of a tool to quantify the areas of lost or altered habitat is presented in the table below.

In the use of this tool, it is important to filter the proposed interventions and to establish a clear value that is lost habitat surface if more than one intervention occurs in the same area. This is one reason why it is important for the analysed impacts to be represented spatially in a GIS and analysed through the use of this system.

A.2 Quantifying habitat fragmentation

The quantification of habitat fragmentation should take into consideration two main components:

» A.2.1 Changes in ecological connectivity at landscape level;

» A.2.2 Permeability of the proposed infrastructure.

A.2.1 Analysis of changes in ecological connectivity at landscape level

This analysis should assess the changes in ecological connectivity at the level of the landscape, taking into consideration impacts which occur at a distance, as well as existing pressures and possible threats which might affect ecological connectivity, either in the context of implementing the project, or without the project.

Table 9 **Example of a table for quantifying lost or altered habitat / favourite habitat surfaces, based on the project's proposed interventions. The column of Natura 2000 sites should be included if suggested plans intersect such an area**

Intervention		Natura 2000 site	Habitat / favourable habitat affected	Surface lost (ha)	Surface altered (ha)
I.C.1	Developing construction site	ROSCI0297	9170	3.6	2.1
I.C.2	Construction of temporary access roads	ROSCI0297	91E0*	0.5	0.15
		ROSPA0028	*Alcedo atthis*	1.3	0.6
I.C.3	Relocation of utility networks	ROSCI0297	6430	0.4	0.1
I.C.4	Road relocation	ROSPA0028	*Ciconia ciconia*	0.5	0.2
I.C.5	Construction of motorway (earthworks)	ROSCI0297	6430	0.45	1.2
I.C.6	Bridges, viaducts, tunnels	ROSCI0297	91E0*	0.04	0.3
I.C.7	Consolidation works	ROSPA0028	*Alcedo atthis*	0.02	0.15
		ROSCI0297	91E0*	0.5	0.25
I.C.8	Hydro-technical works	ROSCI0297	91E0*	0.2	0.05
I.C.10	Restoration works	ROSCI0297	91E0*	0	0.4
...	...	...	...	...	...

* Please note that the effects, values and the information in the rest of the table are only examples. They should be changed and adapted to each EIA.

The analysis should consider all the potential cumulative impacts at the level of the landscape, such as the existence and potential future changes to agricultural areas, forestry management, water management, infrastructure development and urbanization.

For transport infrastructure (especially motorways), it is necessary to analyse the impact on connectivity from changes in the traffic level on the roads adjacent to the proposed infrastructure development (e.g. national roads, first level roads, etc.). Such an assessment was done in the SaveGREEN Romanian Pilot Area Târgu Mureş – Târgu Neamţ, for the adjacent roads, which will be influenced by the construction of a motorway. This analysis indicated that there are several road sections in which the expected changes in the level of traffic will turn these sections from permeable to impermeable (based on the traffic values presented in Figure 6 of this document).

The following map shows the results of the analysis of traffic changes on the roads that are adjacent to the Târgu Mureş – Târgu Neamţ motorway. On the right-hand side of the map, marked in red, is a road section which will be influenced heavily by the motorway, increasing the level of traffic on it from a barrier level (approximately 6 000 vehicles / day) to a completely impermeable level (11 000 – 12 000 vehicles / day). This result underlines the need to propose defragmentation measures in areas which might be located at a certain distance from the project site, and whose connection to the project might not be readily obvious.

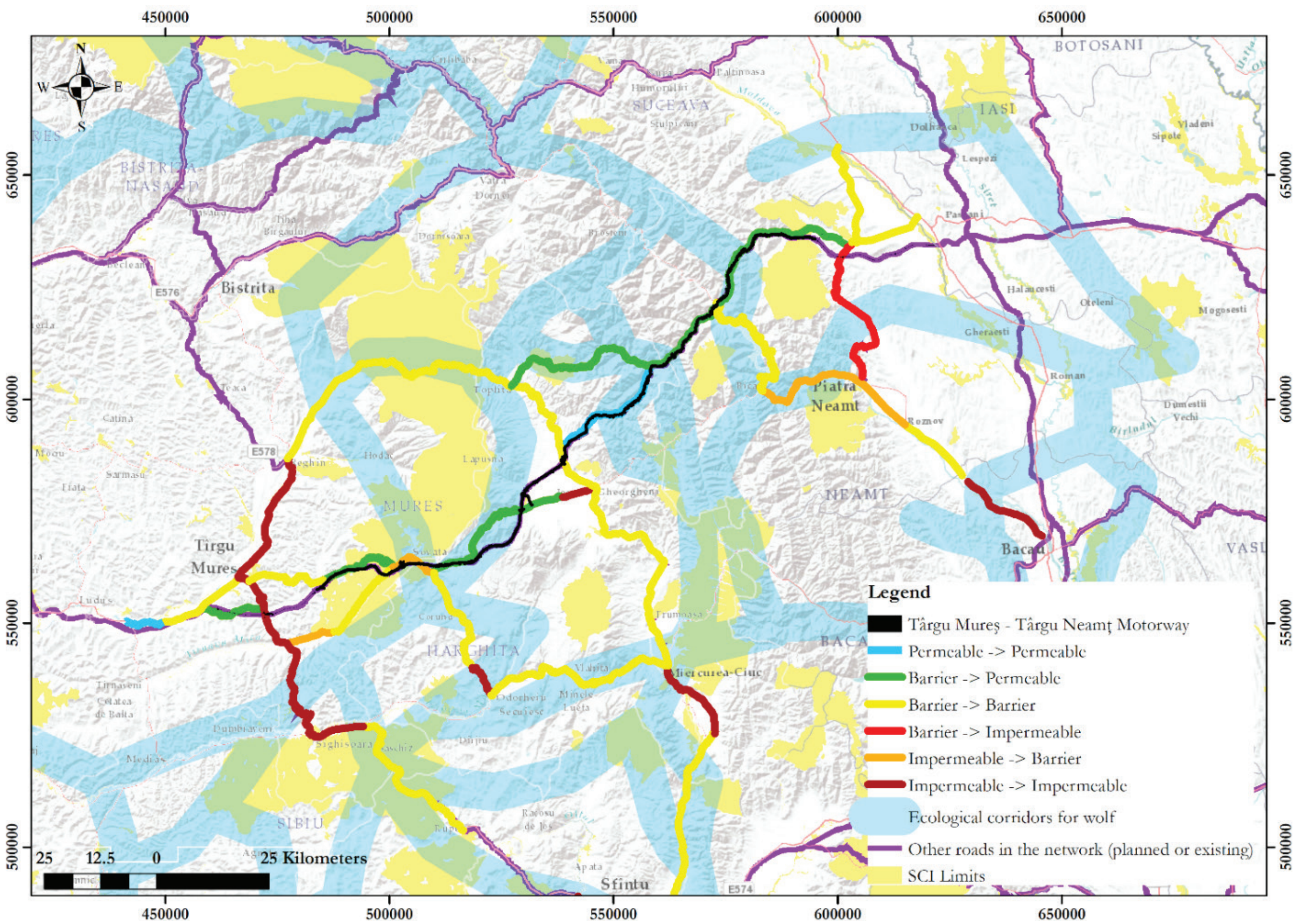

Figure 3 Changes in the permeability of the adjacent roads, following the construction of a new motorway. The data used forecasts the level of traffic from 2050

A.2.2 Analysis of the permeability of the proposed infrastructure

The analysis of the permeability of the proposed infrastructure can show how it will fit into the landscape from an ecological connectivity standpoint.

For the analysis of the permeability of the linear infrastructure, two aspects should be assessed:

A.2.2.1. The level of **permeability of the proposed structures** (bridges, viaducts, tunnels, underpasses, etc.) in a structural connectivity approach, considering, for instance, their Openness Index (OI);

A.2.2.2 The **behavioural fragmentation** caused by high levels of noise, light or anthropic presence and disturbance.

Both assessments must have a holistic approach considering both permeable structures and negative factors, in order to realistically portray the impact on functional connectivity for the full spectrum of local species.

A.2.2.1 Analysis of the permeability of the proposed structures (bridges, viaducts, tunnels, underpasses, etc.).

This analysis is aimed at showing if the structural connectivity requirements are fulfilled by the proposed infrastructure project. It is based on two main parameters:

1. **The size of the proposed structures** and their calculated Openness Index (OI).

   The Openness Index is one of the most important and widely used methods to analyse the potential of a structure (an underpass) for ensuring permeability. It is calculated as:

   OI = width x height / length (the width of the underpass, multiplied by its height, divided by its length) (Hlaváč *et al.* 2019).

   Different values for the index indicate a different probability of fauna species using that structure to pass the infrastructure. The following table shows different probabilities of underpass usage in relation to the dimensions of that underpass.

OI interval	Example of dimensions	Functionality for terrestrial mammals up to the size of fox and badger	Functionality for medium-sized mammals (roe deer, wild boar)	Functionality for large mammals (red deer, moose, large carnivores)
0.1 – 0.7	3 x 2 : 30	Minimal	NO/Blockage	NO/Blockage
0.7 – 1.5	10 x 3 : 30	Medium	Minimal	NO/Blockage
1.5 – 2.0	13 x 4 : 30	Good	Medium	Minimal
2.0 – 4.0	20 x 5 : 30	Very good	Medium	Minimal
4.0 – 8.0	30 x 6 : 30	Very good	Good	Medium
8.0 – 40.0	50 x 20 : 30	Very good	Very good	Good
Above 40.0	70 x 25 : 30	Very good	Very good	Very good

Figure 4 Functionality level of different values for the OI of underpasses (© Hlaváč *et al.* 2019)

Forest habitats

Animal category	Recommended average distance between functional passages
Mammals up to the size of fox and badger	1 - 2 km
Medium-sized mammals	2 - 5 km
Large mammals: in areas of permanent occurrence	3 - 5 km
Large mammals: outside of permanent occurrence areas	Only on migration corridors or in linkage areas (see Chapter 6.4)

Grasslands and shrubs

Animal category	Recommended average distance between passages
Mammals up to the size of fox and badger	1 - 2 km
Medium-sized mammals	3 - 8 km
Invertebrates and small mammals (the European ground squirrel)	3 – 5 km (adapted overpasses with steppic vegetation)
Large mammals	Only on migration corridors or in linkage areas (see Chapter 6.4)

Agricultural landscape

Animal category	Recommended average distance between passages
Mammals up to the size of fox and badger	1 - 2 km
Medium-sized mammals	5 - 10 km
Large mammals	Only on migration corridors or in linkage areas (see Chapter 6.4)

Figure 5 Recommended frequency (density) for functional structures on a linear infrastructure project, based on the different types of habitats (© Hlaváč *et al.* 2019)

2. **The frequency (or density) of functional structures** for different fauna categories. The recommended frequency varies depending on the fauna groups and can range from 1 km in the case of small mammals, amphibians and reptiles to 5 km or more in the case of large mammals. The following table shows the recommended density of fauna passages in various types of habitats.

The analysis of proposed linear infrastructure permeability can be assessed using a matrix, an example of which is presented below (Table 10).

In order for the proposed infrastructure to be considered permeable, it should fulfil the requirements for **functionality** and for **distance to the next functional structure**. Based on the results of the analysis, proposals for additional underpasses, overpasses or ecoducts can be made.

The completion of the different columns should follow the methods presented below.

Table 10 Explanations and methods for completion of the permeability assessment table

Column	Method for completion
Area sensitivity	Categories established as: *Very low, Low, Medium, High, Very high*, based on the features of the landscape. Should be completed based on the expert opinion. For instance, presence of settlements would indicate a *Low* area sensitivity, while an ecological corridor would have a *Very high* sensitivity.
Natural protected area	Should be completed with information on whether the structure is included in a Natura 2000 site or other natural protected area.
Km of structure start	Represents the location (according to the kilometre markers of the proposed infrastructure) of the analysed structure (bridge, viaduct, tunnel, etc.).
Km of structure end	
Type of structure	Indicates the structure under analysis. The assessment can include bridges, viaducts, tunnels, underpasses, overpasses, culverts or any other structure which intersects the proposed infrastructure.
Length (m)	Represents the total length of the structure and equals the difference between the *Km structure end* and *Km structure start* columns.
Obstacles for movement	Indicates the presence of any obstacles, which might affect the fauna movement. Can be deep water, a road, a railway or any other element that the structure crosses over, which can affect movement.
Number of openings	The number of openings of the structure (e.g. a bridge might have 2 openings or more). It is used to correct the length of the structure and establish a usable length.
Other movement limitations (m)	It indicates (in meters) how much of the structure is considered to be impermeable. The presence of a 5-meter-wide road would indicate a limitation of 5 meters.
Total movement limitations (m)	Calculation of the total movement limitations, taking into consideration the number of openings (multiplied by 3 for an average-sizes bridge pillar of 3 meters) + the other movement limitations.
Length corrected for obstacles (m)	Represents the length of the structure minus the total movement limitations.
Average height (m)	Represents the average height of the structure, as measured based on the project drawings.
Width (m)	The width of the road, which the structure passes under.
OI	Openness Index, calculated as stated above.
Functionality	Determined on the basis of the OI, as defined in Figure 2.
Distance requirements	The distance from the analysed structure to the next functional structure. It takes into consideration the results of the functionality analysis and shows if the distance requirements are fulfilled. The values for what represents a fulfilment of the distance requirements are based on the values in Figure 3 and on the sensitivity of the area (first column of the table).

Table 11 Example of a matrix for assessing the permeability of the linear infrastructure proposed by a project. Inputs marked in red text are proposals for improving permeability

Area sensitivity	Natural protected area	Km of structure start	Km of structure end	Type of structure	Length (m)	Obstacles for movement	Number of openings	Other movement limitations (m)	Total movement limitations (m)	Length corrected for obstacles (m)
High		916	1+031	**Bridge**	115	Canal	3	60	66	49
High		2+978	3+158	**Bridge**	180	River	5	48	60	120
High		4+825	4+863	**Bridge**	38	Canal	1	23	23	15
High		5+004	5+034	**Bridge**	30	Canal	1	9	9	21
High		6+980	7+088	**Bridge**	108	Canal	**3**	12	18	90
High		9+535	9+590	**Bridge**	55	Creek	1	18	18	37
High		**12+500**	**12+600**	**Ecoduct**	**100**		**1**	**0**	**0**	**100**
High		13+376	13+425	**Bridge**	49	Creek	1	15	15	34
High		**16+100**	**16+200**	**Ecoduct**	**100**		**1**	**0**	**0**	**100**
High		18+357	18+406	**Bridge**	49	Creek	1	9	9	40
High		**19+806**	**19+820**	**Mammal underpass**	**14**		**1**	**0**	**0**	**14**
High		20+561	20+668	**Bridge**	107	Creek + county road	2	26	29	78
Very high	ROSCI0297	22+974	23+014	**Bridge**	40	Creek	1	10	10	30
Low	ROSCI0297	26+182	26+287	**Viaduct**	105	Creek + European road	2	30	33	73
Low	ROSCI0297	26+385	26+451	**Bridge**	66	River	1	26	26	40
Low	ROSCI0297	26+735	26+776	**Bridge**	41	Creek	1	11	11	30
Low	ROSCI0297	26+904	26+954	**Bridge**	50	River	1	10	10	40
Low	ROSCI0297	27+099	27+148	**Bridge**	49	River	1	9	9	40
Low	ROSCI0297	27+490	27+540	**Bridge**	50	River	1	10	10	40
High	ROSCI0297	31+285	31+367	**Bridge**	82	Creek	3	12	18	64
High	ROSCI0297	32+249	32+386	**Viaduct**	137	Creek	3	16	22	115
Very high	ROSCI0297	33+080	33+174	**Bridge**	94	Creek + European road	2	17	20	75
Very high	ROSCI0297	34+352	34+414	**Bridge**	62	Creek	3	22	28	34

Reasoning for sensitivity

Location of structure (bridge, viaduct, etc.)

Type of structure

Length of structure

Obstacles

Number of openings of structure

Movement limitations

Movement limitations considering the support structures for openings

Length corrected for limitations

Average height (m)	Width (m)	OI	Functionality			Distance requirements					
			Large mammals	Medium mammals	Small mammals	Distance to the next functional structure (km)	Large mammals	Distance to the next functional structure (km)	Medium mammals	Distance to the next functional structure (km)	Small mammals
3	26	6.28	Medium	Good	Very good	1.947	Yes	1.947	Yes	0.974	Yes
5	26	24.31	Good	Very good	Very good	0.806	Yes	0.806	Yes	0.278	Yes
2	26	0.88	No functionality	Minimal	Medium	2.117	Yes	0.141	Yes	0.141	Yes
3	26	2.21	Minimal	Medium	Very good	1.946	Yes	1.946	Yes	1,964	No
4	26	12.69	Good	Very good	Very good	5.412	Yes	2.447	Yes	0.157	Yes
2	26	2.85	Minimal	Medium	Very good	2.91	Yes	1.412	Yes	0.285	Yes
0	**26**	**-**	Very good	Very good	Very good	3.5	Yes	0.776	Yes	0.265	Yes
3	26	3.31	Minimal	Medium	Very good	2.675	Yes	2.675	Yes	0.04	Yes
-	**-**	**-**	Very good	Very good	Very good	4.361	Yes	2.157	Yes	0.08	Yes
2	26	3.69	Minimal	Medium	Very good	2.155	Yes	2.155	Yes	0.424	Yes
2	**26**	**1.08**	No functionality	Minimal	Medium	6.362	Yes	0.741	Yes	0.741	Yes
5	26	16.40	Good	Very good	Very good	5.514	Yes	2.306	Yes	0.132	Yes
3	26	3.15	Minimal	Medium	Very good	3.168	Yes	0.847	Yes	0.847	Yes
8	26	23.05	Good	Very good	Very good	0.098	Yes	0.098	Yes	0.098	Yes
8	26	12.62	Good	Very good	Very good	2.299	Yes	0.284	Yes	0.284	Yes
4	26	4.23	Medium	Good	Very good	1.974	Yes	0.128	Yes	0.128	Yes
2	26	2.97	Minimal	Medium	Very good	1.796	Yes	0.145	Yes	0.145	Yes
3	26	5.03	Medium	Good	Very good	1.602	Yes	0.342	Yes	0.342	Yes
3	26	5.03	Medium	Good	Very good	1.21	Yes	1.21	Yes	0.9	Yes
19	26	47.59	Very good	Very good	Very good	0.882	Yes	0.882	Yes	0.228	Yes
6	26	24.77	Good	Very good	Very good	0.694	Yes	0.694	Yes	0.694	Yes
8	26	21.97	Good	Very good	Very good	0.247	Yes	0.247	Yes	0.247	Yes
7	26	8.72	Medium	Very good	Very good	1.101	Yes	1.101	Yes	0.286	Yes

Average height of structure

Width of structure

OI of the structure

Functionality for different groups (based on IO)

Distance to the next functional structure for different groups and assessment of fulfilment of distance requirements for each group

A.2.2.2 Analysis of behavioural fragmentation

For the analysis of behavioural fragmentation, an assessment related to the total time of the day during which the proposed project structure is impermeable for fauna should be carried out. Impermeability for fauna is related to disturbance for fauna species. In the case of road infrastructure, it can be related to road traffic, as indicated in various guidelines, including the IENE 'COST 341 Habitat Fragmentation due to Transportation Infrastructure' 15, one of the most important documents elaborated on the topic. Values of more than 10 000 vehicles / day are considered to be impermeable to most species, while values over 1 000 vehicles / day are barriers for species (most sensitive species).

If information is available, the fluctuation of the traffic intensity (number of vehicles in an established unit of time) has to be analysed in comparison with the daily activity patterns of the local wildlife species in order to identify the conflict time zones and their duration (e.g. if the traffic is more intense during dusk or early morning and as certain species are more active in these intervals, the number of victims due to collision might be higher).

The approach presented below has been proposed especially for railway projects. but it can be adapted for road projects as well. It uses a simple calculation for estimating the amount of time in a day when the infrastructure is not permeable for animals due to the presence of human activity (in this case running trains).

Based on the existing literature related to behavioural fragmentation due to railroads, a significant impact (completely impermeable infrastructure for most terrestrial animals) occurs on multiple lane railroads with a traffic of more than 15 trains per hour (Seiler & Helldin 2006). In such a situation, the railroad would be occupied by trains for approximately 60% of a full 24-hour interval. An example of a table for assessing behavioural fragmentation for railroads is presented below. The hourly intervals are only an example in these tables and should be specified according to the information available. Any additional or more in-depth information should of course also be included.

Traffic density	Permeability
Road with traffic below 1000 vehicles/day	Permeable to most wildlife species
Roads with 1000 to 4000 vehicles/day	Permeable to some species but avoided by more sensitive species.
Roads with 4000 to 10000 vehicles/day	Strong barrier, noise and movement will repel many individuals. Many trying to cross the road become road casualties.
Motorways with traffic levels above 10000 vehicles/day	Impermeable to most species.

Figure 6 Values of traffic density at which the road is considered impermeable (© Iuell *et al.* 2003)

15 The Handbook is a living document, available for consultation at the following link https://www.iene.info/projects/iene-handbook/

Table 12 Estimation of the percentage of time in which a railway can act as a barrier before a railway rehabilitation project (2023 scenario)

2023									
Hourly interval		Number of hours / interval	Total no. of minutes per interval	Total no. of trains per interval	Barrier effect before train pass (minutes)	Barrier effect during train pass (minutes)	Barrier effect after train pass (minutes)	Total no. of barrier minutes	Percentage of time in which there is a barrier effect (%)
6:00	18:00	12.00	720	20	1	0.5	1	50	6,94
18:00	22:00	4.00	240	14	1	0.5	1	35	14,58
22:00	6:00	8.00	480	14	1	0.5	1	35	7,29

Table 13 Estimation of the percentage of time in which a railway can act as a barrier after a railway rehabilitation project (2040 scenario)

2040									
Hourly interval		Number of hours / interval	Total no. of minutes per interval	Total no. of trains per interval	Barrier effect before train pass (minutes)	Barrier effect during train pass (minutes)	Barrier effect after train pass (minutes)	Total no. of barrier minutes	Percentage of time in which there is a barrier effect (%)
6:00	18:00	12.00	720.00	25	1	0.5	1	8,7	8,7
18:00	22:00	4.00	240.00	40	1	0.5	1	41,7	41,7
22:00	6:00	8.00	480.00	60	1	0.5	1	31,3	31,3

B. Quantification of species disturbance

B.1 Quantifying species displacement

The quantification of species displacement should be done by modelling the effects with the potential to cause displacement, and by subsequently analysing the overlap of modelling results with favourable habitats in the surroundings.

The most likely effect that can lead to disturbance is the increase of noise levels in the case of linear infrastructure projects, especially due to traffic. This can be quantified through noise level modelling and calculations. The results of the modelling can then be applied to the map of favourable habitat areas for species, thus showing the expected noise levels in the favourable habitats.

Based on existing literature, the level of noise associated with species displacement varies depending on the species. The values are usually available in specific studies dedicated to a particular species.

B.2 Quantifying species mortality

Wildlife mortality induced by human activity can be considered a type of disturbance to a species due its potential impact on the entire species population, especially in the case of important and Priority Species according to National and European biodiversity policy and legislation. In the case of strictly protected Natura 2000 species (species listed in Annex 4 of the Habitats Directive), Article 12 of the Habitats Directive states that deliberate killing or deliberate destruction of eggs is forbidden. This situation is explained in more detail in section 3.4 of this Toolkit.

To quantify species mortality in the case of linear infrastructure projects, it is particularly important to analyse the risk for roadkill or railkill during operation, as this is the situation in which this type of impact is most likely to occur. While the other project phases should not be ignored the most relevant phase is the operation period, for this type of impact.

Quantifying species mortality based on literature data

The risk of mortality for an individual of a given species can be estimated based on roadkill / railkill rates recorded in the literature on the subject. If possible, it is preferable for the risk of mortality to be assessed both for the construction, as well as the operation and decommissioning phases of the project.

In general, the scientific literature indicates average values for roadkill risk associated with different species. One example is an article from 2020, *Roadkill risk and population vulnerability in European birds and mammals*[16], published by Grilo *et al.* Other examples are also available in the literature. It is worth noting that these resources should be used with caution, as the situation analysed in the articles can be different from the one in the area of the project. If available, it is preferable to use resources from the same country as the one in which the project is proposed.

The following table shows an example that could be used for the estimation of wildlife

Table 14 Example of a table for estimating wildlife mortality due to road traffic during the operation of a project

Category	Species	Average roadkill rate (number of individuals / km / year)	Length of species habitat crossed by road (km)	Estimated mortality of individuals (number of individuals per year)
Birds	*Strix aluco*	2.32	45	104.40
...	...	...	...	...

16 The article is available here: https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2216.

mortality due to road traffic during the project operation. It is based on an estimation of the number of individuals potentially killed per kilometre per year, relative to the number of kilometres of favourable habitat intersected by the infrastructure. The areas of favourable habitat can be either already established (for instance by a protected area manager) or estimated based on the analysed species characteristics.

While this approach to quantification certainly has many limitations, its main advantage is the ease of implementation and the low cost for the calculation.

If the specific project situation allows for detailed field observations, it is recommended to use a methodology for quantifying mortality on the basis of fieldwork data. One example of such a methodology is presented below.

Quantifying species mortality based on fieldwork data
This methodology is preferable to the one based on existing literature in situations when there is time for monitoring and when the funds are sufficient to allow for detailed field data collection. It can work in situations where infrastructure already exists and the project proposes an upgrade.

The methodology involves the following steps:

- **Collection of fieldwork data** in a specific way, which allows for the development of certain mortality risk calculations.

  The methodologies needed for field observations should be able to show the areas of transit for animals on the existing infrastructure. Observations can be carried out using the usual methods, such as sign tracking or camera traps (more information on field methodologies can be found in Output T1.1 'A Methodology for Standardised Monitoring of Ecological Connectivity – Guidelines for the analysis of structural and functional connectivity', developed in the SaveGREEN project).

  The elaborated observation protocol needs to address the species particular characteristics (e.g. if a species is nocturnal, the use of camera traps should also cover nighttime) and to use appropriate methods for observation. If possible, the whole project area should be monitored. The monitoring period should ideally cover all the seasons of the year.

  As a minimum, the collected should cover:

  - Total time of monitoring activities (in hours);
  - Direction of movement of animals;
  - Flying height, for flying species;
  - Characteristics of the project operation (e.g. types and sizes of trains for railroad projects, traffic density for road projects, etc.).

  All of these collected data should be used for the estimation of the collision risk for the species in the project area.

- **Estimation of collision risk** for different species, based on the collected data.

  This estimation should be done on a species-by-species basis, taking into consideration the already collected data from the field. It defines an 'area of risk' based on the characteristics of the infrastructure (in the example below, applied to a railroad project, the area of risk is based on the train size) and uses it to estimate a number of potential victims for each species.

  In the table below is an example of how to calculate the mortality risk for different species, applied to a railroad upgrade project in Romania.

Table 15 **Example of a table used for estimating the number of potential victims, based on field observations**

Group	Species	Species' active period (no. months)	Individuals / minute	Yearly no. of crossings of the risk area*
Invertebrates	*Lycaena dispar*	5	0,0002	45
	Coenagrion ornatum	3	0,006	810
	Cerambyx cerdo	5	0,0002	45
Amphibians	*Bombina*	6	0,0015	388,8
	Hyla orientalis	6	0,0005	129,6
	Pelophylax esculentus	6	0,002	518,4
Reptiles	Lacerta viridis	6	0,001	259,2
	Natrix tessellata	6	0,0015	388,8
	Emys orbicularis	6	0,0005	129,6
Birds	*Alcedo atthis*	7	0,0005	173,7
	Circus aeruginosus	9	0,0001	74,4
	Nycticorax	9	0,0001	74,4
Mammals	*Sus scrofa*	12	0,0003	376,3
	Canis aureus	12	0,0001	124,3
	Pipistrellus nathusii	9	0,01	1791,00

* Risk area = 5 m height x width of railway

Number of months when the species is active

Number of individual crossings / minute (calculated as number of crossings divided by the total observation time in minutes)

Calculated as number of crossings X total number of days of species activity

Probability of collision	Deadly area (m)	Collison rate	Potential yearly no. of victims (with avoidance rate)	Avoidance rate
0,0006	3	0,02	0,37	70%
0,0006	3	0,39	96,53	
0,0006	3	0,02	0,37	
0,0008	0,2	0,27	32,28	70%
0,0008	0,2	0,10	3,98	
0,0008	0,2	0,35	54,5	
1,3E-05	0,2	0,003	0,27	
0,0001	0,2	0,05	6,13	
0,0008	0,2	0,10	3,98	
9,3E-05	3	0,01	0,14	95%
8,6E-05	3	0,006	0,02	
8,7E-05	3	0,006	0,02	
0,0002	3	0,08	6,75	80%
0,0002	3	0,03	0,76	
0,0001	3	0,24	21,8	

Probability of collision: Calculated based on the train density X animal movement velocity / deadly area. It shows the probability of collision for an individual in the defined deadly area.

Deadly area (m): Area where animals can die on the railway (either by being crushed by wheels or hit by the railway car)

Collison rate: Calculated as: 1-(1-probability of collision)^yearly no. of crossings in the risk area

Potential yearly no. of victims: Calculated as collision rate X yearly no. of crossings X avoidance rate

Avoidance rate: Avoidance rate taken from literature data

3.2.3.5 Assessment of impact significance

The assessment of impact significance should take two main criteria into consideration:

» **The sensitivity** of the area and the environmental components under analysis;

» **The magnitude** of the proposed project interventions.

Table 16 Aspects to be considered when establishing the sensitivity of an area

	Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Very high	• Protected areas for water intakes • Natural water bodies with good ecological and chemical status • Highly modified water bodies with good ecological potential and good chemical status	• Protected hydrogeological areas • Groundwater bodies with a good quantitative status and good chemical status	• Area where exceedances of maximum allowable concentrations for several air pollutants relevant to the proposed project occur frequently	• Household and community gardens	• Scientific reserves designated for the protection of geological, paleontological or speleological value • Important areas for geological, paleontological or speleological research	• Scientific reservation • Strictly protected areas and key protection areas within protected natural areas of national interest • Virgin forests • Wilderness areas • Priority habitats • Habitats of priority, endangered or critically endangered species
High	• Natural water bodies with moderate ecological status and good chemical status • Natural water bodies with good ecological status and without good chemical status • Highly modified water bodies with very good ecological potential and without good chemical status • Highly modified water bodies with moderate ecological potential and good chemical status	• Groundwater bodies in which the hydrostatic level is lowered • Groundwater bodies with a good chemical status for which there are no exceedances of the quality values	• Areas with occasional exceedances of maximum allowable concentrations for several air pollutants relevant to the proposed project	• Protected areas designated for protection of soils	• Nature reserves designated for the conservation of geological, paleontological and speleological value; • Geoparks designated and recognized in the Global Network of Geoparks Areas with the potential to be designated as a natural reserve for the protection of geological, palaeontological or speleological value	• Natura 2000 habitats and habitats of Natura 2000 species within the boundaries of Natura 2000 sites • Nature reserves • Nature monuments • Protected natural areas of county and local interest • Buffer zones (sustainable conservation areas, sustainable management areas) within protected natural areas of national interest • Wetlands of international importance • Important Bird Areas (IBA) • Ecological corridors • Critical habitats of species community and national interest • Critical habitats of vulnerable and threatened species

Sensitivity and magnitude have to be established for each potentially affected environmental component mentioned in the EIA Directive. For this, it is recommended to use different sensitivity and magnitude classes. Examples of such classes are presented in the following table, although these classes have to be adapted based on the situation of each country.

The tables below show different issues based on which the sensitivity of the area and the magnitude of the project proposals can be established.

Landscape	Social and economic issues	Cultural heritage
Landscape features: • Internationally designated areas of landscape importance (UNESCO heritage, natural world heritage sites) • Landscape areas in an excellent state of conservation (traditional landscapes) with a high level of aesthetic and cultural value • Areas that have exceptional characteristics from an aesthetic and perceptual point of view (high level of wildness, high degree of' 'naturalness', tranquillity, isolation, lack of man-made features) • Persons affected: • Dwellings and accommodation positioned to benefit from visibility to the highly sensitive landscape	• More resource-dependent communities/ resources affected and which there are no alternatives • Lack of skilled and experienced workforce • Development-induced changes in community/ community risk not understood by most adults • Many business owners and proprietors perceive that this change will affect their ability to maintain their livelihood or quality or life at an acceptable level and may have to leave the area/community • An extremely high level of concern is expressed by NGOs and/or stakeholders about the impact of the proposed development • Communities predominantly made up of declining indigenous ethnic minorities that may be affected by the proposed development	• UNESCO sites designated for their cultural, historical or archaeological value
Landscape features: • Areas valued or designated for national landscape significance • Areas with a high degree of naturalness and/ or dominated by landscape features with traditional characteristics, preserving the distinctive character of an area from a historical and cultural point of view, characterized by the absence of modern man-made structures • Persons affected: • Local residents • Users of outdoor touristic facilities where the value of the landscape is important or integrated into that activity (e.g. users of trails designed to allow landscape viewing • Communities that have views of the landscape they value	• A community dependent on the affected resource(s) and which does not have any alternatives nearby • Many people and business owners which perceive the change as affecting their ability to maintain their livelihood or quality of life at an acceptable level • A high level of concern is expressed by NGOs and/ or stakeholders about the impact of proposed developments • Communities, including declining indigenous ethnic minorities, that may be affected by the proposed development	• Sites of archaeological, historical or cultural importance designated at national level • Protected historical, archaeological and cultural monuments

	Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Moderate	• Natural water bodies with moderate ecological status and without good chemical status • Natural water bodies with poor ecological status and with good chemical status • Highly modified water bodies with moderate ecological potential and without good chemical status • Highly modified water bodies with poor ecological potential and good chemical status • Permanent water courses that are not defined as water bodies	• Groundwater bodies which have a good chemical status, but for which there are exceedances of the quality values	• Areas where there are no exceedances of maximum allowable concentrations for air pollutants relevant to the proposed project • The values are in the range 75-100% of the Maximum Allowable Concentrations (MAC) and there is no prospect of exceeding the MAC in the short term (2-3 years)	• Agricultural land used for flower production, fruit production and other valuable crops	• Geoparks under designation or nationally designated and not included in the Global Geoparks Network • Areas with valuable geological features that have the potential to become geoparks	• Sustainable development areas within protected natural areas of national interest • Favourable habitats for species of Community and national interest outside protected natural areas (species are abundant/ newly recorded; main migration corridors are identified) • High Nature Value (HNV) meadows, important bird meadows, traditional orchards, hills and mountain fens • Semi-natural ecosystems not targeted for conservation (e.g. seed reserves, dendrological parks, urban parks and gardens, etc.)
Low	• Natural water bodies with poor ecological status and without good chemical status • Natural water bodies with bad ecological status and with good chemical status • Highly modified water bodies with poor ecological potential and without good chemical status • Highly modified water bodies with bad ecological potential and good chemical status • Irrigation channels	• Groundwater bodies with a good quantitative status and a good chemical status • Groundwater bodies with a poor quantitative status and a good chemical status	• Areas where there are no exceedances of maximum allowable concentrations for air pollutants relevant to the proposed project • The values are in the range of 50%-75% of the MAC and there is no prospect of exceeding the threshold of 75% of the MAC in the short term (2-3 years)	• Agricultural land used for growing cereals	• Important areas in terms of petrography or presence of valuable minerals as resources	• Man–made habitats (e.g. plantations, agricultural crops, abandoned farmland, ruderal plant communities, etc.) without management objectives and without the presence of species of conservation interest

Landscape	Social and economic issues	Cultural heritage
Landscape features: • Landscape with few intact or distinct natural or historic features, but which is valued by the local community • Man-made landscape dominated by large, numerous and/ or noisy buildings/ structures • Natural landscape degraded or altered as a result of agricultural land use - arable or pasture • Persons affected: • People at work, industrial facilities	• Some households dependent on affected resources for which there are no nearby alternatives • Limited skills and limited work experience in the available workforce • Some people and business owners perceive that this change will affect their ability to maintain their livelihood or quality of life for a significant period of time (>1 year) • The changes generated by the development induce risks to the community/ communities that are understood by all adults but without experience of living and working in the conditions proposed by the project • Some stakeholders express concerns about some forms of impact on some communities • Communities predominantly made up of indigenous ethnic minorities that may be affected by the proposed development	• Sites of archaeological historical or cultural importance designated at county level
Landscape features: • Landscape with few intact or distinct natural or historic features, but which is valued by the local community • Man-made landscape dominated by large, numerous and/ or noisy buildings/ structures • Natural landscape degraded or altered as a result of agricultural land use - arable or pasture • Persons affected: • People at work, industrial facilities	• Households or communities using affected resources have access to nearby alternatives whose use may indirectly cause reduced negative impacts • Skilled labour lacking relevant experience • Some stakeholders express concerns about some forms of impact on a small number of communities • Communities including indigenous ethnic minorities that may be affected by the proposed development	• Sites of archaeological, historical or cultural importance designated locally or used by the local community to maintain traditions

	Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Very low	• Natural water bodies with poor ecological status and without good chemical status • Highly modified water bodies with bad ecological potential and without good chemical status • Non-permanent water courses	• Groundwater bodies with a poor quantitative status and a poor chemical status	• Areas where there are no exceedances of maximum allowable concentrations (MACs: limit values and critical levels) for air pollutants relevant to the proposed project • The values are less than 50% of the MAC and there is no prospect of exceeding the threshold of 50% of the MAC in the short term (2-3 years)	• Pastures	• Areas with no particular geological features and where no material of paleontological interest is present	• Habitats within human communities strongly influenced by their activities (e.g. lawns, wastelands, etc.).

* Please note that these indicators and the information in the rest of the table are only examples. They should be changed and adapted for each EIA by the EIA developer

Table 17 Matrix for establishing the magnitude of the changes proposed by the project

		Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Negative	**Very high**	Modifications that directly contribute to preventing the improvement of the chemical status and/ or changes to other quality criteria of the water body leading to deteriorations of the status of the water body (area/ length of changes ≥ 25% of the area/ length of the water body)	Quantitative changes (e.g. significant intakes) that may lead to deterioration of the quantitative status of the water body (area with exceedances of threshold values/ quality criteria is ≥ 25% of the area of the water body) Changes that directly contribute to preventing improvement of the quantitative and/ or qualitative status of the water body	Exceedance of maximum allowable concentrations (MACs) of pollutants in ambient air as a result of the project contribution plus the values already existing under initial conditions	Exceedance of pollutant concentrations in the soil corresponding to the soil intervention thresholds	Loss or alteration of ≥ 20% of the identified geological resource	Actions that together with other pressures and threats affect biodiversity by exceeding thresholds set for a favourable conservation status (in the absence of thresholds, damage to >20% of the biological component)
	High	Changes in quality criteria over a length/ area between 15-25% of the length/ area of the water body	Quantitative changes leading to significant decreases in an area between 15% and 25% of the surface area of the water body and/ or qualitative changes leading to exceedances of threshold values/ quality criteria in an area between 15% and 25% of the surface area of the water body	The contribution of the project plus existing values lead to concentrations between 70-99% of the MAC	Loss of productive capacity for more than 10 years	Loss or alteration of 10-20% of the identified geological resource	Actions that together with other pressures and threats lead to damage to biodiversity, by exceeding 50% of the threshold value established for maintaining a good conservation status (in the absence of thresholds, damage to 10-20% of the biological component)

Landscape	Social and economic issues	Cultural heritage
Landscape features: Landscape dominated by derelict/built elements that are not considered valuable by the local community Persons affected: No or limited visual access	• Households or communities using affected waste have access to nearby alternatives whose use may not cause negative impacts • The workforce is skilled and with relevant experience • The changes generated by the development induce risk to the community/ communities that are understood by all adults who have experience of living and working in the conditions proposed by the project • Stakeholders do not express concerns about possible forms of community impacts • Communities that do not include indigenous ethnic minorities or that include such groups but may not be affected by the proposed development	Sites that are not of archaeological, historical or cultural interest and are not considered important by the local community for maintaining traditions

Landscape	Social and economic issues	Cultural heritage
• The investment will dominate the landscape or generate significant changes in landscape quality or character • Definitive changes to a large area and/ or the introduction of elements that will fundamentally change the character of the landscape • Temporary changes where restoration of the landscape to its original state could take more than 10 years	• Displacement or abandonment of ≥20% of households from the total number of households in the settlement • Loss of a significant number of jobs (≥20% of the existing number of jobs in the community), without alternative opportunities during a year after losing the job (other than the ones that imply a change in the living place) • Large scale perception related to the negative impact and/ or loss of opportunity for improvement of the quality of life, resulting in frustration and disappointment, which can lead to an increase in migration and threaten the integrity and viability of the community	Activities that lead to the total alteration of the cultural resource
• The investment will result in an obvious change to the existing landscape and/ or cause obvious changes in quality and/ or development that will result in significant negative changes to the character of the existing landscape • Temporary changes where restoration of the landscape to its original state could take 5-10 years	• Displacement or abandonment of 5-20% households from the total number of households in the settlement • Loss of 5-20% of the number of jobs existing in the community • Changes which have differential adverse effects on the quality of life and employment opportunities for vulnerable groups (e.g. people with disabilities, the elderly, refugees, people who live below the poverty line)	Activities that lead to the alteration of 50-75% of the cultural resource.

		Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Negative	Moderate	Changes in quality criteria over a length/ area between 5-15% of the length/ area of the water body	Quantitative changes leading to significant decreases in an area between 5% and 15% of the surface area of the water body and/ or qualitative changes leading to exceedances of threshold values/ quality criteria in an area between 5% and 10% of the surface area of the water body.	The contribution of the project plus existing values lead to concentrations between 50-70% of the MAC	Accidental releases of pollutants leading to extensive damage and for which restoration to original conditions is not possible in less than 1 year	Loss or alteration of 5-10% of the identified geological resource	Actions that together with other pressures and threats leading to damage amounting to 25% - 50% of the threshold value set for maintaining good conservation status (in the absence of thresholds, damage to 5-10% of the biological component)
Negative	Low	Changes in quality criteria over a length/ area between 2-5% of the length/ area of the water body	Quantitative changes leading to significant decreases in an area between 2% and 5% of the surface area of the water body and/ or qualitative changes leading to exceedances of threshold values/ quality criteria in an area between 2% and 5% of the surface area of the water body.	The contribution of the project plus existing values lead to concentrations between 20-50% of the MAC	Exceedance of pollutant concentrations in soil by more than 75% of the soil intervention thresholds	Loss or alteration of 2,5-5% of the identified geological resource	Actions that together with other pressures and threats leading to damage to biodiversity exceeding 10%-25% of the threshold value set for maintaining good conservation status (in the absence of thresholds, damage to 2.5-5% of the biological component)
Negative	Very low	Changes in quality criteria over a length/ area < 2% of the length/ area of the water body	Quantitative changes leading to significant decreases in an area <2% of the surface area of the water body and/ or qualitative changes leading to exceedances of threshold values/ quality criteria in an area <2% of the surface area of the water body.	The contribution of the project plus existing values lead to concentrations <20% of the MAC	Loss of productive capacity over 5-10% of the productive capacity	Loss or alteration of <2,5% of the identified geological resource	Actions that together with other pressures and threats affect biodiversity by up to 10% of the threshold value set for maintaining good conservation status (in the absence of thresholds, damage to maximum 2.5% of the biological component)
	No change	There are no sources of water contamination or their contribution is indeterminable	There are no sources of groundwater contamination or their contribution is under the detection threshold.	There are no sources of air contamination or their contribution is under the detection threshold.	There are no sources of soil contamination/ structural alteration or their contribution is not detectable	Changes that do not affect the geological resource	Actions that do not affect biodiversity components or whose changes are not identifiable
Positive	Very low	Modifications that improve water body quality criteria over a length/ area <2% of water body length/ area	Actions leading to avoidance/ reduction of significant declines over <2% of the water body surface area.	Actions contributing to the reduction of air pollutant concentrations by <10% of the MAC	Actions leading to the reduction of pollutant concentrations in soil below the soil action threshold, but not less than 75% of the soil intervention threshold	Modifications that improve <2,5% of the identified geological resource	Actions that lead to the improvement of biodiversity by a maximum of 10% of the threshold value established for maintaining a good conservation status (in the absence of thresholds, maximum 2.5% of the biological component affected)

Landscape	Social and economic issues	Cultural heritage
• The investment will result in an obvious change to the existing landscape and/ or cause obvious changes in quality and/ or character of the landscape. Definitive changes to the landscape in a certain area. New elements can be obvious, but not significantly unusual • Temporary changes where restoration of the landscape to its original state could take 2-5 years	• Displacement or abandonment of <5% of households from the total number of households in the settlement • Loss of 2,5-5% of the existing number of jobs in the community	Activities that lead to the alteration of 25-50% of the cultural resource.
• The investment will generate minor changes to the landscape, without affecting its general quality • Temporary changes where the restoration of the landscape to its original state might take 1-2 years	• Temporary reduction (<1 year) of income for some of the households and/or temporary effects on the quality of life and local businesses, including improvement opportunities • Loss of >2,5% of the number of existing jobs in the community	Activities that lead to the alteration of 10-25% of the cultural resource.
Small changes to the landscape components or introduction of new elements which are in accordance with its surroundings or do not generate noticeable changes to them	• Short-term changes that consist of disturbance / reduction of viability / opportunities for businesses, household activities, jobs and income	Activities that lead to the alteration of <10% of the cultural resource.
Imperceptible changes to the landscape components	• Changes that do not influence the local population	Activities that do not influence the cultural resource.
• Size, scale and/or geographic extension of the improvements is very low, compared to the surface of key landscape components • Effects of the benefits are recorded on a very small spatial scale • Changes are short term (<1 year)	• Measures that ensure short-term maintenance / improvement of the number of jobs and/or improvement of the quality of life for the local communities.	Activities that lead to a very small promotion of the cultural resource.

		Surface water	Groundwater	Air	Soil	Geology	Biodiversity
Positive	Low	Modifications that improve quality criteria over a length/ area between 2-5% of the length/ area of the water body	Actions leading to the avoidance/ reduction of exceedances of threshold values/ quality criteria across <2% of the surface area of the water body	Actions contributing to the reduction of air pollutant concentrations by 10-20% of the MAC	Actions leading to the reduction of pollutant concentrations to values between the alert threshold and < 75% of the soil intervention threshold	Modifications that improve 2,5-5% of the identified geological resource	Actions that lead to the improvement of biodiversity by 10-25% of the threshold value established for maintaining a good conservation status (in the absence of thresholds, maximum 2.5-5% affected of the biological component)
	Moderate	Modifications that improve quality criteria over a length/ area between 5-15% of the length/ area of the water body	Actions leading to the avoidance/ reduction of significant pressures on a surface between 2% and 5% of the surface of the groundwater body	Actions contributing to the reduction of air pollutant concentrations by 20-50% of the MAC	Actions leading to the reduction of pollutant concentrations in soil and falling within the range >75% of alert threshold	Modifications that improve 5-10% of the identified geological resource	Actions that lead to the improvement of biodiversity by 25-50% of the threshold value established for maintaining a good conservation status (in the absence of thresholds, maximum 5-10% affected of the biological component)
Positive	High	Modifications that improve quality criteria over a length/ area between 15-25 % of the length/ area of the water body	Actions leading to the avoidance/ reduction of exceedances of threshold values/ quality criteria across 2-5% of the surface area of the water body	Actions contributing to the reduction of air pollutant concentrations by 50-70% of the MAC	Actions leading to the reduction of pollutant concentrations in soil and falling within the range >50% of alert threshold and <75% of alert threshold	Modifications that improve 10-20% of the identified geological resource	Actions that lead to the improvement of biodiversity by ≥50% of the threshold value established for maintaining a good conservation status (in the absence of thresholds, maximum 10-20% affected of the biological component)
	Very high	Actions leading to the improvement of the chemical status and/ or ecological potential status of the water body Modifications that improve the status of one or more quality criteria over a length or area ≥ 25% of the length/ area of the water body	Actions leading to the avoidance/ reduction of exceedances of threshold values/ quality criteria across 5-10% of the surface area of the water body	Actions contributing to the reduction of air pollutant concentrations by >70% of the MAC	Actions leading to the reduction of pollutant concentrations in soil to within normal values	Modifications that improve ≥ 20% of the identified geological resource	Actions that significantly contribute to the improvement of the conservation status (reaching a better conservation status). If no thresholds exist, improvement of biodiversity for more than 20% of the initial state

Landscape	Social and economic issues	Cultural heritage
• Minor but notable changes that improve the elements and characteristics of the type of landscape • Size, scale and/or geographic extent of the improvement is small compared to the surface of key components of the landscape • Effects of benefits are registered on a small spatial scale • Changes are short-term (1-2 years)	• Measures that ensure an increase in the number of jobs and/or improvement of the quality of life for up to 2,5% of the settlement population.	Activities that lead to a promotion of the cultural resource.
• Changes which considerably improve the elements and characteristics of the type of landscape • Size, scale and/or geographic extent of the improvements is moderated compared to the surface of key components of the landscape • Changes are medium-term (2-5 years)	• Measures that ensure an increase in the number of jobs and/or improvement of the quality of life for up to 2,5% - 5% of the settlement population.	Activities that lead to a medium promotion of the cultural resource.
• Major changes that improve the element and characteristics of the type of landscape • Size, scale and/or geographic extent of the improvements is large, compared to the surface of key components of the landscape • Effects of benefits are recorded on a large spatial scale • Changes are medium to long-term (5-10 years)	• Measures that ensure an increase in the number of jobs and/or improvement of the quality of life for up to 5% - 10% of the settlement population • Measures that have as an effect the significant improvement of conditions for vulnerable groups	Activities that lead to a high promotion of the cultural resource.
• Major changes that improve characteristics of the type of landscape • Size, scale and/or geographic extent of the improvements is very large, compared to the surface of key components of the landscape • Effects of benefits are recorded at a very large spatial scale • Changes are long-term (>10 years)	• Activities that lead to the creation of a significant number of jobs and new business opportunities for local communities, as well as to the significant increase of the quality of life in these settlements (at least 20% of the population should benefit from these changes)	Activities that lead to a very high promotion of the cultural resource.

The levels of significance which can be used are:

- Significant impact (negative / positive);
- Non-significant impact (negative or positive);
- No impact (where it is estimated that there will be no changes regarding the environmental component.

For establishing the significance of impacts, it is recommended to use a matrix such as the one in the following table.

The explanations associated to the below matrix are the following:

Colour code	Impact significance	Required measures
(red)	Negative significant impact	If effective measures to mitigate the impacts cannot be formulated (for the residual impact to be non-significant), impact avoidance measures must be adopted (changes to the location of the project, changes to the technical solutions proposed). Compensatory measures might be necessary if the residual impact remains significant.
(yellow)	Negative non-significant impact	Measures for avoidance / mitigation are not necessary, but can be formulated to reduce the impact to a minimal level.
(blue)	No impact	No measures are necessary.
(light green)	Positive non-significant impact	Any measure that can lead to the extension / multiplication of effects.
(dark green)	Positive significant impact	

Table 18 Matrix recommended for establishing the impact significance

Significance of impacts		Magnitude of changes				
		Negative very high	Negative high	Negative moderate	Negative low	Negative very low
Receptor sensitivity	Very high	Significant negative	Significant negative	Significant negative	Significant negative	Non-significant negative
	High	Significant negative	Significant negative	Significant negative	Non-significant negative	Non-significant negative
	Moderate	Significant negative	Non-significant negative	Non-significant negative	Non-significant negative	Non-significant negative
	Low	Non-significant negative	Non-significant negative	Non-significant negative	Non-significant negative	Non-significant negative
	Very low	Non-significant negative	Non-significant negative	Non-significant negative	Non-significant negative	Non-significant negative

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	No change	Positive very low	Positive low	Positive moderate	Positive high	Positive very high
	No impact	Non-significant positive	Significant positive	Significant positive	Significant positive	Significant positive
	No impact	Non-significant positive	Non-significant positive	Significant positive	Significant positive	Significant positive
	No impact	Non-significant positive	Non-significant positive	Non-significant positive	Non-significant positive	Significant positive
	No impact	Non-significant positive	Non-significant positive	Non-significant positive	Non-significant positive	Non-significant positive
	No impact	Non-significant positive	Non-significant positive	Non-significant positive	Non-significant positive	Non-significant positive

3.3 The Appropriate Assessment

3.3.1 Requirements of the Habitats and Birds Directives

In the case of linear infrastructure, which intersects, or is located close to Natura 2000 sites, or has the potential to affect the integrity of a Natura 2000 site, the environmental impact assessment should take into consideration the requirements of the Habitats Directive and Birds Directive. Of particular importance are paragraphs 3 and 4 of article 6 of the Habitats Directive, which state the following:

> *„(3) Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4 , the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and , if appropriate, after having obtained the opinion of the general public.*
>
> *(4) If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature , the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.".*
>
> ***European Commission, Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora***

Considering the provisions of the Directive, the likelihood that a habitat or species can be significantly affected by the project interventions needs to be established. To do so, analysts need to consider whether and to what extent (significant or non-significant) the interventions proposed by a project can affect the parameters established for a habitat or species according to their specific conservation objectives.

This Appropriate assessment process has three main stages, according to European Commission guidelines:[17]

1. Screening stage. The main purpose of this stage is to establish if the project has any direct link or is necessary to the management of a Natura 2000 site, and if it is not, to identify whether the project can have a significant impact on the site (by itself, or in combination with other plans or projects), in view of **the site's conservation objectives**.

One of the most important steps in this stage to establish whether any Natura 2000 sites are potentially affected by the analysed project. An infrastructure project can affect not only intersected Natura 2000 sites, but also adjacent sites, including sites located at a large distance from the project (for instance through the interruption of an ecological corridor).

The identification of sites potentially affected by the implementation of a project should be done by following the next steps:

- Identification of Natura 2000 sites intersected by the project. This step implies a spatial overlay in GIS of all the project interventions with the Natura 2000 network in Europe. Based on this overlay, a list of intersected Natura 2000 sites should be produced.
- Identification of Natura 2000 sites in the project's zone of influence. The zone of influence can include sites which are not intersected by the project, but are located nearby and thus can be affected by project

17 The most recent set of guidelines was released in 2021 and is available at this address: https://ec.europa.eu/environment/nature/natura2000/management/pdf/methodological-guidance_2021-10/EN.pdf.

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effects (e.g. noise can propagate and reach them, wastewater flowing into a river can affect sites located downstream of the project, etc.). To establish the zone of influence, it is necessary to analyse all the project effects, their spatial extent and the mechanisms for their propagation.

» Identification of Natura 2000 sites hosting fauna species that can move to the project area and that can be affected outside of the site limits. This involves Natura 2000 sites which might be located at a large distance from the project, but whose species can reach the area of the project.

» Identification of Natura 2000 sites whose connectivity or ecological continuity can be affected. This involves sites, which might be affected by potential interruption of ecological connectivity. They could be located at a large distance from the project area, based on ecological corridor linkages.

Following these steps should produce a list of Natura 2000 sites potentially affected by the proposed project. For each of these localities, the impact on the site's integrity needs to be assessed.

2. Appropriate assessment. If the possibility of significant impacts on Natura 2000 sites cannot be excluded, the next phase of the procedure involves the assessment of impact in view of the **Natura 2000 site-specific conservation objectives**. An example of the methodology, which can be used for this assessment is presented in this Toolkit, in Table 19.

3. Derogation from art. 6 paragraph (3), in certain conditions. The third important step can occur only if a significant residual impact is identified, but the plan or project must continue due to 'imperative reasons of overriding public interest'[18]. This is possible only if there are no alternatives available, if the imperative reasons are adequately justified and if compensatory measures are provided, in order to sustain the coherence of the Natura 2000 network.

Each stage of the procedure is influenced by the previous stage. Therefore, defining the order in which these stages are followed is essential for the correct application of art. 6, paragraphs (3) and (4) of the Habitats Directive. The following diagram (Figure 2) shows a step-by-step overview of this procedure.

18 Explanations regarding what can be considered an 'imperative reason of overriding public interest' is provided in section 3.3.2 of the 2021 European Commission guideline on impact assessment on Natura 2000 available at: https://ec.europa.eu/environment/nature/natura2000/management/pdf/methodological-guidance_2021-10/EN.pdf

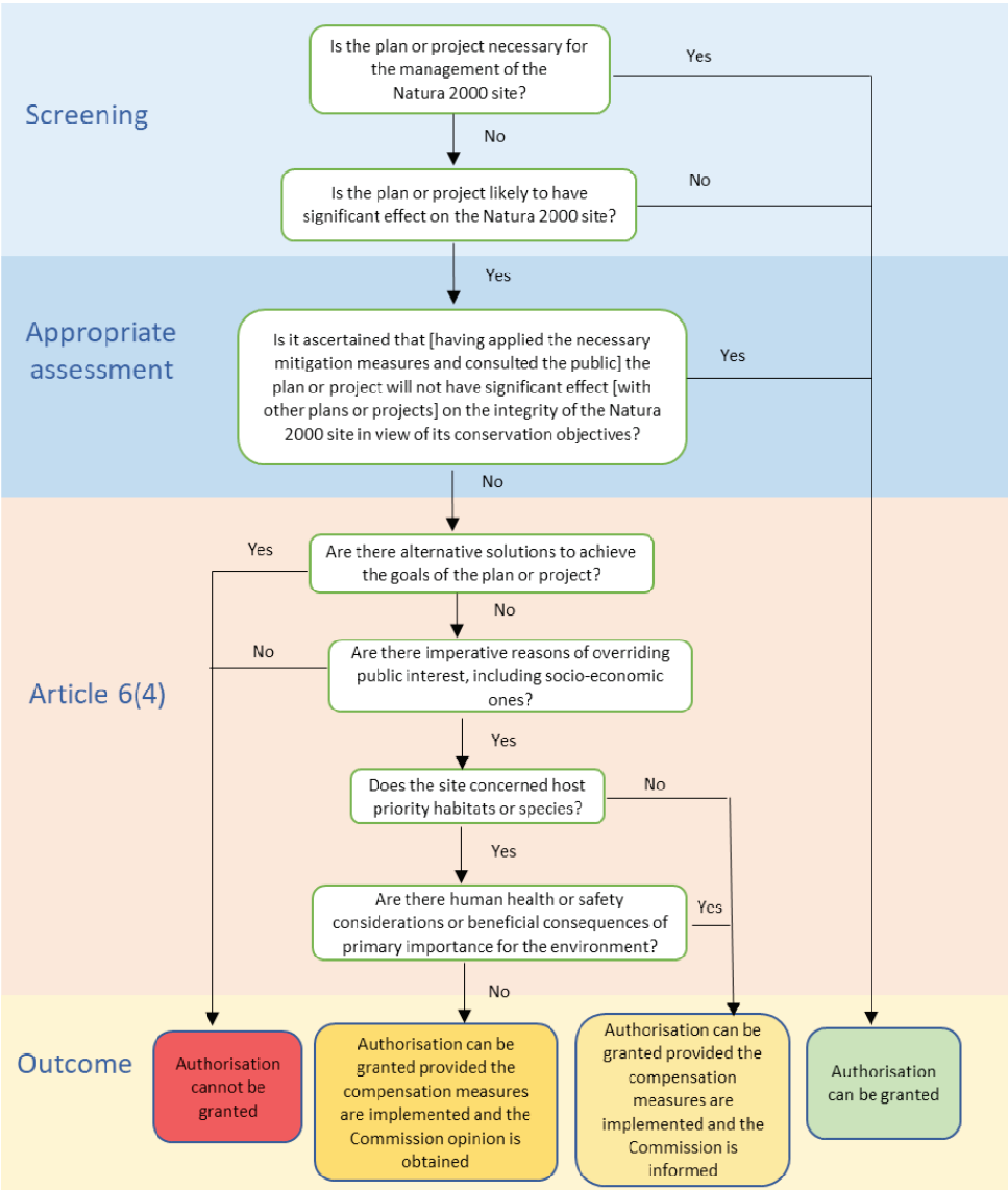

Figure 7 Step by step process for assessing impacts on Natura 2000 sites through an Appropriate Assessment (© European Commission 2021)

3.3.2 Assessment of significance of impacts in Natura 2000 sites

In the case of Natura 2000 sites or important biodiversity areas harbouring Priority Species or Habitats, an impact can be considered significant if it **affects the integrity of the sites**.

According to the European Commission, the integrity of a site "is considered as a quality or condition of being whole or complete. In the dynamic ecological context, it can also be considered as having a sense of resilience and ability to evolve in ways favourable to conservation.

The integrity of the site can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, which enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated" (European Commission 2021).

The **integrity of a site** is directly related to the **site's conservation objectives**, its key natural features and the ecological structure and functions they create. Therefore, if the conservation objectives are not considered to be significantly affected (undermined, or prevented from being achieved) by the plan or project, the integrity of the site is also not considered to be affected (European Commission 2021).

3.3.3 Site-specific conservation objectives (SSCO)

The site-specific conservation objectives are the most important component in the assessment of impacts of a plan or project on a Natura 2000 site. They are a set of conservation objectives, which are specific to each Natura 2000 site. The SSCO have to be established by the Natura 2000 management authorities. Conservation objectives are set for each habitat type and species and are related to their conservation status in that particular Natura 2000 site – if the conservation status is Favourable, the conservation objective is to maintain that status, while if the status in Unfavourable – inadequate or Unfavourable – bad, the objective is to improve the conservation status.

SSCO are based on a series of specific parameters, which are established for each habitat type and each species in turn. They include a target to be achieved and a unit of measurement. If possible, they also include additional information regarding the reasons justifying the attribution of a particular status for a given habitat or species. Examples of SSCO from different countries are presented in the following figures.

Conservation Objectives for : Bricklieve Mountains and Keishcorran SAC [001656]

1092 White-clawed Crayfish *Austropotamobius pallipes*

To maintain the favourable conservation condition of White-clawed Crayfish (*Austropotamobius pallipes*) in Bricklieve Mountains and Keishcorran SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No reduction from baseline. See map 5	Within Bricklieve Mountains and Keishcorran SAC white-clawed crayfish (*Austropotamobius pallipes*) is found in Lough Labe. The species was reported from Lough Labe by both O'Connor et al. (2009) and Gammell et al. (2021). The lake is within a single 1km grid square (G7212) and no other occupied 1km squares are known from this SAC. Habitat for the species is limited, the lake south of Lough Labe, Lough Gowra, is a turlough and, therefore, is not suitable habitat. The species may occur in the stream linking these two waterbodies, but this needs to be confirmed
Population structure: recruitment	Percentage occurrence of juveniles and females with eggs	Juveniles and females with eggs in at least 50% of positive samples taken at appropriate time and methodology	See Reynolds et al. (2010) for further details. Gammell et al. (2021) found a high percentage of juveniles in samples from Lough Labe
Population size	Catch per unit effort	No reduction from baseline of 1.0	The catch per unit effort (CPUE) figures are based on the figures in O'Connor et al. (2009) and Gammell et al. (2021). Both surveys used hand searching, but the value in O'Connor et al. (2009) was less than 1, whereas it was more than 6 in Gammell et al. (2021). A baseline of 1 is set across the range of techniques, but this may be refined with more detailed assessment of the stock. Gammell et al. (2021) gave a population abundance grade of very high
Negative indicator species	Occurrence	No non-indigenous crayfish species	Non-indigenous crayfish species (NICS) are identified as a major direct threat to the white-clawed crayfish and as a disease vector, in particular crayfish plague (*Aphanomyces astaci*), which is fatal to white-clawed crayfish. The possession, import and intentional release of five species of invasive alien crayfish is banned by Statutory Instrument No. 354/2018
Disease	Occurrence	No instances of disease	Crayfish plague, caused by the water-borne mould *Aphanomyces astaci*, is identified as major threat to the species in Ireland. Instances of crayfish plague have occurred in Ireland since 2015 causing local extinctions. There have been no confirmed or suspected outbreaks in this SAC
Water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	White-clawed crayfish are not considered very sensitive of water quality but are intolerant of low pH and poorest water quality, and lack of calcareous influence. Baseline levels need to be determined for Lough Labe as it is monitored for water quality by the Environmental Protection Agency (EPA)
Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline from the baseline	White-clawed crayfish need high habitat heterogeneity. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree roots. Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter. These conditions and habitat features must be available on the whole length of occupied habitat. Gammell et al. (2021) scored the habitat heterogeneity and, following this methodology, the baseline score of 0.45 is set

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9130 Asperulo – Fagetum beech forest

The surface of this habitat in ROSCI0122 is 6311 ha and its conservation status is **favorable** (conservation status from the point of view of surface favorable, structure and function favorable, perspectives favorable). The site-specific conservation objective for this habitat is to **maintain its favorable conservation status**, as defined by the following parameters and target values:

Parameter	Unit of measurement	Target value	Additional information
Surface area / size of the habitat	ha	At least 6.311	These central european beech habitats, without regional Carpathian endemic species, often distributed as a mosaic in the landscape, were identified on the Northern slope of the Făgăraş, where they extend on the valley slopes until an altitude of around 1000 meters, from which they are replaced (gradually, the limit is never clear) by the acidophilic and alkaliphilic varieties of habitat 91V0. Habitats 9110 and 9130 are more rare on the Western, Eastern and Southern slopes of the site ROSCI0122, where beech forests are associated more with habitats 91V0 and 91K0 (Baseline study on forest habitats). The surface occupied by the forests included in this habitat in the Northern part of the site is considerable and very close to the maximum potential for this type of habitat.
Characteristic tree species	Percent cover / 1000 m2	At least 70%	*Fagus sylvatica* , *Carpinus betulus, Quercus petraea, Acer pseudoplatanus, Cerasus avium* , *Sorbus torminalis, Ulmus glabra, U. minor, Tilia cordata*
Characteristic species for herb layer	Number of species / 1000 m2	At least 3	During monitoring of the habitat 9130 the presence and population of the following taxons, typical for these beech forests, will be analysed: *Lamium maculatum, L. galeobdolon, Melica uniflora, Galium odoratum, G. schultesii, Dentaria bulbifera, Anemone nemorosa.*
Invasive and allochtonous tree species, including not corresponding ecotypes	Percent cover / 1000 m2	Less than 20%	The problem of invasive species is less relevant in the case of this habitat type, as it is very stable from the structural and functional point of view, according to baseline study. Artificial introduction of *Picea abies* should be avoided.
Deadwood volume	m3 / ha	At least 20 Current value should be evaluated in a 3-5 year period and target value reviewed accordingly	Baseline value not known. Should be evaluated within earliest possible period. Current level for this forest habitat type is not known and should be evaluated in a pilot study within a year in the site ROSCI0304 Hârtibaciu Sud-Vest and ROSCI0132 Oltul Mijlociu-Cibin-Hârtibaciu. Depending on funding availability a comprehensive evaluation of deadwood at the national level would be planned in 3-5 years.

▲ **Figure 9** Example of SSCO for the habitat 9130 in a Natura 2000 site in Romania

◀ **Figure 8** Example of SSCO for the species Austropotamobius pallipes in a Natura 2000 site in Ireland

Spatula querquedula

Parameter	Unit of measure	Target value	Additional information	Specific conservation objectives for the area
Habitat of the species: Area of suitable nesting habitats	ha	At least 29,3 ha	Calculated on the basis of the area of the swamp to the village of Pojarevo.	Maintenance of the area of the breeding habitats of the species in the area at the rate of at least 29,3 ha.
Habitat of the species: Area of suitable food habitats of the **species during migration**	ha	At least 463 ha	Calculated on the basis of the open water areas along the Danube river within the SPA plus the area of sand hair and islands.	Maintenance of the area of the appropriate nutrient habitat of the species in the protected zone at the rate of at least 463 ha.

Figure 10 Example of draft SSCO proposed for a Natura 2000 site in Bulgaria

When assessing potential impacts on SSCO, it is important to consider other landscape level issues as well, such as the existence of other infrastructure elements, other pressures or potential threats. As can be seen in the examples above, some parameters also have the potential to be influenced by other stakeholders (e.g. water management authorities, forestry management, etc.).

It should also be mentioned that SSCO might not be available in all European countries, or they might still be at different stages of development or approval. Nevertheless, the assessment of potential impacts should at the very least take into consideration the basic components involved in the evaluation of the habitats and species' conservation status: habitat surface, population size, etc.

Table 19 **Example of a matrix which can be used for assessment of impacts on the specific conservation objectives of habitats and species (first half)**

1	2	3	4	5	6	7	8
Natura 2000 site	**Natura 2000 component**	**Natura 2000 code**	**Habitats / species**	**Type of presence**	**Location relative to the project**	**Directive Annex**	**Source of spatial data**
ROSPA0001	Birds	A229	Alcedo atthis	R	The project is located at a distance of approximately 1.6 km from the species habitat. The species was sighted at a distance of approximately 500 m from the project.	Annex I	Field observations, distribution maps
...	...	...	...	...	...	...	...
Code and name of the site	Category of biodiversity component	Code of habitat / species	Name of analysed habitat / species	Type of presence of species	Description of the location of the habitat / species habitat in relation to the project (is intersected / is not intersected). Distances to the closest habitat area from the project should be measured.	Annex in which the habitat / species is listed	Sources for the spatial data used for the assessment

In accordance with the requirements of the Habitats Directive and the whole environmental legislation at the European level, the Appropriate Assessment should be based on the precautionary principle, meaning that the absence of scientific evidence regarding a significant negative impact of an action cannot be used as a justification for approving said action. When applied in practice, the precautionary principle should imply that the absence of significant negative impacts on Natura 2000 sites must be demonstrated before a plan or project can be authorised.

The assessment of impact significance in relation to Natura 2000 sites should be done taking into consideration the parameters established for the habitats or species in their specific conservation objective. An impact can be considered significant if one or more of the project interventions (alone, or acting cumulatively with other threats and pressures) affect a parameter in an important way and do not allow that parameter to reach its target.

In the case of Romania, it has been observed that the specific conservation objectives established for Natura 2000 sites do not take ecological connectivity into consideration as a parameter. However, in the Appropriate Assessment, Article 10 of the Habitats Directive has to be taken into account and cohesion of the Natura 2000 network has to be secured.

The assessment of impact significance in the context of biodiversity can be achieved with the use of a table, elaborated specifically for the aim of evaluating the impact on the Specific Conservation Objectives. The use of a table allows for the case-by-case analysis for each parameter established, a specific requirement of the European Commission.

An example of such a table, together with explanations for the completion of the various columns is presented below.

9	10	11	12	13	14	15	16
Source of information	**Conservation status**	**Conservation objectives**	**Parameter**	**Measuring unit for parameter**	**Current (minimum)**	**Current (maximum)**	**Target value**
Management Plan, Specific conservation objectives	Favourable	Maintain the favourable conservation status	Population size	Number of individuals	14	16	15
...	...	...	...	...	...	...	...
Sources for the information regarding the habitat / species in the site	Conservation status of the habitat or species in the site	Conservation objective for the habitat or species in the site	List of parameters established for the habitat or species	Measuring units for each parameter established for the habitat or species	Current value for the parameter (minimum value)	Current value for the parameter (maximum value)	Target value established for each parameter

Table 20 Example of a matrix which can be used for assessment of impacts on the specific conservation objectives of habitats and species (second half)

17	18	19	20
Likely to be affected by the project?	**Reasoning behind attributed likelihood to be affected**	**Quantification of impacts (units of measure)**	**Potential impact (without measures)**
Yes	While the project will not intersect the favourable habitat of the species, individuals have been sighted at a small distance from the project area. There is therefore a risk for mortality during the operation phase of the project, due to collision with road traffic.	Maximum 6 individuals per year	Significant
...	...	...	...
Conclusion on whether the parameter can be affected by the project. Should be completed with a „Yes" or „No" answer. The assessment should be done on a case-by-case basis, considering the project effects on each parameter.	Supportive arguments for the conclusion presented in column 17. The arguments should be clear, based on verifiable evidence and, if possible, should provide numerical evidence (e.g. for the distance to a certain habitat patch).	Clear value of the quantified impact on each parameter considered to be affected by the project.	Conclusion on whether the parameter is affected in a "Significant" or "Non-significant" manner by the project.

3.3.4 Step by step approach to analysing the impact on the Natura 2000 SSCO

Each type of identified impact can act on one or multiple conservation parameters, as established for each habitat and species. For instance, 'habitat alteration', might influence the 'Characteristic species abundance' for a habitat and also the 'Water quality' for a species of fish. It is important in this context for the assessment to be done case by case, taking into consideration the different types of impact, which can affect a certain parameter.

The use of a table such as the one presented previously can aid in ensuring that the assessment is done thoroughly. In most situations however, its use is not obligatory and the assessment can be done without such a table. The main steps for analysing the impact on Natura 2000 SSCO should be similar, whether an assessment table is used or not.

3.3.4.1 Locating the habitats and species

Locating the habitats and species in relation to the project location is an important step in the analysis of impact. The analysis details the location in which the habitat, species or the species favourable habitat was reported within the Natura 2000 site, in relation to the projects' components. In order to fulfil this requirement, taking into consideration all components and using all data and information available regarding species and habitat distribution within the natural protected area is necessary. Using field data collected for the project's environmental studies, aimed exclusively at the project sites and their surroundings, is not sufficient. Taking into consideration that the process of collecting field data has a limited

21	22	23
Reasoning behind estimated impact	**Proposed measures**	**Residual impact**
The level of impact is high, considering the size of the species population in the site. While the species has a favourable conservation status in the site, the estimated level of mortality is high enough to endanger the population in the site and contribute to its significant decline within the space of a few years once the project becomes operational.	M20 (anti-collision panels), M21 (additional warning panels)	Non-significant
...	...	...
Supportive arguments for the conclusion presented in column 20. The estimated impact should be assessed without the proposed impact avoidance or mitigation measures. The arguments in this column should present clear and concise explanations for the conclusion regarding impact significance, based on the characteristics of the species population in the analysed site and bioregion.	List of measures proposed for avoiding or mitigating the assessed impacts.	Conclusion on whether the residual impact (after the implementation of the measures) is "Significant" or "Non-significant".

purpose within the project, these data cannot be used in order to exclude a species presence from the project area. If habitat conditions exist for a certain species or if public data (especially the site's Management Plan) considers the area as favourable habitat for a species, this information must be considered in the assessment. This analysis should also take into consideration the location of ecological corridors in relation to the project, as these areas can indicate a potential presence of the species in certain areas.

Information regarding distribution can be obtained from various national and international databases, reported to EEA, public data, etc.

3.3.4.2 Identification and assessment of impacts

The identification and assessment of the impact on Natura 2000 sites, taking into consideration SSCO, must consider all project components and stages: construction (including demolition works and auxiliary works such as new access roads/ rehabilitation of existing roads, building new power lines, etc.), operation (including waste transport activities) and decommissioning (if necessary).

In order to identify and assess the impact on the SSCO, the following steps are needed:

1. Analysis of the objectives, parameters and targets set for each habitat and species protected under the Habitats and Birds Directives that are included in the SSCO;

2. Case by case analysis for each site and habitat/species, regarding each parameter which could be impacted by the proposed project, through the following steps:

   a) Identifying the likelihood to impact the habitat/species: Is the habitat/species habitat intersected? Is it located within the action area of an effect generated by the analysed project? Can individuals reach the project area? Can non-native/ invasive plant species reach the protected habitat/species habitat because of the project? Can the project affect one of the ecological functions of the habitat/ species?

In order to identify likely impact of the individual project components, the structural and functional ecological relations within the site must also be considered. The analysis of structural and functional relations involves establishing interdependencies between abiotic components (e.g. watercourses, surface and underground water bodies, forested areas, agricultural lands, etc.) and the existing habitats and species, as well as between habitats and species (e.g. habitat requirements for certain species, trophic relations, etc.). Identifying and representing them schematically can lead, for example, to the identification of a possibility to impact a species, even if that species was not reported in the project's proximity, by impacting its food source or its movement requirements.

b) Identifying the possibility for a parameter to be impacted: is there a cause-effect relation between project activities and the analysed parameter (e.g. physical or chemical interactions)?

3. Justifying how each SSCO parameter could be affected;

4. Estimating/quantifying (where possible) the impact (e.g. habitat area loss following construction, estimated number of individuals for wildlife species which could die as a result of implementing the project). The impact quantifications must be based on the project's technical data, results of data modelling obtained in environmental studies (e.g. modelling of air pollutant dispersal, noise level modelling, water pollutant dispersion modelling, etc.), monitoring results for similar projects/ activities etc.;

5. Assessing impact significance, without considering the impact avoidance and reduction measures, and justifying it, taking into consideration detailed qualitative and quantitative assessments;

6. Proposing measures designed to avoid/ reduce impacts, which can ensure a non-significant level for the residual impact.

3.3.4.3 Assessment of impact significance

The assessment of impact significance is one of the most important components in the impact assessment process. The impact must be described by one of the following two categories: **significant** and **non-significant**. It is not recommended to use different classes such as: low impact, moderate impact, high impact, etc.

Establishing the degree of significance can be based on the following parameters:

1. Quantitative – the percentage of the target value which is affected. The analysis must be done on a case-by-case basis, taking into consideration the criteria mentioned below, without the use of pre-defined general thresholds. In the case of priority habitats, any habitat loss can be considered as a significant impact;

2. Qualitative:

i. If the project affects the central or marginal area of the habitat;

ii. The conservation status at the site level and at the biogeographic level;

iii. The presence of the habitat or species in other Natura 2000 sites;

iv. Species located at the limit of their distribution;

3. Ecological functions:

i. Maintenance / reestablishment of the ecological connectivity;

ii. Maintenance of the critical physio-chemical parameters, such as water level;

4. The parameters of the types of impact.

When establishing the significance of an impact, a precautionary approach is necessary. Impacts can be considered significant when there are no sufficient data to clearly show non-significant level of impact, and the conservation status is unfavourable, population size is small or there is potential for a cumulative impact.

Affecting a parameter as a consequence of the changes generated by the project or in combination with other plans or projects can lead to the SSCO target not being achieved. Preventing the SSCO target from being achieved should be considered a significant impact.

Following the assessment of impacts, avoidance or mitigation measures should be proposed. Details on the methodology for the proposal of appropriate measures is presented in section 3.6 of this Toolkit.

3.4 Assessment of impacts on habitats and species outside natural protected areas

The protection of species outside Natura 2000 sites is a requirement of the European Commission, as stated in Article 12 of the Habitats Directive. Article 12 (presented in the text box below) addresses the species listed in Annex IV(a) of the Habitats Directive and is aimed at different types of direct threats to these species.

As stated in this Article, in the case of strictly protected Natura 2000 species (species listed in Annex 4 of the Habitats Directive), the following actions are prohibited:

1. All forms of deliberate capture or killing of specimens of Annex IV (a) species. By "deliberate", the Court of Justice of the European Union (CJEU) indicates "direct intention" as a meaning. Deliberate actions are understood as actions carried out by a person or body, who knows that their action will most

Article 12

1. Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV(a) in their natural range, prohibiting:

(a) all forms of deliberate capture or killing of specimens of these species in the wild;
(b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;
(c) deliberate destruction or taking of eggs from the wild;
(d) deterioration or destruction of breeding sites or resting places.

2. For these species, Member States shall prohibit the keeping, transport and sale or exchange, and offering for sale or exchange, of specimens taken from the wild, except for those taken legally before this Directive is implemented.

3. The prohibition referred to in paragraph 1(a) and (b) and paragraph 2 shall apply to all stages of life of the animals to which this Article applies.

4. Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV(a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.

Figure 11 Article 12 of the Habitats Directive (© European Commission) likely lead to an offence against a species, but chooses to ignore the risks and consciously accepts the foreseeable results of their action.

2. Deliberate disturbance of Annex IV (a) species. This addresses activities that deliberately disturb a species to the extent that may affect its chances of survival, reproductive ability or breeding success or that leads to a reduction of the area occupied by the species or its relocation or displacement. These activities are considered a "disturbance" under the terms of Article 12. This is particularly important for species in the period of breeding, rearing, hibernation and migration.

3. Deliberate destruction or taking of eggs from the wild. This refers to any activity that deliberately leads to the destruction or taking of eggs from the wild.

4. Deterioration or destruction of breeding sites or resting places. This applies to all breeding sites and resting places and to their long-term potential deterioration over time. Any measures proposed for these sites should address not only their physical integrity, but also their ecological functionality.
   In this context, it is important to mention that not only "deliberate" deterioration or destruction is prohibited, but all acts or deterioration or destruction, regardless of whether they are deliberate or not (European Commission 2021b)

In the context of environmental impact assessment for projects, the European Commission posits the following issues as needing to be assessed, regardless of the placement of a project inside a Natura 2000 site:

- If any of the species listed in Annex IV(a) to the Habitats Directive is present in the project area;
- If any of the breeding sites or resting places of the species listed in Annex IV(a) to the Habitats Directive are present in the project area;
- If any of these species and/or their breeding sites or resting places will be 'impacted' (killed, disturbed, damaged, etc.) by the construction and/or operation of the project;
- If the conditions set out for derogation in accordance to Article 16 of the Habitats Directive are fulfilled (European Commission 2021c).

Following an assessment of this type, the project proposals can either be modified, or, if that is not possible and the rest of the requirements are fulfilled, a request for derogation in accordance to Article 16 of the Habitats Directive can be submitted.

3.5 Assessment of impact in a transboundary context

The assessment of impacts in a transboundary context should also focus on the identification of significant impacts according the Espoo Convention (Convention on Environmental Impact Assessment in a Transboundary Context, UN 1991). However, instead on focusing on the environmental components in the country in which the project is proposed, it should focus on determining whether there is a chance for significant impacts on environmental components (including Natura 2000 sites) in another country.

In accordance with the European Commission's requirements, it is necessary, if potential significant impacts are expected to occur in another state, to conduct collaborative discussions as well as a joint Assessment and joint Environmental Impact Assessment reports, which take into consideration the whole proposed project. Details related to the methodology for conducting a transboundary impact assessment is available in the Commission's 'Guideline on the Application of the Environmental Impact Assessment Procedure for Large-scale Transboundary Projects'.[19]

3.6 Tools for designing prevention, avoidance, mitigation and / or compensation measures

The identification of a significant impact implies the need to propose avoidance, mitigation and / or compensation measures. The proposed measures must be specific and applicable to the significant impacts identified.

For the identification of appropriate measures, the following steps should be taken:

1. Identification of **prevention measures**. These have the role of preventing the occurrence of an impact, by eliminating the cause of its occurrence. A prevention measure can be the elimination of a certain intervention in a project, thus eliminating the impacts that said intervention would have led to.
   Prevention measures are a key component, which member states should take in order to avoid deterioration or disturbance following predictable events. They can also be taken outside Natura 2000 sites, for protection of species under Annex 4(a) of the Habitats Directive.

2. Identification of **avoidance measures** (or changes to the alignment of linear infrastructure). These measures do not prevent the occurrence of an impact, but they avoid a significant level of the impact. If prevention is not possible, these are the preferred types of measures and should be implemented whenever possible.

3. Identification of **mitigation measures**. If neither prevention nor avoidance measures are applicable, mitigation measures should be proposed to ensure the reduction of the significant impacts identified;

4. Identification of **compensatory measures**. If, after the application of the previously mentioned measures, the level of impact cannot be reduced to a non-significant level, compensatory measures have to be proposed to offset the significant impacts. It is important to note that in the Appropriate Assessment process, compensatory measures can be proposed only after an analysis of any possible alternative solutions and if the project is deemed to be of 'overriding public interest'. Compensatory measures in the AA process should also involve either notifying the European Commission, or approval by the EC, depending on the type of habitat or species potentially affected.

The measures proposed have to be formulated using a **SMART** methodology. They have to be **S**pecific, **M**easurable, **A**chievable, **R**ealistic and **T**ime-bound, addressing the parameters considered to be affected by the analysed project.

After the proposal of the appropriate measures for each possibly significant impact caused by the analysed project, their applicability to each group of habitats and species has to be established, as well as their efficiency. The proposed measures should have a very clear aim: to reduce the residual impact of a project-related intervention to a non-significant level.

It is important to analyse if the proposed measures have the potential to affect other species than the ones for which they were proposed. This can be done through the use of table similar to the one below.

19 The Guideline is available at the following link: https://ec.europa.eu/environment/eia/pdf/Transboundry%20EIA%20Guide.pdf.

Table 21 Example of a table that can be used for analysing the efficiency of measures and the identification of potential additional impacts caused by the measures proposed

Measure	Habitats	Plants	Inverte-brates	Ichtyo-fauna	Herpeto-fauna	Birds	Bats	Other mammals	Recommendations
M1. Installation of anti-collision panels	N/A	N/A	+	N/A	-	+	+	-	Implementation of the measure can lead to habitat fragmentation. It is necessary to provide gateways for allowing fauna to traverse the linear infrastructure.
...	...	...	...	...	...	...	...	...	...

3.7 Tools for monitoring

Monitoring has to be carried out to ensure the effectiveness of the proposed measures, as well as for assessing the residual impacts. It should also be able to show whether there is a need for any adjustments to the already implemented measures or if any further additional measures are needed. Monitoring should cover all the biodiversity components, as well as the parameters for which measures have been proposed. It is preferable for monitoring to be done based on the parameters established for each habitat or species. The monitoring activities should be done to prove that the aims of the measures are reached. In the monitoring programme, it is recommended that the associated aims are quantified through the use of specific indicators and associated targets, which can show if, when and how a measure is effective. For example, the implementation of a reinforced fence along a new motorway should be monitored through monitoring of fauna mortality, with an indicator for the number of collision victims.

As stated before, monitoring should involve three stages:

1. Before construction (data of the baseline condition analysis);

2. During construction;

3. After construction.

Table 22 Example of a table for the proposal of a monitoring programme

Affected component	Form of impact	Indicator	Measuring unit	Monitor-ing fre-quency	Thresholds / Targets	Monitoring locations	Other observations
Birds	Species disturbance	Equivalent noise level during daytime	dB(A)	Monthly	48	Km 256+500	Long-distance measurements in at least 3 locations
(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)

The monitoring required in the pre-construction phase should preferably cover at least 2 years before the project construction begins. It should address the biodiversity components relevant to the area in which the project is proposed and use monitoring methods selected specifically for this aim. Within the SaveGREEN project, a monitoring tool has been developed with a focus on structural and functional connectivity and has been tested in the project's pilot areas.

The monitoring plan should be specific and should establish the parameters, indicators, measurement units, as well as monitoring frequency, locations and, if possible, methods.

3.8 Proposed indicators for the Cost-Benefit Analysis

One important component of the Environmental Impact Assessment is represented by the elaboration of a Cost-Benefit Analysis (CBA). For this analysis, it is necessary to quantify and put into monetary terms the corresponding financial losses caused by the impacts of a project on the environment, including on ecological connectivity.

The estimation of losses due to a project can be performed by analysing the change wrought by the project on the Total Economic Value of each analysed environmental service. The Total Economic Value has two main components: the use value and the non-use value (European Commission 2014).

Use value refers to the "social value people have from actually using a good or potentially using it in the future (e.g. recreational activities, productive activities such as agriculture and forestry, etc.), as well the benefits derived from the goods and services provided by the ecosystem that are used indirectly by an economic agent (e.g. the purification of drinking water filtered by the soil)" (European Commission 2014).

Non-use value refers to the value placed by each individual "not only on the well-being produced by the good's existence per se on himself/herself (existence value), but also on the well-being caused to other individuals by the availability of that good, either in the same generation (altruist value) or future generations (bequest value)" (European Commission 2014).

The values are linked to the ecological services provided by the ecosystems. Impacts that the analysed project can have on ecosystems can in turn lead to a decrease in the ecological services and a depreciation of their value.

The two value categories are further broken down into different types of benefits. A synthesis of these benefits is presented in the diagram below.

The most common mechanisms for valuating environmental costs and benefits are 'the willingness to pay' and 'the willingness to accept compensation'. These are defined as:

- 'Willingness to pay' is "the maximum amount of money an individual is prepared to give up to secure an environmental improvement or to avoid an environmental loss (in quality or quantity of a good)" (SR EN ISO 14007:2020);

- 'Willingness to accept compensation' is "the minimum amount of money an individual is prepared to accept as

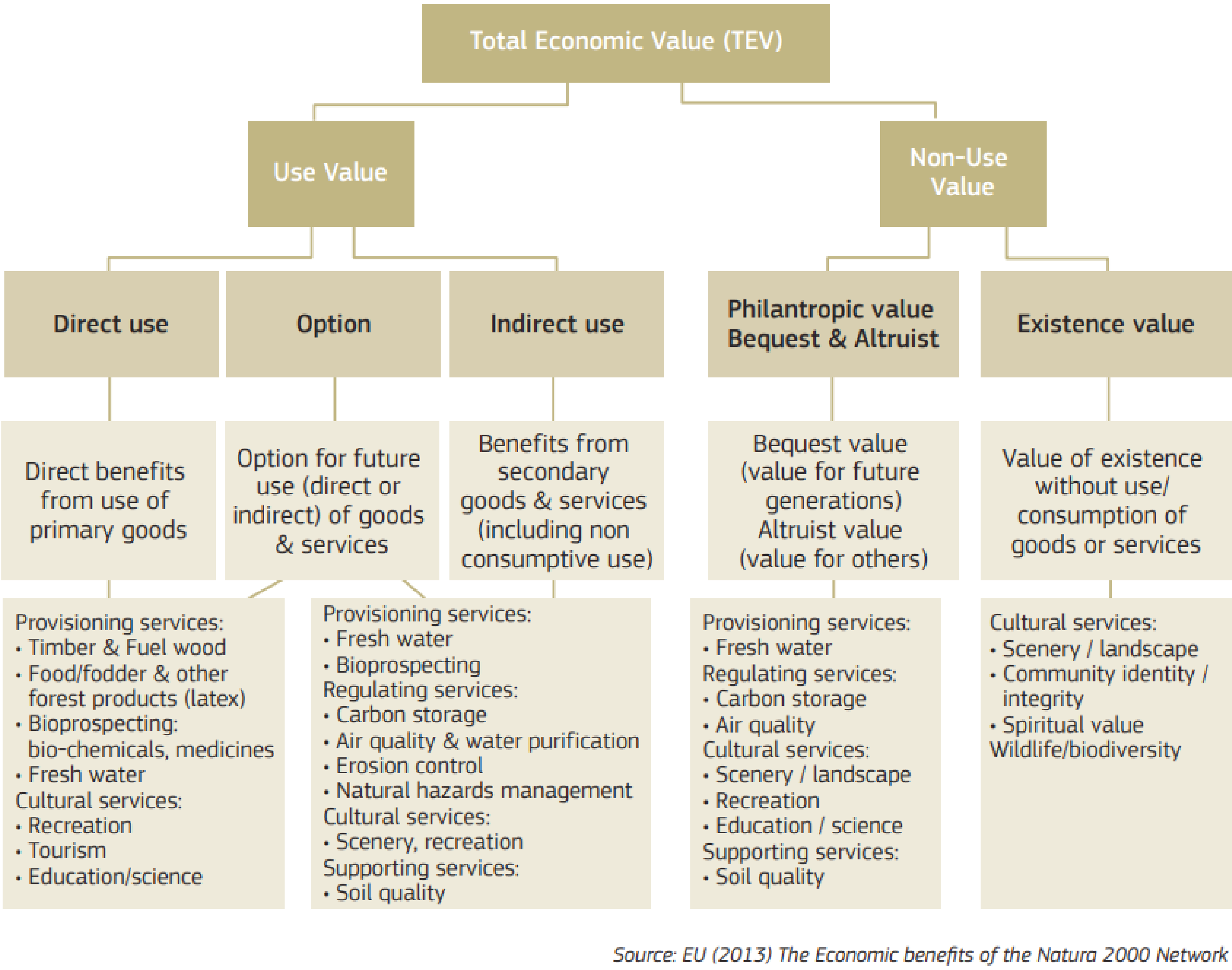

Figure 12 Schematic representation of the different components of the Total Economic Value (TEV) (© European Commission 2014)

compensation to forgo an environmental improvement or to tolerate an environmental loss" (SR EN ISO 14007:2020).

Ecological connectivity is considered to be a 'supporting ecosystem service', which provides non-use value through its role in maintaining ecosystem functions and the future availability of ecosystem services (Milton *et al.* 2019). The valuation of potential losses in this situation is therefore a bit more difficult than in the case of use values.

The most appropriate method, which can be used for valuing the potential loss of ecological connectivity is the assessment of the willingness to pay. However, this parameter is highly dependent on the specific conditions of the area under analysis and the stakeholders residing there. It is therefore very difficult to propose an all-encompassing value that could be used anywhere. If the conditions of the project allow, a separate study that analyses the willingness to pay of the stakeholders for the ecological connectivity of the area should be carried out. The results of this study could then be included in the Cost-Benefit Analysis to inform the decision in the best way possible.

Another method for valuing potential losses in ecological connectivity could be the use of standardised values from the Ecosystem Services Valuation Database (ESVD), developed by The Economics of Ecosystems and Biodiversity (TEEB) (*ESVD, 2020). This method has the advantage of being generally applicable and not geographically specific. The main disadvantage is that it is based on average monetary values associated with ecological services, and thus might not correctly reflect the particularities of a certain area.

The ESVD is comprised of an Excel file, with average values (in US dollars/ha/year) for different ecosystem services and different land use categories. A financial estimation of the potential losses due to impacts on ecological connectivity can be done through the application of the following steps:

1. Calculation of the area potentially affected by the project impacts on the ecological corridors. This can be estimated as the area in which there are likely to be changes in the flora and fauna populations due to interruption of connectivity;

2. Estimation of the area potentially affected by categories of land use, using any type of land use resources considered adequate for the project area;

3. Selection (from the list available in the ESVD) of the ecosystem services affected by the changes in ecological connectivity. These should be selected based on the characteristics of each project (for instance, if a project will lead to the interruption of riparian corridors, it can be considered that the 'Regulation of water flows, Erosion control' and 'Maintenance of soil fertility' services can be affected as well);

4. Calculation of the total possible damages of the project, based on its interventions and the estimation from the ESVD;

5. Integration of the value into the Cost-Benefit Analysis.

The results of the valuation carried out with the use of the ESVD should be considered with caution, and preferably confirmed by experts with knowledge of the area under analysis before being integrated into the CBA.

20 The Excel file is available here: https://www.es-partnership.org/esvd/esvd-download/esvd-version-december-2020/.

References

ASRO, (2020), *SR EN ISO 14007 Environmental management - Guidelines for determining environmental costs and benefits* (No. 14007)

Borlea, S., Doba, A., Nistorescu, M., (2021), *Report on the collection and gap analysis of existing methodologies / best practices / training materials*, Work Package 1. Methodologies and tools, SaveGREEN project

ESVD, (2020), Ecosystem Services Valuation Database: version December 2020, available at https://www.es-partnership.org/esvd/esvd-download/esvd-version-december-2020/

European Commission, (1992), Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)

European Commission, (2009), Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive)

European Commission, (2001), Directive 2001/42/EC of the European Parliament and of the Council on the assessment of effects of certain plans and programmes on the environment (SEA Directive)

European Commission, (2014), Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

European Commission DG REGIO, (2014), *Guide to Cost-Benefit Analysis of Investment Projects*

European Commission, (2019), *Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC*, Publications Office of the European Union

European Commission, (2021a), *Commission notice. Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC*

European Commission, (2021b), *Guidance document. The strict protection of animal species of Community interest under the Habitats Directive. A summary*, Publications Office of the European Union (ed.)

European Commission, (2021c), *Commission notice. Guidance document on the strict protection of animal species of Community interest under the Habitats Directive*

European Commission, (2013), *Guidance on the Application of the Environmental Impact Assessment Procedure for Large-scale Transboundary Projects*

Georgiadis L. (Coord.), (2020), *A Global Strategy for Ecologically Sustainable Transport and other Linear Infrastructure*, IENE, ICOET, ANET, ACLIE, WWF, IUCN, Paris, France, pg. 24

Grilo, C., Koroleva, E., Andrášik, R., Bíl, M., & González-Suárez, M., (2020). *Roadkill risk and population vulnerability in European birds and mammals.* Frontiers in Ecology and the Environment, 18(6), pg. 323–328

Hlaváč, V., Anděl, P., Matoušová, J., Dostál, I., Strnad, M., Immerová, B., Kadlečík, J., Meyer, H., Moț, R., Pavelko, A., Hahn, E., Georgiadis, L., (2019), *Wildlife and Traffic in the Carpathians. Guidelines how to minimize impact of transport infrastructure development on nature in the Carpathian countries*, Danube Transnational Programme TRANSGREEN Project, The State Nature Conservancy of the Slovak Republic, Banská Bystrica

Iuell B., Bekker G.J., Cuperus R., Dufek J., Fry G., Hicks C., Hlaváč V., Keller V.B., Rosell C., Sangwine T., Torslov N.- & Wandall B. Le Marie, (Eds), (2003), *Wildlife and Traffic - A European Handbook for Identifying Conflicts and Designing Solutions. Prepared by COST 341 - Habitat Fragmentation due to Transportation Infrastructure*, Delft, The Netherlands, Ministry of Transport, Public Works and Water Management, Road and Hydraulic Engineering division

Joumard, R., & Nicolas, J. P., (2010), *Transport project assessment methodology within the framework of sustainable development*. Ecological Indicators, 10(2), 136–142. https://doi.org/10.1016/j.ecolind.2009.04.002

Milon, J. W., & Alvarez, S., (2019), *The Elusive Quest for Valuation of Coastal and Marine Ecosystem Services*. WATER, 11(7), pg. 1518

Nistorescu, M., Ioniţă, A., Doba, A., (2019), *Keeping Nature Connected - Environmental Impact Assessment (EIA) for Integrated Green Infrastructure Planning. Training Package*. TRANSGREEN Project, https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/35/f5374e0aee3813cfd352c8005b5ceb0da52d52c5.pdf

Seiler, A., Helldin, J-O., (2006), *Mortality in wildlife due to transportation*, In Davenport, J. & Davenport J., "*The Ecology of Transportation: Managing Mobility for the Environment*", series: Environmental Pollution, Springer, pg. 165 – 189

PILOT AREAS:

Austria

1 Kobernausser forest

2 Pöttsching (Alpine-Carpathian Corridor)

Czech Republic/Slovakia

3 Beskydy-Kysuce CZ-SK cross-border area

Hungary/Slovakia

4 Novohrad-Nógrád SK-HU cross-border area

Ukraine

5 Zakarpattia region

Romania

6 Mureş valley (Arad-Deva)

7 Mureş Valley (Târgu Mureş – Târgu Neamţ)

Bulgaria

8 Rila-Verila-Kraishte corridor

Project partners:

Austria: WWF Central and Eastern Europe (Lead Partner), Environment Agency Austria

Bulgaria: Black Sea NGO Network, Bulgarian Biodiversity Foundation

Czech Republic: Friends of the Earth Czech Republic – Carnivore Conservation Programme, Transport Research Centre Czech Republic

Hungary: CEEweb for Biodiversity, Hungarian University for Agriculture and Life Sciencis

Romania: Zarand Association, EPC Environmental Consultancy Ltd., WWF Romania

Slovakia: Slovak University of Technology in Bratislava – SPECTRA Centre of Excellence of EU

Associated Strategic Partners:

Austria: Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology

Bulgaria: Ministry of Agriculture, Food and Forestry – Executive Forest Agency, Southwestern State Enterprise SE – Blagoevgrad

Czech Republic: Ministry of the Environment, Nature Conservation Agency

France: Infrastructure and Ecology Network Europe (IENE)

Germany: Bavarian State Ministry of the Environment and Consumer Protection

Greece: Egnatia ODOS S.A.

Hungary: Natinoal Infrastructure Developing Private Company Ltd. (NIF Ltd.), Ministry of Agriculture, Danube-Ipoly National Park Directorate

Romania: Ministry of Environment, Waters and Forests, Ministry of Public Works, Development and Administration, Ministry of Transport, Infrastructure and Communications

Slovakia: State Nature Conservancy, Ministry of Environment, Ministry of Transport and Construction, National Motorway Company

Ukraine: M.P. Shulgin State Road Research Institute State Enterprise – DerzhdorNDI SE, Department of Ecology and Nature Resources of Zakarpattia Oblast Administration

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