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Assessment, Compensation and Biodiversity Offsets of Environmental Impacts

The German-Russian Compendium

Практическое применение методов оценки и компенсации нарушений окружающей среды и биоразнообразия

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1. INTRODUCTION

The system of environmental impact compensation as it exists in Russia is focused mainly on offset payments. These payments, in so-called “consolidated form”, are paid directly into the federal and regional budgets. Thus, the fees, paid for environmental impacts in accordance with approved fixed rates and methods of environmental impact assessment, are rarely earmarked for environmental measures, and almost never for compensation for the concrete impact for which they have been paid.

According to the requirements of the Budget Code of the Russian Federation, the expenditure of compensation fees charged for environmental impacts is made with no consideration for the purpose or extent of that compensation. As a result, investors cannot estimate the expected costs of nature conservation measures and, consequently, investment profitability. All entities with budgetary financing are funded according to national economic and budgetary spending considerations.

Under the UN Stockholm Declaration on the Human Environment of June 16 1972, the “polluter-pays” principle implies that the authorities are to determine that the polluter is to bear the expenses of carrying out measures of environmental improvement. In Russia however, this principle has been transformed into a different principle – that “of paying for the right to impact the environment”, as it is easier for many project developers to pay than to take measures for the protection of nature.

It is thus necessary to create a mechanism to secure environmental impact compensation under these conditions – a natural compensation system supported by legal and methodolical principles, excluding monetary compensation. In Russia, there are no principles or methods for real environmental impact compensation, so that the mechanisms for the avoidance of negative impact on the environment work ineffectively.

Germany and Russia have been cooperating for over 20 years in the area of environmental protection within the framework of the agreement signed by the Federal Republic of Germany and the Russian Federation in 1992. In the context of this agreement, experts from Germany and Russia have realized a large number of scientific and practice-oriented projects.

During the period of cooperation it turned out that Germany has a set of principles and effective methods for the assessment, avoidance and compensation of environmental impacts, supported by extensive legal and methodological bases that have been developed over the course of decades. The compliance with these principles have made environmental safety a national policy priority, and have given the country a leading role in the area of environmental protection among economically developed countries.

In this context, a new project was realized with the goal of incorporating German and European experience on avoidance and compensation of environmental impacts into the Russian national system of environmental impact assessment.

For this purpose, an attempt was made to single out major methodological elements of environmental accompaniment of projects from the Russian, German and European experience. A set of these elements forms a body for the assessment of environmental impacts and their compensation, regardless of the country involved or the normative documents used. A clear understanding of the meaning of these elements should allow all participants interested in ecological accompaniment of investment projects to find effective methods of problem solution and compromises for the resolution of conflicts arising during project planning and realization, and thus to balance the public interest in further economic development with that of the improvement of the condition of the environment.

The present project was supported by the Ministry of Natural Resources of the Russian Federation and German Federal Ministry for Environment, Conservation and Reactor Safety. This compendium is

focused on the conceptual, informative and methodological levels of environmental impact assessments for project realization and the development of measures of natural compensation. It is designed to promote acceptable standards and minimal practical requirements in this area. For this purpose, this compendium describes the general state of Russian standards, and presents German and European methods of natural impact compensation. The German experience is adapted to Russian practice in such a way as to permit the application of the methods described in this book for impact assessment and their compensation as possible instruments for the solution of similar tasks in Russia.

This compendium does not claim to provide unequivocal answers to all questions arising in the context of the ecological accompaniment of investment activity. It is designed to help participants orient themselves more easily in a concrete situation, find required information material, and select or develop appropriate methods for problem solution. We hope that this book will help readers improve the quality of work on a project, cut the costs of its realization, and, ultimately, promote the improvement of the environmental quality.

This book is a result of long-term cooperative effort between Russian and German experts in the assessment of environmental impacts. Its concept and contents were discussed at joint seminars and conferences held in Moscow, Bonn, Irkutsk, Dresden and at Lake Baikal between 2003 and 2013. The following experts contributed significantly to the compilation of this book: on the German side, Heinrich Schmauder, Prof. Adrian Hoppenstedt and Prof. Dr. Wolfgang Wende; and, on the Russian side, Victoria Venchikova, Prof. Anatoly Ignatov and Prof. Dr. Elena Zelinskaia. This book was prepared for publication by Dr. Valery Kravchenko and Svetlana Golubeva of the Sochava Institute of Geography of the Siberian Branch of the Russian Academy of Sciences, and by Anja May and Juliane Albrecht of the Leibniz Institute of Ecological Urban and Regional Development in Dresden. The authors are grateful to the above mentioned consultants and those who were involved in the discussion of the book, and for their valuable advice and information provided for its publication.

2. COMPENSATION OF IMPACTS UPON THE ENVIRONMENT IN RUSSIA

2.1. The basis for impact compensation in the environmental legislation

2.1.1. Federal laws stipulating the procedure for impact compensation

Definition of environmental impact under the law of the Russian Federation

The definition of environmental impact is stated in Article 1 of the Federal Law «On Environmental Protection» [1], as negative changes of the environment as a result of pollution causing degradation of natural ecological systems and/or depletion of natural resources.

Pollution of the environment means the input of substances or energy into the environment the properties, location or amount of which affect the environment negatively, whereas a negative effect on the environment means the effect of economic and other activities causing negative changes in environmental quality.

Hence, the principle nature conservation law of the Russian Federation states that impacts on the environment are directly associated only with the pollution of the same. Other types of impacts, such as direct destruction of biotopes or the deterioration of landscape quality, are not stipulated directly in this law.

The principles of assessment and compensation of impacts on the environment

The Law «On Environmental Protection» contains the following general principles for the assessment and compensation of environmental impacts as a result of damage to the environment:

- An environmental impact caused as a result of the violation of environmental law is to be compensated voluntarily or through the decision of a court or arbitrage
- The scope of an environmental impact caused as a result of the violation of environmental law is ascertained by taking into account:
  - The actual expenses spent on the restoration of the impacted environmental state, including all losses and lost profits
  - Any projects for reclamation and restoration, and
  - The established rates and methods of assessment of environment impacts, approved by executive authorities responsible for state management in the sphere of environment protection (in case of absence of such projects)..

These principles are consistent with those provided under the Civil Code of the Russian Federation [2]. In particular, Article 15 «Compensation of Losses» states that losses are understood to constitute those expenses to be incurred for the restoration of the violated rights and the loss or damage to property, including lost profits. The real damage is determined from the cost of the lost property, and the lost profit by ascertainment of the reduction in the amount of profit that the person would have received under ordinary business conditions, had his rights not been violated.

The Civil Code of the Russian Federation also defines the concept of damage:

- Losses (real damage and lost profit)
- Harm to life and health, and
- Moral damage.

Environmental impacts are compensated under Article 77 of the Federal Law «On Environmental Protection». Thus, applicability of the regulations of the Russian Federation Civil Code is confirmed by this law.

Item 2 of Article 29 of the Federal Law «On Atmospheric Air Protection» [3] states that citizens and public associations have a right to lodge claims for compensation for harm to their health and damage

to their private property and to the environment caused by pollution of the atmosphere. This damage is compensable in full and in accordance with the established rates and methods of damage assessment. In the absence of such rates and methods, the damage shall be compensated in full and in accordance with the actual costs for the recovery of health and private property and of the environment, by those persons and legal entities responsible for such atmosphere pollution (Article 32 of this law).

Principles specified by the legislation determine impact compensation mainly in monetary terms, without differentiation between the damage caused to nature and to persons or legal entities. Legislation does not directly specify the requirement for the restoration of the impacted environment.

Sanctions for an environmental impact (environmental violation)

An environmental impact is permitted if an appropriate permit (licence or limits) has been obtained. In this case, a legal environmental impact is compensated via the system of ecological payments:

- For natural resources, or
- For negative impact on the environment.

The compliance of environmental impacts with the licence is controlled by the inspection of such licenses and consistent monitoring of the emissions or discharges of harmful substances, waste dumping, and other approved activity impacting on the environment.

There are other licensing regulations. For example, special laws regulate the duties of water users, including hydraulic enterprises, with respect to their use of rivers and their exploitation of hydropower (Water Code [4] and the Federal Law «On the Safety of Hydraulic Structures» [5]). The violation of existed regulations on the interaction of hydraulic structures with the environment constitutes an environmental offence.

Sanctions for violation of licensing regulations (environmental offence) are specified in the RF Code of Administrative Offences, the Russian Tax Code and the Civil Code of the Russian Federation. Property, disciplinary, administrative and criminal liabilities are stipulated for the breach of legislation in the field of environment protection, under Article 75 of the Federal Law «On Environmental Protection».

Federal authorities and authorized government bodies are entitled to bring to material or other responsibilities for environmental offence. At the same time, local government bodies do not have such powers and can only address them by means of an appropriate application to regional or federal authorities.

The powers of the Russian Federal Government bodies and of those of the constituent territories of the RF in the regulation of environmental impact assessment

The powers of the Russian Federation government bodies (Article 5 [1]) in the area of environmental protection include:

- The establishment of the procedure for determining the size of payments for emissions and discharges of pollutants into the environment, waste disposal and other types of environmental impact
- An economic assessment of the impact of economic and other activities on the environment
- An economic assessment of natural and natural-anthropogenic objects
- A list of violations of the law in the area of environmental protection which present a threat of harm to the environment.

The powers of the government bodies of the RF territories (Article 6 [1]) in this respect include:

- Lodging a complaint in court demanding, in accordance with the law, the restriction, suspension or prohibition of economic and/or other activities which violate the law in the area of environmental protection
- Submitting a claim for compensation of environment damage as a result of a breach of the law in the area of environmental protection

- Allowing organizations to perform an economic assessment of environmental impact caused by economic and other activities, and implementing the ecological certification of enterprises and territorial bodies.

The above review of federal legislation shows that it contains no direct reference to any natural compensation. A number of contradictions in the Law «On Environmental Protection» make it difficult to understand either the necessity for such compensation or its procedure.

Under Article 3 of this law, the protection, reproduction and rational use of natural resources, as well as charges for the use of nature and the compensation for environmental impacts, are included in the principles of any activity affecting the environment, and subsumed under the concepts «charges for use of nature » and «compensation for environmental impact». As it is impossible to compensate for an environmental impact only by means of payment for environment use, it is obvious that environmental impact is to be compensated in-kind.

At the same time, Article 14 states that negative impacts on the environment and compensation for environmental impacts are to be regulated economically, i.e. in a form of monetary compensation (payment).

In a certain sense, the concept of natural compensation of impacts is stipulated in Articles 34-39 of this law. This refers to the need to design measures for environment protection, restoration of the environment, rational use and reproduction of natural resources and environmental safety in the location of buildings, structures and other facilities, their design, construction, reconstruction, operation, maintenance, conservation and dismantling. However, the law does not stipulate the procedure for the development of such measures.

The Regulation on the Environmental Impact Assessment of Proposed Projects [8] and regulation on the list of project documentation [9] in which this procedure is to be stipulated consider only the development of measures on the avoidance or minimization of these impacts and the assessment of the significance of residual negative impacts and their consequences. The natural compensation of these residual impacts is not provided. In practice, they are compensated in monetary terms.

2.1.2. Regional legislation determining the procedure of impact compensation

Regional environmental legislation duplicates mainly federal laws, specifying only the rates of payment, supplemented by regional coefficients, which can either increase or decrease the total. The exception is the environmental legislation of Moscow, which provides for certain measures of natural compensation. In particular, Moscow laws [10, 11] and associated normative documents [12-14] stipulate:

- Mandatory full compensation of impacts caused to urban soils, either by monetary or natural means: The type of compensation is determined by the Moscow executive authority. The natural compensation is carried out by specialized organizations in the form of reclamation, rehabilitation and/or detoxification of urban soils, with the costs borne by the individuals or legal entities causing the damage. In case of illegal impervious coverag of soil, the impact compensation is performed soils by removing the impervious coverage and recovery of soils;

- Mandatory compensatory creating of green aeras in all cases of impacts or destruction of green plantations: Compensation for green space is to be carried out during the next season suitable for tree planting, but in no case later than one year after the destruction of the green plantations. Trees and bushes are to be planted on the same plot of land where they were destroyed. Moreover, the amount of plants and the area occupied by them is not to be reduced. Alternatively, they may be planted on another plot of land, but within the same administrative territory, and with double the number of plants, and on double the area.

Recently, an experience of natural compensation for impacts has emerged in the construction of Olympic facilities in Sochi. Here, a set of methods for the rehabilitation of relocated plants and animals was developed [15]. The goal was to provide scientific support for the resettlement of rare and

endangered species of plants and animals which potentially could affect from negative impact during the construction of Olympic facilities. The programme includes:

- An inventory of flora and fauna species direct affected from negative impacts
- Removal of specimens from habitats
- Collection of reproductive materials
- Selection of places for replanting of plants and relocation of animals
- Relocation
- Reproduction of species outside their natural habitats
- Relocation, reintroduction and rehabilitation
- Comprehensive monitoring of the state of rehabilitated species of flora and fauna and disturbed habitats
- Protection of planted vegetation and relocated animals, and protection of habitats disturbed as a result of the negative impact of the introduction of alien flora and fauna species.

Moreover, certain environmental requirements for the planning and construction of the Olympic facilities, which have been approved in 2009 by State Company «Olympstroy», include measures that can be interpreted as compensation:

- Conservation of existing and reconstruction of adjacent natural territories and natural biotopes damaged as a result of the construction, with the goal of biodiversity preservation
- Development of new high-quality sustainable, modern facilities of landscape architecture and integrated site improvement
- Selection of a plant assortment taking into consideration the natural-climatic zone and minimization of costs for the further maintenance of the facilities built.

Although there is no equivalent restoration of the homogeneous functions of nature and of functionally homogeneous natural structures, and the WWF experts have identified weaknesses in the compensation measures and of the time lag involved [http://wwf.ru/about/positions/sochi2014], this experience, needs study and further development.

2.2. Methods for determination of environmental impacts, and common practice of compensation for them

At present, an extended understanding of the impact of environment and natural resources is interpreted as a monetary assessment of all negative effects resulted from environment pollution and damage to natural resources. Hence, total damages (losses) consist of:

- Compensation for violated rights
- Real environment damage, and
- Lost profits.

Real damage results from costs of losses or damage, together with the expense of restoration.

Calculations of real damage often include not only the actual expenses incurred by a person, but also the expenses which this person is to pay for the restoration of the violated rights [2, Item 2, Article 15]. The need for such expenditures and their claimed amount are supported by calculations justified by cost estimates (calculations) of expenditures for the elimination of defects, agreement, a degree of responsibility for breach of obligations, etc.

The real damage to the environment as a result of negative impacts is assessed as follows:

- Direct losses
- Expenses for elimination, and
- Compensation for the effects of pollution.

While assessing direct losses, the scope of natural damage is first estimated, and then its monetary cost is estimated.

The special features of the Russian system of environmental impact assessment include:

- The protected-asset-based approach, i.e. the calculation of compensation for impacts upon each environmental asset, e.g. soil, air, water, etc., and
- Prevalence of normative requirements for methods of assessment.

Normative methods are methods associated with the formalization of the effect and assessment on that basis of the scope of damage according to the approved costs. At present, a great number of normative and methodological documents to assess environmental impact are used [16-23 and others]. All these documents stipulate the cost equivalent of damage assessment.

Charges for use of nature include payment for natural resources, environment pollution and other types of impacts. Charges for natural resources are raised for:

- The right to use natural resources within fixed limits
- The above-limit and/or irrational use of natural resources, and
- The reproduction and conservation of natural resources.

Payment for the use of natural resources does not exempt the users from the implementation of measures for the protection of the environment and compensation for the impacts caused by environmental violation. These measures are in most cases either compensated by payment or realized formally.

Payment for environmental pollution is charged for:

- The emission of pollutants into the atmosphere
- The discharges of pollutants and microorganisms into water bodies
- The disposal of industrial and consumer wastes
- The pollution of soils, and
- Environmental pollution by noise, heat, electromagnetic or ionizing radiation, and/or other types of physical effects.

Payment is fixed according to basic standards, taking into consideration the origin of the natural object or resource used, i.e. the protected-asset-based approach is used. That means that the damage is assessed from separate environmental media or elements of the environment and regulated by independent normative-methodological documents, e.g. [16-23].

Three types of basic fixed payments are established for each pollutant (waste), taking into consideration the level of harmful effect and the threat to the environment and to the health of the population:

- For emissions and discharges of pollutants, disposal of wastes and other types of pollutants, within fixed limits
- For emissions of pollutants and wastes, disposal of wastes and other types of pollution exceeding fixed limits, or
- For unauthorized emissions and discharges.

These differ in terms of the amount of payments: the payments for above-limit emissions and discharges are five times higher than those for emissions and discharges within the limit, and 25 times higher for unauthorized emissions and discharges.

Payments for pollution of the environment are assessed for:

- Expenses associated with the compensation for impacts upon natural objects and resources
- Stimulation in reduction of emissions and discharges or compliance within permissible limits, or
- Stimulation of investments for planning and realization of green areas.

Existing legislation stipulates three approaches of compensation associated with the compensation of impacts upon the environment and resources. The impact can be compensated according to:

- Fixed rates

- Approved methods for the calculation of the scope of an environmental impact, or
- The actual expenditures for the restoration of the impacted condition of the environment.

In fact, these three options are not approaches to impact compensation, but rather different methods of payment calculation. In all three options, the ecological impact is compensated by an entity causing the impact, and liable for it. The third option may appear to be natural compensation for an impact, but in fact, the impact is assessed not on the basis of fixed rates and methods, but of the costs of the restoration measures, the realization of which is not in fact ensured, and is in practice rarely implemented.

The calculated costs of an impact are paid to the affected party – the citizen, enterprise, institution, or organization – to allow it to take measures to restore the environmental losses. That means that the owner of the natural object affected does not have the right to spend the money paid in compensation for any purpose other than for the restoration of the impacted natural object. If that object is in public use, the sum of the impact is paid into the general state budget at the respective level.

Besides the monetary form of payment, the legislation stipulates natural compensation for environmental impacts. The respondent is obliged to restore the impacted state of the environment at his/her own expenses in accordance with the project of reconstruction works.

Despite the existence of two forms of impact compensation (monetary and naturally), the first is the more common. Natural compensation for impacts is stipulated in the legal documents as a possible or additional form and, moreover, is not supported by specific normative-methodological documents.

2.3. Deficits of the Russian system of impact compensation

The main deficit of the Russian system of environmental impact compensation is the absence of precisely stated requirements for mandatory natural compensation adequate to these impacts. Under existing legislation, only the possibility of such compensation is provided. As a result, the methodological base for the assessment of impacts and the development of measures for their compensation is practically absent in Russia, excluding the standards for mining industry and legislative acts of certain regions.

With respect to the exception for the mining industry, the lands used are reclaimed, i.e., they are rehabilitated for further use, instead of being restored to their near-natural state. The experiences in Moscow, or with the Olympic construction site in Sochi, show that more attention is paid to find an alternative/substitute site for the impacted area, on which as offsetting measure certain species being restored in some manner, but not with support for the natural balance and without equal restoration of similar functions.

Under the OVOS procedure, governed by the Regulation on the Environmental Impact Assessment of Proposed Projects [8], it is stated that the impacts remaining after the implementation of measures for the avoidance and minimization of loads on the environment are to be assessed. These impacts are to be compensated by special measures. In this respect, apart from the absence of any legal stipulation for the compensation of impacts, the following difficulties arise:

1. The OVOS has been virtually abolished as a stage in the state ecological expertise procedure. Under existing legislation, most investment activities do not require any expertise, although as a final stage under this procedure, compensation measures must be developed in the OVOS.

2. The assessment of remaining impacts is not described in the normative-methodological documents.

3. The development of compensation measures and the ascertainment of the correspondence of their scope to the expected impacts are absent. No such system has been developed during the entire period of the existence of the ecological expertise, beginning in the late 1980s.

4. The existing paradigm of impact compensation, even in monetary terms, is based on an assessment of the impact in relation to one protected asset, although it may affect a few environmental assets, or be of a cumulative type. The problem of integrated assessment of impacts and their compensation is not considered in either legal or methodological documents.

3. COMPENSATION FOR IMPACTS UPON THE ENVIRONMENT IN GERMANY

Aspects of the evaluation of negative impacts upon the environment, including biological diversity, and the compensation for those impacts, are an element in a number of laws in Germany. On the one hand, these involve the implementation of the stipulations of international conventions, or transposition of EU Directives into German law; on the other, the specific Impact Mitigation Regulation for Germany. Depending on the level of assessment and/or the object under examination, this evaluation is specified in a number of laws. In the following, the essential legal foundations, particularly with regard to demands upon the assessment of and compensation for effects upon the environment, will be briefly presented. The purpose is to compare and contrast especially the Environmental Impact Assessment (EIA) with the Impact Mitigation Regulation (IMR).

3.1. International Requirements Transposed into National Law

Convention on Biological Diversity

The object of Article 14 of the Biological Diversity Convention [32] is the impact assessment and the reduction to a minimum of detrimental effects. Article 14, Section 1a, provides for parties to «introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity, with a view to avoiding or minimizing such effects». For the transposition of Article 14, the following examination and procedural steps are proposed for the guidelines of COP VI/7: screening, scoping, effect analysis and evaluation, minimization measures, reporting measures, review of the planning processes, decision-making, monitoring and an environmental audit. These are very similar to those of an SEA, and EIA or IMR. The requirement for compensation measures is only marginally mentioned [68, p. 56]. Hence, compensation can be understood to be included under the so-called «redress» measures, along with avoidance and minimization [25, p. 6].

The transposition of the Biodiversity Convention into national law occurred in 2002 by incorporation into the Federal Nature Conservation Act (BNatSchG). Under the amended version of that law in 2009, the goal of the preservation and development of biological diversity remains a general principle of the conservation of nature and care of the landscape (§1 Sect. 2 & 3, BNatSchG). In the amended Federal Environmental Impact Assessment Act (UVPG) of 2005, biological diversity was defined as a protected asset to be taken into account in EIAs (§2 Sect. 1 no. 1, UVPG).

Directive on Environmental Impact Assessment

The EIA is based on the European EIA Directive [27], which has been amended numerous times, and is to be completely revised in the immediate future [31]. Under this Directive, certain projects are to be subjected to environmental impact assessment. The stipulations contained in the Directive have been implemented with essentially the same content in Germany under the Federal Environmental Impact Assessment Act (UVPG) [35].

The purpose of the EIA is to ensure that the direct and indirect impacts of certain public and private projects on the environment can be ascertained, described and evaluated comprehensively and at an early date under uniform standards (§1 UVPG). Since the EIA, under §2 Sect. 1 UVPG is a non-independent part of official authorization procedures, its results are taken into account in the context of these procedures. However, the EIA has no material legal effect: in other words, a negative EIA does not automatically stop a project.

Directive on Strategic Environmental Assessment

For certain plans and programmes, the EIA is supplemented by the Strategic Environmental Assessment (SEA). This is based on the SEA Directive [30], the stipulations of which have been transposed in Germany into the European Law Adaptation Act for the Construction Sector (Europarechtsanpassungsgesetz EAG-Bau) [36] and by the amendment to the UVPG [35].

The SEA is a non-independent part of the procedure for the establishment or change of plans and programmes which are accepted by a government agency, a government, or via legislation (§2, Sect. 4, Clause 1 UVPG). While the EIA is only activated once environmentally significant projects have been approved, the SEA is already applicable during the planning stage. This is designed to take account of the fact that important, environmentally significant strategic decisions are often already taken in the context of the preliminary plans and programmes. The SEA is designed to ensure that planning processes in which the course is set for later approval decisions will be environmentally acceptable, transparent, and implemented with public participation.

The focus of the SEA is the identification of cumulative impacts, and the assessment of large-scale planning alternatives, but also of technical and systemic alternatives, and of needs assessments. One peculiarity of the SEA is moreover the requirement for monitoring significant impacts upon the environment after the implementation of the plan (§14m, UVGP). No equivalent monitoring measures apply for EIAs at the project level; however, such measures are to be introduced in the process of the revision of the EIA Directive [31].

The Habitats Directive

The Habitats Directive Assessment is based on Article 6 of the European Habitats Directive, and has been transposed into German law by means of §§34 ff. BNatSchG. Accordingly, projects or plans (cf. §36 BNatSchG) are to be examined prior to authorization or implementation for compatibility with the preservation goals of a Natura 2000 area, if such projects are likely to cause significant negative impact (cf. §34, Sect. 1 BNatSchG).

The European Natura 2000 Network consists of protected areas certified under the Habitats [26] or Birds Directives [28]. Their goal is to ensure the continued existence or re-creation of favourable preservation conditions of natural habitat types and habitats of species in their natural areas of dissemination.

In the context of a preliminary examination of habitats, the question of whether the negative impacts on Natura 2000 areas can be definitively ruled out is first of all examined. If this is not the case, the habitats compatibility of the project is to be investigated on the basis of preservation goals of the area.

If a negative impact on the preservation goals can be ascertained, the project is fundamentally inadmissible (§34, Sect. 2 BNatSchG). Exceptions are possible and acceptable only for reasons of urgent and predominant public interest, including those of a social or economic nature. There must be no possible alternative under which the purpose of the project can be achieved at some other place with no or lesser negative impacts (§34. Sect. 3, BNatSchG). In case of approval, «coherence measures» necessary to ensure the contiguousness of the Natura 2000 Network are to be implemented (§34, Sect. 5, BNatSchG).

Environmental Liability Directive

The reason for the European Directive 2004/35/EC on Environmental Liability with regard to the Prevention and Remedying of Environmental Damage was that hitherto, it has not been possible to claim damages against anyone for impacts upon such community assets as species, soil, or the air, which have no property assignment [60, p. 67]. The Directive was transposed into German law with the Environmental Damage Act of May 10, 2007 and the necessary adaptation of the BNatSchG, the Federal Soil Protection Act and the Federal Water Act. «Prevention» (hereinafter: «mitigation» – Trans. Note) has priority, based on the «polluter-pays» principle. In case of the occurrence of environmental damages, the Directive provides for a procedure for the «determination of remedial measures» [68, p. 59]:

- Primary remediation: The return of the damaged natural resources and/or impaired services to their baseline condition → compensation in-kind
- Complementary remediation: Compensation for damaged natural resources and/or services which cannot be fully restored → equivalent offsetting of remaining impacts
- Compensatory remediation: Compensation for interim losses of natural resources and/or services [29, Annex II].

The area of application refers only to damages due to accidents, or which occur in certain professional activities. These stipulations do not apply if possible impacts have already been assessed, e.g. in the context of a Habitats Directive Assessment, Impact Mitigation Regulation, the establishment of a local development plan, etc., and have been officially approved [68, p. 61].

3.2 The Legal Foundations for the German Impact Mitigation Regulation

3.2.1 Impact mitigation regulation under Conservation Law (BNatSchG)

The Impact Mitigation Regulation (IMR) was introduced in Germany in 1976 with the Federal Nature Conservation Act (BNatSchG). The law was substantially amended with regard to the Impact Mitigation Regulation in 2002 and 2009; in the current version, valid as of July 29, 2009, the respective stipulations are contained in §§13-19 [33]. As a result of the new competing legislative competence of the federal government in conservation law, which was implemented in the context of the federalism reform of 2006, the new stipulations on impact regulation are «directly» valid. State-level regulations on impact mitigation regulation have been largely obviated since the new BNatSchG came into force. Complementary state-level regulations, and those which deviate from the federal regulations in a permissible manner, do, however, continue in force.

Under §13 BNatSchG, the Impact Mitigation Regulation is a general principle of conservation law. Accordingly, significant negative impacts upon nature or the landscape are, as a priority, to be avoided by the party implementing the project. Non-avoidable significant negative impacts are to be compensated by in-kind compensation or offsetting measures or, if that is not possible, by offset payment. States may not deviate from this general principle [38, Art. 72 Sect. 3 No. 2].

Existence of an impact as a precondition

Under §14, Sect. 1 BNatSchG, impacts upon nature or the landscape are those which change the form or use of land areas or of aquifers connected with the biospheric soil stratum in a manner of considerable detriment to the efficiency of the balance of nature or the quality of the landscape. The concept of impact thus consists of two components: in the first part, the impact modality is regulated, and in the second, the potential for negative impacts is established [71, p. 133]. The form means both the geomorphological phenomenology and the stock of vegetation of the areas concerned [79, p. 682]. Typical changes in the form of areas of land include changes due to residential or commercial construction, or to the construction of road and rail lines. Use refers to any use of an area for a certain purpose [79, p. 682]. A change in use exists if «an existing use is replaced by another» [71, p. 134]. That includes e.g. the construction of structures on existing open spaces, and the transformation of grassland into farmland. Under §7 Sect. 1 No. 2 BNatSchG, the components of the balance of nature include the soil, the water, the air, the climate, plants and animals, and the structure of interaction between them. For the determination of the quality of the landscape, the evaluating observation by people is determinate. Accordingly, an impact on the quality of the landscape exists if the changes are such as to be perceived as detrimental by the average observer sensitive to the beauty of a naturally developed landscape [34].

In §14, Sect. 2, Clause 1 BNatSchG, the so-called agricultural privilege is also stipulated. Accordingly, the use of the soil for agricultural, silvicultural and fishing purposes is generally freed from the Impact Mitigation Regulation, provided it corresponds to good professional practice.

Decision-making sequence of the Impact Mitigation Regulation

The permissibility of projects depends on compliance with certain requirements and duties which are staggered in relation to one another [71, p. 139]. This so-called cascade of legal sequence encompasses:

- Requirement to avoid negative impacts where possible (§15, Sect. 1 BNatSchG)

- The duty of compensation or offsetting for unavoidable negative impacts (§15, Sect. 2, Clause 1 BNatSchG)
- The requirement of a balanced consideration of interests between non-avoidable negative impacts upon nature and the landscape on the one hand and the interests in the implementation of the impacting measure on the other (§15, Sect. 5 BNatSchG)
- The duty, in case of approval of a project after a balance consideration of interests, to render monetary compensation for the damages caused (§15, Sect. 6 BNatSchG).

Under the BNatSchG amendment of April 4, 2002, the «offsetting measures» item, which originally was subsequent to the «balanced consideration of interests» item, has, for reasons of planning practicality, been moved to the stage prior to that of «balance consideration» (see Fig. 4.3, p. 28). Addressing the issue of compensability or non-compensability of impacts prior to the consideration of interests, as provided by the 2002 version of the BNatSchG, had the advantage that it permitted «not just 'something or other', but rather, really ambitious and extensive compensation measures» to be carried out [66, p. 121]. If the consideration of interests takes place after the stage of compensation/offsetting, the danger is that in actual fact, for almost any impact, «some offsetting measure or other will be conceivable» [66, p. 121]. Even if the sequence of decisions of compensation and offsetting is now equivalent under the BNatSchG, the terms «on-site, in-kind compensation» and «offsetting» are still distinct. However, that does not mean that the responsible authority can make a decision arbitrarily. Rather, it has the duty to make the decision which is substantively the best and most proportionate [71, p. 146].

Under §15, Sect. 1, Clause 1 BNatSchG, the party causing the impact has a duty to refrain from any avoidable negative impact upon nature and the landscape. An impacts is to be considered avoidable if an acceptable alternatives exists which achieves the purpose of the project at the same place with less impact on nature and the landscape, or with none at all [§15, Sect. 1, Clause 2 BNatSchG]. That means that the duty of avoidance of an impact refers primarily to the type and scope of the realization of the project, and less to the issue of whether the project is fundamentally admissible or not [99, p. 277]. The duty of avoidance mandates that the party carrying out the project do so as environmentally compatibly as possible during the planning and implementation phases [92, p. 137]. Inasmuch as negative impacts cannot be avoided, this fact must be demonstrated as per §15, Sect. 1, Clause 3 BNatSchG.

The party implementing a project must compensate or offset any unavoidable negative impacts by conservationist and/or landscape care measures (§15, Sect. 2, Clause 1 BNatSchG). An impact can be considered compensated if and when the negatively affected functions of the balance of nature have been restored in-kind, and the quality of the landscape has been appropriately restored or newly established (§15, Sect. 2, Clause 2 BNatSchG). For compensation, land areas must be used which in fact require upgrading, and which can be upgraded. Moreover, a functionally specific spatial connection between the impact and the compensation must exist. «Complete» minimum level of protection of nature and the landscape is best achieved if the compensation is primarily implemented at the point of the impact. An impact can be considered offset if and when the negatively affected functions of the balance of nature have been established in the natural area affected in an equivalent manner, and the quality of the landscape has been appropriately newly established (§15, Sect. 2, Clause 3 BNatSchG).

Compensation and offsetting must be carried out «within an appropriate period» (cf. §15, Sect. 5 BNatSchG), preferably simultaneously. Since this is not always realizable in practice, prior compensation and offsetting measures can be considered, which are booked in so-called eco-accounts and land pools, and which can be «withdrawn» as needed (cf. §16, Sect. 2, BNatSchG). The reason for this rule is, first, the idea of improving the interaction between compensation and offsetting measures, and, second, the need to counteract the problem of the lack of available suitable land areas, particularly in densely populated areas, and in the case of major projects [64, p. 17 ff.].

After implementation of the examination for the reduction of the expected project-related impacts upon nature and the landscape (mitigation, compensation, offsetting), a balanced consideration of interests between the existing potential quantity of negative impacts upon nature and the landscape on the one hand, and the interests which are the reason for the project on the other, is to be undertaken [71, p. 151]. (Regarding the legal situation prior to the 2002 amendment to the BNatSchG, see above). Under§ 15, Sect. 5 BNatSchG, an impacting project may not be authorized or implemented if the impacts

cannot be either mitigated or else compensated or offset within a reasonable time period, and if the interests of nature and the landscape have priority over other interests, in accordance with a balanced consideration of all demands on nature and the landscape. The duty to present evidence and the burden of proof for the priority of the interests of nature and the landscape is incumbent upon the responsible authority [80, p. 768].

Under §15, Sect. 6, Clause 1 BNatSchG, the party causing the impact must render an offset payment if a project is approved or implemented, even if the impacts are unavoidable, or cannot be compensated or offset during an acceptable period of time, and the project has nonetheless been approved after consideration of the interests of nature and the landscape and the interests for the implementation of the project. The duty to render offset payment is subsidiary to the compensation and offsetting measures, and hence the «last resort». Under §15, Sect. 6, Clause 1 and 2 BNatSchG, the level of offset payment is calculated according to the average cost of non-implemented compensation and offsetting measures (i.e., according to the theoretical restoration costs), or according to the duration and severity of the impact. The offset payment is earmarked for measures of conservation and landscape care, preferably in the natural area affected (§15, Sect. 6, Clause 1 BNatSchG). It is to permit an additional upgrading of nature and the landscape, and not the funding of other government conservationist requirements [71, p. 159].

The details of compensation for impacts have hitherto been regulated by ordinances of the states, which makes the legal situation fairly confusing, due to the multiplicity of legal sources and divergences in detail [71, p. 166]. Based on §15, Sect. 7 BNatSchG, the federal government on November 5, 2012 submitted a draft of an ordinance on compensation for impacts upon nature and the landscape called the Federal Compensation Ordinance (BKompV) [39], the goal of which is to unify standards and procedures for handling impacts all over Germany, and thus to make implementation more effective. In particular, the ordinance is designed to regulate the details regarding the content, type, and scope of compensation and offsetting measures, but also the amount of offset payments and the procedure for imposing them. Whether and when the compensation ordinance will go into force is, however, currently an open question.

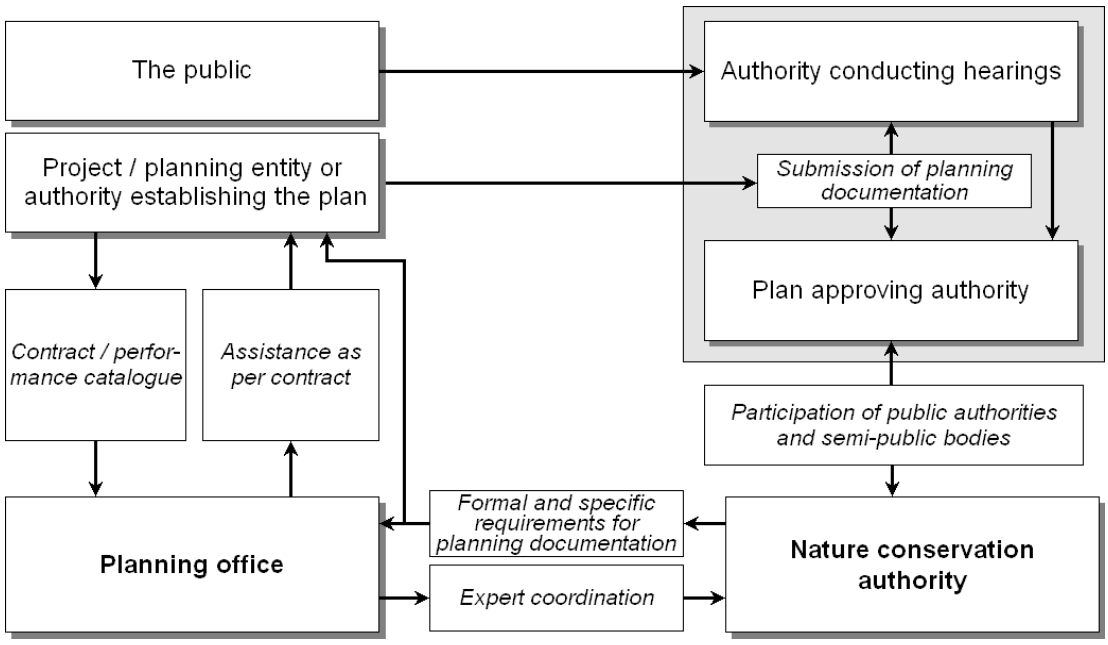


Fig. 3.1: Actors in the planning and authorization process for plan approval procedures [45, p. 55].

Procedure for the Impact Mitigation Regulation

The Impact Mitigation Regulation is regularly used in the context of other sectoral legal authorization procedures, e.g. plan approval procedures for road-building projects (so-called «piggyback procedures»). The responsible authority in that case, under §17, Sect. 1 BNatSchG, is the one supervising

the project. The conservation office merely has a collaborative role; in particular, it has to implement the interests it is intended to protect. The actors in the planning and authorization process for plan approval procedures are shown in Fig. 3.1, and the tasks and interests of the institutionalized actors in Table 3.1.

If an impact requires no other sectoral legal authorization (e.g. landfills, or the removal of the hedge which is a characteristic feature of the landscape), the responsible conservation office then renders the decision itself (§17, Sect. 3 BNatSchG).

Table 3.1

The tasks and interests of institutionalized actors in the plan approval procedure [45, p. 56]

Function/Tasks	Interests
Project developer	
Establishment of the project planning and realization process, and drafting of the necessary planning documentation	Realization of project related and economic interests Time and cost efficiency Legal security (orientation toward legally requisite approval preconditions, and minimum professional standards)
Planning office/ Examining expert	
Client (compliance with contractual obligations): • Development of planning documentation including nature conservation measures • Consulting the project developer regarding particular procedural steps, etc. • Internal coordination with the nature conservation authority • On the one hand, a «partner» of the project developer; on the other, a «necessary evil»	Representation of the requirements under conservation law to ascertain the negative impacts resulting from a project On the one hand, minimum standards; on the other, flexible adaptation to the basic conditions of the contract and the specific planning procedure
Responsible authority	
Authority conducting hearings: • Compilation and ascertainment of the substantive matters to be taken into account • Checking the project plan against the applicable professional stipulations; elimination of conflicts • Preparation of the material necessary for a balancing of interests	Realization of planning goals Legal correctness of objections • Ascertainment of the facts • Legitimation of decisions regarding legal permissibility and requirements for material compensation
Plan approving authority: • Checking for compliance with formal procedural stipulations; • Examination of the material necessary for a balancing of interests compiled by the authority conducting hearing • Balanced consideration of remaining conflicting interests • Issuance of the official plan approval decree (with conditional requirements	Ensuring the procedural and decision-making certainty (legal security) with regard to the project developer and the parties affected by the planning process Legitimation of the determination as to the material compensation obligations
Nature conservation authority	
One public authority in the hearing procedure: • Providing information about and representing the interests to be taken into account with respect to conservation law • Qualification of the plan approval documentation by means of statements, e.g. regarding the requirement profile for the landscape management planning process *Determination of conduct or agreement:* • Realization of the conservation and landscape protection goals, particularly ensuring non-degradation • Ensuring that these substantive preconditions for the application of the intervention rule apply • Substantive evaluation and, if necessary, checking of the Landscape Management Plan (German: LBP) • Decisions regarding the mitigation hierarchy, particularly the proposed avoidance and compensation measures (in-kind/on-	Realization of the goals of nature conservation and landscape protection, in accordance with the participation rules in state-level nature conservation legislation: • Improvement of the nature conservation aspects in the project documentation, including consultation of the project developer • Improvement of the preparation for the decision-making process by initiation of sufficient clarification of the factual situation regarding the impacts of the project • Representation of and/or protection of conservationist interests in the procedure, with respect to other interests

site or out-of-site/off-site	

3.2.2 Impact Mitigation Regulation under Construction Law (the Federal Building Code/BauGB)

In order to take into account the specific requirements of overall spatial planning, the impact mitigation regulation under «conservation law», as specified in the BNatSchG, is supplemented by that under «construction law» (§1a Sect. 3 BauGB), and under «spatial planning law» (§8, Sect. 5, Clause 2 ROG). Since the latter is only facultative (e.g. for regional plans or statewide spatial plans), the following will address only the impact mitigation regulation under construction law.

In the urban land-use planning process, the Impact Mitigation Regulation is part of the overall consideration process. Under §1a, Sect. 3, Clause 1 BauGB , in case of impacts at the level of the urban land-use planning, the mitigation and compensation for likely significant impacts upon the landscape and upon the efficiency and functionality of the balance of nature are to be taken into account during the balanced consideration of interests.

The standard for the mitigation and compensation of an expected impact is provided by the principles of a fair consideration of all public and private interests affected, with and against one another. This means that the Impact Mitigation Regulation under construction law is not a mandatory planning guideline [63, p. 12]. Unlike the Federal Nature Conservation Act (BNatSchG), the Building Code (BauGB) does not differentiate between compensation and offsetting. The direct spatial context between impact and compensation mandated under conservation law is moreover also partially obviated [74, §1a].

The BNatSchG is the special law which governs the examination of whether the Impact Mitigation Regulation is to be applied in urban land-use planning or not, and hence the decision regarding the question of whether an impact is present and how it is to be evaluated under conservation law [74, §1a]. The legal consequences and the implementation of the projects to be expected on the basis of the urban land-use planning are however covered by the Building Code. With regard to legal consequences, this specifies not only the above described consideration-of-interests stipulation, but also requires that the compensation be carried out by appropriate presentations and stipulations in the land-use plan and local development plan (§1a, Sect. 3, Clause 2 BauGB). Moreover, such presentations and stipulations may also occur at a place other than that of the project-related impact (§1a, Sect. 3, Clause 3 BauGB). A checklist for simplified procedures in processing the Impact Mitigation Regulation for local development plans is shown in Table **A.1 Annex 1**.

3.3 Commonalities and differences of examination instruments

The Impact Mitigation Regulation complements the instruments specified under European law, the EIA, the SEA and the Habitats Directive Assessment. They have a number of overlaps in their basic principles, but differ with respect both to their areas of application and to the legal consequences they trigger.

By contrast with the Impact Mitigation Regulation, the EIA and the SEA are not limited to a purely conservation law aspects, but rather are oriented toward a comprehensive overall view of environmental relationships, which explicitly include people, the population, and cultural and material assets. The Habitats Directive Assessment has the narrowest scope of application, and is used exclusively in the case of the negative impact upon protection and preservation goals of a Natura 2000 area.

Differences exist with regard to the level of examination. While the SEA is carried out for plans, and the EIA exclusively for single projects, the Impact Mitigation Regulation is generally applicable both at the planning and at the project levels (see Tab. 3.2).

The legal consequences, too, are different. For example, sequence of decisions stipulated under §15 BNatSchG create clearly stipulated preconditions under which an impact upon nature and the land-

scape may be permissible. The Habitats Directive Assessment as per §34 BNatSchG has considerable implementation force, including strict, fully actionable admissibility preconditions for negative impacts upon Natura 2000 areas. Things are very different with the EIA and the SEA, the results of which merely need to be «taken into account» during the consideration of interests in the planning process; i.e., they are largely of «declaratory nature» [100, p. 50]. Their usefulness, however, is that they contribute to a comprehensive ascertainment and evaluation of the environmentally related impacts of projects and plans.

Table 3.2

Applicability of environmental impact assessment instruments at the planning and project levels

Assessment instruments	**Examination level**	
	Urban land-use planning (land-use plan and local development plan)	Single projects
Impact mitigation regulation	Impact mitigation regulation under construction law, §1a BauGB	Impact mitigation regulation under conservation law, §§13 ff. BNatSchG
Strategic environmental assessment	SEA, §2, Sect. 4 BauGB	-
Environmental impact assessment	-	EIA, §3, Sect. 1 UVPG
Habitats Directive Assessment	Habitats Directive Assessment for Planning, §1a, Sect. 4 BauGB	Habitats Directive Assessment for Projects, §§34 ff. BNatSchG

The greatest overlap exists between impact mitigation regulation and environmental impact assessment. Both instruments are designed to permit the evaluation of possible environmental impacts of a planned project.

Table 3.3

Comparison between impact mitigation regulation and environmental impact assessment [73, pp. 13-14]

Impact Mitigation Regulation as per the Federal Nature Conservation Act (German: BNatSchG)	Environmental Impact Assessment as per the Federal Environmental Impact Assessment Act (German: UVPG)
Goals	
Preservation of the efficiency and functionality of the natural balance, and of the variety, uniqueness and beauty of the landscape	Effective precautionary environmental protection by means of timely and comprehensive ascertainment, description and evaluation of the environmental impacts of a project, and early consideration in official approval decisions)
Area of applicability	
Changes in the form or use of land areas, or changes of the water table connected with the animate topsoil level, such as to potentially have a considerable negative effect on the efficiency and functionality of the natural balance or the quality of the landscape	The project is a component of either Annex 1 (EIA-mandatory projects), or Annex 2 (case-by-case examination) of the UVPG, re significant impacts on the environment, according to legal assessment standards
Protected assets	
Efficiency and functionality of the natural balance or the quality of the landscape	Human beings (including their health and well-being), animals and plants, the soil, the water, the air, the climate and landscape, cultural assets and other assets, and the interaction between these protected assets
Legal results	
The impact shall be disallowed if the negative impacts cannot be avoided or compensated, and the interests of the conservation of nature and care for the landscape have priority over other interests; an impact which would destroy irreplaceable biotopes of strictly protected animals and plants may only be approved if urgent requirements of the public interest justify such a measure	No immediate legal results; statements on avoidance, minimization and compensation measures in the context of the EIA are largely of declaratory nature, their goal being to make clear which consequences could result from the implementation of such a project
Technical document	
Landscape Management Plan (German: LBP)	Environmental Impact Study (German: UVS)

In practice, their respective technical contributions, the «environmental impact study» (EIS) of the EIA, and the «landscape management plan» (LBP) of the Impact Mitigation Regulation, are closely coordinated with one another. That is possible because the essential work steps are largely identical [73, p. 15] (ascertainment and evaluation of the existing situation, forecast of the effects, ascertainment and evaluation of environmental impacts, determination of the severity of the impacts, planning of precautions for mitigation and/or damage limitation, planning compensation measures). The main work steps of a landscape management plan are shown in Fig. 3.2

There are differences with regard to the legal foundations, areas of applicability, protected assets, and especially legal consequences (see Fig. 3.3 and Tab. 3.3).

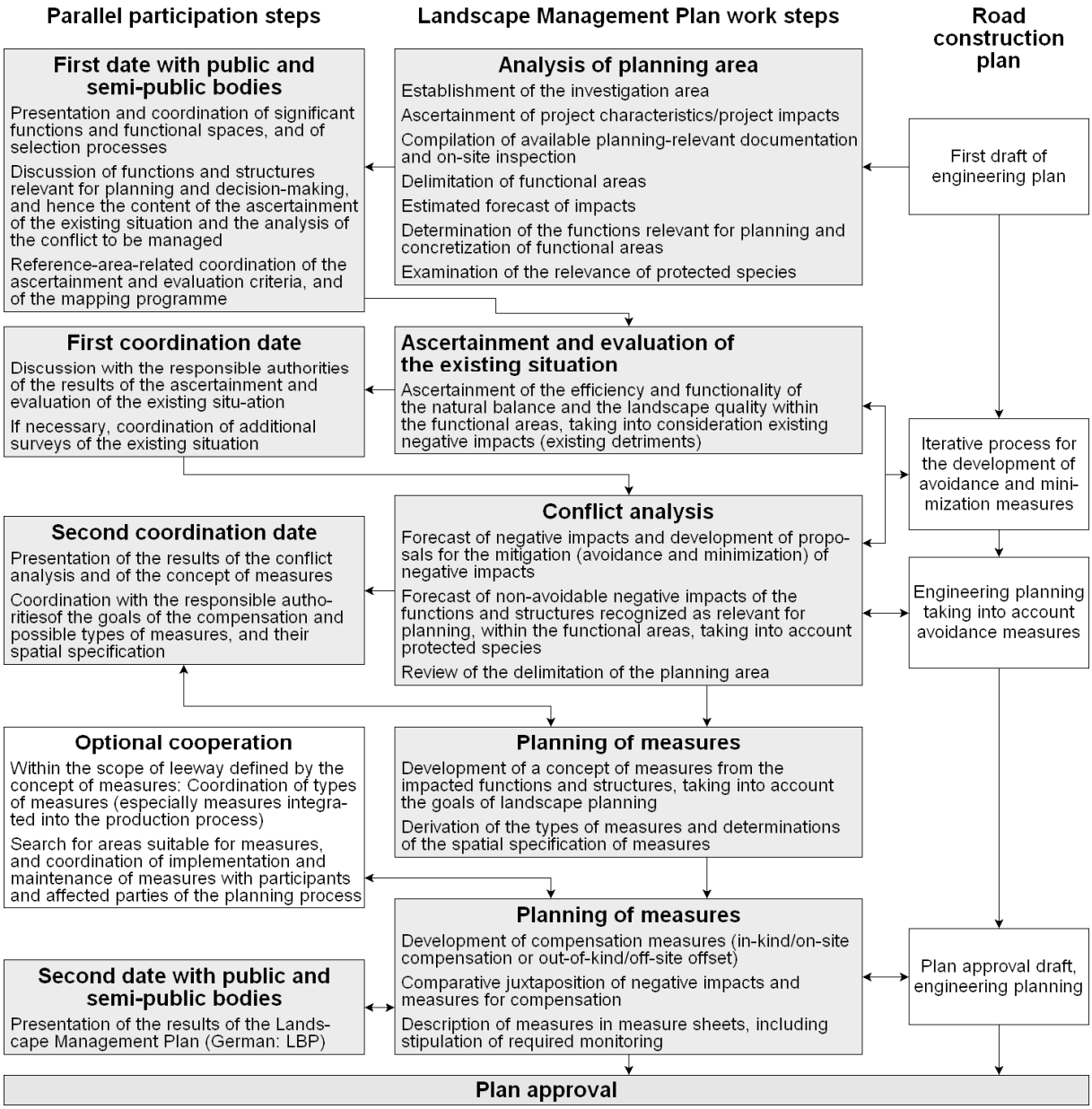


Fig. 3.2: Course of the investigation and work steps of a Landscape Management Plan (LBP) [49, p. 47]

Of all the assessment instruments stated, only the Impact Mitigation Regulation has a comprehensive approach with regard to protected assets, full coverage of the area, and material consequences, i.e. a legal binding nature [50, p. 222; 68, p. 61; 93, p. 53]. The German model could therefore be of interest to other countries as well [67, p. 10.1; 93, p. 47; 101, p. 111]. In countries with comparable regula-

tions, such as Sweden or the Netherlands, the national literature «often explicitly makes reference to German federal impact mitigation regulation, and demands that closely similar regulations be adopted» [67, p. 101]. The realization that the EIA «should, as a logical consequence of a comprehensive examination, require that the negative impacts occurring be correspondingly compensated» is ever more widespread [51, p. 6]. Accordingly, the EIA would have to be developed further in such a way «that the elements of the profile of the Impact Mitigation Regulation which exceed the measure reference standards of the EIA would be effectively integrated into the EIA» [100, p. 46 ff]. Another scenario might be the development of instruments comparable to the German impact mitigation regulation in the other European countries.

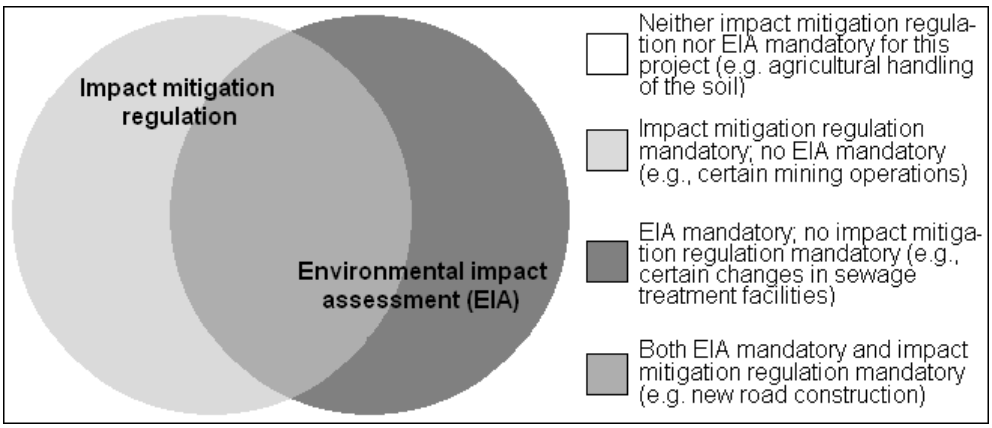


Fig. 3.3: Area of applicability of the Impact Mitigation Regulation and Environmental Impact Assessment [72, p. 29]

3.4. Analysis of Strengths and Weaknesses of the German Compensation System

The strengths of the Impact Mitigation Regulation derive from the following principles and requirements, based on the BNatSchG:

- Full scale application in case the likelihood of an impact exists, i.e. Implementation of the goals of conservation even outside of protected areas, and hence maintenance of minimum standards in average landscapes (so-called «full-scale minimum level of protection») [46, p. 4; 67, p. 10.6]
- Application of impact mitigation regulation even in cases in which there is sufficient likelihood that the efficiency and functionality of the balance of nature or of landscape quality will be significantly impacted upon (preventive effect)
- The impacts upon nature and the landscape caused by the impacting project may not become a burden upon the public, but must rather be borne by the party implementing the project («polluter-pays») [54, p. 256]
- The goal is no reduction in the quality of nature, e.g., no net loss in the environmental account, or maintenance of the status quo of the balance of nature and the landscape quality (no net loss)
- Maintenance of the specified sequence of decision-making (mitigation → compensation → offsetting → offset payment).

Under sectoral and procedural law, impact mitigation regulation has an outstanding role, since material triggers cause legal consequences [64, p. 17]. Early participation by conservation authorities make the procedure more qualified technically. This leads to greater legal certainty in the result [51, p. 5].

In spite of these positive effects of the Impact Mitigation Regulation, a number of deficits exist in implementation, including [51, p. 6; 64, p. 18; 67, p. 10.2; 97]:

- There are legal deficits such as the sometimes contradictory court rulings, non-uniform interpretation of the terms «compensation» and «offsetting» under the BNatSchG and the BauGB, and the complexity of the legal terminology used in legislation.
- The mitigation principle is far too seldom implemented in many planning processes, even though the selection of sites, dimensions and types of projects can avoid and/or minimize environmental impacts.
- There are technical/methodological deficits, such as the shaky scientific justification for certain legal terms, with a large methodological diversity which has developed over the course of years, especially due to the fact that responsibility has been located at the state level.
- There is increasing lack of suitable areas for compensation measures (land availability). Moreover, there have been communications and acceptance problems with respect to the land users affected (especially in agriculture) and property owners with regard to willingness to provide land areas for compensation measures.
- Compared with the past, more measures are being implemented, but there continue to be deficits with regard to the long-term securing of care measures (see Fig. 3.4).
- Often, there is a lack of implementation, success and efficiency monitoring of compensation measures (follow-up controls), or the monitoring period is too short to permit an adequate assessment of the success and efficiency of a measure.
- There is increasing overlapping of compensation measures with new impacts (e.g. roadside planting and photovoltaic facilities).

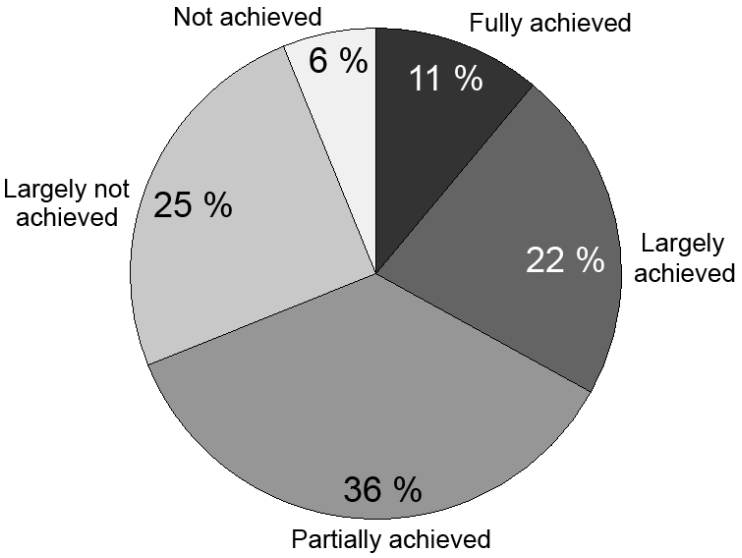


Fig. 3.4: Checking the success of compensation measures. Carrying out function control for 32 of a total of 67 measures, as part of a research project [98]

The Impact Mitigation Regulation, in spite of these deficits, remains one of the most important and most successful conservation instruments in Germany [51, p. 5]. After almost 40 years, during which the Impact Mitigation Regulation has existed, procedural and methodological approaches for the derivation of mitigation (avoidance/minimization) and compensation measures have been «highly developed and comprehensively tested» [51, p. 6], and can be considered exemplary at the international level as well [44, p. 11]. To date, there are very few examination instruments «which attempt to achieve conservation-appropriate use of nature and the landscape in direct discussion with users in this breadth and depth» [44, p. 21]. In conclusion, it can be stated that the Impact Mitigation Regulation provides a decisive legal foundation for the transposition of various requirements under European law and at the international level.

4. RECOMMENDATIONS FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACTS AND THE DEVELOPMENT OF MEASURES FOR THEIR AVOIDANCE AND COMPENSATION

4.1. Development of measures for impact compensation as a final stage of environmental impact assessment

The major stages of impact assessment of a proposed project, and their content and methodological approaches have been described in detail in [24]. This book considers only certain methodological aspects of these stages directly related to the development of compensation measures.

The structure of the environmental impact assessment includes the following stages (Fig. 4.1):

Preparatory stage:

- Description of a proposed project, ascertainment of effect factors and their assessment
- Specification of the scope of the investigation
- Delimitation of the area segments for the investigation: the impact area, the effect area, and the compensation area

Analysis of the territory:

- Specification, description and assessment of affected environmental components
- Differentiation of areas with different level of conflicts, and identification of the main conflicts.

Development of the planned project options:

- Impact assessment of options taking into account conflicts ascertained

Prediction of impact and comparison of planned project options:

- Forecast of all effect factors on the assets and functions of the environment in the context of their assessment
- Asset-by-asset comparison of options, based on the forecast
- Integrated assessment of options, choice of preferred option.
- Ascertainment of significant negative impacts.

Development of nature protection measures

- Development of measures for avoidance, minimization and compensation of expected negative environmental impacts.

The impact assessment documentation and the project documentation submitted to the state expertise include the development of nature protection measures. Unlike the document [8], this work presents a package of measures aimed not only at avoidance and minimization, but also at compensation for expected negative environmental impacts which may arise as a result of a proposed project. Such measures are developed after obtaining forecast of environmental impacts taking into consideration recorded effects. If the impairment is significant, measures are selected for elimination of the effect that causes this impairment, or for minimization of its level. After the development of such measures and the modification of the original characteristics of the technical project, the impact is re-evaluated. If the remaining impacts still have high level of impairment, measures are developed for compensation of these impacts.

In the Russian regulatory documents concerning OVOS [8], there is no direct mention of the necessity for the development of compensation measures for nature conservation. In this book, we will therefore, by analogy with the German terminology, call this complex of measures «measures on impact mitigation regulation» or simply «impact mitigation regulation».

Figure 4.2 shows the detailed stages of environmental impact assessment (Fig. 4.1) in the context of Impact Mitigation Regulation and the development of measures for the avoidance, minimization and compensation of impacts.

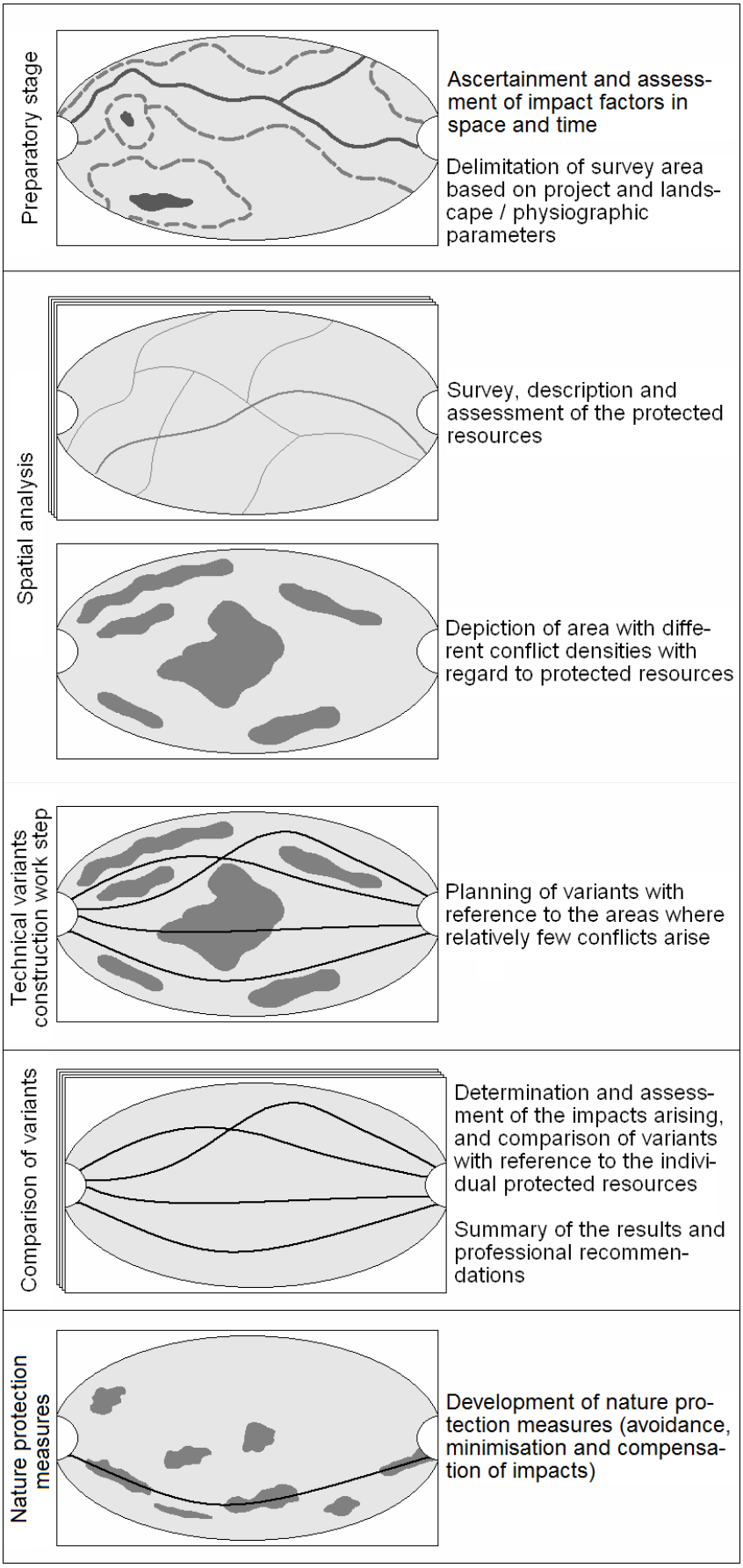


Fig. 4.1: The main stages of environmental impact assessment, and its role in measures on impact mitigation regulation [own illustration based on 55, p. 7].

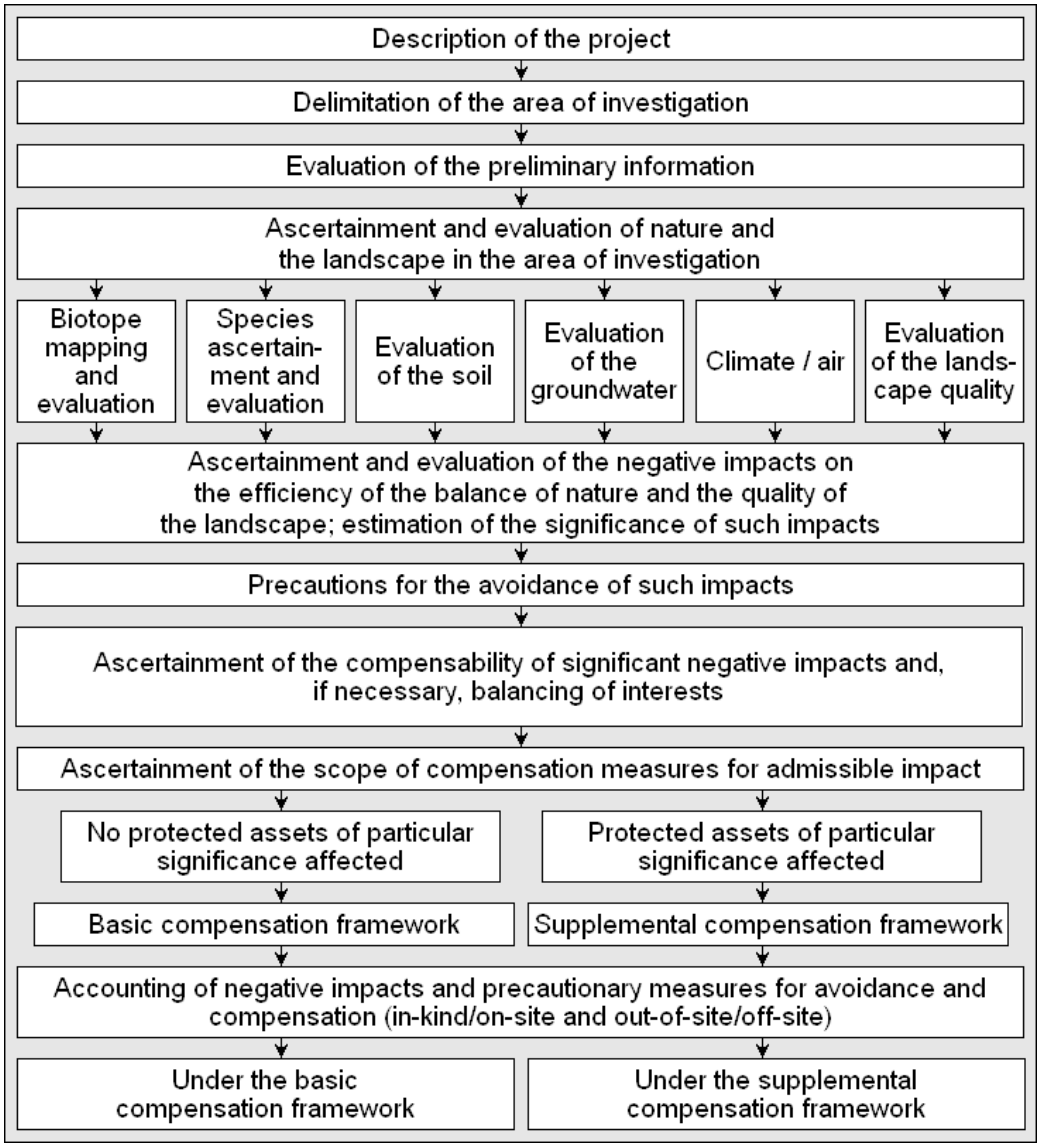


Fig. 4.2: Work steps for the application of Impact Mitigation Regulation [90, p. 120].

The following types of measures have been developed [49, pp. 40-41].

Mitigation measures

Mitigation measures are measures by means of which possible negative impact on nature and the landscape can be wholly (avoidance) or partially (minimization) prevented. These include particularly structural measures (e.g. tunnels, green bridges, passageways, guide facilities), and measures for the protection against temporary endangerment of nature and the landscape (e.g. fencing in, protection of bodies of water and single trees, or protective planting in the context of the construction procedure).

On-site, in-kind compensation measures

This type of compensation refers to conservation and landscape care measures suited to restoring the negatively impacted functions and structures of the natural balance in the same functional manner, or which provide for the restoration or landscape appropriate new creation of the landscape quality. However, this does not fundamentally mean the identical re-creation of the same structures.

Offsetting measures

Offsetting measures are conservation and landscape care measures which become necessary if in-kind compensation is not possible. Offsetting measures should be capable of restoring in an equivalent manner the functions and structures of the natural balance destroyed by the project, or of ensuring the restoration or the landscape-appropriate new creation of the quality of the landscape.

Design measures

The landscape-appropriate greening and incorporation of such artificial structures as embankment areas, motorway interchanges, median strips, shoulders, de-watering basins, and/or noise protection facilities are referred to as design measures, inasmuch as the vegetation elements of such ancillary areas of roadways have no compensatory effect. Measures outside the scope of care and maintenance which provide a considerable contribution to landscape appropriate restoration and new creation (e.g. planting of trees and shrubs on embankment areas or in interchange areas) generally serve as compensation and/or offsetting measures for the affected functions of the landscape quality. Measures which do not provide any landscape-appropriate restoration or new creation, and the only purpose of which is to provide greening for the route (e.g. the seeding of landscape lawns in de-watering basins, or the greening of median strips) are purely design measures. These measures are to be considered part of the operation area of the project, and do not assume any compensatory function for the quality of the landscape.

The preparation of a balance sheet of impacts and results of measures for their avoidance, minimization and compensation is the important step in the scheme in Fig. 4.2. Such a balance sheet is necessary for the ascertainment of impacts remaining after all measures have been fulfilled and all decisions made concerning the efficiency of measures on impact mitigation regulation and, in general, on its permissibility and hence on the legality of a project.

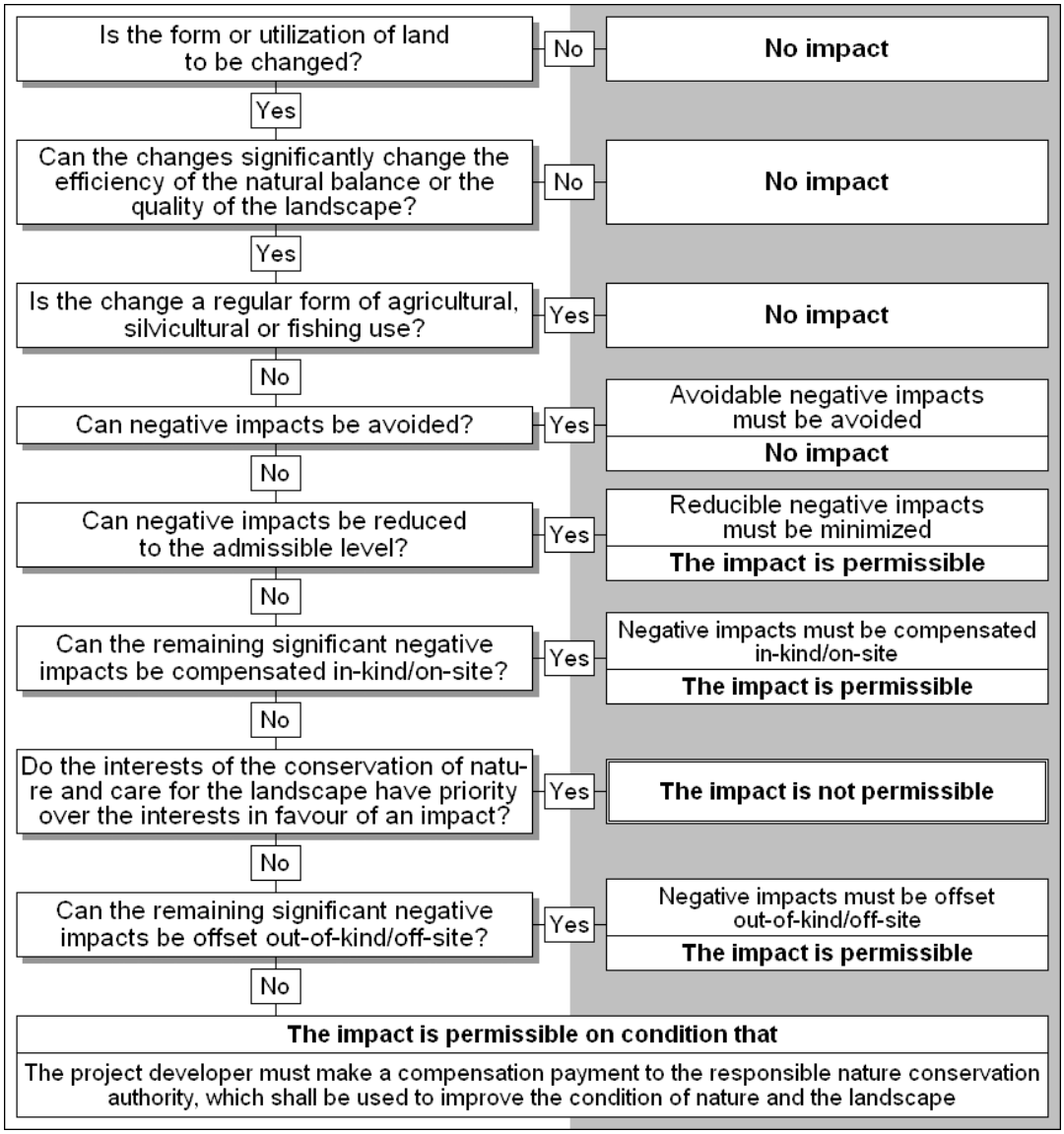


Fig. 4.3: Sequence of examination and legal results of Impact Mitigation Regulation [87, p. 4].

It should be noted that monetary compensation may be used only as an exception. In any case, compensation fees are spent on out-of-kind/off-site offsets, when full compensation of impacts has not been achieved within the framework of the proposed project. In Germany, this problem is often solved by using an available offset measure from a «pool» of compensation areas and measures (see Section 4.14).

The decision on the necessity for compensation, on determination of its type and efficiency, and on the permissibility of an impact is based on the scheme shown in Fig. 4.3. Decision-making is carried out step-by-step. First, the possibility of impact avoidance is ascertained. If that is not possible because of the technical specific characteristics of the project, an attempt is made to minimize these impacts to the permissible level. If the impacts remain significant after such measures, measures of compensation are developed. If it becomes clear that not all impacts can be compensated completely or partially, chosen choice must be made: what is more important for the public interest – the need for the realization of the project, or the interest in nature conservation. If nature protection takes priority, the proposed project is considered impermissible. Otherwise, offsets are developed. If not all impacts can be changed, approval of the project with monetary compensation may be permissiblbe with targeted equivalent environmental improvement at another site. This is the same offsetting, but is organized differently.

A number of assessments should be made for the development of nature protection measures at each stage of the OVOS. A short list of such assessments and their main tasks are given in Table 4.1. The most important questions, each of which requires an answer at each stage under consideration, are shown in Fig. 4.4. The manner of problem definition and of reaching solutions are shown in **Table A.2, Appendix 1.1**. A detailed description of all assessments performed at different stages of the OVOS and during the development of the nature protection measures (Impact Mitigation Regulation) is provided in the next sections. It is necessary to point out that the selection of methods for assessment should take into account the interests of all participants of the project coordination. These interests are listed in **Table A.3, Appendix 1.1.**

Table 4.1

Substantive methodological task complexes of Impact Mitigation Regulation in Germany [43, p. 68]

Task complexes	Goal and purpose of the evaluation process
Ascertainment of the situation Ascertainment and evaluation of the efficiency and functionality of the natural balance and the landscape quality	Evaluation of the impact area, with the goal of the differentiation of the significance of values and functional characteristics: • as the basis for the evaluation of the impacts (comparison of the situation) • as a reference situation (initial or target situation) • as the basis for the justification of avoidance measures
Estimate of effect Ascertainment and evaluation of the effects expected from the project and from the compensation measures	Evaluation of the changes caused by the impacts of the project, as a component of the forecast/estimation of the impacts • with regard to type and extent/intensity (relevance) • with regard to correspondence with normative goals and principles of the Nature Conservation Act, or local environmental planning Evaluation of site-specific and construction-engineering-related avoidance options Evaluation of the improvements (upgrades) caused by the compensation measures • with regard to type and extent/intensity (relevance) • with regard to correspondence with normative goals and principles of the Nature Conservation Act, or local environmental planning
Compensation determination Evaluation in the context of determination of type (qualitative equivalence) and scope (quantitative equivalence) of negative impacts and compensation	Evaluation of upgrades caused by compensation measures (component of forecast and estimation of effects) • with respect to contribution to upgrade of value/functionality • evaluation of equivalents of functions according to type and scope (equivalence)

1. Impact determination

Is an impact present?
Which projects, project segments or aspects constitute changes in the form or use of plots of land under the law?
Which negative impacts or intensities of impact will be sig-nificant or permanent under the law?

2. Determination of the efficiency of the natural balance and the quality of the landscape (ascer-tainment and assessment of the existing condition and forecast of the impact)

How should the efficiency of the natural balance and the quality of the landscape be ascertained and assessed?
Which model of the natural balance and of landscape quality should be selected in which cases?
How can the significant negative impacts of a project be ascertained / forecast?

3. Avoidance / Minimization

Can the project be prevented?
Can the negative impacts of the project be fully or partially avoided (minimized)?
Which measures would be proportionate?

4. Determination of compensation (in-kind/on-site)

Which negative impacts can generally be compensated in-kind/on-site or not?
Which compromise goals can be obtained in which quality, order of magnitude (extent), within which period of time and over which course of time, in order to compensate significant negative impacts on-site?
Where must appropriate plots of land be available in sufficient size?
Which measures should be carried out, and when, in order to be likely to achieve the goals?

5. Balancing of interests

What value should be used in order to balance the interests of nature and of the landscape on the one hand, and other interests of the project on the other?

6. Determination of offset (out-of-kind/off-site)

Which offset goals can be attained in which quality, order of magnitude (scope), within which period of time and over which course of time, in order to compensate significant negative impacts out-of-kind/off-site?
Where must appropriate plots of land be available in sufficient size?
Which measures should be carried out, and when, in order to be likely to achieve the goals?

7. Determination of the amount of compensation payments

How can the amount of compensation payments to be rendered by the project developer be deter-mined in case of impacts which cannot be fully compensated, either on or off-site, in accordance with the law?

8. The balance of effects

How can the balancing of impacts, prevention and compensation (on-site or, where necessary, off-site) be carried out?

Fig. 4.4: Works steps, points for decision and essential issues [69, p. 11].

4.2. Delimitation of the area to be studied

The area under study is delimited in such a way that all options of expected negative environmental impacts of a project could be fully considered in space.

The following characteristics are taken into consideration in the delimitation of the area under study:

- Sizes of effect areas with project related impacts, including significant negative ones
- Spatial relationships of the affected functions of the environmental assets, including those for the planning of compensation measures
- Manners of input and distribution of harmful emissions
- Potentially affected specially protected areas.

The following structural elements are identified on the area under study (see Fig. 4.5).

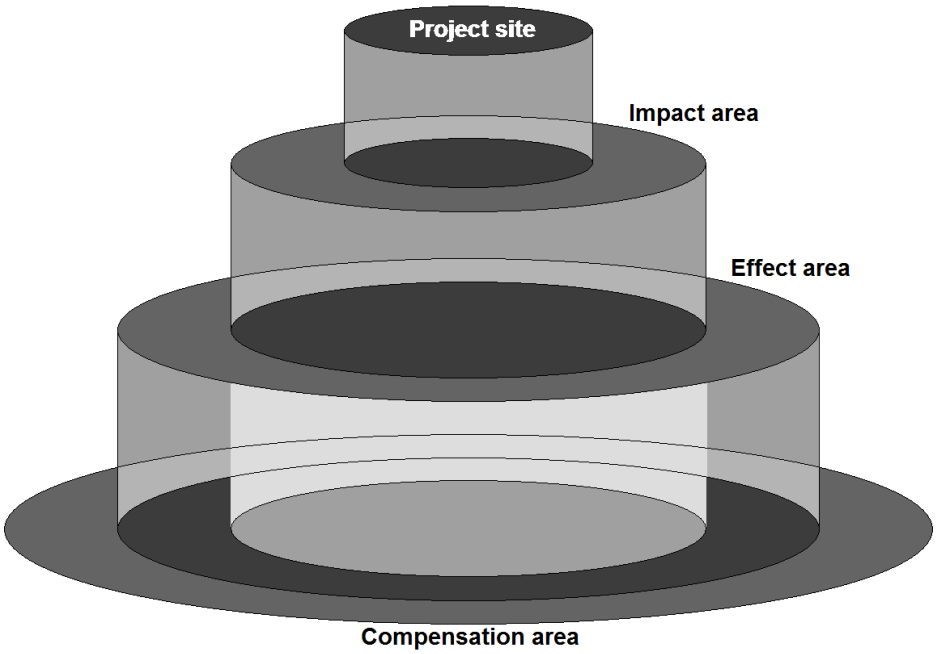


Fig. 4.5. Structural elements of the area for the proposed project [72, p. 57].

Project site – The project site refers to the area of land to be used directly for the project (site, route, etc.). At the project site, the functions and values of the natural balance and of the quality of the landscape will be directly impacted by the project, as a result of its construction activities and facilities. It is the point of origin for all negative impacts caused by facilities, construction activities and operations. The project site, with any alternative sites and options, is defined in the project description.

Impact area – The impact area is the area with significant or permanent negative damage due to facilities, construction and operations. It thus encompasses the project site and, depending on the type of project, any adjacent or distant areas which may be affected. Therefore, an analysis of the negative impacts to be caused by a project is essential for delimiting its area of impact. These impacts should be categorized according to the significance or duration of their effects for the efficiency of the natural balance and of the landscape quality.

Effect area – The effect area encompasses the entire area in which project related negative impacts may have an effect. It generally extends beyond the impact area, i.e. the area in which significant or permanent negative impacts are to be expected.

The effect area is usually defined in such a way that it outlines the territory within which negative effects on specific functions of the environmental assets are expected. Depending on the size and specific characteristics of these effects, one or several zones can be determined, e.g. along the road (Fig. 4.6).

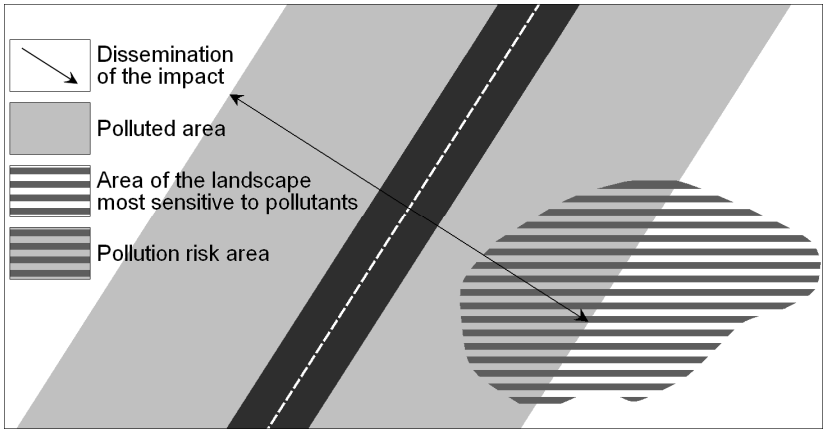


Fig. 4.6. Delimitation of effect and impact areas [58, p. 8].

Effect areas are delimited on the basis of the significance of effect factors, taking into consideration the susceptibility of environmental assets. Therefore, it is necessary to justify the susceptibility level, if it is not stipulated by industry standards (see Section 4.4.2).

Compensation area – The compensation area is the area for which compensation and offset measures are to be provided. It may extend beyond the affected area, particularly in the case of so-called «compensation pool solutions».

4.3. Ascertainment and assessment of impact factors

4.3.1. Ascertainment of single impacts

All impact factors are ascertained at the stages of project realization, in the context of its technical and technological components:

- Impacts caused by **construction related technological processes** at construction sites (preparatory measures, construction of sites, installation of technical equipment, etc.).
- Impacts caused by **project construction**. Usually these impacts are irreversible and persistent.
- Impacts caused by **maintenance** of facilities (removal of wastes, water and energy supply, discharges and emissions of harmful substances into the environment under normal and under emergency conditions, electromagnetic and radiation emission, etc.);
- Impacts caused by the shutdown of facilities, subsequent reclamation, and ultimate disposal of industrial wastes (utilization and recycling).

Environmental assets and their functions, which are affected by these factors, are also determined. Impact factors vary depending on the type of activity. Examples of impact factors for different types of activity and environmental assets affected by them are shown in **Tables A.4** & **A.5, Appendix 1.2.**

The lists of impact factors given in these tables are not complete. However, they describe these factors as the most common. Such lists appear to be useful in the preliminary analysis of impacts, and are the basis for the control these impacts in accordance with the OVOS specifications by any participant of the project accompaniment. Impact factors for certain types of activity are given in greater details in [24] in Appendix 2.4 (Table II.2.12 – Mining, Table II.2.14 – Railway construction, and Table II.2.15 – Road construction).

4.3.2. Ascertainment of cumulative impacts

Cumulative impacts are impacts resulted from changes caused by past, present or reasonably predicted future activities which accompany the proposed project and enhance its environmental impact. Synergic impacts emerge as a result of the combined intensification of single impacts. The list of major cumulative impacts is given in Table 4.2, and they are illustrated in **Table A.8, Appendix 1.2**.

As cumulative impacts usually affect several environmental assets, they are described in terms of the assessment of the relationship between these assets (Section 4.4).

4.3.3. Assessment of impact factors

Each factor revealed is assessed from

- The scope, frequency and persistence of the impact
- Its radius or effect area
- The intensity of the impact and of the changes it will likely cause within this radius or area.

Examples of possible assessment techniques of some of these characteristics are given in **Tables A.5, A.6 and A.7, Appendix 1.2.**

Table 4.2

Major types of cumulative impacts [61, p. 274]

Impact type	Description of impact	Example
Total temporal impacts	Persistent or repeated impacts (effects occur sequentially)	Uncontrolled waste dumping on shores of lakes and rivers
Total spatial impacts	Impacts are distributed such that their radii intersect	Separation of biotopes due to road network construction
Interaction of combinations	Simultaneous effects of many sources within one environment	Emissions into atmosphere from many sources
Time-shift impacts	Persistent, slow manifestation of impact consequences	Damage to forests, carcinogenic processes
Impacts remote from the area of their occurence	Impact consequences manifested far from the point of their causal source	Dams, transfer of emission impurities in atmosphere
Trigger or threshold impacts	Sudden initiation of environmental processes that significantly change the behaviour of the system	Wash-out of heavy metals after depletion of the absorption capacity of soils
Unexpected structural changes	Multi-environmental or multi-system impacts accompanied by long-term changes in natural systems	Effect of increased carbon dioxide emission on the global climate
Induced impacts	Ancillary and subsequent effects of the initial action	Road construction causing development of residential areas

4.4. Description and assessment of environmental assets and their functions

4.4.1. Accounting of certain assets and their functions

Only the following environmental assets are considered in the assessment of compensation for significant negative impacts:

- Flora and fauna
- Soils, including the geological environment
- Ground and surface waters
- Air and the climate, and
- The landscape.

This list is shorter than the list of environmental assets used for general impact assessment in accordance with the OVOS. Such components as «humankind» and «cultural and other material resources» have been excluded from the list, as the impacts upon them are compensated in another ways than the impacts upon environmental assets.

Another step in the OVOS investigation process is the description (inventory) and assessment of these assets and their functions. They are performed in the context of forecast of effects and impacts. All important functions of the enumerated assets are taken into consideration. Certain functions used in the description and assessment are shown in Table 4.3. A more complete list of criteria is given in **Table A.9, Appendix 1.3**.

4.4.2. Assessment of certain assets and their functions

The ***significance (value)*** of a function is usually assessed for a concrete asset. Sometimes the category ***susceptibility*** is assessed for certain functions and impact factors. The evaluation system of criteria is developed for the assessment of these categories.

The following technology is used for the assessment of environmental assets. A step assessment scale is developed for each criterion having qualitative or numerical values for each step, e.g. low value – Step III, medium value – Step II and high value – Step I. The number of such steps depends on the number and availability of information: the more detailed and reliable this information is, the greater number of steps can be assigned. There is no need, however, to strive for extra specification. In reality, 3 to 5 steps are enough.

Table 4.3

Functions for describing the efficiency of the natural balance and the landscape quality [70, pp. 34-35]

Species and communities
Functions for species and habitats Legally protected rare and endangered biotopes and species **Special habitat functions** Minimum areas, networking functions (habitats, partial habitats, stepping-stone habitats)
Landscape quality
The function of experiencing nature Visual, acoustical, tactile and other structural and functional spatial prerequisites for experiencing nature and the landscape, and for recreation **The function of documentation and information** Evidence of natural and landscape history, e.g. soil and other geological particularities; cultural landscapes, etc.
Soil
Buffering and filtration function Retention of liquid or gaseous immissions into the soil Sink and storage functions for CO_2 **Infiltration function** Permeability of soils and soil surfaces for the recharging of groundwater **Erosion protection function** Protection of the fertile topsoil from water or wind erosion Soil dampness, vegetation coverage, slope inclination, climatic influences, etc. **Biotic yield function** Natural yield capacity of the soil as a basis for the production of biomass and sustainable use for the generation of healthy food crops, with reduction to a minimum of additional energy input **Habitat function** The soil as a habitat for plants and animals, and for the development of biotopes
Water
Groundwater recharging function Groundwater recharging quantities, and quality of infiltrating water **Groundwater protection function** Protection of aquifers and bodies of groundwater from pollution and «excessive» withdrawal Covering strata, soil types, etc. **Surface water protection function** Protection of the water quality and quantity of surface bodies of water (including as basis of life and habitat for animals and plants) **Retention function** Water retention «in the field», and through the maintenance and expansion of retention spaces and facilities
Climate/Air
Bioclimatic compensation function Thermic components: Overheating in metropolitan areas and areas with high degrees of impervious coverage. Physical components: Generation and transfer of cold and clean air. **Immission protection function** Protection from air pollution of all kinds Vegetation as a filter for polluted air, air pollutants, climatic effects

Criteria can be assigned on the basis of two principles:

- Individual selection of criteria for each step of the assessment scale
- Selection of universal criteria similar for all steps.

The realization of the first principle means a reference description of the state of the asset to which its particular value is to correspond. The comparison of the real situation with these references at a concrete site allows referring the value of the analysed asset to this or that step. Such an approach provides the possibility to assess the situation rapidly, which is very important for preliminary impact assessments. At the same time, it is impossible to investigate separate functions of the asset. An example of similar assessment for the asset «Air and climate» using a five-step scale is given in Table 4.4. A

similar example of the assessment for all assets using a three-step scale with the differentiation within the step, is given in **Table A.10, Appendix 1.3**.

Table 4.4

Evaluation framework for the protected asset «Climate / Air» [77, p. 23]

Classification	Evaluation criteria
Level A very high	• Cold air corridors relevant for residential areas • Steep inclines near residential areas (> 5°, or 8.5% incline) • Areas which are particularly active in terms of clean air and/or the bio-climate (e.g. forests, large orchard meadow complexes) • Climate protection forest, immission protection forest
Level B high	• Cold air generation areas relevant for human habitation (inclines of 2° to 5°, or 3.5 to 8.5% incline; cold air formed there can flow directly into residential areas, or is collected by way of cold air corridors, and thus passed into residential areas) • All other cold air corridors (i.e., those not directly relevant to residential areas); areas active in terms of clean air and/or the bio-climate (e.g. small forests, scattered orchard meadow complexes) • Protective planting
Level C medium	• Cold air generation areas with low incline (cold air generation areas not relevant to residential areas) • Areas in which neither significant cold or fresh air generation is provided, nor in which significant air pollution exists
Level D low	• Areas with little pollution of clean air or the climate, e.g. residential areas with significant greenery
Level E very low	• Areas with major pollution of clean air and/or the climate, which affects adjoining areas, e.g. industrial areas polluting commercial areas

Another approach is more universal. It allows a detailed analysis of certain functions of the asset, assigning similar criteria for all assets at each steps of the assessment. Moreover, the number of steps may be arbitrary, which allows the use of developed criteria for other projects. An example of a five-step scale assessment of universal criteria of the asset «Landscape quality» is given in **Table A.11, Appendix 1.3**. The principles of biotope assessment and an example of the use of these principles are given in **Table A.12, Appendix 1.3**.

The susceptibility of environmental assets and their functions with regard to consequences resulted from a proposed project at various stages of its realization (e.g. noise pollution, emissions of harmful substances, ground work, etc.) is determined within the framework of the analysis of the territory. The data obtained are the basis for delimitation of areas with a high density of conflicts which should be avoided if possible.

The impact of any environmental asset, e.g. pollution of the atmosphere, soil and water, changes in water levels or the microclimate, the emergence of barrier effects, or the fragmentation of territory, may affect the function of all assets. Therefore, it is necessary to determine the susceptibility of each asset to this impact factor for a forecast of impacts. The classification of susceptibility results from the type of affected functions with regard to the impact factor under consideration.

For example, determination of the level of susceptibility of a groundwaters aquifer to pollution by harmful substances (an impact factor) is based on the relationship between the occurrence depth of this aquifer to the permeability level of overlying layers. The latter have low susceptibility at deep occurrence of groundwater with well isolating overlapping. In case of shallow aquifer with no overlap, its susceptibility is high.

A specific susceptibility scale for each environmental asset to the impact factors is determined.

4.4.3. Accounting of asset relationships

Besides the assessment of certain environmental assets and their functions, it is necessary to take into consideration the relationships of these functions within and between certain environmental assets of their ecosystem. Such an assessment is carried out in three steps:

- Accounting of relationship for each environmental asset,
- Asset accounting of relationships,
- Accounting of impact transfer from one asset to another.

Detailed description of these stages is given in [24], Appendix 2.4, Table II.2.16, II.2.18 – II.2.20. It is important to point out the practical aspect of accounting of protected asset relationships.

The majority of certain functions of the environment are realised in combination with several assets. In general, it is possible to distinguish an asset for a concrete function with which it is connected, depends on, to a greater extent, or maximally affects. There is no necessity to estimate this function for all assets in which it is ascertained and with which it is connected. It is enough to assess the function only for a concrete asset. Figure 4.7 shows relationships between assets and their certain functions and those assets are shown for which it is enough to assess a concrete function.

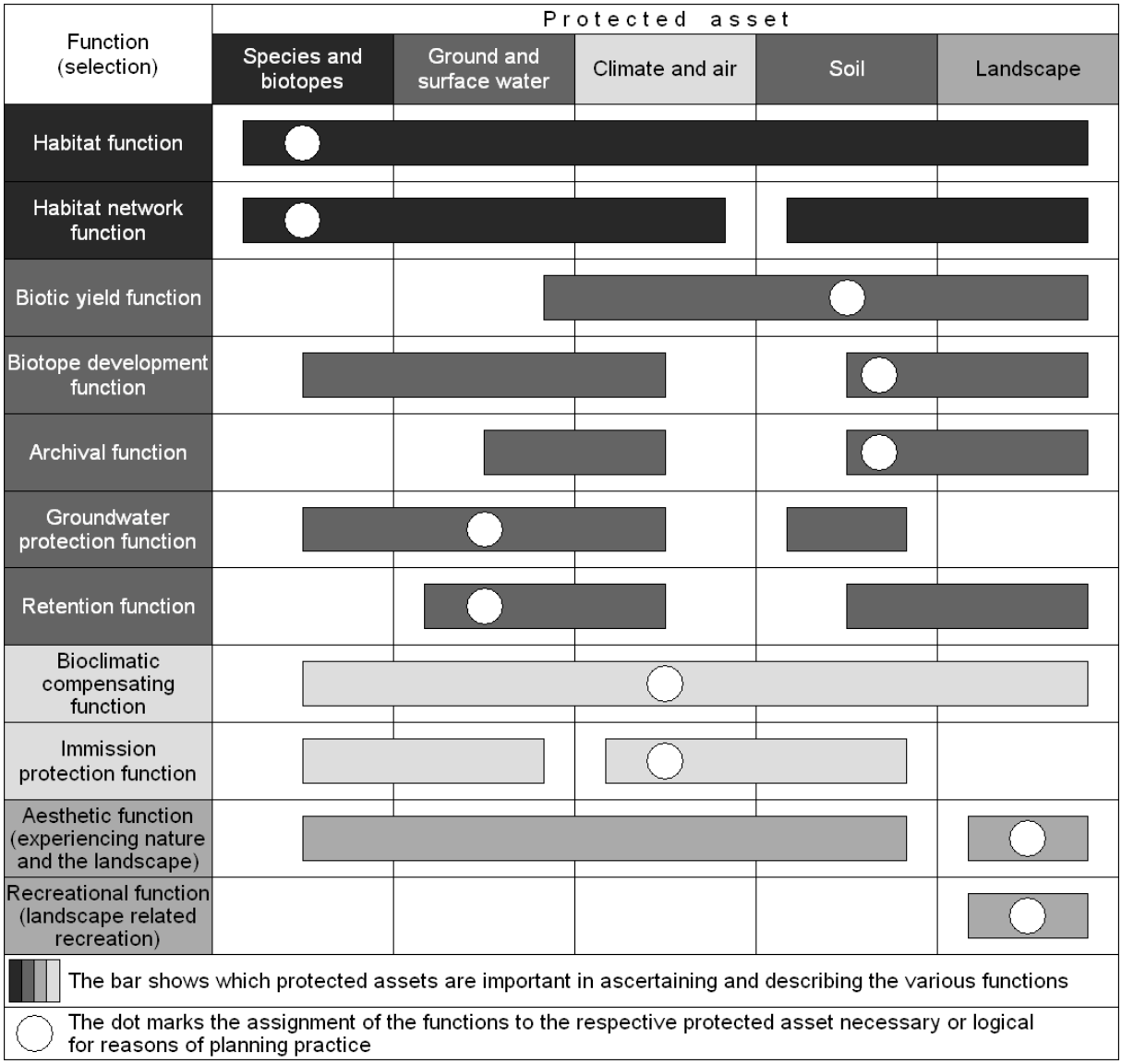


Fig. 4.7: Relationships between protected assets and the functions of nature and the landscape [45, p. 134].

4.5. Forecast of the impacts of environmental assets and their functions

The forecast of impacts is based on the results of the analysis and assessment of impact factors and state of certain environmental assets and their functions.

The main input characteristics for forecast are the following:

- The intensity of the impact on the analysed environmental asset analysed, and its functions and forecast for the assessment of impacts
- The significance (value) of the environmental asset analysed, and its functions
- The susceptibility of the environmental asset analysed, and its functions
- The description of an effect area or areas, including their assessment in categories of susceptibility and significance (value).

The forecast is based on a comparison of intensity of impact on the analysed asset or its function, and its susceptibility or significance (value). These characteristics are expressed in certain grades of estimation described in Sections 4.3 and 4.4. The level of impacts is considered to be higher at those sites in the impact area where the highest intensity of this impact corresponds to the highest susceptibility or significance of the environmental asset analysed, or its functions. The accuracy and objectivity of a forecast depends on the estimation scales, i.e. on how precisely and objectively they have been developed.

To compare the intensity of impact on the asset analysed, or its function/susceptibility or significance (value), matrices are used, in which these indices are combined. The principle of construction of such matrices is shown in Fig. 4.8.

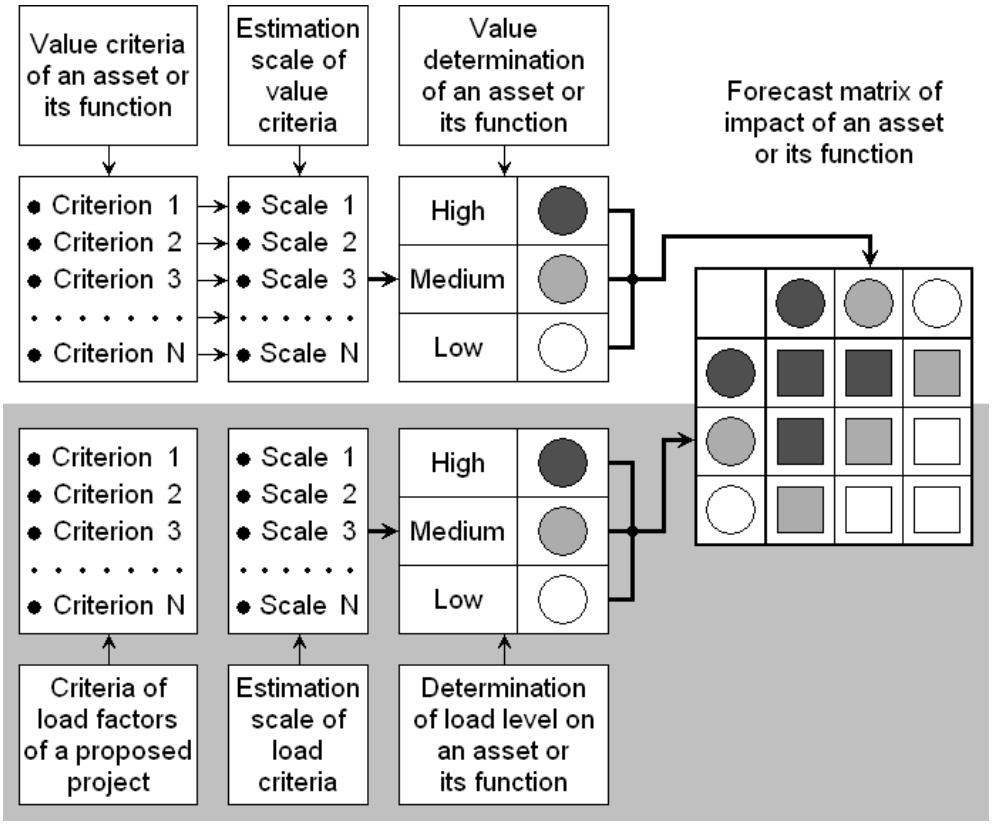


Fig. 4.8. Forecast matrix of the impact on the environmental asset or its function.

Values of susceptibility or significance (value) are ranged from estimation criteria. The same principle is used for ranking intensity of load resulted from impact factors. The intensity of impact will be higher, for example, at a high level of load and a high value of the function. If the load and value are low, insignificant impact is expected. In this case, the matrix is symmetrical. In principle, depending on the specific characteristics of the proposed project, it can be asymmetrical. For example, if the function

value is high, the impact will be recognized as significant, regardless of load level. However, the use of such asymmetrical matrices must be justified.

Four different methodological approaches are used to forecast impacts, depending on the types of impact and the conditions under which the particular project is to be realized. The description of these approaches is given in **Table A.13, Appendix 1.4**.

4.6. Ascertainment of significant negative impacts

Compensation measures are developed for those impacts which remain after the implementation of avoidance and minimization measures, and which are considered significant and persistent. The criteria according to which impacts ascertained as a result of forecast regarding certain environmental assets and their functions are shown below, referred to the category under consideration [47, p. 98; 90, p. 126].

Soil

Impacts upon the functions of the soil and its physical, chemical or biological characteristics are always to be considered significant if:

- The soil functions are completely removed.
- Certain soil determining factors and characteristics, such as the water balance, the structure and the nutrient content are drastically changed, so that a change in the soil development must be expected.
- These functions and/or the characteristics of the soil are fundamentally changed in a negative manner. Hence, the removal of the body of the soil and subsequent impervious coverage is generally a significant impact.
- The content of heavy metals and organic contaminants is increased above the natural, geogenically determined level.
- Occurrences of plant and animal species of the Value Levels III-II are to be affected
- Biotopes of Value Levels III-II will be destroyed by the mining process, or damaged due to changes in the groundwater level, emissions or the felling of forest stands.

Groundwater

Impacts upon the new formation of groundwater are to be considered significant if:

- Impervious coverage and anthropogenically transformation of the landscape considerably reduce the rate of local new groundwater formation.
- Groundwater withdrawal causes the site and living conditions for plants and animals, particularly of the soil, to be changed in such a way that population and soil development changes occur.
- Groundwater flow conditions are considerably affected, and as a result, the site and living conditions of plants and animals are changed, or the exit of groundwater to the surface, e.g. in source areas, is considerably changed.
- The groundwater quality is impacted in such a way that the physical, chemical or biological characteristics of the groundwater diverge considerably from the natural, geogenically determined quality, and if as a result the site and living conditions of plants and animals are changed.
- Opencast mining may have significant impacts on the groundwater.

Surface water

Impacts upon surface waters are to be considered significant if:

- They are completely removed.
- Their characteristic structures are considerably changed, or the flow conditions and the runoff process are negatively affected.
- The physical, chemical or biological characteristics of water diverge negatively from the initial conditions, and as a result, the site and living conditions of plants and animals are negatively changed.

- The landscape scenery is negatively affected.

An increase in surface water runoff is considered significant if as a result the whole runoff situation is increased, or that of a surface body of water cannot be retained in any other near-natural manner.

Climate/Air

Impacts are to be considered significant if:

- Overbuilding, removal of vegetation cover and site changes, particularly due to impervious coverage, destroy or considerably change meso-climatic and micro-climatic functions.
- The functionality of spaces or corridors suitable for air exchange is considerably reduced, and their beneficial effects for functionally associated target areas can no longer be fully provided.
- Traffic-related air pollution changes considerably the air quality parameters, so that functions of the natural balance or the landscape quality sensitive to air pollution emissions, such as low-nutrient biotope types or areas with limited air exchange, are drastically changed.

Animals, plants and their habitats

Impacts affecting animals, plants and their habitats are to be considered significant if habitat and functional areas in which the species communities have not previously been strongly degraded are negatively changed, or value determining species and development potentials, particularly characteristic site factors, are negatively affected.

Impacts are to be considered persistent if species or typical species communities cannot be restored to their former population density per unit area within a period of five years after termination of an intervention caused by road building. Habitat mosaics interdependent in terms of time, space and function, which are generally target systems in the reference area on the bases of concrete conservationist and landscape maintenance goals, particularly according to the goal statements of the Landscape Plan for the preservation or development of habitats, cannot be restored to their original functional structures during such a five-year period.

Species and biotopes

Impacts affecting species and biotopes are to be considered significant if:

- occurrences of plant and animal species of the Value Levels III-II are to be affected
- biotopes of Value Levels III-II will be destroyed by the mining process, or damaged due to changes in the groundwater level, emissions or the felling of forest stands.

Landscape quality

Impacts affecting landscape quality are to be considered significant if:

- Structural/aesthetic qualities and values are anthropogenically transformed or reduced.
- The function of elements, structures or parts of the landscape which provide cultural-historical and or historical information, symbolic content such as sense of identity or identification possibilities, and sites for recreational and leisure time use, are considerably reduced, disturbed or destroyed, so that the changes evoke negative feelings for an average observer open-minded to the beauty of a landscape.
- In the context of the recreational value of the landscape and its recreational functions the level of the evaluation of the pre-intervention condition has been considerably increased by traffic noise pollution, i.e. arithmetically by at least 2 dB (A). This does not preclude the possibility of cases in which a lesser increase in the evaluation level may also result in significant impact.
- Accessibility is reduced because paths important for landscape related recreation are removed and connections are interrupted.
- Impacts affecting landscape quality are to be considered significant if the areas of Value Level III are degraded to Value Level II, or if areas of Value Level II are degraded to Value Level I.

Tables A.14 and A.**15** give examples of the use of the criteria mentioned above for the construction of roads and other linear structures.

4.7. Development of impact avoidance and minimization measures

The development of such measures is aimed at avoidance of significant negative impacts or their minimization to permissible level. It is necessary to distinguish between avoidance of impacts in the effect and impact areas.

In the effect area, it is necessary to strive to avoid, or at least minimize all impacts. Impact avoidance and minimization measures in this area are implemented at the stage of project approval at the expense of its changes. If it is impossible to change the design of an investment project due to certain specific features, measures are developed which are implemented during the stages of project realization – construction and maintenance, appropriate to the environmental asset and its impacted functions. The main principles of development o such measures for project approval or its realization are listed below [88, pp. 13-14].

Planning

- Non-consumption of areas of particular importance for nature conservation and landscape management; decision in favour of the route least critical from a conservationist point of view
- Parallel routing to existing lines and structures
- Protection of near-natural habitats and landscape elements, occurrences of endangered species, soil and surface formations of natural or cultural/historical significance, and areas and components of characteristic value for the landscape, from removal and disturbance by relocation or route shift
- Limitation of the construction area
- Construction of underground segments and laying of underground cables with avoidance or limitation of intrusion into groundwater and groundwater lowering (e.g. at excavation sites in groundwater dependent biotopes, installation of clay drainage system)
- Orientation of building foundations extending into the groundwater body in line with the groundwater flow direction, to prevent groundwater backup
- Planting of vegetation for protection of forests exposed by power line cuts.

Execution

- Implementation of certain measures (such as land clearing, earth-moving work, construction work) outside of sensitive periods for certain species
- Restriction of the effects of construction operations (e.g., securing of habitats, trees or sites from vehicular traffic or damage); consideration of the guidelines for the protection of trees and shrubs in the area of construction
- For underground cables, preference for closed construction
- For underground cables in groundwater-dependent habitat types, usually no groundwater lowering during the growing season
- Avoidance of the introduction of non-native topsoil
- Appropriate temporary storage of topsoil, and no storage on areas valuable for nature conservation
- Storage and replacement of soils separated by topsoil and subsoil, to permit restoration of the original soil structure
- Loosening up of compacted areas after completion of the construction process
- Careful disposal of wastes, materials, etc., after completion of the construction process
- Transplanting valuable vegetation stands
- Labelling of the overhead lines according to the state of the art, in order to avoid animal losses due to collision.

In the impact area, in the area with project facilities and their infrastructure, avoidance is first of all realised mainly by means of the optimization of the site selection for a proposed project. Such optimization is carried out at the OVOS site selection stage, seeking the project location with the lowest level

of ecological risk. Any remaining significant negative impacts as a result of the direct effect must be compensated.

The most significant difficulties arise when an investor seeks changes in the stipulations made in the initial project in order to balance the interests of nature conservation. These changes require compromise solutions and can be developed in three main directions:

- The principal alternatives of the proposed project from the viewpoint of nature conservation
- Reduction of the proposed project scope
- Selection of other environmentally reasonable sites for the proposed project.

Examples of measures on avoidance of impacts for all three directions are given in **Table A.16, Appendix 1.6**.

Table A.17, Appendix 1.6 gives examples of the avoidance of impacts upon various environmental assets that are common for all types of the activities, whereas **Table A.18, Appendix 1.6** presents measures on avoidance of certain types of impacts.

Examples of measures on avoidance for certain types of the activity are given in **Table A.19, Appendix 1.6** (road construction), **A.20** (construction of railways), **A.21** (mining), **A.22** (laying of oil- and gas- pipeline), **A.23** (housing plans and their development), and in **Table A.38, Appendix 1.7**.

4.8. Development of impact compensation measures

4.8.1. General procedure of compensation measure development

The derivation of concrete compensation and offsetting measures for the restoration of the negative impacts upon the balance of nature and the landscape quality is carried out on the basis of:

- The goals and principles of conservation and landscape care, and the precepts of landscape planning derived from it, or from other regional conservationist goals;
- The requirements of species protection;
- The concept of project-related measures;
- The compensability of impact.

The sequence of steps for the development of compensation measures is shown in Fig. 4.9. Before concrete development of measures, their concepts and the goal of the entire project are stipulated. The measures developed are to correspond to nature conservation goals established for this area within the framework for territorial projects at any level. If there are no such projects for a concrete area, thegoal of the measure is to be derived from the general nature protection goals. An exemplary list of such goals is shown in **Table A.24, Appendix 1.7**.

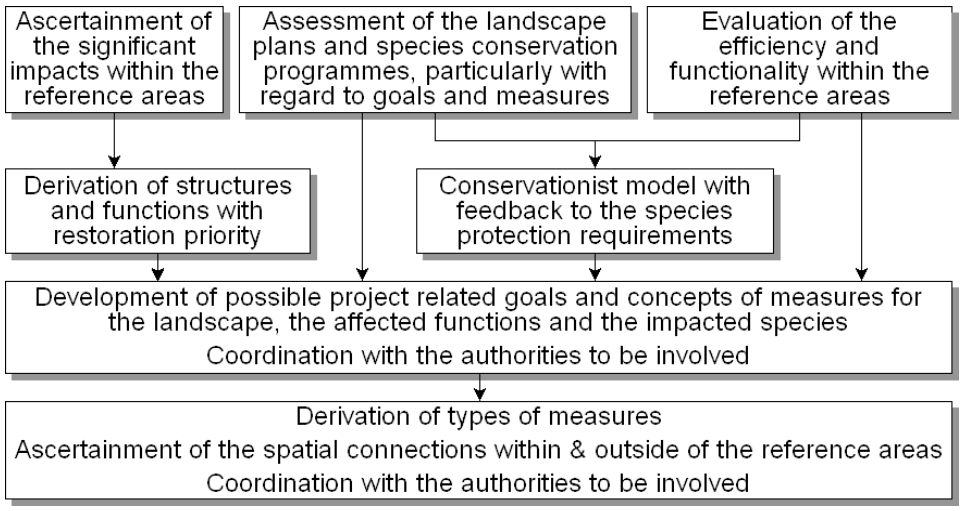


Fig. 4.9. Work steps for the derivation of the goals of the compensation scheme, and for the implementation of suitable types of compensation [49, p. 38].

As soon as the programme of the measures and its goal are ascertained, certain compensation measures and suitable areas for their implementation are selected according to the scheme shown in Fig. 4.10.

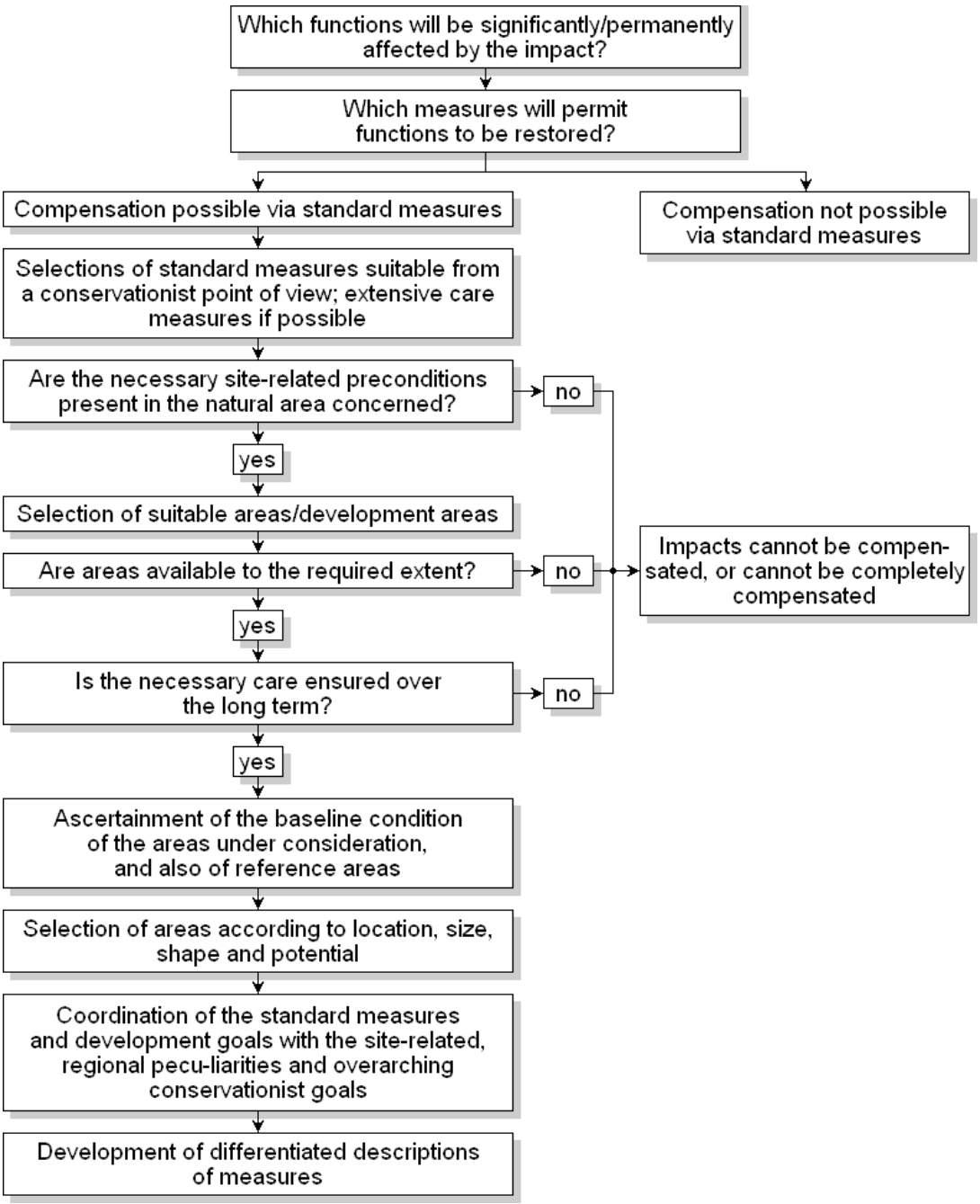


Fig. 4.10. Selection of measures and areas for compensation [81, p. 103].

Only areas which will require upgrading and are capable of being upgraded can be considered for compensation and offsetting measures. These preconditions are met if they can be upgraded to a condition which can be categorized as ecologically higher than the baseline condition.

In the process of the derivation of compensation and offsetting measures for the negatively impacted functions and structures, it is necessary to take into account the respective baseline situations of the areas impacted and of the potential compensation areas [49, pp. 71-72].

Criteria regarding the baseline situation of areas impacted, prior to the impact:

- Significance of the areas concerned
- The sensitivity toward the impact factors of the road building project
- The type, intensity, the spatial scope and duration of the impact, and
- The restorability of structures/functions over time.

Criteria for the assessment of potential compensation areas, for the purpose of a development forecast:

- Availability of suitable site factors, donor populations, etc.
- Upgradability of the area in which the measure is to be implemented
- Functional and spatial connections between the compensation area and the adjacent structures/ functions, and exchange and interactive relationships with neighbouring habitats.

The type and scope of the measures are determined after comparison of the affected area with the area of the supposed compensation.

Guidelines for the derivation of compensation and offsetting measures:

- The type and scope of compensation and offsetting measures are to be justified case-by-case, both spatially and functionally.
- The scope of compensation and offsetting measures is determined on the basis of the type and scope of negative impacts, the losses of structures and functions, and the possibility of upgrading through compensation and offsetting measures.
- The possibility of the multiple effectiveness of compensation and offsetting measures for various functional impacts, or also so-called multifunctional compensation for negatively impacted functions of the balance of nature and of landscape quality which are relevant for planning, should be examined.
- With regard to landscape quality, the question should be addressed as to which measures determine the characteristic structural principles and arrangement patterns of the landscape negatively impacted, and to which extent these measures will lead to a restoration or new creation of the affected landscape area.
- The possible upgrading through compensation/offsetting measures should be represented on the basis of the baseline situation of the areas used for the measure.
- The required scope of compensation for the restoration of the effectiveness and functionality is to be justified in a comprehensive manner.

More detailed requirements for the ascertainment of measures for certain environmental assets are given in **Table A.25, Appendix 1.7**.

Production-integrated measures

So called production-integrated measures for agriculturally used areas have the goal of achieving improvements of biotopes and habitats by means of applied use concepts (e.g. extensification of agricultural use, renunciation of ploughing to a depth of 25 cm, or doubling of the space between rows of crops), without removing these areas from production. Production-integrated measures are only suitable as compensation measures if they result in significant upgrading of the balance of nature and/or of improvements for certain species.

Multifunctional compensation

In the context of ascertainment of the situation, the functions of the balance of nature are first of all separated according to the protected assets to which they refer, so as to be able to recombine them on the measure side, if possible on one and the same area of measure implementation. In the context of measure planning, the question should generally be examined whether the measures for the biotope

structures impacted will also compensate multi-functionally for the negative impacts upon the reference areas for animal species, for abiotic natural assets, and for the quality of the landscape. Examples of potentially multifunctional compensation and offsetting measures are shown in Table **A.26, Appendix 1.7.**

Specific characteristics of the development of compensation measures and approaches for their implementation are shown in **Tables A.27 and A.28, Appendix 1.7**, respectively.

The interim programme of compensation measures developed on the basis of stipulated principles is specified taking into consideration other measures and supplemented by follow-up care measures (Section 4. 8. 6) and control of its effectiveness (Section 4.12). Such an interim programme is shown in **Table A.29, Appendix 1.7**.

4.8.2. Standards for the selection of compensation and offsetting measures [83, pp. 20-21]

Standards for the description of compensation measures

- Type and content of measures
- Clear definition of the target condition, with the presumed required development duration
- Biotope/use type at the outset
- Location of measure, with map
- Scope of measures
- Point in time and duration of the implementation of measures
- Care and development measures required to achieve the target condition (information on duration, points in time and any intervals of the respective care steps)
- Identification of party responsible for the care
- Manner in which the area is to be secured

Standards for the suitability and the acceptability of the compensation measures

Basic requirements

- High probability of success for actual implementation and permanence
- Permanent effective supervision of the areas must be provided
- Selection of areas on which the natural balance and the quality of the landscape can be upgraded, and require upgrading
- Basic suitability of site conditions with regard to the goals of the compensation measures
- No «dual occupancy» of areas which have already been used for compensation measures for other impacts
- No use of areas which could be significantly impacted by planned or foreseeable projects, even if such impacts upon the area would only be indirect
- «Rehabilitation measures» such as ammunition clearance or toxic site rehabilitation are generally excluded
- No crediting of protected area certification (area protection only); land in protected areas can be used if it can be ecologically upgraded, and that would be useful from a conservationist viewpoint

Functional requirements

Compensation measures require in-kind restoration of the functions and values existing prior to the impact, in a close functional context. That does not mean that the identical restoration is required, but rather that the essential functions which the landscape previously fulfilled must also be able to be fulfilled in the future. This is as a rule possible if the same or similar elements are restored. The more important the lost function is, the closer the relationship of the compensation measures to the affected functions must be in order to be able to be counted as on-site in-kind compensation.

For offsetting measures, the functional relationship is looser. Nonetheless, offsetting measures should have as close as possible an approximation to the criteria of on-site in-kind compensation, and the ef-

fectiveness and functionality of nature and the landscape should be restored in a similarly equivalent manner.

Spatial requirements

For recognition as on-site in-kind compensation measures, a close spatial relationship to the impacts to be compensated is necessary. Only those measures can be recognized which affect the space in which the significant negative impacts are to occur. Measures in the direct impact area of operationally caused negative impacts will not be recognized. These are considered landscaping measures which may in exceptional cases be recognized as compensation for negative impacts on the appearance of the landscape. For offsetting measures, the spatial relationship is looser. This compensation can be carried out at a greater distance and in a different manner – «off-site/out-of-kind». In any case, a spatial connection between the impact and the compensation areas must exist, e.g., within the same natural spatial region.

Time related requirements

In order to achieve recognition as on-site/in-kind compensation measures, the functions and values impacted upon must be able to develop effectively to their pre-impact quality within 25 years. Any measures which will require a longer period of time are to be considered offsetting.

The implementation of compensation and offsetting measures should begin simultaneously with the initiation of the impacting project, at the latest, and should be concluded by the time that project is completed, in order to minimize the so-called «time-lag effect». This requirement refers to the technical implementation of compensation measures and of follow-up care. Depending on the goal of the particular measure, the development and maintenance care may require a longer period of time.

If negative impacts upon sensitive functions, such as breeding losses for bird species, are expected, compensation and offsetting measures may be necessary even prior to or during the implementation of the impact.

The «time-lag» effect

In the case of compensation measures carried out only at the time of the impact or thereafter, temporary compensation deficits up to the achievement of the target condition may occur. This «time lag» between the impact and the compensation measure should be kept as short as possible. If there is nonetheless a time delay, this must be taken into account in the implementation and measurement of the compensation and offsetting measure, by the adoption of temporary measures to minimize the temporary negative impacts, or by increasing the scope of the measure. In that way, the remaining ecological deficit of the compensation area, which still requires further development, with respect to the impacted area can be compensated. The additional compensation requirement is calculated according to the duration of the delay occurring since the established point in time of implementation, in relation to the development time required to complete achievement of the target condition of the measure.

Example. In the authorization certificate, the planting of a hedge has been stipulated as compensation for the loss of field groves. The planting should have been carried out at the beginning of the impact. Due to a delay in provision of the required compensation areas, the implementation of the measure has been delayed by five years. With reference to an assumed development duration of 20 years until achievement of the target condition of the hedge, the five-year delay corresponds to a proportionate period of 25%. Accordingly, the time lag is to be compensated for by increasing the scope of the measure by 25%. If the necessary area is not available, an offset payment for the additionally required measure is to be paid.

Requirements on the extent of the area

As a rule, significant negative impacts are to be compensated on an area at least as large as the impacted area.

The scope of the compensation depends on:

- The type and extent of impacted functions and values of nature and the landscape
- The baseline condition of the compensation area; the higher its ecological value, the greater the area

- The upgrading attainable through biotic and abiotic measures
- Whether all impacted functions can be compensated on the same area, and whether this makes sense from a conservationist point of view
- The time of implementation; early measures are more efficient, and can thus result in a reduction of the required area
- The period of time necessary for achieving the target development goal.

4.8.3. Compensation or offsetting measures?

The definition of these types of compensation measures is given in Section 4.1. The main differences between them are in the requirement for the ***preservation of functional and spatial relationships*** for compensation measures, and the possibility of restoration within a short period of time (usually no more than 25 years for these measures). The preservation of territorial relationships can be visually exemplified.

A territory with two landscape meadows was provided for the construction: a meadow with wild fruit trees over 30 years old and a ploughed field. The significance of these sites is assessed at the first step of the development of compensation measures. It is higher for the orchard meadow – Category II and for the ploughed field – Category I (Fig. 4.11).

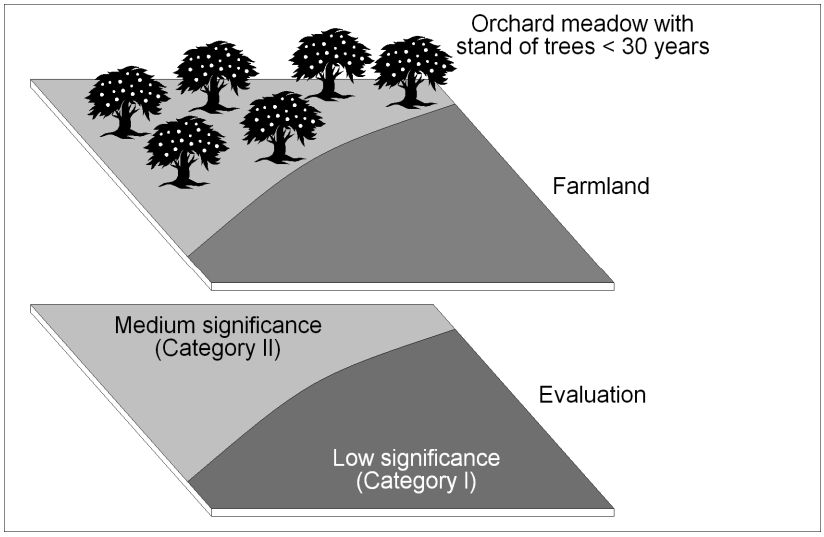


Fig. 4.11. Determination of compensation measures. Step 1. Categorization of the planning area prior to construction. Areas with different significance for natural balance and landscape scenery [41, p. 10].

In the second step, the level of effect seriousness is assessed. For example, one part of the site construction is occupied by more buildings than another. To assess this site occupancy index, a two-step scale is used. The threshold value, including impervious coverage, is 0.35 of the total area. A higher level of effect is determined for compact construction planning (Fig. 4.12).

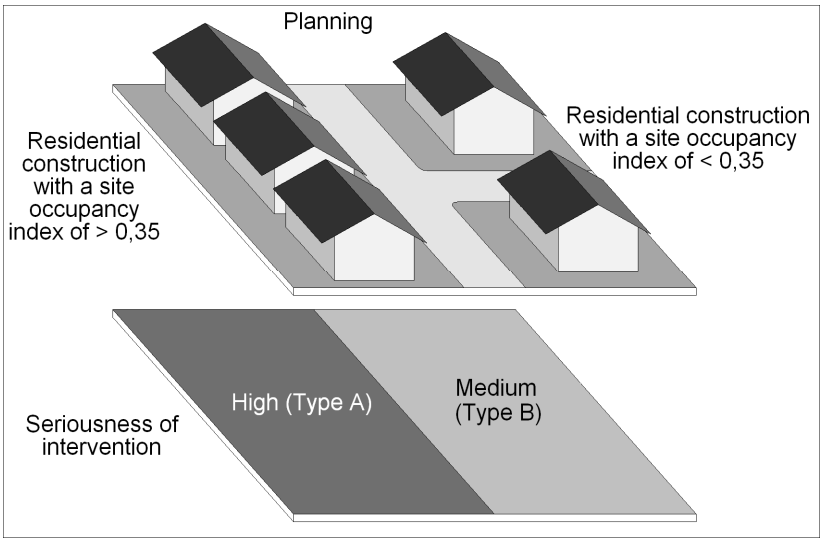


Fig. 4.12. Determination of compensation measures. Step 2. Categorization of the planning area according to the planning. Areas with different levels of seriousness of intervention (degree of impervious

coverage and degree of use) [41, p. 11].

The intensity of impacts is assessed in the third step, by overlapping the plan of the evaluation of the state and the building scheme (Fig. 4.13). Since the plan calls for use of the entire area for construction, all impacts are considered significant, and it is necessary to compensate the area proportionately to the degree of impact.

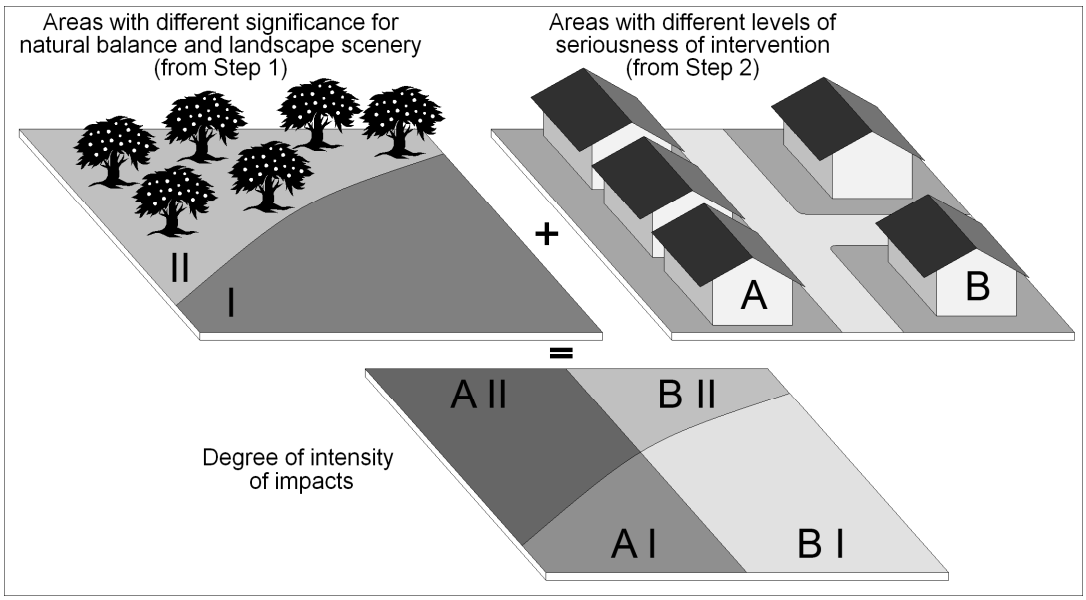


Fig. 4.13. Determination of compensation measures. Step 3. Process of derivation of impact intensities (see Table 4.5) [41, p. 12].

One of the methods for determining the proportionality level used to assess the compensation scope is a method of compensation factors (see Section 4.9). A scale is used to establish a relationship between the intensity of impacts, the significance of the area lost, and the compensation factors (Table 4.5). The area required for compensation is determined by multiplication of an appropriate coefficient by a lost area of a certain type.

Table 4.5

Matrix for establishing compensation factors [41, p. 13]

Areas of various significance for the natural balance and the quality of the landscape	Areas of varying gravity of impact	
	Type A High degree of impervious coverage and/or use Established Site occupancy index of >0.35, or corresponding gravity of impact	**Type B** Low to medium degree of impervious coverage and/or use Established Site occupancy index of <0.35, or corresponding gravity of impact
Category I **Areas of low significance**: • Farmland • Intensively used pastureland, intensively cared-for green spaces • Streams placed in pipelines • Cleared out farming landscapes	A I **0.3 – 0.6**	B I **0.2 – 0.5**

Category II **Areas of medium significance:** • Primary afforestation, or forests not appropriate to the site • Isolated groups of trees, field groves, hedges and sunken pathways • Species-rich or extensively used pastureland • Floodplain sites • Existing village edge areas with established green structures	A II **0.8 – 1.0**	B II **0.5 – 0.8**

Table 4.5 (Continuation)

Category III **Areas of high significance:** • Near-naturally structured, site appropriate forests with a high share of locally native tree species • Older shrub and hedge landscapes, species-rich forest margins • Naturally or near-naturally river sections • Spaces which provide for climate regulation of settled areas • Traditional cultural landscapes with cultural-historical land-use forms	A III **1.0 – 3.0**	B III **1.0 – 3.0**

After the ascertainment of the scope of compensation, a type of compensation measures is selected – either a compensation or an offsetting measure. In this case, the selection depends on specific characteristics of the construction, and the selection of a site of the required size within the construction area. If this choice is possible, compensation measures are developed for this impact area (Fig. 4.14).

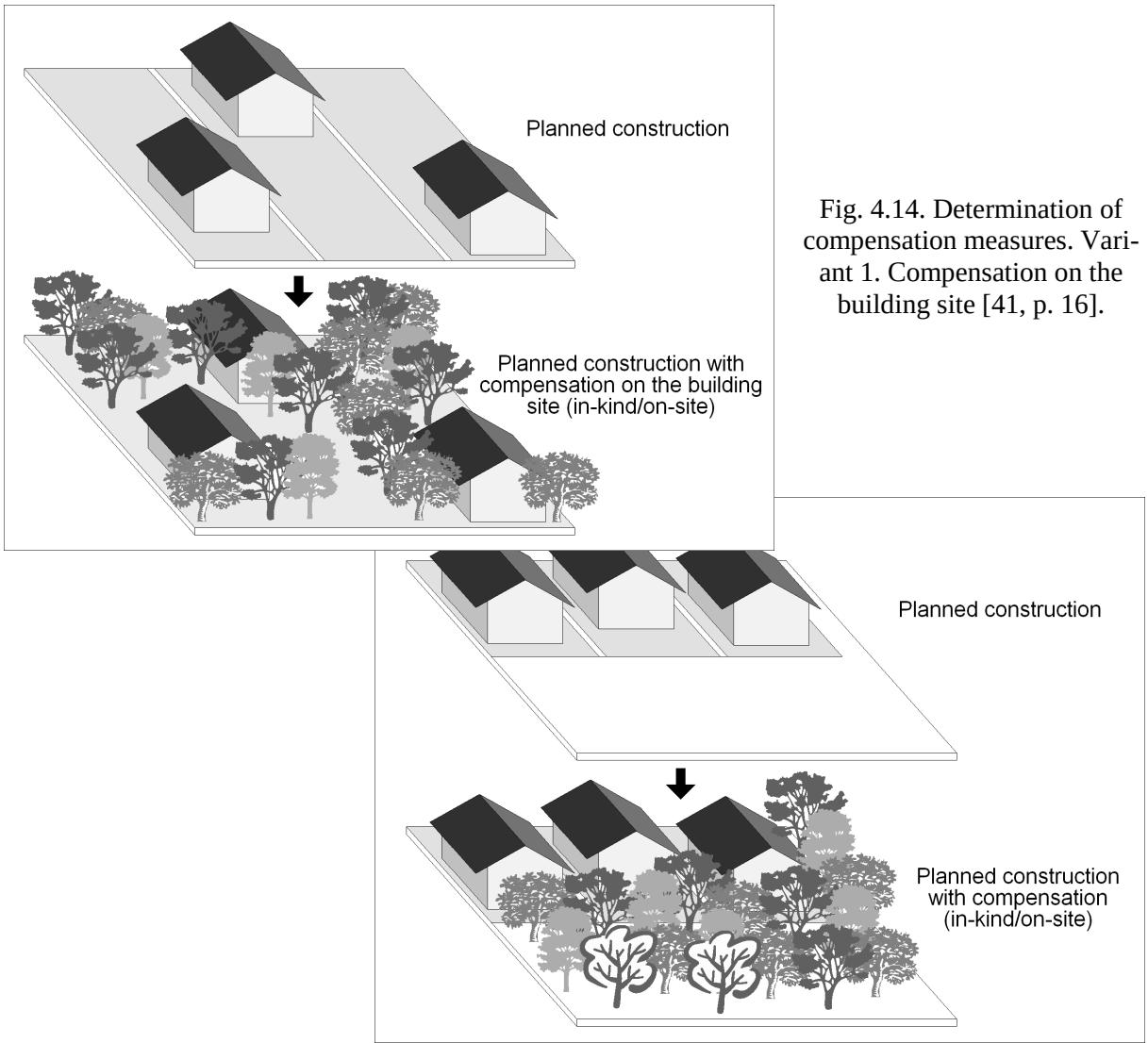


Fig. 4.14. Determination of compensation measures. Variant 1. Compensation on the building site [41, p. 16].

Fig. 4.15. Determination of compensation measures. Variant 2. Compensation on other sites covered by the local development plan, for example, planting a green margin around the estate [41, p. 16].

If it is impossible to find the required areas, appropriate areas directly adjacent to the impact area are selected. In this case, it is necessary, first, to increase the significance level of these areas and, second, to take measures to enable the restoration of lost functional relationships (Fig. 4.15).

If it is impossible to find vacant areas that meet the requirements of functional and territorial relationships (Section 4.8.2), offsetting measures are implemented outside the impact area, but under similar environmental conditions (Fig. 4.16).

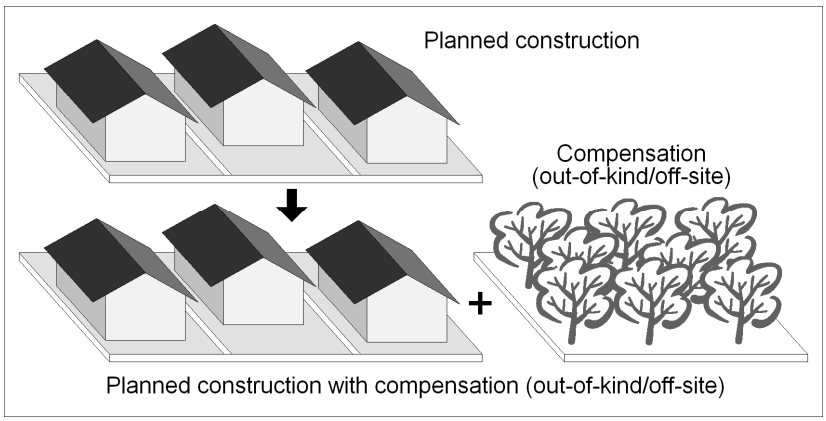


Fig. 4.16. Determination of compensation measures. Variant 3. Out-of-kind/off-site offset outside the building zone (Out-of-kind/off-site compensation on another site, for example, transformation of an intensively used meadow into woodland or into a low-nutrient meadow) [41, p. 17].

The selection of compensation or offset measures, depends on the possibilities of impact restoration for a certain period of time is determined from the duration of this period. The recovery period depends on how long society can wait for the results of compensation, i.e. improvement of the ecological situation which will have deteriorated due to the project implementation. In Germany, this term is 25 years. Approximate terms of recovery of certain ecosystems or biotope types and related possibilities of their compensation or offsetting measures are given in Table 4.6.

Examples for determination of compensation measures – in-kind/on-site or out-of-kind/off-site – are given in **Table A.30, Appendix 1.7**.

4.8.4. On-site/in-kind compensation measures [62, pp. 58-59; 89, p. 49; 90, p. 128]

An in-kind restoration of impacted functions (on-site/in-kind compensation measure) is necessary if the following three conditions have been met.

The compensation measure must be:

- ***Appropriate*** for the support of local goals of conservation and landscape care
- ***Implementable*** and ***effective*** in the near future; and
- Compatible with the principle of ***proportionality***.

Appropriateness

The in-kind restoration of impacted functions must correspond to the local and regional goals of conservation and landscape care, which are as a rule laid down in the landscape plan and/or the landscape framework plan, and have already been described, underpinned by proposals for measures. In addition to the existing plans, it is necessary to consider the current planning processes, programmes and targets of the nature protection authorities. With these procedures, it can be ensured that the selected areas will in fact be those requiring upgrading, so that on these areas a concrete requirement for upgrading measures exists, from a conservationist point of view.

Rapid realizability and effectiveness

With regard to these factors, a number of aspects are significant:

1. First of all, the areas must be «upgradable» with respect to the particular functions. Through the implementation of appropriate measures, a higher value condition must be achievable. For this purpose, the areas must also be development capable, i.e. it must have suitable site conditions for the rapid restoration of the respective function/s. For example, it is very advantageous to choose the same types of sites as compensation areas, in terms of water, alkaline and nutrient content, as the areas affected by the impact.

Table 4.6

Development times for ecosystems and biotope types. Possibilities of compensation (on-site and/or offsetting) [72, pp. 169, 225]

Development time, years	Eco-systems and/or biotope types
Compensable biotope types. Development times <25 years	
<5	• Short-life ruderal vegetation • Pioneer stages of sandy low-nutrient grassland, secondary sandy low-nutrient grassland, e.g., in sand quarries • Eutrophic and/or species-poor, structure-poor ditches
5 – 15	• Most manifestations of acidic soil shrubbery and hedges • Nitrophilic high forb fields • Long-lasting ruderal fields
15 – 25	• Species-rich high forb fields, • Shrubbery on fallow land • Relatively species-poor secondary sandy low-nutrient grassland and semi-dry grassland • Pioneer forests
Only offsettable biotope types. Development times 25–150 years	
25 – 50	• Vegetation of secondary oligotrophic and mesotrophic standing bodies of water, species-poor sedge reeds • Species-rich, strongly structured ditches and creeks • Broom heaths on fallow land
50 – 80 50 – 150	• Quaking bogs and other land-forming ecosystems on standing bodies of water (species-poor examples) • Certain manifestations of thermophilic shrubbery, • Species-rich meadows, mown twice annually • Certain manifestations of open bog woods rich in coniferous trees and birch, on drained bogs, secondary growth

2. It is also important that the areas not presently be of high value, since then, on the one hand, upgrading would be difficult and second, the danger would exist that a compensation measure could result in worsening of the situation for certain functions, and hence itself constitute an impact (examples: placement of a seepage depression for the support of new groundwater formation in a valuable damp meadow; planting of trees/shrubs to enhance the appearance of the landscape in a low-nutrient meadow the preservation of which is important from a conservationist point of view).

3. Moreover, the success of such a restoration measure must be relatively certain. The sense of a measure can, e.g., be considered uncertain if the period of time elapsing until it will become effective is very great, i.e., rapid restoration is not possible. «Rapid» means a period of 25 years at a maximum, so that compensation measures must provide a complete realization of the impacted functions after 25 years of the latest. Accordingly, negative impacts upon functions caused by a project which will have a development period of more than 25 years must be considered non-compensable from the outset.

Proportionality

Measures meet the requirements of proportionality if the expense for in-kind restoration of the impacted functions is not disproportionately great with respect to the effects to be attained in that way.

Compensability of significant negative impacts upon species and biotic communities

Compensation cannot be achieved unless the biotope types affected by the impact can be restored within a reasonable period of time within the area of concerned. Moreover, resettlement by the species and biotic communities involved must be possible within that period of time.

The biotope types are distinguished according to the following criteria:

Site-related restorability:

- Difficult or impossible to restore
- Restorable with average cost and effort, or with simple design measures at the appropriate places
- Easy to restore.

Time-related restorability:

- Cannot be restored within a reasonable period of time
- Time required for restorability depends on concrete characteristics of the area, and must there-fore be examined on a case-by-case basis
- Restorable within a reasonable period of time.

In the case of biotope types for which the time required for restorability must be examined on a case-by-case basis, the following matters must be taken into account:

- One and the same biotope type may be restorable at various speeds, depending on site conditions, location in the space, and other characteristics.
- For characteristic biotope type complexes, lengthy development time periods are generally required. Many organisms are, in their life cycles, dependent upon precisely such biotope complexes.
- In certain cases, locally typical concentrations or rarities of biotope types must be taken into account with particularly shorter or longer development periods.

The resettlement conditions for the affected species and biotic communities must generally be ascertained in each particular case and evaluated in context. Here, the following criteria must be taken into account

- Size of the compensation areas
- Minimum areas for the affected species/biotic communities
- Specific suitability of the habitats
- Proximity and accessibility of dissemination-capable populations of the respective species
- Possibilities for the establishment of species
- Degree of endangerment of the species.

The occurrence of specialized species in a biotope is often based on a long historical development rich in tradition. If the concrete population becomes extinct in a certain biotope, resettlement will often not be able to succeed. At least in the case of plant and animal species of the categories «threatened with extinction» and «strongly endangered», resettlement can generally be considered unlikely. The same is true in the case of a concentration of endangered species.

A number of conditions have been identified which limit the compensabilities of certain environmental assets.

Species and biotopes

Significant impacts are especially non-compensable if:

- Occurrences of plant and animal species of Value Level III are affected, and the affected species cannot be maintained in the respective population size, and/or
- Restoration or new creation of the affected biotope types of Value Levels III & II is not possible with the same characteristics and sizes over the medium term (i.e. up to 25 years)

Soil

In case of the excavation of soil of Value Level III, no compensation is generally possible. In the case of soil of Value Level II, a case-by-case examination is necessary to determine whether the soil func-

tion can be restored in a similar or equivalent manner. In particular, the previous pollution load of the soil must be taken into account.

Groundwater

In areas of special significance, compensation for the impact can generally only be partially provided (in case of change in the groundwater supply). Other negative impacts are not compensable.

Landscape quality

Compensation can be achieved if it is possible to attain the same value level over the medium term (i.e., up to 25 years) after restoration or landscape appropriate new creation.

Examples of compensation measures are given in **Table A.31, Appendix 1.7**.

4.8.5. Compensation of impacts on specially protected natural areas [78, pp. 1-2]

In case of the impact on specially protected natural areas and landscapes, compensation measures are selected according to the scheme shown in Fig. 4.17.

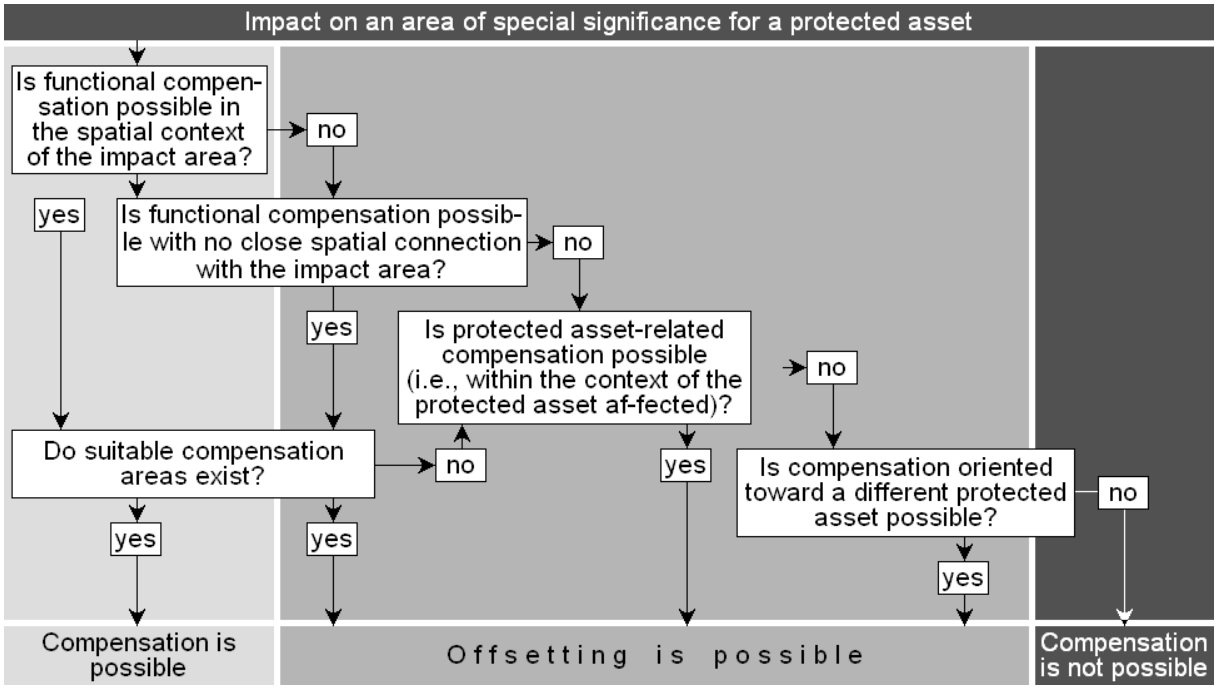


Fig. 4.17. Selection of compensation measures of impact on specially protected natural areas.

As the first step, a possibility of complete compensation of the entire impacted structure in close spatial connection with the impact area is examined. If such a possibility exists and there is an area suitable as compensation, this is then implemented as an in-kind/on-site measure. If there is no such a possibility, the possibility of out-of-kind/off-site compensation (offset) is examined:

- Complete compensation of the entire affected structure without close spatial connection
- Asset-by-asset compensation only within the affected asset at any place
- Asset compensation at any place where an asset differing from the affected one is restored, but also with the protected status.

If none of the enumerated possibilities can be realized, the compensation is considered impossible, and the impact impermissible. Compensation in monetary terms is not applied to the specially protected areas.

Examples for the ascertainment of the type and scope of compensation measures for impacts in areas of special significance for certain protected assets

Example 1

The planning area consists entirely of low-nutrient grassland of a medium level site. The protected asset Plants/animals is claimed to be of special significance because of its habitat and species protection functions. By contrast, the protected assets Soil, Water, Climate and Landscape quality/recreation have medium-level functional characteristics, and are hence protected assets of only general significance. Accordingly, the compensation is to be effected for the former protected asset, as follows:

1st Step: Functional compensation (e.g. impact upon the habitats of meadow breeders)
→ Compensation through support for the habitat conditions of meadow breeders in the spatial context of the impact area

2nd Step: If functionally impossible in the spatial context
→ Functional offset without close spatial connection

3rd Step: If functionally impossible (e.g. lack of suitable area)
→ Protected-asset-based offset (i.e. within the context of the protected asset Plants/animals), e.g. by supporting open-country species

4th Step: (fourth step non-applicable, since it can generally be assumed that the impact upon the protected asset Plants/animals can be compensated within the context of that protected asset).

After the types of mitigation and compensation measures have been justified and established by oral arguments, the quantification of the scope of measures follows, based on offsetting calculation of value levels and areas. The previous selection of suitable measures ensures that lost quality is not compensated by higher quantities. A purely quantitative approach is not acceptable.

Possibly, the measures will (in this case) fail to compensate subsidiary impacts on the other protected assets, or at least may not do so fully. In that case, additional measures will be necessary.

Example 2

The planning area consists entirely of a farm field. The protected asset Plants/animals is claimed to be of low significance, while the protected assets Landscape quality/recreation and Climate have medium functional characteristics, and are thus protected assets of only general significance. By contrast, the protected assets Soil and Water are of special significance. Accordingly, the compensation is to be oriented toward the latter two protected assets, as follows:

1st Step: Functional compensation (e.g. impact on the soil of a field with a high filtration/buffering capacity, and high recharging of groundwater (special significance), and simultaneously weakly developed functions for the protected asset Plants/animals (low significance).
→ Compensation by support for the corresponding functions, e.g. by improvement of filtration/buffering capacity of soil (impervious coverage removal of previously similarly efficient soil, and thus some simultaneous increase of groundwater recharging, or placement of upper soil material on soil of low or medium functional efficiency)

2nd Step: Functionally impossible in the spatial context
→ Functional offset without close spatial connection

3rd Step: If functionally impossible (e.g. lack of suitable area)

→ Protected-asset-based offset; measures to be considered include the following:

- Impervious coverage removal (buildings, roads, car-parks, etc.)
- Erosion protection measures such as installation of protective strips on steep inclines to reduce the length of the slope
- Application of upper soil on eroded or functionally weak soil (provided this does not affect other protected assets)
- Deep loosening of severely compacted soil (e.g. former construction sites, car-parks)
- Roof greening (generally a mitigation measure)
- Transformation of farmland into grassland on extreme sites (soils prone to soil-plogging; waterlogged or floodplain soils).

4th Step: If protected-asset-based compensation is impossible

→ Offset for a different protected asset (e.g., planting of a hedge or opening of a reinforced source); the extent of area for the measure can be ascertained verbally/argumentatively, or via monetary evaluation.

4.8.6. Care of compensation measures

Care measures are required in order to achieve and preserve the goals of any compensation measure.

Such care is carried out at the following stages of the measure:

- During development, up to the achievement of the goal of the measure goal
- During functioning, after achievement of the goal of the measure.

The goal of care during development is the continuing increase of the value of the compensation area up to the target. Figure 4.18 shows the schematic development of a compensation measure for the transformation of farmland into dry grassland.

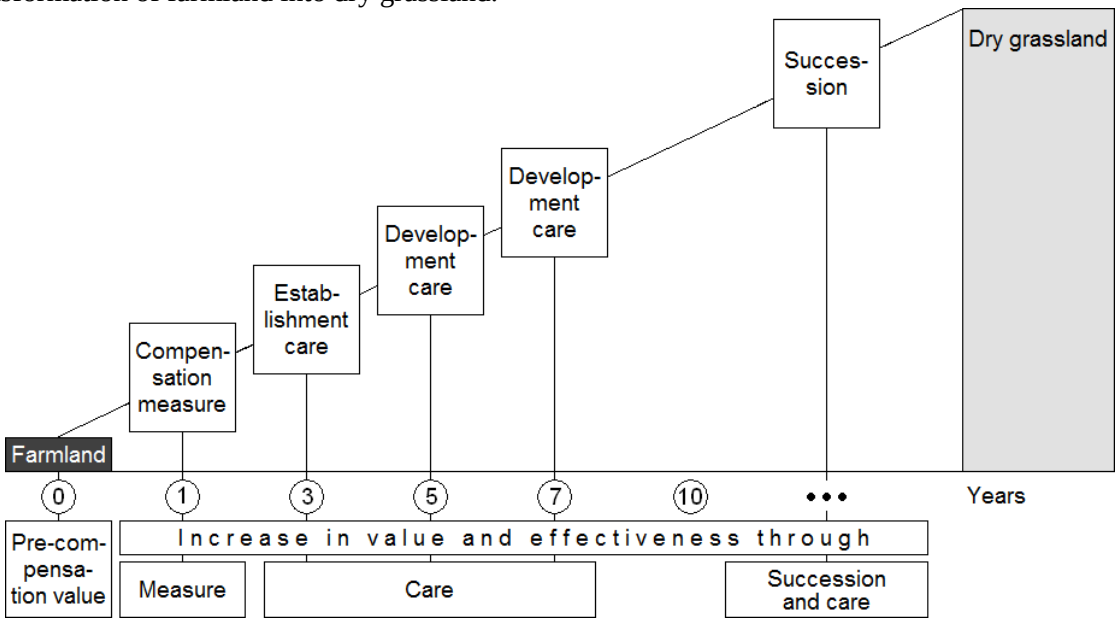


Fig. 4.18. Measures for increasing the value and developing the effectiveness of compensation and offsetting measures. Example: From farmland to dry grasslands [69, p. 73].

These measures are to be described with the following information [83, p. 31]:

- On the categorization into follow-up, development and maintenance care measures
- On the likely duration and frequency of care
- Regarding maintenance care: a stipulation is only acceptable if it is appropriate to the normal care of a plot of land, not oriented toward its economic utility (e.g. sporadic mowing of dry meadows, trimming of hedges or trees)
- Regarding the planned performers of care measures
- Regarding care to economic use (e.g. extensive pasturing/mowing):
- The stipulation of such care is to be limited to a maximum of 25 years if it is to be implemented by a private party.

Examples of the follow-up care of the compensation measures are given in **Table A.32, Appendix 1.7**, and examples of similar measures are shown in **Table A.33, Appendix 1.7**.

4.8.7. Integration of compensation measures in production and cooperation of parties

In the case of production-integrated measures, biotope value improvements are achieved on agriculturally used land by means of appropriate farming methods, without removing the areas from agricultural use.

Such integration, as well as the development and implementation of compensation measures, is to be realized by the cooperation of all parties involved in the planned project. Moreover, more possibilities emerge for the solution of problems associated with the realization of planned compensation measure. The advantages of cooperation and its possible contribution to the solution of these problems, and the upgrading of the environmental situation are schematically shown in Fig. 4.19.

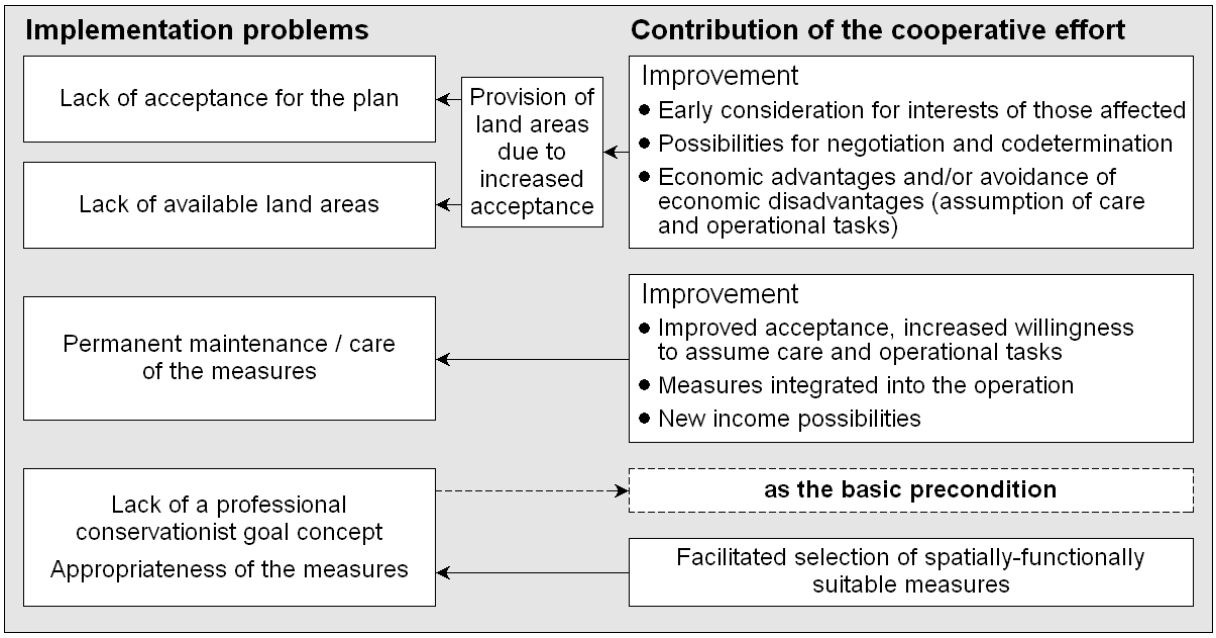


Fig: 4.19. Contribution of cooperation to the solution of the problems of implementation of the Impact Mitigation Regulation (German: Eingriffsregelung) [49, MB 29, p. 5].

The main problems in the implementation of the Impact Mitigation Regulation are lack of available land areas, and the necessity for long-term care of the development and functioning of compensation measures. These problems are solved automatically during incorporation of the measures into production on condition that an owner of the production agrees to fulfil them, and understands the technological and economic benefits of such a cooperation effort. Figure 4.20 shows the advantages of cooperation between an investor of the proposed project, a nature conservation agency and farmers into whose activity compensation measures can be incorporated.

The following list provides a selection of production-integrated measures [49, MB 34, pp. 1-2]:

Measures on farmland (retention of farming use)

Soil management measures

Soil management with deadlines stipulations

- Powerless farming
- Gentle farming with mulch tilling
- Fallowness during periods of high biological activity (spring and autumn); tillage, if possible, only during the summer (July/August)
- Fallow periods through the cultivation of perennial crops with no mechanical tillage
- No herbicide use.

Fallow fields

- Abandonment of use of the field (fallow)
- Permanent fallows

- Use extensification after intentional nutrient impoverishment

Inter-cropping

- Introduction of organic substances (inter-cropping, shredded green material)
- Crop sequence with lengthy soil coverage
- Creation of long-term soil coverage by seeding, planting or mulching.

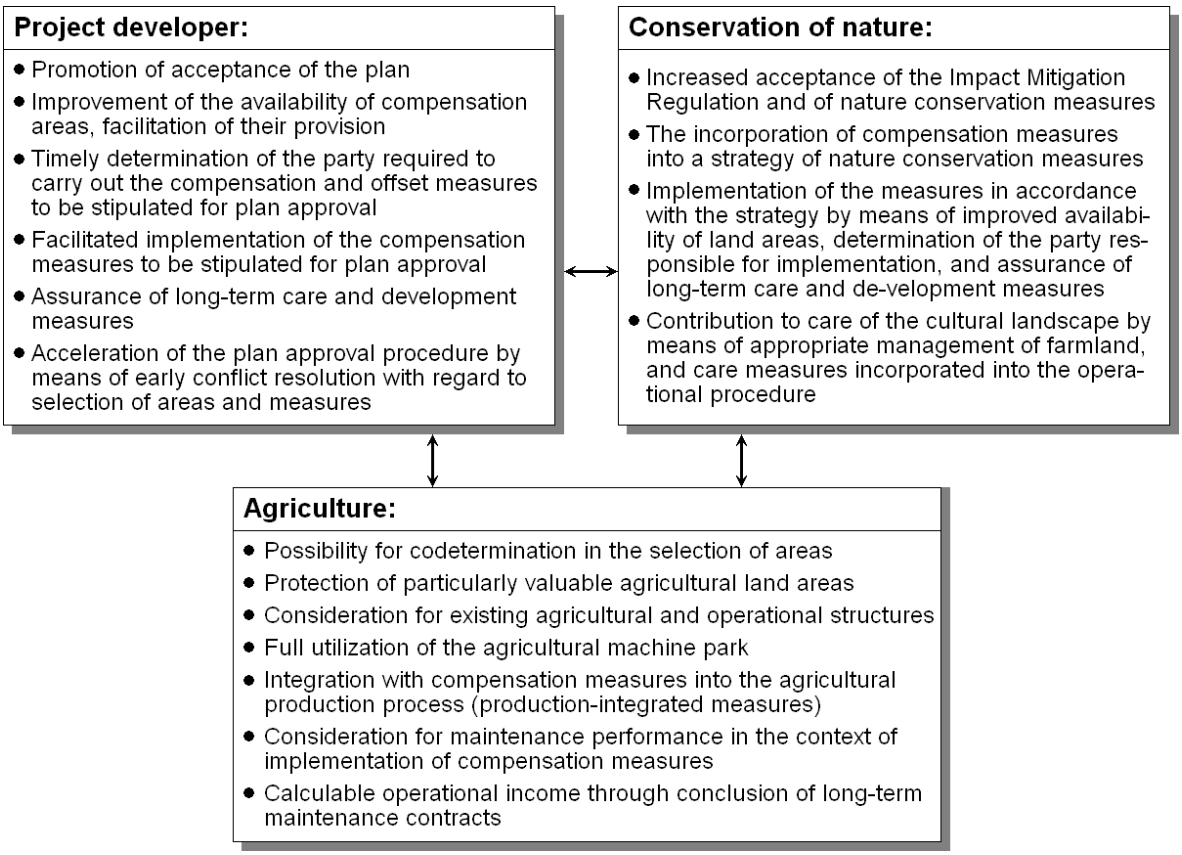


Fig: 4.20: Advantages of cooperation from the point of view of project developers, the nature conservation authority, and farmers [49, MB 29, p. 3].

Marginal strips of fields

- Conservation-appropriate use of farm fields and their edge strips to protect field biotic communities.

Measures on farmland (transition to other uses)

- Transition from farmland to extensive grassland (removal of mown material, soil impoverishment)
- Use transition after intentional nutrient impoverishment
- Creation of strips at the edges of fields and along bodies of water.

Measures on grassland

- All-year extensification of grassland without time limitation on use by mowing or pasturing
- Use of grassland with time limitation
- Abandonment of use of grassland (fallow).

Conservation-appropriate management of other biotope types

- Special management principles for low-nutrient meadows and dry heaths
- Special management principles for wet meadows, damp heaths and sedge reeds
- New planting and maintenance of existing fruit tree stands.

Additional examples on compensation measures given in **Appendix 1.7** are listed below:

- General measures for impact compensations of different functions of the environment resulting from certain effects – **Tables A.34** and **A.35**;

- Special compensation measures for various environmental assets – **Table A.36**;
- Examples of typical measures or types of land use at the compensation sites – **Table A.37**;
- Examples of compensation measures for different types of activity:
  – for road construction – **Table A.38**;
  – for linear constructions on different lands – **Table A.39**;
  – for mining – **Table A.40**.

4.9. Approaches to compensation ascertainment

There are four approaches to compensation ascertainment, which are listed in Table 4.7.

Table 4.7

Procedures/approaches for compensation ascertainment [45, p. 198]

Designation	Designation refers to
Biotope value method	• The basis for the judgement (biotope types) • The value equivalent (biotope value) upon which the accounting is based
Compensation area factors	• The existence of a benchmark value for the area equivalent upon which compensation ascertainment is based (multiplier or ratio)
Creation cost approach	• The formation of an equivalent for the ascertainment of the scope of compensation and accounting on the basis of the cost of the measure
Oral/planning-oriented argumentative procedure	• The form of presentation of the facts of the matter (also called descriptive) and/or the value expression of an evaluation • The procedure/form of derivation and/or justification for the need for compensation

Each of these approaches has its own limiting conditions for application. The selection of any approach depends on the concrete situation that causes the impact and on the detailed assessment of the state of the affected and compensation areas. The list of advantages and disadvantages of these approaches given in Table 4.8 provides degree of support in the selection.

These approaches allow the ascertainment of compensation scope related to biotopes, if restoration of their affected functions occurs no time-lag. If the «time-lag» effect is expected, the scope of compensation increases, or additional measures are stipulated (Section 4.9.5).

Table 4.8

Advantages and disadvantages of various approaches to compensation ascertainment [72, p. 218; 73, p. 104]

Advantages	Disadvantages
Approaches related to biotope value	
• Possibility of legalization within the framework of regulation documents • Possibility of using existing data on biotope value or justification of this value within the framework of a certain project • Relative simplicity and availability for understanding by non-professionals, positive appreciation of the public • Possibility of visual presentation of characteristics complicated for understanding, e.g., impact duration, development period of compensation measure, environmental value of the affected and compensation areas, etc.	• Functional and spatial relationships are insufficiently assessed because only certain biotopes of the environment are analysed • Impossibility of assessing linear or point impacts; • Impossibility of taking into account impacts of abiotic components • Possibility of using approaches only in those cases when impacts result in reduction of the value • Linear calculation of biotope value is insufficiently justified • Different scales and criteria of assessment are used for ascertainment of compensation scope.
Approaches related to compensation area coefficients	
• Possibility of unifying an approach for different projects based on development of standard com-	• Little freedom of action and absence of possibility to take into account concrete specific characteristics of the

pensation factors for a concrete area • Possibility of justifying own compensation factors for a concrete project • High reliability of developments from the viewpoint of nature protection agencies and possibility of getting fast results.	project using standard compensation factors • Insufficient justification of standard compensation factors for large areas • Unfitness for assessment of measure scope using offsetting measure • Danger of negligent treatment of spatial functional relationships

Table 4.8 (Continuation)

Advantages	Disadvantages
Approaches related to costs of measure implementation	
• High flexibility in planning and implementation of compensation measures • Possibility of avoiding insufficiently justified relationships between the biotope value and area as the compensated area is ascertained via cost equivalent • Evidence of the result justified by the lowest cost	• if the assessment is carried out without connection to an assessment of nature protection value, there is a temptation to violate the principle of impact avoidance, e.g., loss of biotopes with high nature protection value, the restoration of which would be cheaper than avoidance; in this case, it is necessary to correct the planned project
Approaches of planning-oriented logic argumentation	
• High flexibility in the development of a certain project • Possibility of providing an assessment of all sufficient functions of the environment and their relationships • Well-ascertained relationship between impact and compensation • Legal assurance in case of understandable and convincing arguments • There is no need to use assessment without strict methodological justification	• High demands to the development without standard methods • Impossibility of method standardisation and danger in obtaining differing results because of high subjectivity of assessments • Significant dependence of the result on the professionalism of a project developer • Danger of subjectivity of the results at weak logic structuring of arguments • Major efforts for coordination and verification of the results by interested agencies

4.9.1. The biotope value approach

The main assessment parameter in the methods of this group is the biotope value prior to the impact expressed in points according to a certain scale. The biotope value is assessed at one of the stages of OVOS (Section 4.4). Assessment by different methods is based on the comparison of the biotope value C_V with one or several characteristics prior to the impact:

- C_N – biotope value after the impact
- C_R – value of compensation measure (value is the goal of the measure)
- C_C – value of the compensation area prior to the measure implementation.

The time T_C. needed for restoration of environmental functions and its productivity up to the planned level is also taken into consideration. The restoration is considered to last no longer than a certain period T_0, 25 years for the majority of biotope types. The deficit of environment productivity is not apparent until after a longer period. This deficit is to be compensated by an additional compensation or offsetting area, in order to ensure that the productivity remain unchanged after the impact during the restoration period T_C. The compensation area increases on comparison with that of the impacted site: the more significant the impact and the longer the restoration period are, the larger the affected area is.

General principles for ascertainment of compensation area are as follows.

Fig. 4.21.A. As a result of an impact on an area of high value, the latter decreases by more than one step (in this case, two steps). Depending on the compensation area value, the following options are then possible:

- The value of the compensation area is low, and it is possible to raise it up to the level lost in the impact area (by two steps). In this case, the compensation area is to be no smaller than the impact area
- The value of the compensation area is medium, and it is impossible to increase it by two steps. In this case, the value of this area increases by one step, and its area increases by comparison with the impact area.

Fig. 4.21.B. The value of the area decreases by one step because of the impact. Depending on the value of the compensation area, the following options are possible:

- The value of the compensation area is the same as the value of the impacted area after the impact, and it is possible to raise it up to the level lost in the impacted area. In this case, the compensation area is to be no smaller than the impacted area.
- The value of the compensation area is low. For the restoration of the lost value, it is necessary to raise it by two steps: the area of the compensation site can thus be decreased compared with the impacted site.

Fig. 4.21.C. The value of the impact area is medium and, as a result of the impact, is reduced by one step. Depending on the value of the compensation area, the following options are possible:

- The value of the compensation area is low, and it is possible to raise it by one step up to the level lost at the impact site. In this case, the compensation area is to be no smaller than the impact area. Or, if the value at the compensation sites is increased by 2 steps, the compensation area is reduced;
- The value of the compensation area is medium. Its value is to be increased by one step, otherwise the compensation does not occur and the area of the compensation site is to be no smaller than the impact area.

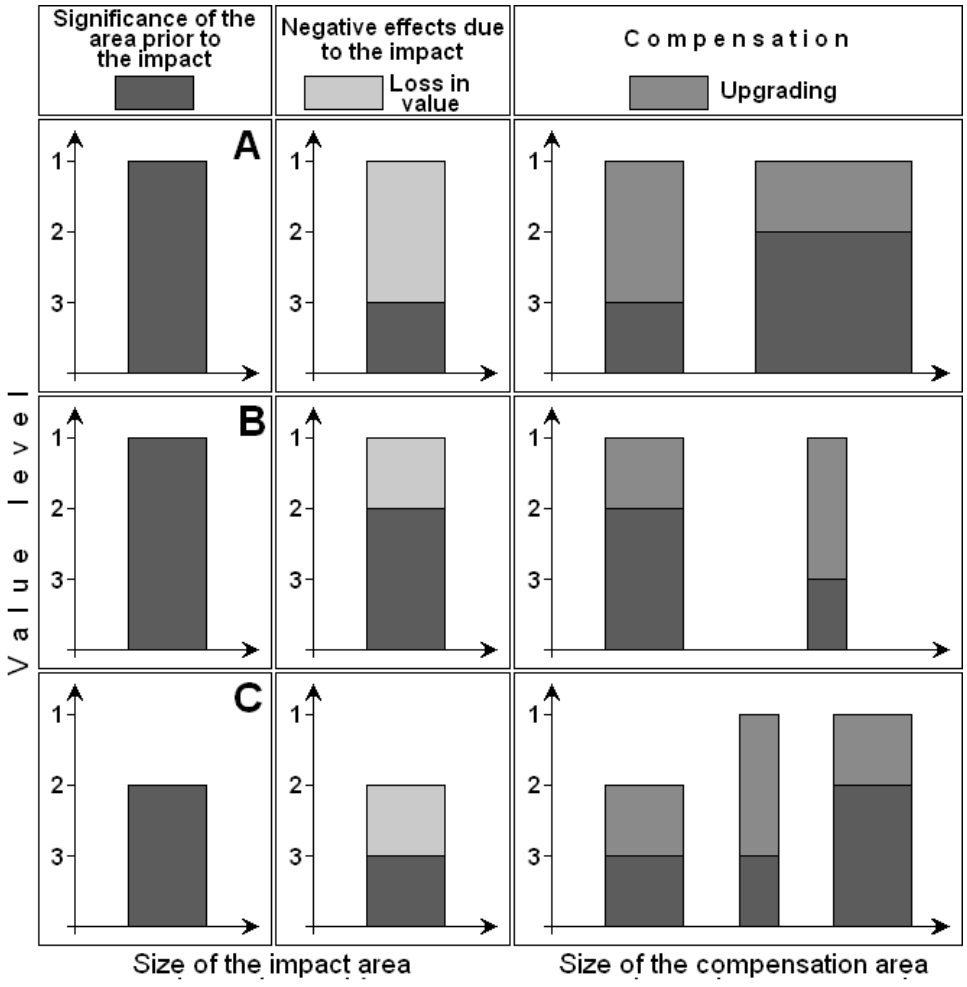


Fig. 4.21. Principles for the ascertainment of the scope of compensation [76, p. 75].

Below are the schemes of the ascertainment of the area of impact compensation at various stages of the proposed project [adapted according to 72, pp. 202-208].

Ascertainment of impact compensation area during exploitation of facilities

Calculation from value difference of the impact area before and after the impact

The following calculation scheme is the simplest approach used for ascertainment of the compensation area F_C:

$$F_C = F_0 \cdot (C_V - C_N) \cdot \frac{T_C}{T_0}, \text{ at } T_C > 25 \text{ years and}$$

$$F_C = F_0 \cdot (C_V - C_N) \text{ at } T_C \leq 25 \text{ years,}$$

where F_0 is the area of the affected site.

The scheme allows the assessment of real losses of the value of the environmental assets and their functions. The time level T_0 is set for long-term persistent effects to eliminate the deficit of the environmental productivity. Such an approach is reasonable for ascertainment of the compensation scope at the expected time of <25 years. If the period of compensation measure is longer, the offsetting measure is necessary.

Example

Area of the impact site , ha	$F_0 = 1$	$F_C = 1 \cdot (3-0) \cdot \frac{30}{25} = 3.6$
Value of a biotope prior to the impact, points	$C_V = 3$	
Value of a biotope after the impact, points	$C_N = 0$ (complete loss of a biotope)	
Expected time of biotope restoration, years	$T_C = 30$	
Area needed for compensation, ha	$F_C =$ **3.6**	

Calculations from value difference of the impact area after the impact and after implementation of compensation measures

This approach is used mainly for compensation measures when the aim goal can be achieved very rapidly ($T_C<T_0$), but long-term follow-up care is necessary to preserve the state achieved. The calculation is inferred from the formula:

$$F_C = F_0 \cdot \left[\frac{C_R - C_N}{2} \cdot \frac{T_C}{T_0} + (C_R - C_N) \cdot \frac{T_0 - T_C}{T_0} \right].$$

Example

Area of the impact site, ha	$F_0 = 1$	$F_C = 1 \cdot \left[\frac{3-1}{2} \cdot \frac{10}{25} + (3-1) \cdot \frac{25-10}{25} \right] = 1.6$
Value of a biotope after the impact, points	$C_N = 1$	
Value of compensation measure, points	$C_R = 3$	
Expected time for biotope restoration, years	$T_C = 10$	
Area needed for compensation, ha	$F_C =$ **3.6**	

Calculations taking into account the value of compensation area before and after measure implementation

The values of the compensation site before and after the measure are used in this scheme as calculated parameters. The scheme takes into account the increase in value which, during the restoration period, evolves at the compensation site in comparison with the lost value at the impact site. The calculations are inferred from the formula:

$$F_C = F_0 \cdot \frac{C_V \cdot k_W \cdot k_T}{C_R - C_C},$$

where k_W is the impact coefficient, $k_W = 1 + \frac{C_V - C_N}{C_V}$,

k_T is the coefficient of restoration time, $k_T = 1 + \frac{T_C}{C_0}$.

The scheme is used for ascertainment of the scope of offsetting measure. It is necessary to pay attention that the denominator in the calculation scheme cannot become zero, as there is no sense in compensation measures at a site if there will be no increase of its value. The ratio $(C_R - C_C) > 0$ is always to be observed.

Example

Area of the impact site, ha	$F_0 = 1$	$F_C = 1 \cdot \frac{3 \cdot 1.67 \cdot 1.8}{3-1} = 4.5$
Value of a biotope prior to the impact, points	$C_V = 3$	
Value of a biotope after the impact, points	$C_N = 1$	
Impact coefficient	$k_W = 1 + (3-1)/3 = 1.67$	
Value of the compensation area prior to measure implementation, points	$C_C = 1$	
Value of compensation measure, points	$C_R = 3$	
Expected time for biotope restoration, years	$T_C = 20$	
Coefficient of restoration time	$k_T = 1 + 20/25 = 1.8$	
Area needed for compensation, ha	F_C = **4.5**	

Determination of compensation area during construction

Impacts are usually short-term at temporal loss of the environmental productivity during construction, e.g., roads, warehouses, noise impact, clean-up of the main construction after its completion (underground pipelines and power lines) etc. This refers to biotopes that can be restored in a short period of time, e.g. ploughed fields, or intensively used meadows and grasslands.

As a rule, it is impossible to restore valuable biotopes in the short or medium term. This refers, for example, to habitats that are sensitive to impervious coverage, and dependant on ground water. Therefore, biotope development will require a longer period and larger areas for compensation measure implementation, compared with the impact area.

Moreover, it is necessary to take into account that even the possibility of restoration does not in principle ensure equal offsetting measures. Therefore, the value of additional measure for biotopes under consideration can be decreased by one step in comparison with the value of the impacted biotope.

In this case, the compensation is performed at two sites – at the impacted site and at the additional F_Z, site, the area of which is calculated from the approaches discussed below.

Calculation from effect and restoration time

The scheme takes into account the effect time T_W during construction, and the time T_C needed for complete restoration of the lost functions and value of the environment. The following formula is used for this calculation

$$F_Z = F_0 \cdot \left[(C_V - C_N) \cdot \frac{T_W}{T_0} + (C_V - C_R) \cdot \frac{T_C - T_W}{T_0} + \frac{C_R - C_N}{2} \cdot \frac{T_C - T_W}{T_0} \right].$$

Example

Area of the impact site, ha	$F_0 = 1$
Value of a biotope prior to the impact, points	$C_V = 3$
Value of a biotope significance after the impact, points	$C_N = 0$
Value of additional compensation measure, points	$C_R = 2$
Impact time, years	$T_W = 2$
Expected time for biotope recovery, years	$T_C = 25$
Additional area needed for compensation, ha	F_Z = **2.1**
$F_Z = 1 \cdot \left[(3-0) \cdot \frac{2}{25} + (3-2) \cdot \frac{25-2}{25} + \frac{2-0}{2} \cdot \frac{25-2}{25} \right] = 2.1$	

Calculation from the actual area of compensation and value of additional site

A situation often arises the less than the entire impact area F_0 located within the construction zone can be recovered. In this case, it is necessary to take into account the factual area of compensation F_A within this zone, the value of a biotope C_A within the construction zone, and the time coefficient for the development of this biotope k_{TA}, as well as the value of the site, at which the additional compensation measure is to be implemented C_C, and the value of this measure C_R:

$$F_Z = \frac{C_v \cdot F_0 \cdot k_{TA} - C_A \cdot F_A}{C_R - C_c}.$$

Example

Area of the impact site, ha	$F_0 = 2$	$F_Z = \frac{3 \cdot 2 \cdot 1{,}2 - 2 \cdot 1}{2 - 1} = 7.2$
Value of a biotope prior to the impact, points	$C_V = 3$	
Factual compensation area within the construction zone, ha	$F_A = 1$	
Value of a biotope created within the construction zone, points	$C_A = 2$	
Time for biotope development within the construction zone, years	$T_C = 5$	
Time coefficient of development of this biotope	$k_{TA} = 1 + 5/25 = 1.2$	
Value of the site for additional compensation measure, points	$C_C = 1$	
Value of additional measure, points	$C_R = 2$	

Methods for calculation of compensation scope using the value of biotopes are to be applied, first of all, to impact areas. For linear and point impacts these methods are ineffective. They are to be used when the value decreases as a result of impacts. These methods are not applicable if the changes resulted from the impact do not affect the value (e.g., creation of barrier effect or isolation of biotopes) or the value of impacted biotopes is low (e.g., intensely used ploughed fields, grasslands and areas poor in species. The schemes analysed do not take into account the impact upon abiotic components. For these cases, methods of planning-oriented logical argumentation are to be applied.

4.9.2. The compensation area coefficients approach

Compensation coefficients express the ratio between the impact area and the area needed for compensation. They are set on the basis of experience for different types of impact, and represent approximate values that determine the lower and upper limits of this ratio. The choice of a certain coefficient depends on the value of the impact area. Examples of compensation coefficients for different environmental assets and compensation measures are given in **Tables A.41** and **A.42, Appendix 1.8**.

These coefficients are not the tools of methodological approaches, as they are not associated with the reference state, impact assessment and procedures for information processing. They can only supplement the method with planning-oriented logic argumentation. Moreover, these coefficients take into consideration only uniform restoration of the impacted or lost biotope (offsetting measure). They are ineffective for equal offsetting measure.

4.9.3. The costs of measure implementation approach

This method is applied when it is impossible, for whatever reason, to compensate the impacted biotope. Therefore, offsetting measure is to be developed. The site area F_E for offsetting measure is determined from the ratio between the costs of the offsetting measure S_A, rbl, as if it has been implemented, and the known specific cost of the offsetting measure U_E, rbl/ha:

$$F_E = \frac{S_A}{U_E}.$$

Example [adapted according to 73, p. 101]

To compensate the impact, 2.5 ha of a certain biotope is to be created. At the same time, specific characteristics of the biotope make it impossible to implement a compensation measure, as its period of realization would be greater than 25 years. In this case, an offsetting measure is to be performed. The area for offsetting measure is determined as follows.

Elements of costs	Cost, thousand roubles
Costs of compensation measure in case it has been implemented	
Creation of 2.5 he of biotope on the ploughed field	3.500
Costs of project works	220
Follow-up care for 25 years	550
Total costs of compensation measure	**4.270**
Specific costs of offsetting measure which is to be implemented, rbl/ha	
Creation of a biotope on the intensely used meadow	550
Costs of project works	76
Follow-up care for 25 years	900
Total specific costs of offsetting measure, rbl/ha	**1.526**
Calculation of scope of offsetting measures	
Costs of compensation measure S_A	4.270
Specific costs of offsetting measure U_E	1.526
Required scope of offsetting measure $F_E = S_A / U_E$ = 2.8 ha	

Based on the costs of fictitious restoration, this approach helps establish the extent for calculation of the compensation area which corresponds to the merits. Moreover, fictitious costs assess fairly correctly, in monetary terms, the impact caused by an effect. At the same, it is important to know that all expenses resulted from measure implementation are to be taken into account as a cost equivalent [45, p. 214]:

- Expenses for purchase of land
- Costs of production (costs of construction work)
- Expenses for follow-up care
- Expenses for development of the measure (project work)
- Expenses for monitoring measure implementation and goal achievement
- Additional payment for elimination of functional disadvantages
- Expenses for associated works, e.g., removal of impervious coverage for restoration of the abiotic functions of soils, and the water balance.

4.9.4. The planning-oriented logical argumentation approach

This method is the least formalized method. The approach of planning-oriented logical argumentation is based on description assessment. The formal synthesis of a large number of data, and the balance accounting of impacts and compensation are not used here. The demand for compensation or offsetting measures is determined on the basis of the qualitative parameters and scopes of impacted value. This allows for a better assessment of complex problems and unique circumstances which are impossible to formalize.

At the same time, an understandable, logical and grounded relationship is to be established between compensation measures, impacted functions and the value of the environment. The area of compensation measures calculated by more formalized methods is not the more important parameter, compared with the choice of appropriate measures and of a site for their implementation.

This method is designed to supplement formal methods of calculation providing a comprehensive analysis of the situation. Moreover, it may be useful for making well-founded and reasonable decisions when there is lack of information.

4.9.5. Possibilities for accounting for time lag, and the initial conservationist significance of compensation areas [72, p. 200]

Time factors

Multiplication factors for increasing the scope of the area, which depend on the length of time that restoration of the impacted functions (biotopes) is to take, are to be applied. Based on approaches practiced and discussed in the professional discourse, the following framework for multiplication factors is proposed:

- up to 25-30 years (compensation) ≤1 – 3,
- 25-30 years to 100 years (offsetting) >2 – 7,
- more than 100 years (offsetting) >3 – 10.

Additional measures due to the time-lag effect

For all impacts which cannot be fully compensated by the point in time stipulated for an accounting (e.g., no more than five years after completion of the project; i.e., if the compensation and offsetting goal has not been achieved or cannot be achieved), additional compensation measures are to be provided. The scope of additional measures is derived from a monetary interest payment model with the aid of which monetary payments can be ascertained for this time lag. The amount of the payment ascertained then becomes the standard for further measures.

Higher value measures

Also conceivable is the implementation of higher value measures than those that would result from the functional connection to the impacts. These could be applied in the framework of offsetting measures. Which measures might be considered is decided on a case-by-case basis, and can be taken from the statements of the landscape plan.

For the handling of pre-existing value on the compensation areas

The respectively current significance for the efficiency of the balance of nature and the landscape quality of an area on which compensation and offsetting measures are to be carried out is to be taken into account in the ascertainment and establishment of compensation measures. Based on the previously existing value, which must regularly be taken as a precondition, the scope of the measure must then either be increased, or higher value measures must be implemented; however, the latter is possible only in the case of offsetting measures. Moreover, possibilities proposed for the handling of the time factor must also be considered here.

4.10. Accounting of impacts and their compensation

The goal of accounting of impacts and of measures for their avoidance, minimization and compensation is to ascertain the remaining significant negative impacts and the sufficiency of measures for impact mitigation regulation. If the accounting shows that significant negative impacts remain, additional measures for their avoidance or compensation are developed. If, for various reasons, that is impossible, possibilities for offset payments are considered. Such investigations are carried out by balancing the interests of nature conservation and the societal effect of the proposed project (Fig. 4.3).

The impact compensation account table contains quantitative and/or qualitative measures for avoidance, minimization and compensation of impacts. This table shows the sizes of compensation areas determined by out-of-kind/off-site offsetting of impacts which have not been avoided or compensated.

The following information is to be included in the impact compensation account table [62, pp. 76-77]

- Characterization of the planning intent, with a focus on the issues relevant for impact prediction

- Description of nature and the landscape in the area presumably to be affected by the proposed project
- Description of the protected assets and functions of nature and the landscape with regard to capacity for further development and specific sensitivity
- Description of the expected negative impacts with regard to the affected assets and functions
- Location and size of the functionally specific affected area
- Type and intensity (gravity) of the functional impacts; duration of the impacts
- Precautions for the purpose of mitigation (avoidance/minimization)
- Description of the remaining significant impacts with reference to the functions affected, specifying type, location and extent
- Compensation measures
- Location and size of the suitable areas for compensation measures
- Compensation goals and expected development times up to the target condition Consideration for the current condition and the previous value of the compensation area
- Description of the required compensation measures, distinguishing between compensation (in-kind/on-site) and offsetting measures (out-of-kind/off-site):
  - type of implementation: establishment, follow-up and development care
  - point in time, duration
  - need for permanent use/care (e.g. maintenance care)
  - responsibility, necessity for implementation and functional controls
- Overall view covering all assets and functions

The conclusive overall view includes a number of tasks [62, p. 77]:

- It should make clear the multiple functions of compensation areas and measures, i.e. the assignment of certain areas/measures to a number of significantly impacted functions (interactions).
- In cases in which as a result of interaction of a number of impacts, each of which is insignificant, an overall significant impact is predicted, it should make this assessment plausible.
- It should show whether improvements/upgrading could result from the realization of the planning intention, and if so, for which protected assets and/or functions.
- It should explain whether and to which extent complete compensation from a conservationist point of view will probably not be achievable by means of compensation or offsetting measures with reference to certain planning intents, or certain functions. In such cases, it must be made clear that the expected condition of the compensation areas (e.g. in 25 years) does not (yet) meet the compensation goal, and that as a result, deficits by comparison with the pre-impact situation are to be expected.

The accounting of impacts can be assessed using any of three approaches:

- Predominantly quantitative taking into consideration the sizes of impact and compensation areas (equivalence of areas)
- Predominantly quantitative taking into consideration not only the sizes of impact and compensation areas but also their quality (equivalence of area value)
- Predominantly argumentative opposition of the project and validation of quality and efficiency of compensation.

The first approach compares the sizes of impact areas with or without the compensation coefficient (Section 4.9.2) with the sizes of areas for their compensation. **Table A.44, Appendix 1.9** shows a simple accounting for various stages of the proposed project, with a 1:1 ratio of impact and compensation areas. **Table A.45, Appendix 1.9**, by contrast, shows a complicated accounting procedure, using coefficients of compensation and also, some multi-functional measures.

The second approach is used for accounting of the value of impacted areas, and the proposed value of compensated areas which are to be achieved after project termination. This value is determined from a 100-point scale (**Table A.46, Appendix 1.9**) and multiplied by an area. The conditional values of im-

pact and compensation thus obtained are compared. It is possible to use such formalized accounting for the entire project.

The third approach involves a comparison of the impacts and compensations on the basis of verbal description of understandable and argumentative relationships between compensation measures on the one hand, and impacted functions and environmental values on the other. This approach provides possibilities for a better assessment of complex problems and unique circumstances. One example of such accounting is shown in **Table A.49, Appendix 1.9**.

The approaches listed above for accounting of impacts and compensation have both strengths and weaknesses. It is therefore appropriate to combine all of them, adding quantitative approaches for accounting of verbal description. Examples of such accounting are shown in **Tables A.47 and A.48, Appendix 1.9**.

4.11. Potentialities of offset payments

In the case of high tension power lines, offset payments may be required, because compensation measures are not possible, or the land needed for them can be procured only at an unrealistically high cost, or not at all.

Points for improving upgrading of the natural balance or of landscape quality by means of offset payments.

Offset payments may be required [83, p. 25]:

- If the required long-term development and care measures for the achievement of the compensation goal cannot be assured, e.g. by presentation of appropriate long-term contracts,
- In case of small-scale measures which cannot be achieved on-site or on other sites of the party causing the impact, and if there would be great difficulty in ensuring effective care and maintenance off-site, e.g. in the case of small-scale planting of trees and scrubs in farmland,
- In case of measures which, in and of themselves, involve a minimal upgrading of nature and the landscape, e.g., in the case of compensation of small-scale impacts in bodies of water or shore areas, in which funds might be used more effectively in connection with other offset payments for other conservationist measures, such as for the installation of small bodies of water, or for larger shoreline renaturation,
- In case of compensation for impervious soil coverage, if no potential impervious coverage removal is available in the natural area, or if, due to the small scale of the measure, no effective impervious coverage removal is implementable, e.g. if removal would only involve portions of large impervious coverage areas which would then have an accordingly minimal conservationist development potential,
- If in the case of an unpredictable delay in the implementation of the measure, an enhanced scope of the measure is necessary due to the time lag effect, and the provision of the areas additionally necessary for this would lead to even greater delays,
- In the case of the construction of large antenna or wind power facilities.

The amount of offset payment is determined in accordance with the duration and gravity of the impact. It can amount to a maximum of 7% of the costs for planning and implementation of the project, including land procurement [88, p. 18].

Offset payments are often required for the installation of high tension power lines, because their impact affects the appearance of the landscape so seriously that it cannot be compensated for. With regard to the significant impact upon other protected assets, compensation is basically possible, provided the necessary plots of land can be procured at reasonable cost.

An example of calculations of offset payments for high-tension power lines in Germany is given in Table 4.9.

Table 4.9

Calculation of the offset payment for high tension power lines, depending on the value level of the landscape appearance affected, and the height of the pylons. Figures indicate percentage of the planning and implementation costs of the project [88, p. 19]

Value level of the landscape quality in an area of 1500 m on each side of the cut	benchmark value for pylons	
	>35 m	>35 m
III – high	7%	6%
II – medium	5%	4%
I – low	4%	3%

A significantly impacted area may include segments assigned to various value levels. In this case, the values are to be calculated and applied separately, in proportion to the segments of each value level.

If a new power line is installed at a distance of up to 200 m from an existing high tension line or other area that has been strongly technologically transformed, such as a wind farm or an industrial and commercial area, the benchmark value along this segment of the route is reduced by half. In this way, the previous impact is taken into account, and an incentive is provided for combining high tension power line cuts.

Under certain circumstances, the removal or greening of structures which disturb the landscape or cause negative impact upon it can in and of itself be considered a minimization or compensation of impacts upon landscape quality. This is true, too, of compensation and offset measures, e.g. for the protection of species and biotopes which are carried out in connection with the power line, if such measures are relevant for the appearance of the landscape. Generally, this is only true of the planting of trees and shrubs. The cost of such measures can be offset against the amount of offset payment.

The offset payment is calculated according to the costs of the compensation measure not implemented. These may in particular cases involve the necessary costs for planning, land procurement and implementation of the measure, including all costs for labour, materials, follow-up and maintenance care.

The amount of the offset payment for non-compensable impervious soil coverage is calculated in accordance with the cost of impervious coverage removal, with an area ratio of 1:1. In practice, based on a large number of impervious coverage removal, a cost of €10/sq m has emerged as an approximate benchmark value. That amount covers all costs for the implementation of the measure [83, p. 26].

In case of significant negative impact on the landscape quality, the offset payment is calculated according to the scope and seriousness of the impact. Unlike with other protected assets, the basis for the calculation of the amount of offset payment is thus oriented not toward the cost of the compensation measure not implemented, but rather in accordance with the quantitative and qualitative impact characteristics of the project. The projects which are primarily considered for compensation payment are those which, due to their dimensions and form are likely to cause alienation or disturbance of the scale and naturalness of the landscape in the area of impact. This means primarily high or visually massive buildings, such as towers, smokestacks or elevated storage facilities, which have a dominant visual effect on the appearance of the landscape, and cannot be compensated for by offset measures.

4.12. Monitoring the implementation and efficiency of compensation measures

[49, pp. 79-81]

Plan approval is part of the approval process. Its purpose is to identify environmental risks of a project from the point of view of the probability of their occurrence and of the extent of the damage they may cause. The goal is therefore to limit planning and measure risks with in the process of implementing Impact Mitigation Regulation, with the aid of the appropriate controls. The instrument «control management» encompasses the processes to be carried out in a normal case:

- Quality assurance of the planning process by monitoring procedural documentation, e.g. on the basis of federal and state regulations, and

- Establishment, care and functional controls, for ensuring the implementation and effectiveness of compensation measures required under the stipulations of the Impact Mitigation Regulation.

The contents and stipulations on risk management are to be prepared and documented in such a way that a comprehensible evaluation of the results of all steps (prognosis of impacts and possible extent and suitability of measures) is assured in the process of project approval. Residual insecurities or informational uncertainties must definitely be noted if ascertainment might result in a requirement for more comprehensive control management.

Quality assurance

In the context of the Impact Mitigation Regulation, the party implementing the project has a duty to:

- Ascertain impacts upon the efficiency and functionality of the balance of nature and the landscape quality
- Avoid such impacts where possible
- Carry out measures to compensate for unavoidable impacts, and
- Assure the long-term functionality of planned measures.

With respect to the quality assurance of the project, this directly implies among other things, the necessity to comprehensively document the results of these steps. Criteria for quality control of project documentation are given in **Table A.50, Appendix 1.10**.

Establishment, care and functional controls

For the party implementing the project, the duty to succeed with regard to the measures moreover directly implies the obligation to carry out follow-up controls, which differ from one another in their depth, with respect to the purposes/goals. Follow-up controls not only constitute compliance with the duty on the part of the party carrying out the project to examine the stipulations under the plan approval process, they also provide information regarding the suitability of the type, implementation and care of the measures. These experiences lead to a continual optimization of the landscape management plan.

Follow-up controls essentially involve monitoring either:

- The technical establishment (establishment control), or
- The goal-oriented development (care and functional controls) of the compensation measure.

Monitoring steps and sequence of implementation, development and functioning of measures are shown in Fig. 4.22. Examples of such control are shownd in **Tables A.51** and **A.52, Appendix 1.10**.

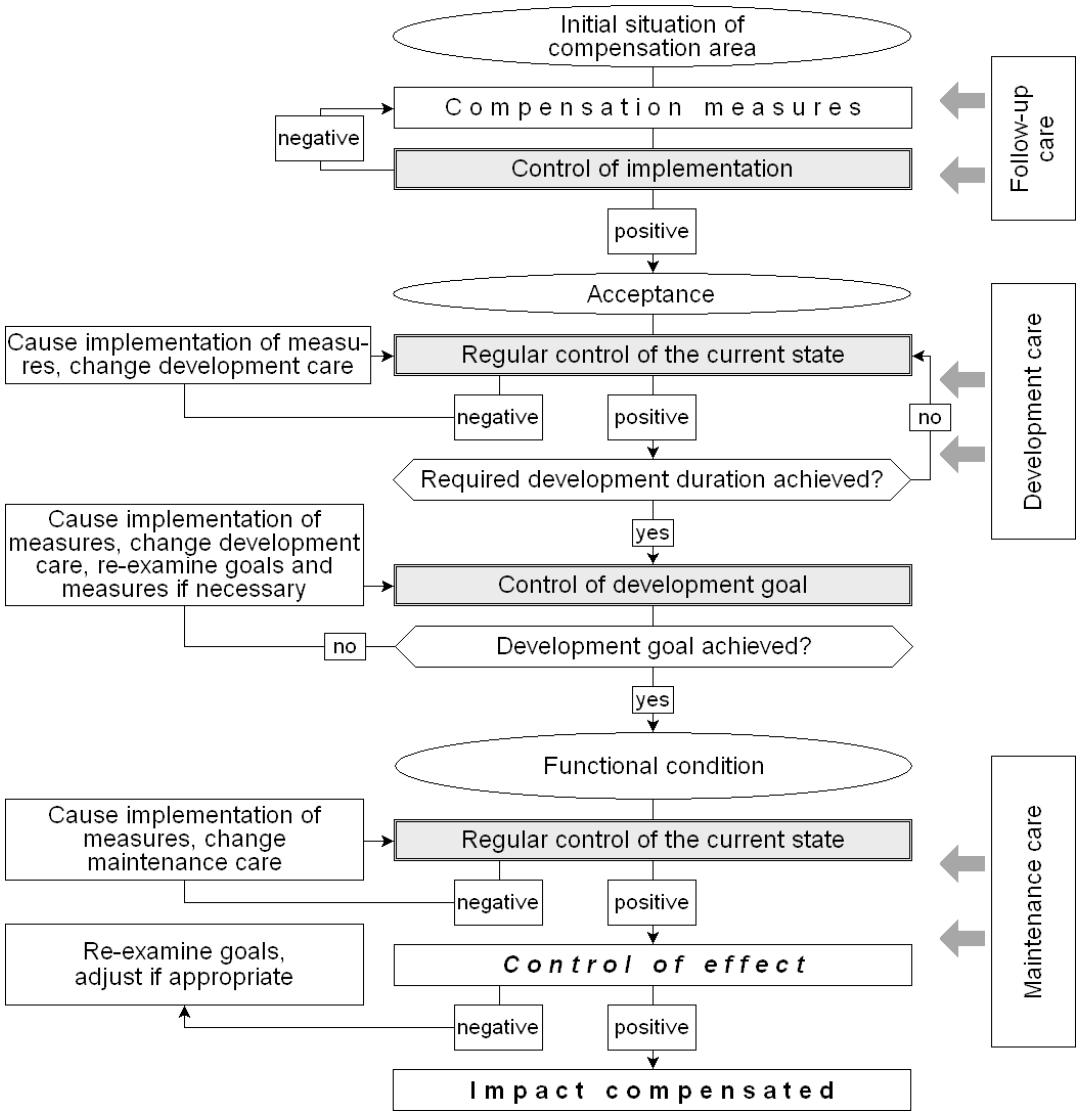


Fig. 4.22. Efficiency control steps [81, p. 94].

Establishment control

The principal duty of establishment control is to check whether the stipulated compensation measures have reached technical implementation, and correspond to planning stipulations (type, length, scope and deadlines). The establishment control may be directly connected with the contractual acceptance procedure of the implementation of landscape care measures.

Care and functional controls

Landscape care measures are only considered to have been concluded once they permanently fulfil their function in accordance with the time stipulations. For that reason, it may be necessary to carry out appropriate care and functional controls. Functional controls are derived from the obligation under the Impact Mitigation Regulation to mitigate and compensate for impacts, and to assure the implementation of measures. A detailed procedure for the monitoring of development goal achievement is shown in Fig. 4.23.

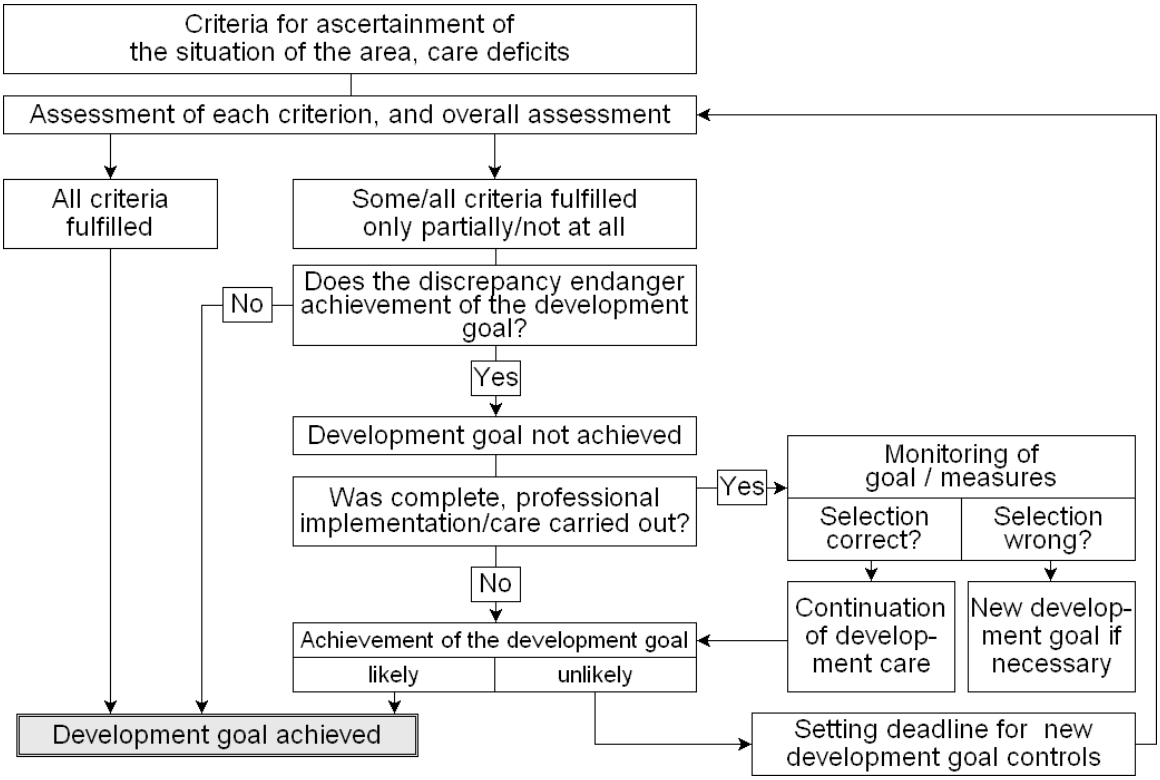


Fig. 4.23. Process of the control of development goal achievement [81, p. 99].

Functional controls are often necessary in cases of development risks with regard to the target condition of habitats and biotopes, or the establishment of habitats. The care and functional controls basically also constitute an examination of whether the measure implemented is still in effect, or whether the care and use stipulations still being maintained. An example of such control is given in **Table A.53, Appendix 1.10**.

For the functional controls, too, the principle of proportionality applies: the more protection-worthy a protected asset and/or the less certain the prospect of success of a compensation measure is, the stricter should the demands be that are placed upon the follow-up controls. In simple cases, a structural control may therefore be sufficient.

Examples of compensation measures and types of monitoring mentioned above are given in **Table A.54, Appendix 1.10**.

4.13. Documentation for the development and accompaniment of compensation measures

The assessment of environmental impacts as a result of a proposed project, and the development of measures for their avoidance and compensation, are the part of the total assessment of environmental impacts in its final stage. Therefore, the major part of documentation supporting nature conservation measures coincides with the OVOS documentation, of which it is a part. Minimal requirements for the list of the documentation concerning the impact mitigation regulations of nature and landscape are as follows [70, p. 41].

Regarding the project

- Description of the goals of the project, justification of the necessity and purpose of the project;
- Description of the most important alternatives to the project examined, including site and/or route alternatives (for implementation of the avoidance requirement);

- Description of the project (including all subsidiary facilities), with information regarding the site, the necessary overall consumption of land area, and a description of the type and extent of other changes of form or of use of the land area (foundations, excavations, landfills, etc.);
- Description of the planned point in time, duration and course of the projected construction phase and construction operations, and necessary consumption of land area;
- Description of the planned operation of facilities in conformity with stipulations, including any necessary maintenance, and the expected emissions to be generated, including both type and extent.

Regarding the efficiency of the natural balance and the quality of the landscape

- Data on overall biotope mapping (biotope types and information on characteristics);
- Data on specific protected assets and functions, inasmuch as functions of particular importance may be affected;
- Description of the quality of the landscape, and also of elements and structures of particular scenic significance;
- Functionally and spatially specific dissemination conditions of potential effects;
- Point in time, duration and course of the significant or permanent negative impacts which may be caused by the project.

Regarding affected protected areas and/or protected objects

- Description of plots of land which are certified as protected areas, and which might be directly or indirectly affected by the project;
- Description of plots of land which fulfil the preconditions for certification as protected areas or objects.

Regarding avoidance and compensation (in-kind/on-site or out-of-kind/off-site)

- Description of the planned measures for the avoidance or minimization of significant or permanent negative impacts;
- Description of the planned compensation measures, including a statement of a balance of the effects of impacts and compensation measures (with a statement of the point in time and spatial extent covered by the statement of balance of effects).

The minimal list of documents given above should contain full and reliable information of the proposed project on compensation measures [88, p. 20].

Ascertainment

- Ascertainment and evaluation of biotopes;
- Ascertainment and evaluation of breeding and visiting birds, and possibly other plant and animal species;
- Ascertainment and evaluation of landscape quality.

Forecasting

Description of the probably significant negative impacts on the efficiency of the natural balance and the quality of the landscape, due to construction, facility and operational causes, according to type, extent and, if appropriate, location in the text and on the plan, in particular with information on:

- Permanent and temporary consumption of land area by construction facilities, including statements regarding the soil and soil types affected;
- Significant negative impacts upon the habitats of endangered plant and animal species (including the danger of collision for birds);
- Significant negative impacts on soil and groundwater;
- Significant negative impacts on the quality of the landscape.

Compensation

- Description of precautions for the prevention of negative impacts;

- Description of compensation measures (in-kind/on-site or out-of-kind/off-site offset), and compensation payments;
- Statements on compensability;
- Proof of the availability of land needed for compensation areas, and assurance of the success of the compensation measures.

A more detailed list of documents supporting the assessment of impacts and measures on their avoidance and compensation is given in **Table A.55, Appendix 1.11,** and its structure **in Table A.56, Appendix 1.11**.

The document developed for determination of compensation measures is used for furthermonitoring of the realization of measures, the achievement of their goals, and their efficiency. This is to be an independent document with the aid of which monitoring agencies, local authorities and nature protection agencies can obtain full information on measures without applying for the project documentation. It is to be brief and understandable and can be documented as a blank form – a data sheet of a measure. Moreover, the exchange of data sheets can be useful for registering compensated areas and measures. Examples of such data sheets and how to fill them in are given in **Tables A.57, A.58** and **A.59, Appendix 1.11**.

4.14. Special forms of the accompaniment of compensation measures at their implementation stages

4.14.1. Pools of compensation areas and measures

In German practice, there is an instrument that is quite unusual for the Russian practice: that of – the pool of compensation areas and measures, which allows a project developer, if it is difficult to obtain a compensation site or to implement offsetting of project-related negative impacts, to acquire them from this pool. Such pools are administered by private agencies that form pools of areas in advance, and ready measures or measures at the development stage.

In Germany, the role of pools as a source for acquiring a compensation area is very significant. Figure 4.24 shows that approx. 75% of project developers resort to this means for the implementation of certain measures within the framework of their projects.

Classification of land and measures pools by task structure [43, p. 38]

- Pools which prepare the compensation process conceptually and address the issues of acquisition and legal security of the compensation areas (area management), but which are not responsible for implementation, supervision and care of the measures.
- Pools which carry out area management and deal with implementation, care and maintenance of compensation measures, but do not draft the conceptual bases for the selection of suitable areas.
- Pools which address all three task areas: conceptual preparation of the compensation measure, area management, and measure implementation.

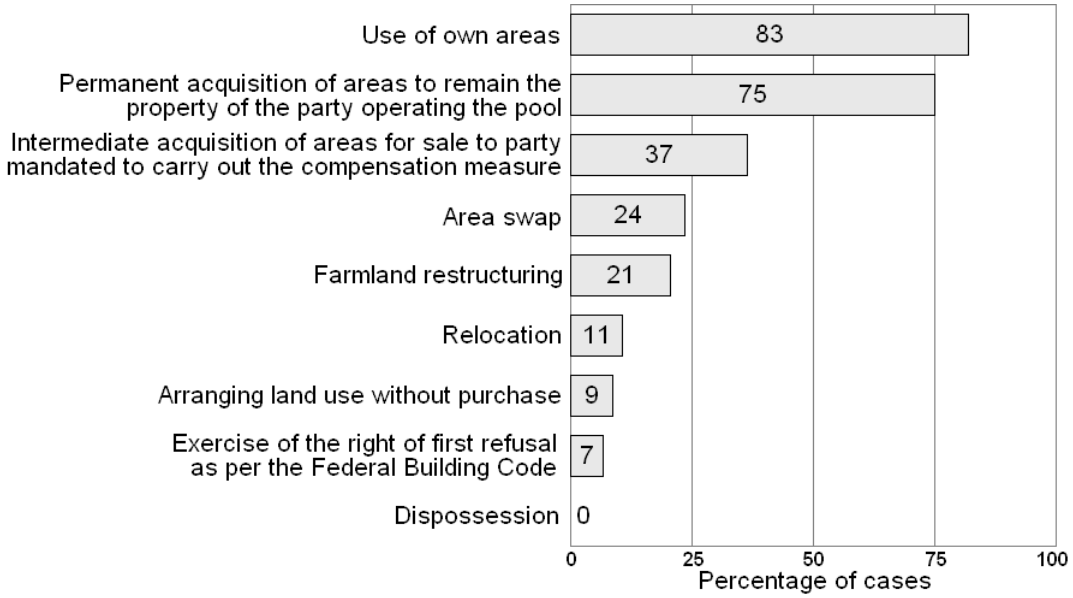


Fig. 4.24. Type and manner of the provision of areas for compensation measures [43, p. 72].

A model pattern of tasks solved by pool owners is shown in Fig. 4.25. Moreover, there are also planned tasks for a project developer. The number of these tasks is not high – 10-20%. It means that these companies have an established structure for their activity.

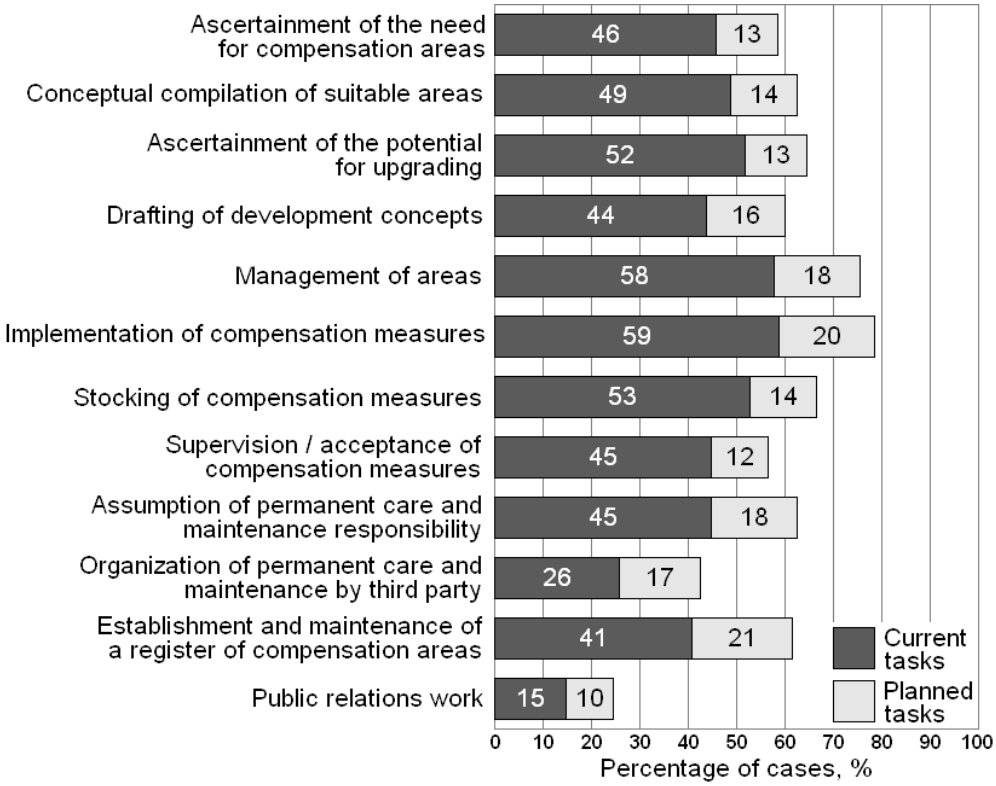


Fig. 4.25. Current and planned tasks of the party operating the pool (land and measures pools) [43, p. 37].

Land pools and measures pools [62, pp. 151-154]

The provision of areas and measures for compensation or offsetting of project-related negative impacts is not a mandatory legal requirement of the Impact Mitigation Regulation. It can be considered an auxiliary instrument for the implementation of the Impact Mitigation Regulation, and has arisen in particular as a reaction to increasing problems in the provision of compensation areas.

In planning practice, strategies and concepts for land pools and measures pools are undertaken by various actors at various levels. Equally diverse is the terminology used: land pool, compensation pool, pool of measures, eco-account, eco-savings, compensation area concept, register of potential areas or ecological soil bank – and the definitions and contents often vary for the same term.

In the following, we will use the overall terms land and measures pools to refer to all strategies which, based on a conservationist planning conception (compensation concept), serve the purposes of compensation as understood in the context of the Impact Mitigation Regulation, as a precaution against future impacts, for the purposes of either

- The provision of areas (land pool), or
- The implementation of any necessary measures (measures pool).

The basic conservationist concept of the pool approach consists of implementing measures which serve the goals and principles of conservation of nature and landscape care, and which will presumably become necessary in the context of the implementation of the Impact Mitigation Regulation, based on a regional or local conservation compensation concept, and thus augment their effectiveness. Of vital importance for the implementation is an early and strategic acquisition of land in order to have areas relevant to the concept available when needed (land pool). The implementation in advance of the measure (measures pool) is relatively secondary.

In cases of the incorporation of areas and measures from the pool into the measure process, the legal requirements for the implementation of the Impact Mitigation Regulation still fully apply. That means that:

- The application of the Impact Mitigation Regulation must occur in sequential stages, each building upon the prior one, in accordance with the legally stipulated order. The existence of land and measures pools may not result in circumvention of the order of steps, particularly the requirement for avoidance, simply in order to permit refinancing of the areas and measures in the pool.
- For an ultimate decision about the necessary precautions for mitigation and compensation measures, as well as regarding the recognition of areas and measures in the pool, a sufficient concretization of the type and scope of the intended project is necessary, so that it can only be conclusively carried out under the local development plan.
- The costs for the previously implemented measures must be billed to the party causing the damage, in line with the «polluter-pays» principle, i.e., the party contracting the project.

In order to fulfil these requirements, certain tasks and work steps need to be carried out, which would be required even if there were no pool. These tasks are as follows:

1. Ascertainment of requirement for land
2. Selection of suitable compensation areas
3. Selection of suitable measures on those areas.

Ascertainment of the requirement for land

A viable compensation concept presupposes an analysis of requirements. The basis for the ascertainment of the type and scope of the need for compensation areas and measures is the analysis of the planning intents to be expected in the reference area, and the potential negative impacts upon protected assets and functions of nature and the landscape that they are likely to cause. Land pools should therefore take into consideration not only biotopes and/or species and habitat function, but rather all potential affected functions.

The estimate of the type and scope of expected negative impacts is, together with the local goals of conservation of nature and landscape care, the decisive foundation for the selection of suitable pool areas, and for the derivation of concrete development goals for those areas.

Selection of suitable compensation areas

The compensation concept must ascertain and explain which areas are suitable, based on their spatial position and their site conditions, to take on measures which can functionally compensate the likely impacts in kind and/or equivalently, and at the same time harmonize with the goals of landscape planning. The selection of areas is to take place in a two-stage process.

- First, compensation search areas are established
- Within these, suitable areas are then more precisely delimited (if necessary, down to the level of single lots).

Areas and spaces are suitable from a conservationist point of view if, in terms of their location and their site preconditions, they have a development/upgrading potential with regard to the functions of nature and the landscape being sought; and if they will be permanently available and usable for the compensation purpose.

On the other hand, areas and spaces are not suitable if they:

- Are located in the effect area of existing, planned or intended impacts which could endanger the success of the compensation measures
- Do not meet the goals and principles of conservation and landscape care, possibly in the concrete form specified by the landscape plan, and/or
- Have already been assigned to other compensation or offset measures.

A documentation of the upgrade capability and/or of the development goals of selected areas, which explains which functions of nature and the landscape specifically can/should be developed on the areas involved.

The concrete selection of areas is to be carried out according to professional conservationist criteria. The definition of key factors based on economic, property-rights-related or other aspects, which could in practice determine the selection of areas, are to be carried out in the context of legal and technical stipulations. It may be admissible under conservation-legal and technical framework conditions, to prioritize those areas which are already publicly owned.

Selection of suitable measures on these areas

In the selection of measures, the following requirements are to be considered:

- The measures are to be developed from the development goals of the landscape framework plan or the landscape plan, and in coordination with the conservation authorities
- The type and scope of the measures are to be established such that they fulfil the necessary criteria for the Impact Mitigation Regulation, i.e. the measures must always be capable of restoring in kind or at least equivalently the functions likely to be affected by the potential impacts
- The measures must be concrete, long-term nature conservation and landscape care measures, and not merely temporary measure.

The compensation concept provides the technical basis both for area management and for early/ precautionary implementation of compensation measures.

For this purpose, building on the compensation concept, a pool is built up consisting of areas suitable for compensation purposes; this is done by land purchase or other measures which will secure availability permanently. The goal is to assure the availability of suitable areas at an early date, and to secure that availability by purchase or other measures. As soon as the availability has thus been secured, the land pool already exists as a supply base of areas which can be immediately accessed in case of need. These may be contiguous areas or a number of separate areas. The basic compensation concept guarantees that the available areas are coordinated so as to be appropriate to the need.

If the nature conservation and landscape care authorities start to implement measures on thus secured areas of the land pool with the prediction of future impacts, they thus create a measures pool. In that way, beyond the holding of areas in the land pool as the basis for the compensation concept, an actual pre-storage of measures also occurs. This implementation is connected with long-term measures management.

The last step in the concept of land and measures pools is the concrete recognition of the pre-initiated measures as compensation for concrete impact. Access to such measures in case of need presupposes a thorough examination of the actual capacity for recognition.

For the recognition of measures, the following requirements must be observed:

- Even in the case of the use of measures from the pool, the requirements of the Impact Mitigation Regulation must be addressed in a corresponding conservationist plan (e.g., green structures plan).
- First, the possibility of mitigation of impacts must be fully exhausted.
- The fundamental prioritization of in-kind compensation measures over functionally similar – equivalent – offsetting measures must be observed.

The actual recognition of previously implemented measures depends on whether the required examination of the actual condition of the area and the development to date lead to the result that the measure is suitable in terms of type and scope to compensate for the expected impact. In this process, as in the case of concept drafting, not only biotope types and species and habitat functions, but rather all affected functions must be taken into account.

The recognition of previously implemented measures may not be allowed to result in a general reduction of the requirement for land for compensation purposes (i.e. as a kind of «ecological interest payment», or a time-dependent value increase between implementation of the preliminarily initiated measures and the point in time of assignment). Rather, this is only admissible inasmuch as an additional area would have had to be assigned to the measure, due to the so-called time lag stipulation, had the preliminary implementation not been carried out. The general reduction of area as an incentive for creating a measures pool is inadmissible under conservation law, and also unacceptable from a conservationist point of view. Moreover, in the case of most biotope types (ruderal fields are an example of an exception) and functions, the notable increase in value only occurs in a minimum of 5 to 10 years. A reduction of the need for compensation areas thus would presuppose measure implementation a long time before the impact, and a very favourable development of the area in question – possibly as a result of appropriate care and/or use.

No measures may be recognized which have been carried out to fulfil duties under other legal stipulations, e.g. care and development requirements as per the Protected Area Ordinance, maintenance requirements in bodies of water, rehabilitation of contaminated sites, etc.

By the same token, the measures may not be financed from subsidy funds; if they are, these funds must be repaid as a precondition for recognition.

The advantages and disadvantages of pool models (land pools and measures pools) [49, MB30, p. 2]

Advantages

- Incorporation of compensation and offsetting measures into an overall concept adapted to the goals of landscape planning; closer meshing of instruments
- Realization of long-term effective major conservation projects, instead of random single measures from various projects with no concept
- The possibility of compensation of negative impacts which would require large-scale functional contexts in order to achieve restoration (e.g., fragmentation of hitherto unfragmented habitats)
- The possibility of the compensation of negative impacts, the restoration of which would require special demands on the location and site of the measure areas (e.g., impacts upon ecosystems in streams and rivers)
- Simplification and effectivization of the care and development management by the consolidation of compensation areas and firmly establishing responsibility for them
- An improved overview of, and facilitated, goal-oriented monitoring of compensation measures
- Goal-oriented land pool stocking in order to avoid changes in the measures concept, or delays in implementation of measures due to a lack of available areas
- In case of preliminary new creation of biotope, reduction of the time-lag effect.

Disadvantages

- Faster legitimation of a project, since sufficient suitable areas and measures are available to ensure compensation; neglect of the examination of the avoidability of negative impacts
- The Impact Mitigation Regulation functions as a financing instrument for conservation measures; its actual intention tends to be neglected

- Offsetting measures which can be carried out with the aid of a pool tend to be preferred over compensation measures, although on-site compensation might be possible
- A lack of a context of derivation: offsetting measures, too, must be oriented toward the functions effected by the impact; this is not always the case for measures pools
- Any necessary conservation and landscape care measures beyond what the Impact Mitigation Regulation requires could fail to be implemented if they cannot be booked onto an eco-account
- Measures which are necessary due to other legal requirements could be credited as eco-account measures.

Pools of compensation areas and measures play an important role in various types of planning in Germany. The planning of the area used is based on landscape plans at various levels. The availability of pools provides a possibility for incorporating in-kind/on-site and out-of-kind/off-site measures into the general conception of the land-use plan and the area-development plan, coordinated with the goals of the landscape plan. The location of pools in this system is shown in Fig. 4.26.

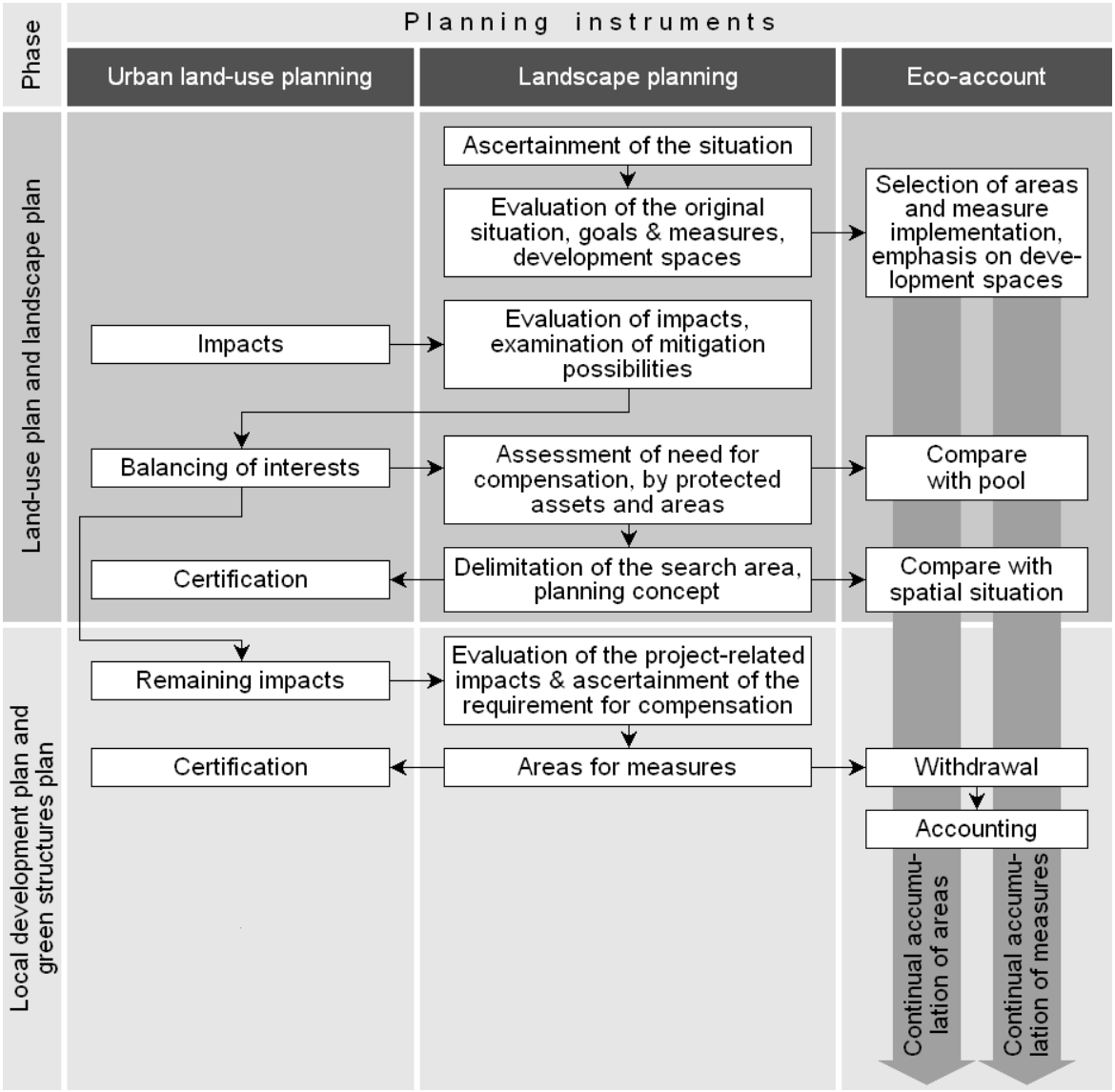


Fig. 4.26. Incorporation of the eco-account into the various planning instruments [94, p. 4].

The toold eco-account and register of compensation areas and measures are closely connected with the pools of compensation areas and measures. Both these instruments used for the implementation of compensation measures are discussed below.

4.14.2. Eco-account

The possible decoupling of the temporal and spatial aspects of compensation measures can be carried out legally and satisfactorily only by way of a systematic procedure which fulfils the following pre-conditions, and/or contains the following elements [94, pp. 2-4]:

Pre-selection of areas

- An estimate of the future compensation requirement
- A planning conception for the potential compensation areas, i.e., suitable areas for compensation measures should be derived from the development concept drafted in the context of the landscape plan on the basis of local conservationist goals
- Precautions for the expected functional connection between the impact and the compensation, by ascertainment of the suitable areas for the protected-asset-based compensation measures, within the framework of the preparatory urban land-use planning (landscape plan, land-use plan)
- In their current condition, the areas must be of low significance for the balance of nature or the quality of the landscape, and be upgradable from an ecological point of view (they must require upgrading and be capable of being upgraded)
- The areas should be part of larger complexes of areas, and not constitute a non-contiguous mosaic of separate areas
- The availability of the suitable areas must be certified by the municipality (e.g. in the context of future land policy, land procurement/exchange, farmland restructuring, contracts, long-term leases)

Booking of the areas in an eco-account

- Spatial and functional securing of the areas in expectation of future construction projects, by certification in the land-use plan
- Development of compensation measures on the basis of negative impacts which are to be expected from the descriptions in the land-use plan, and on the basis of goals set in the landscape plan
- Representation of the areas covered by compensation measures in the local development plan, and/or implementation of other suitable measures on land areas provided by the municipality
- Documentation of the original condition of the areas.

Implementation of preliminary measures

- Implementation of measures and their assignment to a pool
- Documentation of future compensation function through a corresponding representation in the landscape plan, in the explanatory report to the land-use plan, or in the justification of the pre-initiated local compensation development plan, or in some other suitable manner.

Withdrawal of areas and measures from the account

- Evaluation rules for booking and withdrawal of areas and measures; from a conservationist point of view, purely point-based models are unsuitable; better suitable are verbal/ argumentative evaluation procedures and value-level models, as well as a combination of both methods
- Ascertainment of the creditability of compensation measures
- Assignment of compensation areas and measures to a local development plan
- Withdrawal of areas and measures (can only be carried out if the areas have been stipulated in the local development plan with the location, type and scope of the measures)
- Implementation of additional compensation measures, in case of a lack of measures in the pool, or functionally insufficient measures in the eco-account
- Documentation of the type, scope, beginning, conclusion and costs of the upgrading measures
- Financing of the measures completely from the municipality's own funds
- Controlling of termination, implementation and goal achievement
- Refinancing toolkit for charging the costs to the party implementing the project.

Measures which cannot be booked to an eco-account include, e.g.:

- The securing of valuable portions of nature and the landscape, e.g., as nature protected areas, without upgrading measures
- Land procurement
- Purely care and maintenance measures
- Measures derived from already existing legal obligations or design measures to be undertaken for reasons of urban development
- General conservation measures implemented in the past, and measures to compensate negative impacts for already approved projects
- Nature and environmental education measures
- Measures funded by the EU, the federal government, or the state government in which voluntary work is a precondition for the subsidy.

Finally, successful and goal oriented application of the eco-account can only be achieved by means of a compensation concept based on good cooperation and constant communication between urban/landscape planning and conservation authorities, soil management and the register of properties office and the owners/users, and, if necessary, is tied into an inter-municipal or even a regional concept.

4.14.3. Compensation area register

Compensation area registers are directories in which information about compensation and offset measures, including areas where these are to be implemented, are listed, updated and maintained for access.

They can contribute to improved implementation of the Impact Mitigation Regulation; preferably, they should be maintained by the lower conservation authorities.

The primary purposes served by the registries are [87, p. 65]:

- Avoidance of the multiple use of compensation and offset measure areas for different planned projects
- Avoidance of the use of compensation areas by new projects, and the resulting endangerment of the success of the measure (e.g. including via use changes in the areas themselves, or in their effect area)
- Facilitation of establishment and functional controls
- Facilitation of the monitoring of the rendering of offset payments.

One essential task in the context of area and measure pools is the assignment of compensation areas and measures to planned projects. The precondition for this is the direct access in one register to all relevant information on the compensation areas and measures listed in the pool.

In addition to the basis for the selection of available and spatially/functionally suitable compensation areas and measures, such a compensation register can also serve as the basis for entries and deletions in the context of «eco-accounts», for the documentation and follow-up monitoring of measures, and for a targeted, future-oriented area management process.

Any possible multiple use of compensation areas by various planned projects can thus be ascertained at an early date and avoided, as can the attempt to use compensation areas for new projects. Moreover, the maintenance of a monitoring system on the basis of a resubmission regulation or a deadline file for facilitating care and follow-up controls is a necessary element of the function of compensation registers.

Municipal authorities may pass on necessary information to a nature conservation agency for entering compensation areas into a register. This regulation is effective when a municipal government provides compensation areas for implementation of the land-use plan with compensation measures, or when it implements in-kind/on-site and out-of-kind/off-site measures on the areas provided. The information is to be passed to a nature conservation agency in a unified form, together with a general plan of location

of measures as soon as the land-use plan comes into force. An example of this form is given in **Table A.60. Appendix 1.12**.

The spectrum and content of compensation registers are broad [43, p. 46]:

- Simple tables for the implementation of measures
- Maintenance of files on particular compensation areas and measures, with supplemental maps on the current state of implementation of the pool
- Tabular measure sheets with statements on entries and deletions in the context of the maintenance of the eco-account
- Registers maintained with the aid of GIS.

Regardless of the type of the maintenance of the register, it should definitely contain information on the following aspects [43, p. 207]:

- Location and size of the pool areas
- Ownership and use rights
- Biotope type/type of existing use, and evaluation of the original condition
- Stipulations and goals of the landscape plan
- Type of possible compensation measures,
- Evaluation of the target condition
- Manner in which the measure is to be secured over the long term.

As is the register is also to be used for the administration of measures, the information is to be supplemented with the following data:

- Planned project
- Point in time of assignment
- Size of the area assigned
- Implementation, care and maintenance of the measures
- Cost of the measures
- Ecological value of the area at the point in time of assignment
- Follow-up monitoring (point in time and schedule).

Details of exemplary registers with compensation areas and measures are given in **Table A.61, Appendix 1.12**.

5. CONCLUSIONS

The analysis of the Russian, German and European experiences on the assessment of environmental impacts of the planning project and avoidance and compensation of these impacts presented in this book has shown that in any country, with the realization of the project, conflicts may emerge between the existing situation and new initiatives, and between the facilities under construction and the environment. In the solution of these conflicts however, priorities are assigned to a number of different criteria, which often have a strongly subjective nuance. Nevertheless, it should be noted, that there is a growing tendency to prioritizing long-term environmental values. This tendency is reflected in the development of international and national legislation for the defence of the public interest against unreasonable investment initiatives, in the development of local standards and technical regulations which restrain specific types of activities, and in the development of environmental impact compensation technologies.

The comparison of the national experience of various countries allows the determination of deficits of national procedures and the recommendation of methods for their realization.

It should be emphasized that under the conditions of great uncertainty and lack of information, the tasks of assessment, forecast and decision-making in the context of the in-kind impact compensation are complicated. Moreover, these tasks are often to be solved by people with completely different qualifications. Such a situation requires the use of forms of presentation of project information and methods of data processing, which are available to a wide range of people. From this perspective, it can be very useful for Russia to get to know the range of methods for the solution of impact mitigation regulations applied in Germany. These are generally qualitative, semi-quantitative and expert methods with which not only quantitative, but also extensive verbal information can be managed.

Despite the availability of numerous methodological documents on the development of nature protection measures, it is difficult to admit that there is a technology according to which the key issues of the environmental impact assessment can be answered unambiguously and objectively – **What directly will be affected?** and **How is this impact to be avoided or compensated?** The authors of this book express hope that methodological elements of the measures on avoidance and compensation of impacts offered to the readers can contribute to the creation of such a technology.

At the first stages of implementation and efficient application of this technology in Russian practice, it is necessary to test the methods presented on different project types or to develop analogues which can solve the same problems. This is a task for various scientific disciplines, and additional investments and approval by superior authorities are not necessarily required. Such work can be realized within the framework of relatively large planning projects as a continuation of what has been realized under the Russian-German cooperation on the creation of this compendium.

It may be concluded that the implementation of in-kind environmental impact compensation in Russia is urgent and necessary. This will allow the country to significantly improve the environmental situation and reach the European level in the sphere of environment protection.

APPENDIX 1

AUXILIARY MEANS FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACTS AND THE DEVELOPMENT OF MEASURES FOR THEIR AVOIDANCE, MINIMIZATION AND COMPENSATION

Appendix 1.1

General issues concerning development of nature protection measures

Table A.1

Checklist for simplified procedures in processing the Impact Mitigation Regulation for local development plans [41, pp. 6-7]

Questions		Yes	No
0.	**Planning preconditions**		
0.1.	Construction plan with integrated green structures plan (German: GOP)	☐	☐
1.	**Type of project**		
1.1.	Type of construction use. This project is a residential area	☐	☐
1.2.	Dimensions of construction use. Site occupancy index will not be greater than 0.3	☐	☐
2.	**Protected assets: Species and habitats**		
2.1.	The construction area includes only plots with a minimal significance for nature and the landscape. Plots of land of greater significance, such as protected areas or legally protected biotopes or habitats will not be affected	☐	☐
2.2.	The local development plan provides for appropriate measures for habitat improvement	☐	☐
3.	**Protected assets: The soil**		
3.1.	The degree of impervious coverage is to be limited by appropriate measures	☐	☐
4.	**Protected assets: The water**		
4.1.	The depth to groundwater is sufficient. Explanation: The structures will not penetrate into the groundwater	☐	☐
4.2.	Sources in headwater areas, aquifer strata, and regularly flooded areas will remain undisturbed	☐	☐
4.3.	In the construction area, suitable measures for the protection of the water will be provided. Explanation: Possible large-scale percolation, e.g. via green areas or seepage basins, will be provided; private roadways and carparks will receive pervious pavement	☐	☐
5.	**Protected assets: The air/the climate**		
5.1.	In planning the construction area, care was taken to ensure fresh air corridors and the associated cold air generation areas	☐	☐
6.	**Protected assets: The quality of the landscape**		
6.1.	The construction area borders an existing built-up area	☐	☐
6.2.	The planning took into consideration prominent features and areas important for the quality of landscape or for new nature-based recreation. Explanation: The construction area is not detrimental either to prominent features, ridges/slopes visible from afar, or cultural-historical or landscape-defining elements, such as a knoll with a chapel or any similar feature; significant recreational areas have been taken into account	☐	☐
6.3.	Incorporation into the landscape: Appropriate measures have been provided for landscape typical incorporation, such as the formation of a green strip at the edge of the site	☐	☐

If all questions have been answered with yes, no further compensation requirement exists.

Table A.2

Categories for the implementation of work steps and task definitions in the Impact Mitigation Regulation [45, p. 187]

Work step (task definition)	Categories of implementation
Which model constitutes the basis for evaluation?	
Representation of the efficiency and functionality of the balance of nature	Model of protected assets
	Model of functions
	Concept for protected assets/functions
	Concept for protected assets/function groups
	Model of biotope types
	Expanded biotope type-based concept (modular)

Table A.2 (Continuation)

How are significant negative impacts ascertained?	
Assessment of impacts models of impacts	Analysis of causal impact (objective functional analysis of impact)
	Ecological risk analysis (spatial overlay)
	State equation (before-after comparison of the objective level)
	Value equation (before-after comparison at the value level, based on equivalents)
At which level of scale, and in which form, are evaluation statements made, and how are they aggregated?	
Level of scale / form of evaluation statements	Nominal and ordinal scale level, oral
	Ordinal scale level
	Ordinal/quasi-cardinal scale level
Aggregation form	Logical/argumentative aggregation
	Formal/logical aggregation
	Mathematical/logical aggregation
	Mathematical aggregation with argumentative supplement
	Primarily argumentative aggregation
In which form is compensations ascertainment carried out?	
Compensation ascertainment	Planning-oriented/argumentative, with formal elements
	Formal/quantifying, supplemented by planning-oriented/argumentative derivation
	Formal/quantifying
On the bases of which equivalent is the scope of compensation determined?	
Equivalent for measuring the scope of compensa-tion	Area-value equivalent
	Area equivalent
	Cost equivalent
	Objective/functional equivalent
In which form is accounting carried out?	
Accountin	Primarily numerical (area equivalent, area-value equivalent)
	Numerical, with explanatory text (factors)
	Numerical, with planning/argumentative justification or supplement (factors)
	Argumentative justification of the creditability of compensation measures

Table A.3

Interests and motivations of participants in the application of evaluation and balance-of-effects procedures [45, p. 102]

Actors	Interests and motivation
Project developer	• Ascertainment of the situation in compliance with the law, and maintenance of proportionality in terms of cost and time effort for the planning documentation • Proportionality in terms of obligation for avoidance and compensation • Predictability of material obligation; acceptance of typecasting approaches; generalization and model-like simplifications • Acceptance of «fuzziness» • Good understandability and administrative manageability
Planning office	• Professional demands in the context of securing a minimum extent of the contract • Completion of planning and evaluation tasks under the stated contractual conditions • Explainability of the procedural approach toward outsiders • Legitimation of the type and extent of material obligations of project developers
Authority responsible for the procedure	• Proportionality of the effort required for processing and examination • Legal compliance and completeness of the planning documentation/the material for the balancing of interests • Comprehensibility of the manner of the procedure • Comprehensibility and legitimation of the type and scope of material obligations on the part of the project developer (equal treatment)
Conservation authority (implementation)	• Appropriateness of the ascertainment of the situation (completeness) • Appropriateness of the type and extent of material obligations on the part of the project developer • Proportionality of the effort required for processing and examination

Appendix 1.2

Ascertainment and assessment of effect factors

Table A.4

Environmental impact at certain stages of implementation of different types of activity [96, Appendix II, pp. 2-16]

Conventional symbols:

●	Significant specific impacts caused by an object
O	Significant impact possible in certain cases
	Significant impacts, as a rule, do not occur

Environmental impacts	Types of activity											
	Road construction	Road expansion	Construction of railways	High-tension lines	Wind generators	Hydraulic projects	Mining projects	Landfills	Waste incinera-tion plants	Water treatment plants	Holiday camps and hotels	Land planning
1	2	3	4	5	6	7	8	9	10	11	12	13
Flora and fauna												
Impacts caused by construction of facilities (removal of land)												
Loss of biotopes (habitats for flora and fauna), caused by impervious coverage or area use	O	O	O	O	O	O	O	O	O	O	O	O
Loss of functions of significant biotopes, caused by division of habitats into small islands and changes of area conditions (water balance, exposition, and microclimate)	O	O	O			●	●	O	O	O	O	●
Loss of specially protected biotopes and their functions	O	O	O	O	O	O	O	O	O	O	O	O
Loss of partial habitats and functions of specially protected and endangered species	O	O	O	O	O	O	O	O	O	O	O	O
Impacts upon biotopes and parts of habitats, caused by changes of area conditions (water balance, exposition, local climate)	O	O	O			●	●	O	O	O	O	●
Break of relationship between parts of habitats and neighbouring habitats with the same species composition	●		●			●	O	O			O	●
Fragmentation of large areas of habitation and its impact	●		●			O	O	O	O	O	O	O
Use and fragmentation of protected areas	O	O	O	O	O	O	O	O	O	O	O	O
Impacts caused by exploitation												
Impacts of biotopes caused by pollutant emissions, including accidents	●	O						O	●	●		O
Loss of functions of parts of habitats and integral habitats, and the impact caused by visual irritation, noise, vibration, and light	●	O	●		O	O	O	O			●	
Animal collision with vehicle transport	O	O	O									

Table A.4 (Continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
Bird collision with vehicles/aircraft or barriers, flush effects, and obstacles to bird migration				●	●							
Impact upon animal habitats caused by electromagnetic fields				○								
Impacts caused by construction												
Permanent and temporary losses of biotopes, caused by land use during construction	○	○	○	○	○	○			○	○	○	○
Loss of functions and impacts of biotopes, caused by pollutant emissions during construction	○	○	○			○			○	○	○	○
Loss of functions and impacts of habitats and certain areas, caused by visual interferences, noise, vibration, and light	○	○	○	○	○	○			○	○	○	○
Soils												
Impacts caused by construction of facilities (removal of land)												
Loss of soil (impervious coverage), loss of accumulative and regulating functions (destruction of soil structure and its strata)	○	○	○			○	○	○	○	○	○	○
Loss of soil (impervious coverage), destruction of soil of high value for habitat function	○	○	○			○	○	○	○	○	○	○
Impact on the groundwater balance, caused by irrigation or drainage	○	○	○	○	○	○	○	○			○	○
Use of land, laying of roads through the sites with natural monuments, and soil protected forests (erosion threat)	○	○	○			●	●	○	○	○	○	
Impacts caused by exploitation												
Impacts of accumulative and regulating functions, as well as the filtering and buffering capacity of soil polluted by harmful substances, including accidents	●	○						●	●			
Impact upon biotic habitat function caused by pollutant emissions, including accidents	●	○						●	●			
Threat of erosion, instability of slopes caused by increased fluctuation of the groundwater level						○						○
Impacts caused by construction												
Loss of accumulative and regulating functions and fertility, caused by destruction of soil structures and strata, impervious coverage of soil, erosion	○	○	○	○	○	○			○	○	○	○
Loss of functions of biotic habitats, caused by the destruction of soil structures and layers, impervious coverage of soil, erosion	○	○	○	○	○	○			○	○	○	○
Impact upon accumulative and regulatory functions, caused by pollutant emissions, including accidents	○	○	○			○			○	○	○	
Impact upon the function of a biotic habitat, caused by pollutant emissions, including accidents	○	○	○			○			○	○	○	
Groundwater												
Impacts caused by construction of facilities (removal of land)												
Loss of filtration areas and decrease of rate of feeding of groundwater, caused by impervious coverage	○	○	○					○	○	○	○	

Table A.4 (Continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
Threat of seepage of groundwater, caused by tapping of aquifer, for example on slopes, during building of basements, etc.	○	○	○				○				○	
Impact upon the groundwater balance and direction of flow, caused by backwater, straightening and channeling	○		○			○	○	○	○	○		
Lowering of groundwater local level, especially in the regions with high groundwater levels caused by building of basements, or tunnels, removal of soil, etc.	○		○				●				○	●
Road laying through water protected areas	○	○	○			○	○	○	○	○	○	
Impacts caused by exploitation												
Deterioration of groundwater quality, caused by discharge of pollutants, including accidents	○	○						●	○	●		○
Deterioration of groundwater quality in water protected areas, caused by pollutant discharge, including accidents	○	○						●	○	●	○	○
Impact upon the groundwater balance and the conditions of its formation, caused by fluctuations of water levels in man-made reservoirs						●						
Impacts caused by construction												
Lowering of groundwater local levels, especially in regions with high groundwater levels, caused by building of basements, or tunnels, removal of soil, etc.	○		○						○	○	○	
Threat of the seepage of groundwater, caused by tapping of aquifers, for example on slopes, during building of basements, etc.	○	○	○						○		○	
Threat of pollution of groundwater, caused by tapping of aquifers on slopes and during soil removal	○	○	○									
Surface waters												
Impacts caused by construction of facilities (removal of land)												
Loss of streams and natural floodplains, caused by crossing, expansion and relocation of rivers	○	○	○			○	○	○	○	●	○	○
Loss of water bodies and little-changed river banks, caused by crossing of rivers and changes of their regime	○	○	○			○	○	○	○	○	○	○
Loss of springs and their functions	○	○	○			○		○	○	○	○	○
Loss of surface waters and springs, caused by construction of reservoirs						●						
Impact upon the accumulative capacities of floodplains	○		○				○	○	○	●	○	
Impact upon the balance of streams (e.g., change of level and direction of flow) and their nature, especially in the floodplain areas	○	○	○			●	●	○		●	○	○
Impact and crossing of flooded areas	○		○				○	○	○	○	○	○
Impacts caused by exploitation												
Deterioration of water quality and function of habitats of streams, caused by discharge of pollutants, including accidents	○	○						●	●	●	○	○

Table A.4 (Continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
Deterioration of the water quality and function of habitats of streams, caused by discharge of pollutants, including accidents	○	○						●	●	○	○	○
Impact upon balance of streams in their downstream and their self-purification capacity, caused by changes of water regime and fluctuations of flow						●				○		
Impacts caused by construction												
Temporary impact upon surface waters, caused by crossing and expansion of water objects and their backwater	○	○	○	○		○			○	○	○	○
Temporary impact upon surface waters, caused by discharge of pollutants, especially into oligotrophic water bodies, and intake of water	○	○	○	○		○			○	○	○	○
Climate and air												
Impacts caused by construction of facilities (removal of land)												
Loss of forest areas with clean-air and climatic functions, caused by changes of microclimate	○	○	○	○		○	○	○	○	○	○	
Loss of areas with the formation of cold air	○		○			○		○	○	○	●	
Creation of barriers for currents of cold and fresh air with clean-air and climatic functions, caused by building and division of the air pathways	○		○			○		○	○	○	○	
Impact upon meso- and micro-climate, e.g., evaporation, or solar irradiation balance, within urban polluted districts, caused by impervious coverage		○										
Impact upon meso- and micro-climate, caused by intensity of evaporation, changes of temperature and wind above the water surface area of man-made reservoirs and in the area of soil removal						○	○					
Development of temperature inversions in the urban polluted areas, caused by blocking of fresh and cold air pathways	○		○						○			
Road laying through forests that function as climate protection and protection against pollution	○	○	○					○	○	○	○	
Impacts caused by exploitation												
Impact upon cold and fresh air pathways with clean-air and climatic buffering functions, caused by emissions of pollutants	○	○						○	●			
Impact upon areas of accumulation of cold and fresh air with clean-air and climatic buffering functions, caused by emissions of pollutants	○	○						○	●			
Deterioration of air quality, caused by discharge of pollutants	●	○						○	●	○		
Formation of smog, caused by temperature inversions in urban polluted districts	●	○							○			
Impacts caused by construction												
Creation of barriers for pathways of cold and fresh air with clean-air and climatic buffering functions, caused by construction and landfill sites	○	○	○			○			○	○		
Impact upon areas with clean-air and climatic buffering functions, caused by emission of pollutants from construction machinery	○	○	○			○			○	○		

Table A.4 (Continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
Landscape quality and its recreational value												
Impacts caused by construction of facilities (removal of land)												
Loss of areas with specific landscape quality, caused by impervious coverage and use of the area for construction	○	○	○			○	○	○	○	○	●	
Loss of diversity caused by division or fragmentation of vegetative and structural elements such as park alleys, forest plantations, geomorphological structures	○	○	○	○		○	○	○	○	○	○	○
Changes of originality of landscape constituents, caused by division, fragmentation, emergence of technogenic elements (high-voltage line), etc.	●		●	●	●	●	○	●	●	●	●	○
Visual disturbances caused by bridges, dikes and dams	○		○	○	○	○		○	○	○	●	
Division and fragmentation of natural parks, protected landscapes and other protected areas with recreational function	○	○	○	○	○	○	○	○	○	○	●	○
Impacts caused by exploitation												
Impact upon recreational potential, caused by noise pollution and other factors of irritation	○	○	○		○		○	○	○	○	○	
Impact upon recreational potential, caused by visual disturbances, e.g., industrial transport	○	○	○		○			○			○	
Impacts caused by construction												
Loss of areas with specific landscape quality and changes of landscape constituents, caused by the use of these areas, e.g., soil removal, landfill sites, etc.	○	○	○	○		○			○	○		○
Impact upon recreational potential caused by noise pollution and other factors of irritation during construction	○	○	○	○		○			○	○	○	

Table A.5

Essential impact factors at the local development plan level [62, pp. 135-137]

Explanation of symbols:

● Usually relevant;
○ Relevant to a limited degree and/or case-by-case

Impact factor	Cause			Range and intensity of impact	Protected assets affected				
	Constr.	Facil.	Op.		Species/ biotopes	Soil	Water	Climate/ air	Land-scape
1	2	3	4	5	6	7	8	9	10
Use of land area including impervious coverage		●		Scope particularly on the basis of the legal stipulations, concretely estimable in sqm; scope of possible barrier effects to be qualitatively assessed on a case-by-case basis Forecasts of possible barrier effects in particular cases, essentially to be based on functions and sensitivities of the natural balance (e.g. networking structures)	●	●	●	●	●
Use of land area including construction of vertical structures (above & below ground)		●		Intensity dependent upon the stipulations of the local development plan, regarding type and extent of structural use, position of the building object, and the greening of the construction area to be qualitatively assessed. Scope, as in the case of land use including impervious coverage; also, for visual effect, a factor of 30 times the building height (with exceptions for concrete modifications depending on relief and structure of the study area); scope of barrier effects to be assessed qualitatively. Forecasts of barrier effects to be based essentially on the functions and sensitivities of the natural balance (e.g. networking structures, cold air corridors, etc.)	●	●	●	●	●
Use of land area with changes in use/ planting of vegetation, but no impervious coverage (creation of open spaces)	●	●		Changes in use and vegetation structures (without imperviousness and overbuilding), e.g. creation of garden areas within the scope of the local development plan, concretely estimable in sqm, on the basis of the stipulations. Scope and intensity of the use of non-impermeable plots of land as storage areas or carparks; generally only roughly estimable (particularly in the case of commercial areas)	●	●	●	●	●
Maintenance of open spaces			●	Scope of use as open space on the basis of the legal stipulations, concretely estimable in sqm.	●	○	●	○	●

Table A.5 (Continuation)

1	2	3	4	5	6	7	8	9	10
Pollutant emissions	●		●	Intensity generally only ordinally classifiable (industrial areas > commercial areas > mixed construction areas > residential areas); without further information, no estimate of concrete orders of magnitude is possible An estimate of the scope is only possible to the extent that the community has made use of the possibility of establishing the exclusion of certain types of operation (e.g. in the nature of minimum distance directives). Effect forecasts generally very uncertain, and must be based essentially on the immissions sensitivity of adjoining structures and uses, and/or on the groundwater sensitivity of the site. Generally, avoidance may be best achievable by imposing maximum immission values, or the exclusion of certain types of operation	●	●	●	●	●
Noise emissions	●		●	Intensity generally only ordinally classifiable (industrial areas > commercial areas > mixed construction areas > residential areas); without further information, no estimate of concrete orders of magnitude is possible. An estimate of the scope is only possible to the extent that the community has made use of the possibility of establishing area referenced noise emission levels, or the exclusion of certain types of operation (e.g. in the nature of minimum distance directives). Effect forecasts are generally very uncertain, and must be based essentially on the immissions sensitivity of adjoining structures and uses of the site. Generally, avoidance may be best achievable by imposing maximum immission values, or the exclusion of certain types of operation	○				●
Light emissions	○		●	Only a nominal effect estimate is possible; hence, primarily instructions for avoidance are useful (e.g. use of environmentally compatible outside lighting facilities, such as sodium vapor low-pressure lamps)	●				
Heat emissions			●	Intensity generally only ordinally classifiable (industrial areas > commercial areas > mixed construction areas > residential areas); without further information, no estimate of concrete orders of magnitude is possible An estimate of the scope is only possible to the extent that the community has made use of the possibility of establishing the exclusion of certain types of operation. Effect forecasts are generally very uncertain, and must be based essentially on the sensitivity of fresh air and cold air corridors. Generally, avoidance may be best achievable by the exclusion of certain types of operation				●	
Motion disturbance due to leisure, sports or recreational use			●	Intensity generally only ordinally classifiable (industrial areas > commercial areas > mixed construction areas > residential areas); a more precise determination for residential areas is possible on the basis of planned residential units	●				

Table A.6

Intensities of impacts on biotopes depending on distance from the area of intervention and forecast traffic caused pollution [75, pp. II-7, II-8]

Traffic volume (average daily traffic)	Impacted area	Elevation of the road (Gradient) Distance from edge of roadway			Impact intensity in %
		Embankment position 0-2 m cut	Embankment position 2-5 m cut	Embankment position >6 m cut	
>30000	Construction area	Impact zone	Impact zone	Impact zone	**100**
	Effect zone 1	to 50 m	to 25 m	-	**40**
	Effect zone 2	50-100 m	25-75 m	to 50 m	**20**
15000-30000	Construction area	Impact zone	Impact zone	Impact zone	**100**
	Effect zone 1	to 50 m	to 25 m	-	**20**
	Effect zone 2	50-100 m	25-75 m	to 50 m	**10**
<15000	Construction area	Impact zone	Impact zone	Impact zone	**100**
	Effect zone 1	to 25 m	to 10 m	-	**10**
	Effect zone 2	25-50 m	10-25 m	-	**5**

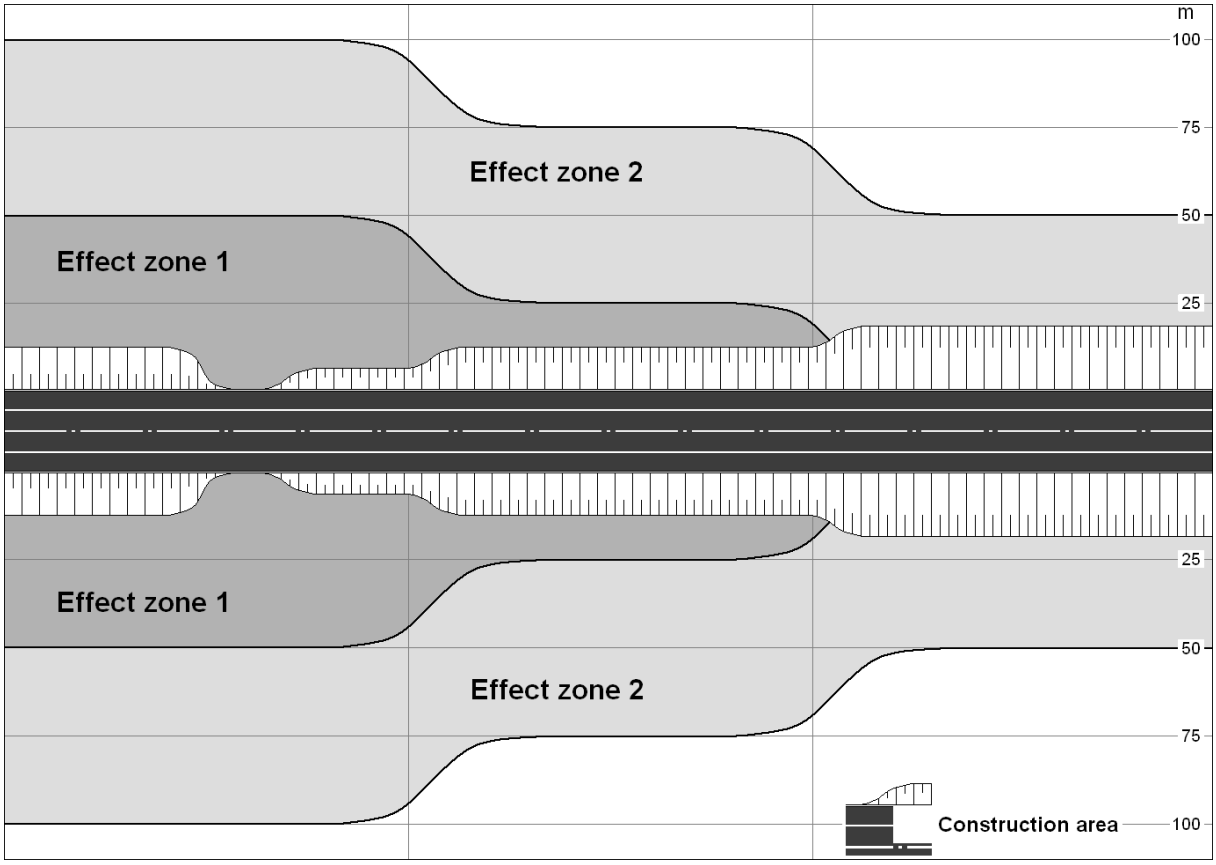


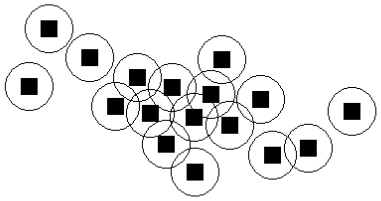
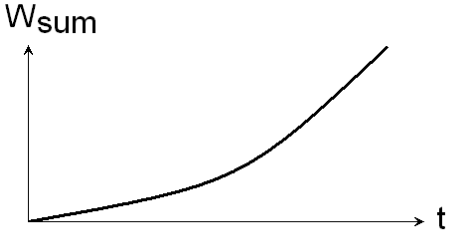
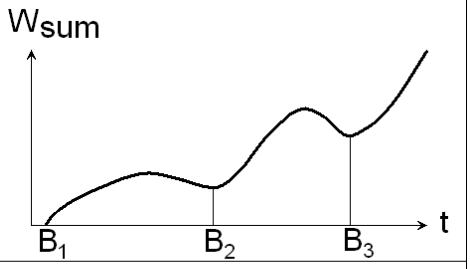
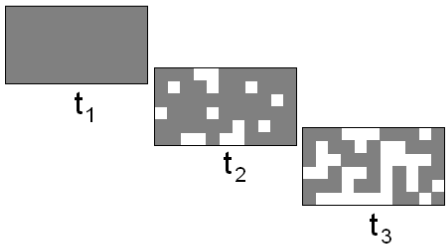
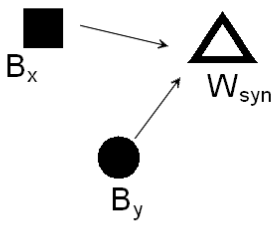
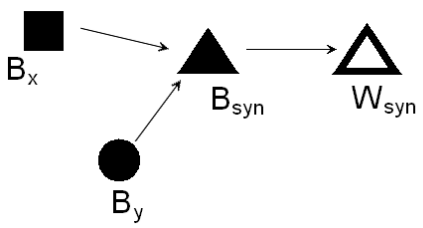
Table A.7

Essential impact factors, dependent on planning intent, at the land-use plan level [62, p. 134]

Impact factor	Cause and point in time of occurrence	Duration	Range (R); Intensity (I) depending on planning intent (planned use area)				
			Residential construction area	Mixed construction area	Commercial construction area	Traffic facilities area	Structurally characterized green space
Use of land area including impervious coverage of land area	Facility	permanent	R: minimal, I: moderate (30 - 80% imperviousness)	R: minimal, I: high (80 - 100% imperviousness)	R: minimal, I: high (80% imperviousness)	R: minimal, I: high (80 - 100% imperviousness)	R: minimal, I: minimal (30% imperviousness)
Use of land area including construction of vertical structures (above & below ground)	Facility	permanent	R: Case-by-case, I: medium	R: Case-by-case, I: high	R: Case-by-case, I: high	R: Case-by-case, I: high	R: Case-by-case, I: minimal
Use of land area with changes in use/ planting of vegetation, but no impervious coverage (creation of open spaces)	Construction; facility	temporary or permanent	R: minimal, I: high	R: minimal, I: Case-by-case	R: minimal, I: Case-by-case	R: minimal, I: Case-by-case	R: minimal, I: high
Pollutant emissions	Construction; operation	temporary or permanent	R: Case-by-case, I: medium	R: Case-by-case, I: medium	R: Case-by-case, I: high	R: Case-by-case, I: high	R: Case-by-case, I: minimal
Noise emissions	Construction; operation	temporary or permanent	R: Case-by-case, I: minimal	R: Case-by-case, I: medium	R: Case-by-case, I: high	R: Case-by-case, I: high	R: Case-by-case, I: minimal

Table A.8

Types of cumulative impacts [61, p. 275]

Type of cumulative impact	Principle (example)
Spatial compaction (addition) of certain loads	
Temporary (accumulative) addition of certain irreversible loads	
Temporary (accumulative) addition of certain potentially reversible loads	
Gradual changes of the environmental state affected by permanent or temporary loads	
Synergetic interaction of different impacts (Bx, By) and emergence of resulting loads Wsyn	
Synergetic interaction of different impacts (Bx, By) and emergence of new factors of impact Bsyn and resulting loads Wsyn	

Appendix 1.3

Description and assessment of environmental assets

Table A.9

Processing of the protected assets [76, pp. 78-80]

Significance/services (Function, values)	Selection of important indicators for the evaluation of services
Soil	
Habitats for soil organisms and natural vegetation	• Range of species • Large-scale presence; frequency of habitats of various biocoenoses • Original character (degree of hemeroby) • Suitability for the development of protection-worthy vegetation
Filter and buffer for pollutants	• Geological structure • Types of soil • Clay and humus content • reactivity (pH value)
Site for crops	• Relief • Type of soil • Root penetration depth • Heat conditions • Natural nutrient capacity, acidity
Groundwater	
Groundwater supply	• Thickness of groundwater body • Characteristics of multiaquifer formation • Groundwater source • Flow direction • Flow velocity • Permeability • Groundwater basin • Covering strata (thickness, permeability, buffering and filtering capacity) • Chemical composition
Groundwater recharging	• Precipitation rate • Climatic water balance • Direct runoff • Capillary capacity of the soil • Permeability of the covering strata • Vegetation • Actual utilization
Surface waters	
Self-purification function	• Watershed area • Surface and water body (standing water bodies) • Runoff quantity, runoff dynamics and flow velocity (streams) • Evaporation rate • Oxygen content • Inflow and outflow • Microbiological composition
Habitat for animals and plants (habitat function)	• Income morphological condition of the water bodies • Trajectory and flow conditions • Composition of the floor (structure, substrate) • Contact possibilities with the hyporheic zone • Formation of the riverbank (structure, material) • Trees and shrubs (including linkage/networking with the surrounding countryside) • Water quality • Occurrence of characteristic animal and plant species, and their communities

Table A.9 (Continuation)

Significance/services (Function, values)	Selection of important indicators for the evaluation of services
Flood prevention (retention functions)	• Utilization/groundcover • Relief • Permeability of soil and subsoil • Degree of regulation of water bodies
Air and climate	
Formation and transportation of fresh and cold air	• Areas of special significance for formation of cold and fresh air (cold and fresh-air pools) • Outflow quantities, level of local exchange processes • Outflow corridors • Large-scale wind distribution • Inversion frequency • Heat pollution • Land-use (especially structural density)
Air filtration	• Surface roughness • Orientation of emission sources
Animals and plants	
Habitat for wild animals and plants Biotope networking Protection status	• Locally typical occurrence of species and species communities • Diversity • Naturalness • Rareness • Completion • Maturity • Endangerment • Representativeness • Area size (distribution of rare or endangered species communities/biotopes) • Development potential
Quality of the landscape	
Occurrence and performance of locally typical landscapes (peculiarity of the landscape) Structural and aesthetic endowment of the landscape (beauty and diversity of the landscape)	• Structure determining landscape elements: groves, orchard meadows, coppices, natural creeks, species rich, layered stands, etc. • Recreationally useful forest areas and structures (forest meadows, forest creeks, beautiful forest scenery, species rich, layered stands etc.) • Relief (diverse relief, scenic possibilities etc.) • Cultural-historically significant elements • Near-natural state (share of ecologically significant structures and areas, biotopes) • Characteristics of the local climate (e.g. sunny and shady locations) • Quiet areas
Landscape related recreation	
Significance of the landscape for quiet, landscape related recreation	• Natural endowment, diversity and characteristics of locally typical peculiarity • Accessibility and assignment to settlement areas and residential areas • Opening of landscape and endowment with recreationally significant infrastructure • Protection status

Table A.10

Classification of the initial state of the planning area in terms of the significance of protected assets [41, pp. 28-30]

Bottom value	Top value
1. Areas of low significance for the natural balance and the quality of the landscape	
Species and habitats Non-natural and strongly anthropogenically affected biotopes, without presence of *Red List* species	
• Roadside greenery with regular, intensive care • Intensively maintained lawn areas, e.g. sports facilities	• Groves (<10 years old) • Intensively used meadowland; intensively cared for green space

Table A.10 (Continuation)

Bottom value	Top value
• Tree nurseries • Partly impervious surfaces, such as gravel or sand covered surfaces, pavements, water-bound pathways	• Simply structured decorative or vegetable gardens, intensively used gardens, commercial horticulture, young orchards • Christmas tree nurseries • Rapid growth plantations • Plantations consisting entirely of exotic tree species (<30 years old) • Vacant lots (<5 years old) • Non-naturally regulated bodies of water
Soil	
• Soil impervious due to buildings, walls, asphalt, concrete or other solid coverage • Paved transport and storage surfaces, paved sports areas (e.g. tracks covered with synthetics)	
Water	
• Bodies of water in pipes	• Non-naturally regulated bodies of water • Areas with permanently lowered water tables • Areas with no water infiltration capacity (dense, virtually impermeable surfaces)
Climate and the air	
• Large impervious soil areas • Vacant lots housing areas, in densely structured environments	• Areas with no locally climatically effective air exchange corridors
Landscape quality	
• Rehabilitation areas, edges of built-up areas, especially in strongly built-up village and urban residential areas (heterogeneous structural forms) • Industrial and commercial areas with no greenery	• Monotonous, simply structured farmland
2. Areas of medium significance for the natural balance and the quality of the landscape	
Species and habitats areas with near natural and / or extensively used elements	
• Non-site-appropriate reafforestations and forests • Groves in residential areas with primarily indigenous species • Intensively maintained lawn areas, e.g. sports lawns • Extensively maintain roadside greenery • Degraded or strongly impaired wetlands and low nutrient sites • Ruderal areas, vacant lots (> five years) • Richly structured gardens • Creeks and small bodies of water with reinforced banks	• Site-appropriate reafforestation • Site-appropriate forests • Short rotation coppices as a storage form of forest use • Isolated groves, field groves, hedges, sunken forest paths • Orchard meadows (trees≥ 30 years old) • Species rich or extensively used meadows (low nutrient/damp meadows and forests) • Occurrence of animal and plant species of local significance in the district, not including *Red List* species
Soil	
• Anthropogenically transformed soil with permanent growth (e.g. meadows, gardens), with no cultural/ historical significance or utility for the development of special biotopes	• Soils with very high natural yield
Water	
• Medium quality bodies of water • Bodies of water with changed courses/positions • Area with high intact distance to groundwater • Input risk with nutrients and pollutants present	• Floodplain sites

Table A.10 (Continuation)

Bottom value	Top value
Climate and the air	
• Well-ventilated area at the edge of air exchange corridors	
Landscape quality	
• Traditional area at the edge of human settlement, with existing, established greened structure	
3. Areas of high significance for the natural balance and the quality of the landscape	
Species and habitats Near-natural biotope and use types, such as	
• Near naturally structured and site appropriate forests with high shares of indigenous tree species, and with the following forest types: • Bog, swamp, marsh and floodplain forests • Forests and shrubs of dry, warm sites, forests on slopes, screes and sunken pathways • Sheep runs as historic forest use forms • Old shrub and hedge landscapes, species rich forest edges • Old isolated hedges • Orchard meadows with old stands of fruit trees (orchard meadows > 30 years old) • Areas of former vineyard sites and abandoned vineyards • Old landscape parks, richly structured gardens with near natural elements • Open rock formations, alpine meadows and small snow valleys, crippled tree shrubbery and tall herb communities • Low nutrient meadows, heaths, turf meadow communities, open inland dunes, thermophile marginal area, open natural block and scree piles • Bogs and swamps, reed beds or rush rich wet and damp meadows, moor grass meadows and source areas • Natural and near natural stream segments, including floodplains and land forming areas of standing bodies of water • Ecologically or geo-morphologically significant habitats, such as caves, natural ponds and small bodies of water • Occurrence of *Red List* species • Important biotope connectivity axes and biotope development areas on soils with priority functions for species and biotope protection	
Soil	
• Rare soils (e.g. bog soils, fly sand) • Unaffected or only slightly changed near natural soil structure • Soils with predominantly protective, filtering and buffering functions	
Water	
• Bodies of water with high water quality • Non-regulated streams and standing water bodies • Areas with no deterioration of the groundwater level • Areas with a low, intact depth to groundwater • Retention areas in floodplains • Areas of great significance for groundwater re-charging	
Climate and the air	
• Climatically effective air exchange corridors • Areas with climate compensation function for human habitation areas	
Landscape quality	
• Areas with natural surface structures which characterize the landscape, such as ridges, hilltops or cliff sides visible from afar • Areas with an ensemble effect (small-scale structured areas), e.g. orchard meadows at the edges of villages • Historic cultural landscapes and parts of the landscape • Areas with cultural-historical landscape elements • Areas immediately adjacent to large-scale protected areas • Elements such as riverbanks forest edges etc., which characterize the landscape, and areas of particular recreational significance	

Table A.11

Evaluation framework for the protected asset «Landscape Quality / Recreation» [77, p. 21]

Criteria	Description
Very great significance (Stage A)	
Diversity	Many diverse structures and/or uses and/or high species diversity (vegetation, fauna) (→high, ordered complexity)
Peculiarity	Exclusively elements of locally typical and characteristic nature; no disturbing anthropogenic transformation of the landscape; uses well adapted to the relief (→cultural-historical development)
Harmony	Good harmonization of natural and anthropogenic elements (→scale appropriate to the relief; regionally typical elements predominate)
Visibility	Area visible from virtually all sides (→open terrain, easy to experience)
Naturalness	Very natural (e.g. natural forest, new natural floodplain landscape, bogs, etc.), old orchard meadows, very extensively managed pastureland, naturally reproducing forests (→little or no anthropogenic influence)
Infrastructure	Numerous recreational facilities available (benches, barbecue sites, etc.) (→facilities enhance recreational quality)
Accessibility	Multifarious comprehensive network of pathways available (> 3 km/sq.km) (→infrastructure facilitates sojourn)
Smell	Pleasant odours (e.g. flowers, hay, fruit) (→ odours enhance recreational quality)
Sounds	Pleasant sounds (e.g. twittering of birds, wind, water, etc.)
Distance to habitation	Close to human habitation (< 1 km from edge of residential area)
Observable use patterns	Area is strongly frequented; multifarious and various use patterns observable
Evaluation example	**Particularly attractive landscape areas, lines or points with very good quality of characteristic features for the natural area.** Special characteristics of peculiarity and diversity (e.g., spaces are located in a large coherent complex of orchard meadows or deciduous forests, are part of a historical cultural landscape, or are culturally significant, are located on natural or near natural bodies of water with the respective near-natural surroundings; historic roadways very characteristic of the landscape, groves or coppices; a terrain with a very strong relief, marked terrain morphological characteristics, natural historical or geologically significant elements, such as ground openings of mines or volcanic craters; or points which provide particularly scenic vistas) Few or no disturbances Very well accessible recreational areas equipped with recreationally effective infrastructure near human habitation; recreational forest (Stage 1); landscape conservation area
Great significance (Stage B)	
Diversity	Many elements of locally typical and characteristic nature; few disturbing anthropogenic transformation of the landscape (e.g. small roads adapted to the relief)
Peculiarity	Other criteria same as for Stage A
Other criteria	Many elements of locally typical and characteristic nature; few disturbing anthropogenic transformation of the landscape (e.g. small roads adapted to the relief)
Evaluation example	**Attractive landscape areas, lines or points with good quality of peculiar characteristics for the natural area.** Recognizable peculiarity, with diversity; like Stage A, but less strongly characteristic (e.g. small, intact orchard meadow areas or areas in large, minimally disturbed orchard meadow complexes; historic roadways, groves or coppices; relief terrain); typical small-scale measures; minimal disturbance Accessible recreational areas equipped with recreationally effective infrastructures near to human habitation, or very well-equipped recreational areas remote from human habitation; recreational forest (Stage 2); landscape conservation area
Moderate significance (Stage C)	
Diversity	Some or few structures and/or uses; moderate use and/or species diversity
Peculiarity	Few elements of locally typical and characteristic nature; little or some disturbing transformation of the landscape

Table A.11 (Continuation)

Harmony	Natural and anthropogenic elements correspond
Visibility	Area visible from several directions
Naturalness	Moderately near natural (average amount of meadowland, open areas, etc.)
Infrastructure	Some recreational facilities available
Accessibility	Network of pathways available (1-3 km/sq.km)
Smell	No odours; or balance between pleasant and unpleasant odours
Sounds	Balance between pleasant and unpleasant sounds
Distance to habitation	1-1.5 km from edge of residential area
Observable use patterns	Area is moderately frequented; some use patterns observable
Evaluation example	**Characteristic features of the natural area are still present, but have been visibly anthropogenic transformed or disturbed.** Landscape typical characteristics are present (e.g. residual Stage B areas), average cultural landscapes, utilization characterized by vacancy and shrubbery; Residential and commercial area with much greenery, clearly locally or regionally typical residential areas with native local vegetation
Low significance (Stage D)	
Diversity	Few structures and/or uses; minimal use and/or species diversity
Peculiarity	Few or no elements of locally typical and characteristic nature; anthropogenic transformation of the landscape very much in evidence
Harmony	Natural and anthropogenic elements correspond little or not at all (→ arrangement not to scale, not in harmony or disturbing; materials not typical for the region)
Visibility	Area visible from very few or no directions (→ area appears inaccessible or closed off)
Naturalness	Not very near natural (e.g., orchard plantations, pine monocultures, farmland, unpaved paths, roads, settlement areas intensively used farmland) (→high anthropogenic influence)
Infrastructure	Few or no recreational facilities available
Accessibility	Incomplete network of pathways (<1 km/sq.km) (→lack of infrastructure makes sojourn difficult)
Smell	Odours detract from sojourn quality (e.g. automobile or industrial emissions, mass animal husbandry, fertilizer, etc.)
Sounds	Sounds detract from sojourn quality (e.g. aircraft, auto, or industrial noise emissions, etc.)
Distance to habitation	Remote from edge of residential area (>1.5 km from edge of residential area)
Observable use patterns	Area is frequented little or not at all; few or no different use patterns observable
Evaluation example	**Anthropogenic transformed areas with primarily uniform use; a few landscape typical characteristics still present.** Landscape typical characteristics are still recognizable (e.g. non-typically cleared out farmland with remainders of vegetational structures, garden house areas, commercial areas greened primarily with local tree species; residential areas greened with local tree species to an average degree
Very low significance (Stage E)	
Diversity	Lack of structures and/or uses; monotonous landscape, hardly any different uses (→monotonous, uninteresting)
Peculiarity	Virtually no elements of locally typical and characteristic nature; anthropogenic transformation of the landscape very disturbing
Other criteria	Other criteria same as for Stage D
Evaluation example	**Poorly structured areas, strongly anthropogenic transformed with fragmentation and disturbances (e.g. noise); no natural characteristics still present** No landscape typical peculiarity still recognizable (e.g. non-typically cleared farmland without remainders of vegetation structures, commercial pine stands, commercial and residential areas with little or no greening; or other areas with highly impervious surfaces); Areas with no sojourn quality (major visual and noise disturbance present)

Table A.12

Classification of protected assets in value levels [42, pp. 231-232; 90, pp. 123-125]

Species and biotopes

Value levels

The following value levels were used

III – Of special significance (markedly characterized by near natural and semi-natural biotope types)

II – Of general significance (The step concerns in particular the wide range of more or less protection worthy biotope types, which have however been significantly affected by various uses, and also small-scale landscape elements each of which is, on its own, of minor significance, but which, in a high-value location are to be evaluated in accordance with their surroundings.)

I – Of little significance (especially intensively used biotope types with few species)

The criteria for the classification of biotope types into the three value levels were:

- near natural character
- endangered character
- rareness
- significance as habitats for plants and animals (special significance of biotopes at extreme sites, and of bright, multi-structured, old biotopes).

Biotope types with multiple value levels

Some biotope types, depending on their concrete performance, are assigned to different value levels.

The value level applicable for the concrete performance of the particular biotope type is ascertained according to the following criteria:

- biotope descriptions in the map key
- area size
- position of the area (e.g. networking function, biotope complexes)
- quality of the performance with regard to site, structure and typical inventory of species
- age of the biotope
- occurence of threatened species.

Occurrence of plant and animal species

III – Occurrences of special significance

- Bird breeding areas of national or state-wide significance
- Migratory bird habitats of international, national and/or state-wide significance
- Occurrence of a threatened animal or plant species; or of an extremely rare animal or plant species; or occurrences of above-average-sized populations of several strongly endangered an-imal or plant species; or occurrences of above-average-sized populations of a large number of endangered animal or plant species.

II – Occurrences of general significance

- Generally high numbers of animal and/or plant species, compared with the expected biotope-specific figure.

I – Occurrences of low significance

- No endangered animal or plant species, and
- Greatly below-average numbers of animal and/or plant species, compared with the expected biotope-specific figure
- No high demand animal or plant species occur.

Classification in value levels for forests

Near natural forests on old forest sites of average to good condition are generally classified as Value Level III.

Provided a minimum value is given, stands are devalued by one stage with respect to the average level, if one or two of the following criteria apply:

- pole forest with no old-wood component
- inclusion of tree species foreign to the site
- not a traditional forest site (non-forested phase during the past 300 years).

In natural areas with a low proportion of forests on old forest sites, all types of forest could be up-graded one level compared with the maximum value in the list, provided this is <III.

Classification of regeneration capacity

✹✹ Difficult or impossible to regenerate after destruction (> 150 years' regeneration time)
✹ Difficult to regenerate after destruction (up to 150 years' regeneration time)
(✹) Difficult to regenerate, but generally not a development goal of conservationists (due to de-generation stage, or major anthropogenic change)
none Possibly regenerate of all: under favourable conditions regenerate a bowl within a relatively short period (up to 25 years)

In the biotopes (✹) and in all biotopes without a ✹ or a ✹✹, compensation and/or offsetting measures are possible

Table A.12.1

Examples for the classification of biotope types [reduced after 42, pp. 232-240]

Biotope type	Regeneration capacity	Value level
Forests		
Mixed oak forest in acidic soil at wet sites	✹✹	III
Forest edge, dry/warm sites	✹	III
Deciduous forest of native species	(✹)	II
Deciduous forest, young stand		II
Inland waters. Streams		
Near natural headwater field	✹✹	III
Reinforced headwater field		II
Near natural, rapid flowing low mountain range river	✹	III
Moderately regulated river		II
Completely regulated river		I
Inland waters. Standing bodies of water		
Naturally formed, near natural, low nutrient small body of water	✹	III
Ponds		II
Land forming area of low nutrient standing water body		III
Naturally formed, non-natural standing water body		II
Non-natural storage or tailings pond		I
Meadows		
Low alkaline, low nutrient wet meadows	✹	III
Species poor mesophilic meadows		II
Seeding grassland		I
Green spaces in areas of human habitation		
Residential area trees, largely native species	✹	II
Ryegrass/Great plantain lawn associations		I
Decorative bushes/edges		I
Old landscape parks	✹	II
Other green spaces and old stands of trees	✹	II
Orchards and vegetable gardens		I
New park facilities		I
Buildings, traffic and industrial areas		
For some units of this group (e.g. embankments, walls with well-developed vegetation or species-rich fauna, or buildings of significance for endangered animal species), a different value level may be established on a case-by-case basis		
Impervious coverage of the soil, buildings		I
Surfaces with no impervious coverage or vegetation		I

Soil

III – Soils of special significance

Near natural soils (natural profile structure largely unchanged; no notable de-watering; no modern farming use; e.g., old forest stands, bog and fen soils or dunes; de-watered little or not at all) if rare

- Soils with particular site properties/extreme sites, if rare, e.g.:
  - very low-nutrient soils
  - very wet soils with a natural water balance, or an only slightly lowered water level, as with bogs and fens, gleys, or floodplain soils
  - very dry soils, such as dry rocky soils, salty soils.
- Soils of cultural/historical significance, if rare
- Soils of natural-historical and geo-scientific significance, if rare
- Other rare soils.

II – Soils of general significance

- Organic and mineral soils anthropogenically transformed by use (by waterway reinforcement, agricultural technology or farming measures, e.g., intensive grassland or farmland use)
- Extensively farmed or fallow/unused organic and mineral soils characterized by use.

I – Soils of low significance

- Rough soil caused by mining/quarrying
- Anthropogenic soils, the structure of which differs completely from the natural structure, due to agricultural processes
- Contaminated soils
- Impervious-covered soils

Groundwater

III – Areas of special significance

- Areas which are sources of drinking water (priority areas)
- Groundwater reserves suitable as sources for drinking water (precautionary areas)
- Areas in which a threat to the groundwater exists as a result of mining/quarrying in view of the nature and thickness of the covering layers of the aquifer.

II – Areas of general significance

- New groundwater formation areas
- Areas with the habitat function, e.g. very wet areas, or bogs

I – Areas of low significance: Other areas.

Landscape quality

III –Areas of special significance: Elements of the landscape which largely correspond to the typical uniqueness of the natural area, are of above-average significance for that natural area, and are free of disturbing objects, noises or smells, especially in areas with:

- A high share of near natural or seemingly natural biotope types
- With naturally characteristic reliefs of exceptional significance for the respective natural area (e.g. ridges, hilltops, steep inclines, dunes, valleys)
- The possibility to frequently experience animal populations typical of the natural area, and with above average characteristics
- Historical cultural landscapes and landscape elements and/or historical land-use forms of particularly characteristic uniqueness
- A high share of typical cultural historical settlement and building forms
- A high density of landscape elements typical of the natural area.

II – Areas of general significance: Elements of the appearance of the landscape in which the uniqueness typical of the natural area is essentially still recognizable, although in a reduced or overbuilt form:

- The areas clearly marked by human use (seemingly natural biotopes present only to a slight degree, the natural development of the landscape only sporadically recognizable)
- Elements of the cultural landscape typical of the natural area are only sporadically present
- Use forms have been progressively uniformized by intensive land-use; the diversity of land-use and landscape elements typical of the natural area is present only to a small degree
- Mining/quarrying areas after rehabilitation show the uniqueness typical of the natural area in terms of size, design and vegetation, albeit in a reduced or overbuilt form
- Other negative impacts such as noise or odours are present.

I – Areas of low significance: Elements of the appearance of the landscape the uniqueness of which typical to the natural area has been largely antrhopogenically transformed or destroyed, in particular:

- Areas with few or no seemingly natural biotopes; character of the landscape marked by intensive human use
- Few or no remains of cultural historic old landscape elements
- Urban or village residential areas with no regional or locally typical building forms
- Areas in which landscape elements typical of the natural area which provide an experience are present only very sporadically or not at all; cleared out, monotonous landscape
- Mining/quarrying areas after reclamation appear foreign to the natural area due to size, shape and/or vegetation
- Areas with additional strong negative impacts of other types (noise, odours).

Appendix 1.4

Forecast of impacts of environmental assets and their functions

Table A.13

Approaches for forecasting of impacts

Four different approaches are used to forecast impacts, depending on the type of effect:

1. Assessment of impacts leading to the direct loss of a natural object or area.

2. Assessment of impacts unrelated to susceptibility and value of the assessed asset or its functions.

3. Assessment of impacts related to the value of an asset or its function (single bond).

4. Assessment of impacts related to susceptibility and value (double bond).

The selection of any approach depends on a number of terms. Their description is given below in the general scheme of selection of approaches for forecasting, Fig. A.13.1.

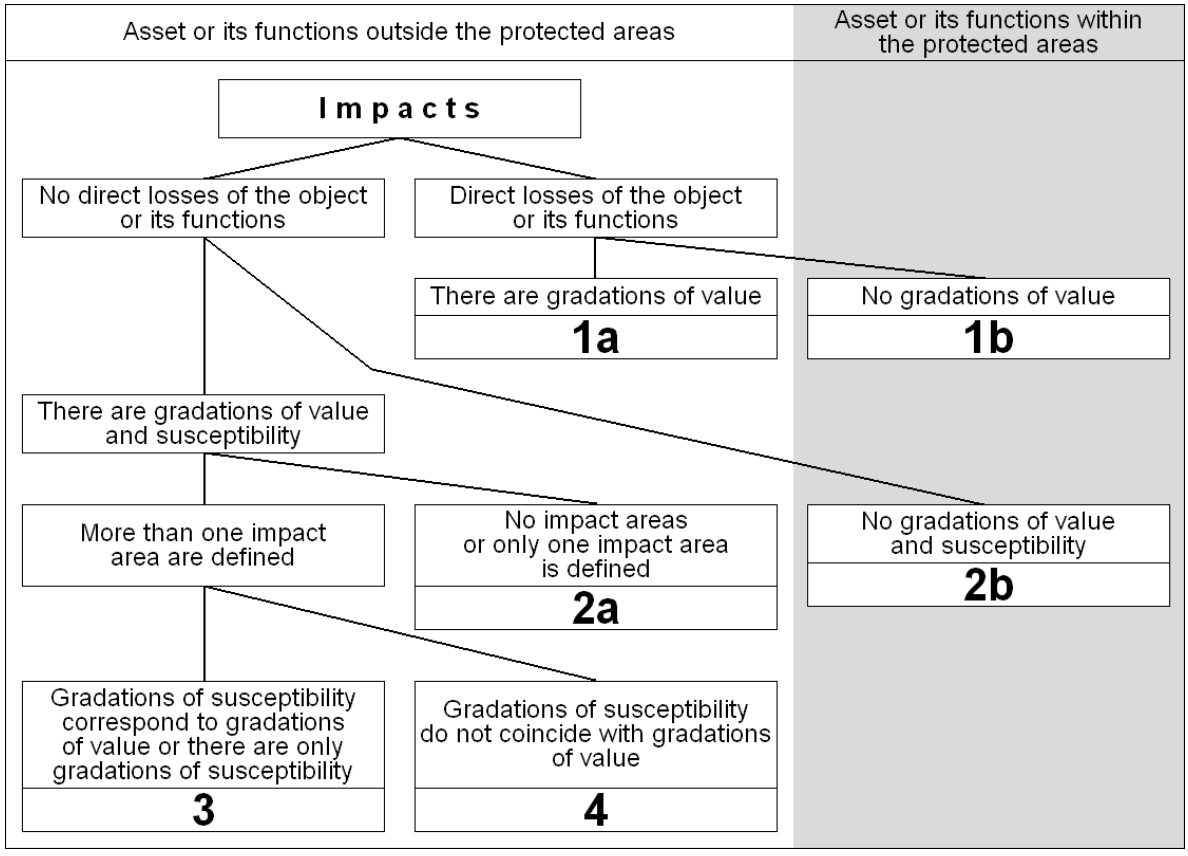


Fig. A.13.1. Selection of approaches for impact forecasting.

Forecast approaches are marked by numbers: 1 – assessment of loss of object or area; 2 – forecast unrelated to bonds; 3 – forecast with single bond; 4 – forecast with double bond [58, p. 75].

1. Forecast of impacts leading to the direct loss of object or area, Fig. A.13.2

This approach is applied in case of direct complete loss of an area or natural object, or of the functions of an environmental asset (Option 1a) or legally protected object (Option 1b).

Option 1a

The intensity of loss (impact) is assessed from the direct loss of area or function of the environmental asset, and depends on the value of the loss. An appropriate scale of value is to be used for determination of the intensity of impact upon the object, area or function. Susceptibility is not considered in this case, as there is a complete loss of area or function.

Option 1b

If the area or function with protected status is directly lost, the level of loss is determined by legislation.

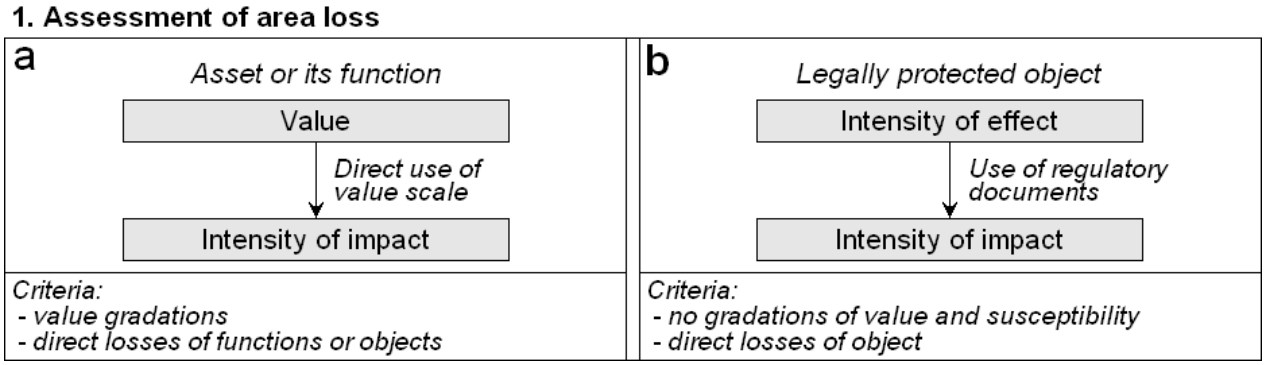


Fig. A.13.2. Scheme of forecast of impacts in case of direct lost of an area (environmental assets or their functions) [58, p. 10].

2. Forecast of impacts unrelated to the value and susceptibility of the assessed asset or its functions, Fig. A.13.3

This approach is used if the function of the environmental asset is directly connected with intensity of load. It is used for both the functions of an asset (Option 1a) and objects with protected status (Option 2b).

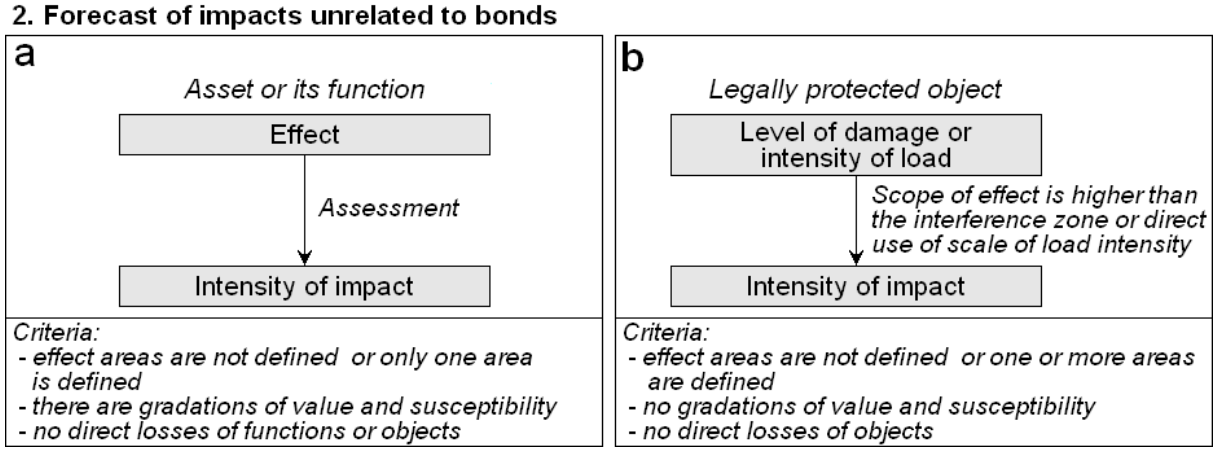


Fig. A.13.3. Scheme of forecast of effects unrelated to the value and susceptibility of the assessed asset or its functions [58, p. 12].

Option 2a

If the function of an environmental asset is impacted and the effect area is not identified, or if only one area is identified and it is difficult to assess the load intensity, the intensity of impact is determined from the existing scales of value or susceptibility.

Example. The susceptibility of aquifers to tapping or to backwater usually depends on the depth to groundwater. However, expected impacts can be estimated only descriptively within the engineering constructions. It is impossible to differentiate them within concrete effect areas.

Option 2b

If the effect areas are not defined, or only one area is defined and the intensity of load can be assessed, the intensity of impact is inferred from the level of damage.

Example. The laying of road a flooding zone isolates large water-detention areas and increases the level of flooding. In this case, as in the previous one, the effect areas are not defined. The extent of impact is possible increase of the impoundment level.

If several effect areas are distinguished, the impact is assessed from the intensity of effect in the corresponding areas.

Example. Several areas can be defined with the respect to the impact upon soil-protective forest land along highways, caused by the introduction of harmful substances. The soil-protective forest is not differentiated in the categories of value and susceptibility, as its status is legally established. Therefore, the risk level is, in this case proportional to load intensity, i.e., to the concentration of harmful substances.

3. Forecast of impacts related to value (single bond), Fig. A.13.4

If several effect areas are defined and categories of value and susceptibility approximately coincide in the contours of isolated areas, or if only the scale of value applies, the forecast is inferred from the value and intensity of load. The impact intensity is determined from the combination of these parameters. Special matrices are composed. An example of one such matrix is shown in Section 4.5.

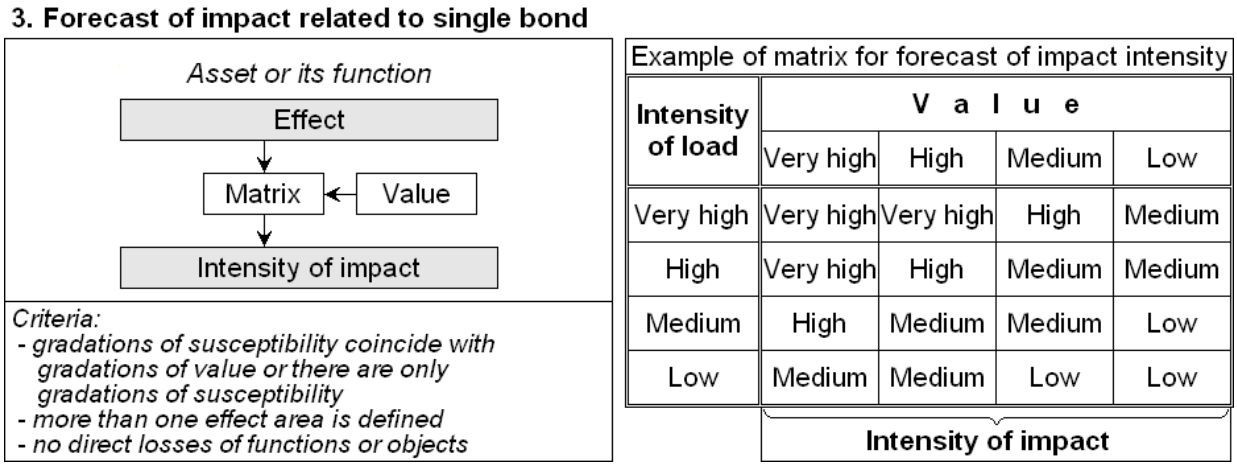
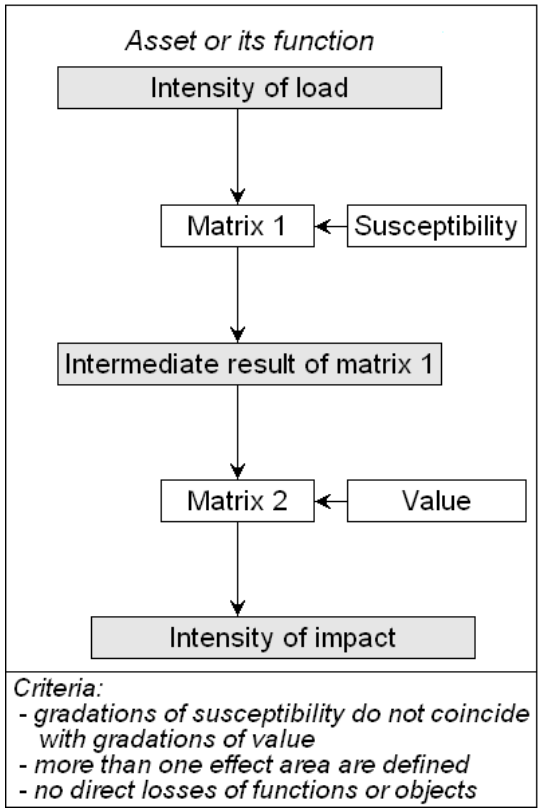


Fig. A.13.4. Scheme of forecast of effect related to value (single bond) [58, p. 12].

4. Forecast of impacts related to value and susceptibility (double bond), Fig. A.13.5

This approach is used under conditions similar to those of the previous ones. However, categories of susceptibility and value do not coincide in the contours of the defined areas. The assessment is performed in two steps. First, a special matrix connects susceptibility and intensity of load. In the second step, the intermediate results obtained are connected with the asset value or its function. The intensity of impact is the product of the second matrix.

4. Forecast of impacts related to double bond



Matrix 1

Intensity of load	Susceptibility			
	Very high	High	Medium	Low
Very high	Very high	Very high	High	Medium
High	Very high	High	Medium	Medium
Medium	High	Medium	Medium	Low
Low	Medium	Medium	Low	Low
	Result of matrix 1			

Matrix 2

Цен-ность	Result of matrix 1			
	Very high	High	Medium	Low
High	Very high	High	Medium	Medium
Medium	High	Medium	Medium	Low
Low	Medium	Medium	Low	Low
	Intensity of impact			

Fig. A.13.5. Scheme of forecast of impacts related to susceptibility and value (double bond) [58, p. 13].

Appendix 1.5

Ascertainment of significant negative impacts

Table A.14

Significant negative impacts due to road construction [85, III.3, pp. 7-10; 82, pp. 107-108]

Explanation of symbols:

- ● Location of road-building project (including construction area)
- ⊙ Immediate vicinity (to approx. 100-500 distance, depending on the conflict situation)
- ○ Broader surroundings (to approx. 2000 m distance, or more in certain cases, depending on the particular dispute)

Type and significance of impacts	Scope of effects
Soil	
Complete loss of function: Impacts on soil function and the physical, chemical or biological characteristics of soil are always to be considered significant if the functions are completely removed. Removal of the topsoil and subsequent impervious coverage of the ground is generally to be considered a significant impact	●
Anthropogenically transformation of the original site conditions and limitation of the soil functions: Removal of the topsoil, particularly on naturally developed sites, by excavation or landfilling constitutes a significant impact. If soils with particularly important functions for the site are involved, e.g. a high biotope development potential, the impact is always considered significant. Otherwise, a case-by-case determination is made. Moreover, if particular soil determining factors and characteristics, such as the water balance, the structure, or the nutrient content are drastically changed, that is also considered a significant impact, since especially changes in soil development may result. If the content of heavy metals or organic substances in the soil exceeds the natural, geogenically determined level, this too is considered a significant impact. The intensity of the impact is essentially dependent on the level of pollutant emissions into the soil, which is in turn dependent on the local volume of traffic	●
Groundwater	
Reduction of groundwater formation: Impacts which disturb the new formation of groundwater are generally considered significant if the local rate of new formation is considerably reduced due to impervious coverage and anthropogenically transformation of the terrain, and if surface areas capable of insuring seepage are lost. Due to their narrow widths, which provide the possibility for seepage of precipitation water in the immediately adjacent area, bicycle paths are generally not considered a significant impact	●
Disruption of groundwater conditions (quantity and dynamics): Groundwater withdrawal leads to a significant impacts if, as a result, the site and habitat conditions of plants and animals – especially the soil conditions – are changed in such a way as to cause changes in the populations and in the soil development. The same is true with regard to a rise in the groundwater level. Impacts on the groundwater flow conditions are to be considered significant if the latter is noticeably affected, and if as a result the site and habitat conditions of plants and animals are changed, or the exit of groundwater to the surface, e.g. in source areas, is considerably changed	⊙
Changes in protective effects relevant to groundwater quality: The removal or reduction of covering strata may cause significant impacts if the result may be a reduction in groundwater quality with negative effects on the natural balance, and particularly on the flora and fauna	●/⊙
Impacts on groundwater quality: Impacts on groundwater quality due to pollutant emissions are considered significant if they cause the physical, chemical or biological characteristics of groundwater to diverge considerably from the natural, geogenically determined quality, and if as a result, the site and habitat conditions of plants and animals are changed	⊙

Table A.14 (Continuation)

Type and significance of impacts	Scope of effects
Surface waters	
Removal of surface water/impact on the structure of bodies of water: Impacts on surface bodies of water are to be considered significant if the latter are completely or partially removed or relocated, their characteristic structures considerably changed, and as a result the site and habitat conditions of plants and animals are negatively changed, or the quality of the landscape deteriorates	●/⊙
Limitation of retention functions in bottomlands: Impacts upon the retention function are to be considered significant if they negatively influence the flow conditions and the drainage characteristics, or if the surface body of water cannot be retained in any other natural manner, and as a result, the site and habitat conditions of plants and animals are negatively changed	⊙
Disturbance of the drainage characteristics/flow conditions: An increase in surface water drainage or other impacts upon a body of water are to be considered significant if as a result the runoff volume of a stream is increased, or if the surface body of water cannot be retained in any other natural manner, and as a result, the site and habitat conditions of plants and animals are negatively changed	⊙
Changes in quality of a body of water: Changes in the physical, chemical or biological characteristics of water are to be considered significant if they lead to negative divergence from the initial conditions, and as a result, the site or habitat condition of plants and animals are negatively changed	⊙
Climate and air	
Loss/basic changes in the local climatic conditions, loss/restriction of compensating functions: Impacts are considered significant if overbuilding, removal of vegetation cover or site changes, particularly as a result of impervious coverage, destroys or considerably changes the local meso- and micro-climatic functions	●/⊙
Impacts detrimental to air exchange: Impacts detrimental to air exchange are considered significant if they result in a considerable reduction in the functionality of suitable spaces and/or corridors for that purpose, and if the beneficial effects of these spaces upon functionally associated target areas can no longer be fully provided	⊙/○
Impacts detrimental to climate functions due to pollutant immissions: Impacts upon air quality due to roadway caused air pollution are considered significant if they result in considerable changes in air quality parameters so that functions of the natural balance, such as areas with limited air exchange, which are sensitive to air pollution immissions, are drastically changed	⊙
Biotopes / Plants and animals	
Complete or partial loss of habitat/biotope destruction/destruction of the vegetation cover and/or of single trees, etc.: Impacts are to be considered significant if habitats and/or biotopes, including the local vegetation, are removed, the biotic communities of which have not been strongly or extremely strongly degraded (e.g. because the areas involved are already built-up)	●
Negative impacts upon populations and biotopes due to changes in site conditions: Impacts are to be considered significant if they negatively affect characteristic site factors so that negative changes in biotic communities, especially of value determining species and their development potentials, are to be expected. This may apply in particular cases e.g. with regard to biotopes especially sensitive to lowering of the groundwater, or to low nutrient biotopes especially sensitive to pollution immissions	⊙

Table A.14 (Continuation)

Type and significance of impacts	Scope of effects
Fragmentation of habitats and functional relationships: Impacts causing fragmentation effects are to be considered significant if they cause permanently negative changes in the conditions of life of the species and species communities which are value determining in the particular affected case, and this involves in particular endangerment of the long-term preservation of the population involved, and its survival capabilities and development potentials (especially its dissemination possibilities)	○
Animal death due to accidents: Deaths of animals are generally to be considered significant, provided that these are species which are value determining in the particular affected area	⊙
Endangerment/disturbance of animals (or their behaviour patterns, etc.): Impacts are to be considered significant if value determining species and their biotic communities are disturbed in their species specific behaviour (e.g. due to noise impacts), so that their long-term living conditions are permanently changed, and there survival probabilities and development and dissemination possibilities are considerably reduced	⊙
Landscape quality and recreational value of the landscape	
Loss of landscape elements which contribute to the experience of a landscape: Impacts on the appearance of a landscape are to be considered significant if they remove structures and elements important for the aesthetic quality and values of the landscape appearance (see also below)	●
Visual disturbance or anthropogenically transformation of the landscape experience (including fragmentation effects): Impacts on the appearance of a landscape are to be considered significant if structural-aesthetic qualities and values of the landscape are anthropogenically transformed or reduced. Moreover, the impacts are to be considered significant if the function of elements, structures or parts of the landscape which provide cultural-historical and/or landscape historical information, symbolic content such as sense of “home” or identity, and the basis for recreational and leisure time use are clearly reduced, disturbed or destroyed. Negative impacts on the quality and appearance of the landscape must evoke negative feelings for an average observer open-minded towards the beauty of a landscape	○
Acoustic and other impacts upon the experience of a landscape/the recreational value of a landscape: Impacts involving the recreational value of a landscape are to be considered significant if the level of the evaluation of the pre-intervention condition has been considerably increased by traffic noise, i.e. arithmetically by at least 3 dB (A), or if noise pollution (immissions) exceed the immission guide value of 50 dB (A). This is not to preclude the possibility of cases that a lesser increase in the evaluation level may also result in significant impacts. In individual cases, other impact factors, e.g. the perceived image of traffic volume, may lead to a significant impact upon the experience of a landscape. Generally, this corresponds with other significant impacts upon the landscape experience	○
Fragmentation and negative impacts on the accessibility of a landscape: Impacts upon the accessibility of the landscape are to be considered significant if paths important for landscape related recreation are removed and connections interrupted. The same is true if the construction of facilities hampers accessibility	⊙

Table A.15

Significant or persistent impairment of the habitat function due to pipelines [57, pp. 50-52]

Type of impact	Characteristics
Plants and animals	
Pipeline route with ancillary facilities, operational strip (temporary	• Removal of vegetation structures and soil strata, causing loss of areas as habitats for vegetation, fauna and soil organisms
Pipeline route with ancillary facilities, operational strip (long-term/permanent)	• Often extended change in site factors, resulting in changed biotic communities, including loss of species following pipeline construction • Often extended changes of habitats in case of removal of habitat types requiring long development periods • Often permanent change of habitats in the area of use limitation caused by the facility • Small-scale complete or partial imperviousness of the soil, with permanent loss of habitat functions in the area of ancillary facilities
Areas along the operational strip (temporary)	• Shift of species spectrum of adjacent areas due to disturbing effects (animals); in some cases also due to changes in site conditions (e.g. changes in hydrological conditions, sediment drift due to intervention in creeks) • Fragmentation of habitats and territories of certain animal species • Prevention or impediment to the dissemination of animal species
Areas along the operational strip (long-term/permanent)	• In some cases fragmentation of habitats and territories of certain animal species (in cases of extended changes in site conditions) • In some cases prevention or impediment to the dissemination of animal species (in cases of extended changes in site conditions) • Endangerment of wooded groves due to wind blow and bark blight • Partial shift of species spectrum of adjacent areas due to changes in site conditions
Soil	
Loss of land area and functions (caused by construction and facilities)	Losses due to land consumption, removal and filling of soils with value and function elements of special significance. Near natural soils with largely undisturbed soil profile, differentiated by: • soils with special biotic potential • regionally rare soils • soils with geo-topic/morphogenetic special forms/fossils
Damage caused by mechanical impacts, such as restacking and vehicle operation (caused by construction)	Changes in soil structure involving sensitive to densification and pressure value and function elements of special significance. Natural soil with largely undisturbed soil profile, differentiated by: • soils with special site factors • agricultural soils with special biotic potential
Damage caused by lowering or retention of groundwater (caused by construction)	Changes in hydrological site conditions (e.g. involving groundwater influenced soils), and associated significant changes in the water balance of the soil, differentiated by: • soils with special biotic site factors • soils with high to very high yield functions, due to construction work, and soil densification or drainage affected ditches
Water	
Loss of land area and functions (caused by construction and facilities)	• Utilization, including installation, covering and pipeline laying, also during the construction period, of – springs and spring areas – streams, including banks and floodplains – standing bodies of water including banks – flooded areas – areas close to groundwater (depressions, floodplains, bogs, hollows etc.; depth to groundwater <2m) • Impervious coverage of groundwater recharging areas

Table A.15 (Continuation)

Type of impact	Characteristics
Damage caused by intervention in groundwater and stratum water, and or in the covering strata (caused by construction and facilities)	Functional impediment of the groundwater balance due to: • removal or penetration of the covering stratum • intervention in the groundwater with the stratum water horizon (e.g. construction ditches, removal coverage, penetration to the aquifer, incisions) • structures within the groundwater (if they fundamentally change the groundwater flow behaviour, e.g. through retention or lowering • changes in the groundwater level in areas close to groundwater (depth to groundwater <2m, depending on the depth of the pipeline ditch) beyond the natural seasonal fluctuation range (lowering, retention)
Damage caused by polluted immissions (caused by construction)	• Changes in the quality of surface waters and of the groundwater through pollutant immissions into the bodies of water in the area of upper, uncovered or minimally covered aquifers (unprotected or relatively unprotected), within drinking water protection areas, groundwater supply areas or areas with a high or very high groundwater supply
Air/Climate	
Loss of land area and functions (caused by construction)	• Losses through land consumption due to wooded groves or forest areas with special local climatic or air quality protection functions (climate protection forest) • Fragmentation by earthen walls or other changes in the surface affecting cold air outflow areas with relation to human habitation (non-wooded slopes with $\geq 5°$ inclines and undisturbed cold air outflow with an effect on human habitation areas) • Local climatic changes along cleared cuts in the forest, with an effect on animals and plants
Damage caused by dust immissions (caused by construction)	• Deterioration of air quality
Note: Loss of land area and functions caused by construction is considered a significant impact, since the restoration of the affected function is only possible over the medium or long-term	
Landscape quality	
Loss of land area and uniqueness (caused by construction and facilities)	• Land consumption in – landscape areas with high diversity, uniqueness and beauty (near natural, richly structured, high in visitor experience, free of disproportionate, technical/structural elements) – quiet landscape spaces (free of significant locally unusual noise impact, such as traffic or industrial noise) – loss of uniqueness by separation of areas and the remainder of residual areas with fundamentally changed spatial impressions (fragmentation) in landscape spaces with high diversity, uniqueness and beauty (naturalness, structural richness, capacity to provide visitor experience), free of disproportionate technical/structural elements or noise impact, such as locally unusual traffic or industrial noise • Loss of characteristic natural or near natural landscape elements (e.g. continuous forest stands, old stands of trees, field hedges, orchard meadows, streams, significant geomorphological objects) • Interruption of view connections by the access road, ancillary facilities or walls and ridges of soil
Damage caused by visual disturbance	• Anthropogenic transformation of natural or near natural landscapes through the introduction of technical/structural elements (e.g. marking posts), or terrain modelling

Appendix 1.6

Measures for the avoidance and minimization of impacts

Table A.16

Potential mitigation measures [70, pp. 67-68]

1. Fundamental project alternatives The selection of fundamentally different solutions which achieve the same purpose in a more environmentally appropriate manner
• The use of renewable energies instead of fossil fuels • A central energy supply instead of large-scale power plants • Reduction of the requirement for construction space by means of denser internal development • Underground cables instead of overhead lines • Investigation of possibilities for shifting traffic flows to other, already existing traffic carriers • Expansion of existing traffic routes instead of the construction of new ones • Optimization of existing dikes instead of the construction of new ones • Use of existing facilities, e.g., old towers for new broadcast facilities, instead of building new ones, etc
2. Reduction of the scope, degree of expansion, etc. of a project Reduction of the consumption of nature and the landscape through reduction of the size of a project
• Reduction of necessary overhead line facilities by decentralizing power generation • Reduction of the need for construction space (thrifty use of land area) by space-saving construction methods, reduction in size of construction areas, reduction of the degrees of development, or of the expense • Reduction of the number of maintenance and access roads along bodies of water • Reduction of the degree of expansion and the cross-section size of roads
3. Selection of environmentally appropriate sites and routes (macro-level)
Avoidance of consumption of unused or largely untouched existing spaces, by concentration of routes and lines: • Concentration of supply lines, traffic routes and power lines by means of parallel routing • Siting of new residential areas adjacent to existing ones Avoidance of consumption of areas important for the conservation of nature and the care of the landscape, taking into account all protected assets and functions (if necessary, internal weighing): • Avoidance of consumption of areas with habitats which can only be partially regenerated, or not at all • Avoidance of consumption of sites with the occurrence of endangered animal and plant species • Avoidance of the fragmentation of complex habitats and the minimum areas of these species • Avoidance of the interruption of migration routes (power lines, wind power facilities, traffic routes, etc.) • Avoidance of consumption of landscapes with high levels of diversity, uniqueness and beauty • Avoidance of consumption of areas of significance for the climate (cold air generation areas, etc.) • Avoidance of impervious coverage and emissions in areas with high groundwater recharging capacity, and of soil with high retention capacity • Avoidance of consumption of areas with high natural yield potentials, etc.

Table A.17

Examples of measures to avoid and minimize impacts on protected assets [72, pp. 159-160]

Plants
Avoidance and minimization measures for construction related impacts • Securing the surroundings of significant and sensitive biotopes against vehicle traffic and storage activity • Space-saving storage of excavated earth and construction material • Exclusion of construction facilities and areas from important biotopes • Protection of the surroundings from emissions, eluviation and percolation of pollutants into the soil • Protection from erosion ***Avoidance and minimization measures for facility related impacts*** • Consumption of less sensitive or less significant biotopes/vegetation • Space-saving construction methods, which avoid – large-scale storage and landfill – effects on the groundwater – changes in flooding conditions

Table A.17 (Continuation)

Animals
Avoidance and minimization measures for construction related impacts
• Securing the surroundings of the construction site against pedestrian and vehicle traffic, and storage activity • Space-saving storage of excavated earth and construction material • Selection of reasonable construction sites from a nature conservation perspective • Use of noise-dampened construction machines • Restoration of richly structured sites after completion of construction site use.
Avoidance and minimization measures for facility related impacts
• Noise protection measures • Consumption of less sensitive or less significant animal habitats • Space-saving construction methods • Preservation of essential structural elements in the landscapes, e.g. vegetation • Green bridges • Overcoming fragmentation by use of underpasses and overpasses • Deflection of animal migration through guide facilities • Avoidance of all fences which are not absolutely necessary • Protective facilities along the transport routes (e.g. Protective planting)
Avoidance and minimization measures for operationally related impacts
• Preservation of spontaneous and rural vegetation
Soil
Avoidance and minimization measures for construction related impacts
• Space-saving storage of construction materials, landfill, stored materials, etc. • Exclusion of construction facilities and areas from significant biotope types • Securing the surroundings of the construction site against vehicle traffic • Careful separation of excavated topsoil and subsoil • Appropriate storage of excavated soil; reintroduction if possible • Care for the soil during storage
Avoidance and minimization measures for facility related impacts
• Space-saving construction methods • Consumption of less sensitive types of soil Adaptation of the building to the optimum terrain height, to avoid large excavations and landfills, and changes in the surface shape (interaction with the quality of the landscape)
Surface waters
Avoidance and minimization measures for construction related impacts
• Careful maintenance of machines and the construction materials storage area • Securing of the body of water against damage (ban on crossing by vehicular traffic, or installation of temporary bridges; ban on vehicular traffic in the short area)
Avoidance and minimization measures for facility related impacts
• Facilities to be installed at a maximum distance from the body of water • Avoidance of areas with retention function • Protection against underwashing by planting vegetation • Planting of riparian vegetation • Avoidance of piping • Sufficient bridge structures and culverts
Groundwater
Avoidance and minimization measures for construction related impacts
• Avoidance of uncovering groundwater • Securing groundwater against outwash from construction materials is, by means of coverage
Avoidance and minimization measures for facility related impacts
• Avoidance of sites with low binding capacity or high groundwater levels • Use of construction methods which protect the groundwater
Climate/air
Avoidance and minimization measures for construction related impacts
• Reduction of vegetation removal to the necessary minimum Restoration of former construction sites

Table A.17 (Continuation)

Climate/air
Avoidance and minimization measures for construction related impacts
• Reduction of vegetation removal to the necessary minimum
• Restoration of former construction sites
Avoidance and minimization measures for facility related impacts
• Selection of construction sites outside air exchange corridors
• Prevention of the blockage of air exchange corridors by buildings, dams etc.
• Preservation or restoration of vegetation cover
• Planning for dust reduction
Avoidance and minimization measures for operationally related impacts
• Planting for the purpose of filtering out dust
Landscape quality
Avoidance and minimization measures for facility related impacts
• Preservation of sensitive landscape quality spaces of special uniqueness, diversity and beauty
• Adaptation of the project to the surrounding terrain forms, or the conscious formation of contrast points
• Preservation of characteristic elements of the landscape and of historic vistas
• Incorporation of the project into the surroundings by appropriate planting
• Preservation of existing road connections and of access by means of bridges and underpasses

Table A.18

Recommendations for Impact Mitigation Regulation for mining projects [86, M4a, pp. 1-19]

Possible impacts	Avoidance and minimization measures
Plants	
• Loss of vegetation and biotope structures • Changes in adjacent (residual) stands	• Preservation of especially protection worthy landscape elements by local modification of mining plans • Protection and securing of adjacent stands during the construction period (e.g., construction fences, protection measures for tree trunks and bark) • Transplanting of particularly protection worthy vegetation • Use of parts of plants which have been removed (securing, preservation and reuse of biomass, e.g. for benjes hedges), including seed potential for site typical vegetation development • Marginal and groundcover planting of existing stands (e.g. to protect the internal local climate of the stand, protection from sunburn)
• Endangerment/limitation of the vitality of plants • Loss of sensitive species/ biotopes • Changes in vegetation structure (damage to vegetation)	• Modification of the project with regard to the location of possible emission sources • Construction of edge walls, planting immission protection vegetation • Establishment or preservation of buffer zones • Restructuring of affected vegetation and biotope structures • Intermediate seeding and/or wetting of the biopiles, intermediate storage areas, excavated areas, transport areas etc.
• Fragmentation/isolation of biotope structures/habitats • Barrier effects/interruption of exchange and interaction relationships	• Strengthening of the biotope structure and existing networks • Marginal and groundcover planting of destroyed vegetation stands
• Changes in riparian vegetation/biotope structures	• Local modification of opencast mining plans
Animals	
• Loss of certain individuals/ species • Loss/changes in habitat structures • Reduction of minimum areas	• Local modification of opencast mining plans • Scheduling of mining so as to take into account the temporary emergence of protection worthy areas, particularly for pioneers (“field rotation” in the excavation area) • Consideration for the seasons (removal of vegetation outside of breeding periods)

Table A.18 (Continuation)

Possible impacts	Avoidance and minimization measures
• Loss of isolated populations Changes in typical animal communities	• Relocation of particular individuals of particularly protection worthy species prior to the initiation of vegetation removal (e.g. collection of amphibians, reptiles, snails) • Preservation and reintroduction of removed vegetational structures, including the species contained in them, and their life phases (in the excavation area and/or in adjacent areas)
• Direct impacts (pollutants, possibly as a result of accidents) • Build-up of pollutants in the food chain	• Modification of the project with regard to spatial assignment of possible emissions sources • Planting of immission protection vegetation, marginal walls • Creation or preservation of buffer zones
• Fragmentation/isolation of animal populations/biotope structures/habitats • Barrier effects/interruption of exchange and interaction relationships • Collisions of wild animals with vehicles	• Preservation of important connection features (e.g. foot bridges, dams) • Scheduling of mining so as to permit the relocation and resettlement of animal habitats • If necessary, installation of fences and guide facilities for wild animals • Installation of crossing aids (e.g. passageways, bridges) • Construction of conveyor belts instead of temporary transport roads
• Disturbance and displacement of sensitive individuals and species	• Low disturbance facilities and spatial orientation of sources of disturbance (e.g. insect appropriate lighting, glare shields) • Creation of buffer zones • Construction of protective ridges of soil and planting of protective vegetation
• Partial or total loss of habitat	• Planting of protective vegetation/integration into the present landscape
Soil	
• Loss and reduction of natural soil functions (habitat function, regulation and storage function, buffer and filtering function), and of the archive function • Loss of areas with retention function	• Avoidance of total impervious coverage in appropriate areas • Drainage delay through activation of backwater areas • Securing of the organism rich topsoil, separate storage, reintroduction in the course of re-cultivation, or on external areas • Securing of affected slopes against erosion and deflation by means of biological engineering measures
• Deterioration of natural soil functions (habitat function, regulation and storage function, and filtering and buffer function)	• Modification of the project with regard to the spatial assignment of possible emissions sources • Construction of protective ridges of soil and planting of protective vegetation • Creation or preservation of buffer zones • Wetting/coverage or intermediate greening of ground which its cover removed, or which is subject to vehicular traffic, in order to prevent dust generation
Groundwater	
• Change in the groundwater supply, due to the reduction in groundwater recharging, depending on the degree of impervious coverage in the mining area	• Avoidance of totally impervious coverage in appropriate areas • Drainage delay through activation of backwater areas, creation of retention areas, e.g. retention basins
• Reduction in groundwater quality, due to a reduction of the groundwater protection function	• Local modification of mining plans so as to take into account especially sensitive areas • Securing of the organism rich topsoil, separate storage if possible, reintroduction in the course of re-cultivation, or on external areas (preservation of the regulatory function of the soil as much as possible)

Table A.18 (Continuation)

Possible impacts	Avoidance and minimization measures
• Pollution of the groundwater due to pollution immission, particularly in case of low depth to groundwater	• Modification of the project with regard to the spatial assignment of possible emissions sources • Construction of protective ridges of soil and planting of protective vegetation • Wetting, coverage or intermediate greening of ground or inclines from which vegetation has been removed, so as to avoid dust generation • Greening with protective function for the groundwater
Surface waters	
• Changes in the drainage regulation and retention function, the self-purification function and the habitat function of surface waters • Impervious coverage or compacting of the soil results in surface runoff which enters the streams or standing bodies of water with virtually no delay. This generally results in increased flooding and the intake of nutrients and pollutants	• Local modification of opencast mining plans so as to take buffer zones into account • Preservation of vegetation stocks of particular significance for the respective surface waters (e.g. construction fences, protection for tree trunks and bark) • Transplanting of particularly protection worthy vegetation • Wetting, coverage or intermediate greening of ground and slopes from which vegetation has been removed, in order to avoid water and wind erosion • Retention and sedimentation basins should be installed • Areas which need to be particularly protected against vehicular traffic should be separated • The capacity of soils to withstand mechanical impacts and vehicular traffic should be particularly considered with regard to soil dampness • Intermediately stored or reconstituted soils should be secured against vehicular traffic, etc. • Retention areas, e.g. retention basins, should be created
Climate/Air	
• Loss of areas with a particularly important air quality compensating function • Change in the local climate • Interruption/barrier of cold air/fresh air outflow • Creation of cold air concentrations due to a backup of cold air outflow	• Preservation of the stock of vegetation, with particularly protection worthy compensatory functions and means of local modification of the opencast mining plan • Protection and securing of marginal stocks during the construction period (e.g. with a construction fence) • Immission protection vegetation • Creation or preservation of buffer zones • Marginal protective vegetation along pathways and roads, in order to reduce impacts upon adjacent areas, and to reduce heating effects by means of shading • Local modification of opencast mining plan to preserve bodies of water and their vegetation stocks with particular significance for the climate
Landscape quality	
• Changes in the qualitative characteristics of the landscape, and hence of the potential for experiencing them • Loss of characteristic parts of the landscape, or culturally/ historical significant landscape elements • Loss of typical land-use forms • Disturbance of the landscape experience by reduction of the aesthetic perception of the landscape due to noise and visual interference	• Preservation of especially protection worthy landscape elements and areas through modification of the mining plan • Creation or preservation of buffer zones; • Low disturbance facilities and spatial orientation of disturbance sources • Construction of embankments for noise protection • Planting of vegetation for visual screening • Integration into the present landscape by appropriate vegetation • Transplanting/relocation of particularly protection worthy components, or, in case of unavoidable loss, appropriate documentation • Construction of structures and visually non-sensitive or poorly visible sites (e.g. taking sharp edges into consideration)

Table A.19

Measures for the mitigation of impacts [82, pp. 184-190]

Meaning of symbols:

Possible measures for avoiding impacts

- ● A primarily or directly avoidance related effect
- ○ A secondarily and/or indirectly avoidance related effect
- ✶ Negative effect possible

Causes

- ■ Causal
- □ Possibly causal

Possible measures for the mitigation of impacts (avoidance and minimization)	Causes:			Protected assets favoured on a case-by-case basis					
	Con-struc-tion	Facility	Opera-tion	Soil	Ground water	Surface waters	Cli-mate	Bio-topes	Land-scape
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Measures relevant for weighing. Changes of line routing									
• Routing by assignment to existing structures/transport routes, particularly for linear structures which cause fragmentation (concentration; preservation of large fragmented areas as much as possible)		■		○	○	○	●	●	●
• Relocation of route (protection worthy areas of nature and the landscape)		■		●	●	●	●	●	●
• Selection of shortest possible routes (minimum possible land consumption)		■			○		○	○	○/✶
Measures relevant for weighing. Road design changes (Protection of sensitive and protection worthy areas of nature and the landscape; minimum possible land consumption; reduction of fragmentation to a minimum; noise protection)									
• Reduction of road cross-sections		■		●	●	○	○	○	○
• Fundamental change of gradient, with general avoidance of high dams and deep cuts		■		●	○		●	●	●
• Reduction of the draft parameter (with a selection of lower design speeds)		■		○	○			●	
• Change of position and formation of particular installations (rest stops, service stations, operational areas, etc.)		■		●	○	○	●	●	●
• Reduction of cuts in highly profiled terrain		■		●	●	(✶)	●	●/✶	●
• Recessed location instead of level location (e.g. the reasons for noise protection)		■		●	●	(✶)	○	○/✶	○/✶
• Changes in bridge types, so as to increase clearance and reduce the number of pillars		■		○	○				●

Table A.19 (Continuation)

1	2	3	4	5	6	7	8	9	10
Measures relevant for weighing. Construction condition changes (protection of sensitive and protection worthy areas of nature and the landscape)									
• Changes in borrow pits and dumps, particularly with regard to location, relief formation, transport routes	■			●	○	○	●	●	●
• Careful site selection for construction facilities and access routes	■			●	●	●	●	●	●
Measures for all protected assets and/or general significance									
• Selection of suitable environmentally appropriate road-building materials (particularly surfacing)		■		●	●	●		○	
• Construction using already fastened road components	■			●	●	●	●	●	●
• Reduction of land consumption to the absolutely necessary minimum (e.g. reduction of artificial slope surfaces	■	■		●	●	●	●	●	●
• Selection of appropriate construction procedures	■			●	●	●	●	●	●
• Road closure during new construction of replacement bridge (no temporary bridges)	■			●	●	●	●	●	●
• Careful installation of construction materials (particularly with regard to the reduction/ limitation of construction site areas)	■			●	●	○	○	○	●
• Selection of suitable, environmentally appropriate maintenance measures (no herbicide use, environmentally appropriate gritting material			■	●	●	●		●	○
• Selection of suitable environmentally appropriate care measures (on edge strips, etc.)			■	●	○	●		●	○
Primarily soil related measures									
• Water permeable pavement for suitable traffic areas		■		●	●	●	○	○	○
• Reduction of land consumption by - routing with balancing earthworks (no borrow pits or dumps) - replacement of embankments with support structures		■		●	○	○	●	●	●
• No vehicular traffic if soil is too wet	□	■		●	○			○	
• Stratum appropriate, careful handling and storage (separation of topsoil from subsoil), and replacement of the soil		■		●	○	○		○	
• Rapid re-greening/intermediate seeding of bare soil	■			●		○	●	○	○
• Footbridges across bogs		■		●	●				

Table A.19 (Continuation)

1	2	3	4	5	6	7	8	9	10
Primarily water related measures									
• Temporary sand traps	■					●		○	
• Avoidance of construction measures on bodies of water (e.g., shifting of watercourses)/ consideration for the existing structure of bodies of water		■				●		●	●
• Avoidance of pipe laying; instead, flow-through structures of adequate size with berms, or bridges with sufficient clearance		■				●	○	●	○
• Retention effective vegetation		■		○	○	●		○	
• Water protection strips		■				●		○	○
• Percolation of surface water locally, via embankments, grassy depressions or seepage facilities (basins, hollows, wells)		■		○	○	●		○	
• Construction related measures: - no intrusion into groundwater - installation of impermeable protective layers under the traffic surface - installation of water treatment systems using materials which pollute the water not permitted - residential and storage barracks not permitted - collection and removal of human wastes from transportable toilets	■	■		*	●	○		*	
• Subsurface structural measures to secure the flow of groundwater and the flow-through capacity		■		(*)	●	○		○	
• Foundation construction measures protective of the groundwater/avoidance of construction methods requiring the permanent removal of groundwater (e.g. underwater concrete instead of drainage)	■	■	■	○	●	○		○	
Primarily plant related measures									
• Protective measures for specimen plants	■							●	●
• Transplanting or relocation of rare plant species and vegetation stands	■	■						●	
• Creation of a forest screen to reduce vegetation damage	■	■					●	●	●
• No construction zones/restriction of the construction area/protection of marginal areas/ fencing in of vegetation areas	■			●	●	●	●	●	●
• Watering of sensitive vegetation stands during drainage measures	■			○	○	○		●	
• Drainage measures to be avoided or seasonably limited	■			●	●	●	○	●	

Table A.19 (Continuation)

1	2	3	4	5	6	7	8	9	10
Primarily animal related measures									
• Green and wildlife bridges of sufficient size, wildlife underpasses, animal passageways and bridge structures (sufficient clearance, berms), especially for the purpose of maintaining animal migration routes		■		(★)		●	○	●	○
• Protective measures for animals, including - limitation on the removal of groves and vegetation stands - protective measures for amphibians - structural design appropriate for otters, as per the state of research - capture and relocation of animal populations (e.g. amphibians, hedgehogs, ants, fish etc.)	■	■						●	○
• Temporary/seasonal restrictions on construction	■							●	○
• Protective measures along roads, e.g. terrain modelling, greening of embankments (e.g. using excess material, or lowering of the gradient), walls, high and dense vegetation, guide fences for amphibians, otters etc.		■		★/○			○	●	●
• Elevated tracks or bridge structures of sufficient size, instead of dam facilities (including preservation of riparian vegetation)		■		○		●	●	●	○
Measures designed primarily for the quality and recreational value of the landscape									
• Design of engineering structures adapted to the landscape and noise protection facilities with respect to arrangement, dimensions, shape, materials and colour		■							●
• Construction methods with landscape adapted greening - supporting structures which can be greened (space-grid walls, coarse-grained gravel gabions, rock-fills) - greened noise protection wall systems		■		(★)			○	○	●
• Landscape appropriate design of embankments/consideration for the relief in new surface design		■		○					●
• Near natural, landscape appropriate design of drainage facilities		■				●		●	●
• Preservation of important hiking trails and connections by means of (green) bridges, underpasses		■							●

Table A.20

Measures for avoidance and minimization of impacts from railway projects [52, pp. 90-92]

Animals and plants

General measures

- Spatial limitation of the construction area
- Time limitation of the construction period (e.g. no construction activity during breeding/spawning periods)
- Protection of site factors of crucial importance for habitats (e.g. by planting vegetation)

In case of impacts due to barrier or fragmentation effects

- Time limitation on the construction period, or construction times outside migration phases
- Crossing aids (e.g. green bridges)
- Creation of new habitats prior to initiation of construction
- Bird markers on railway power lines to prevent collision by migratory birds
- Crossing aids when opening or building cable lines during the spawning migration of amphibians

In case of impacts through noise and pollutant emissions (construction caused)

- Spatial limitation of the construction area/ construction site traffic
- Compliance with the guidance values

In case of impacts through noise emissions (operationally caused)

- Planting vegetation
- Terrain modelling

In case of impacts through the vehicular operations

- Protective measures against collisions (planting vegetation, terrain modelling, protective fences)

In case of impacts due to electric shocks on the overhead lines and traction power lines

- Protective measures against electric shocks on traction power lines according to the state-of-the-art for electric power supply companies
- Protective measures against electric shocks on overhead lines through sufficient distance between pylons and the insulation of tip anchors, shrink tubing at critical points, bird spikes and double insulation on the bracings of the catenary system

Soil

In case of impacts due to excavation

- Spatial limitation of the construction area
  - Protective measures during construction
  - Protection of marginal areas
  - Appropriate storage of soil
  - Avoidance of excavation and filling
  - Avoidance of vehicular traffic
  - Stratum-appropriate storage and replacement of soil
- Avoidance of the introduction of non-native soil
- Prevention of erosion due to construction by installation of catchment basins and embankments

In case of impacts due to changes in the water balance

- Structures which permit groundwater to flow through or around them
- Avoidance of de-watering

In case of impacts due to pollutant emissions (construction caused)

- Selection of appropriate building materials
- Spatial limitation of the construction site/ construction site traffic

Groundwater

- No exposure
- Seasonal limitations
- Groundwater conserving construction methods (e.g. underwater concrete instead of groundwater lowering)
- Groundwater dams
- Ensuring flow-through (culverting, surface filtration, lightweight dams)
- Recharging and drainage
- Percolation of unpolluted surface water

Table A.20 (Continuation)

Surface water
• Seasonal limitations • Ensuring of minimum water flow to maintain ecological efficiency • Avoidance of piping • Ensure continuity • Preservation and/or protect shorelines • Avoidance of riverbank reinforcement and river-bottom restructuring • Avoidance of borrow pits and changes in the longitudinal gradient • Containment during construction • Proving bridges during construction • Adequate bridge structures • Adequate passage structures • Temporary sand traps
Climate / air
In case of impacts on the meso-climate • Spatial limitation of the construction area in case of loss of climate-relevant structures ***In case of impacts on air exchange corridors*** • Planning avoidance/reduction as a result of changing the position and height of the roadway, and/or roadside structures (e.g. embankments)
Landscape quality
In case of impacts due to buildings, ancillary facilities and earthworks • Spatial limitation of the construction area • Limitation on the intensity of measures • Consideration of the relief in the surface design • Installation of green bridges • Maintenance of accessibility for the purpose of recreational suitability • Adaptation of the building to the best terrain height, hence avoidance of large-scale excavations and landfills, and changes in terrain contour • Adaptation of the building shape and colour to the surrounding residential structure • Securing/restoration of vegetation and/or planting • Avoidance of consumption of attractive and sensitive recreational areas • Routing of hiking trails and other recreational pathways with underpasses and overpasses • Promotion of alternative recreational possibilities; creation of new points of attraction • Avoidance of areas with potential archaeological finds • Wide clearance around cultural assets for reasons of maintaining their structural stability, of immission control, of vibration control, and of landscape quality ***In case of construction caused impacts*** • Avoid interruption of trails through construction roads, fences, other facilities • Restoration of recreational areas temporarily used for the construction process ***In case of operationally caused impacts*** • Planting of vegetation strips • Terrain modelling • Corrosion protection for cultural assets • Construction around or above the cultural assets, if necessary

Table A.21

Precautions for avoiding impacts from opencast mining projects [90, p. 127]

Relocation of the mining project; partial termination of mining
• Non-use of areas with high significance for particular protected assets, including any requisite buffer areas • Protection of surface waters, e.g. by avoiding mining in the vicinity of bodies of water
Time limitation on mining
• Implementation of certain measures (e.g. clear-cutting, landfilling of bodies of water) outside of growth, breeding and spawning periods • Avoidance of mining of cliff-sides with occupied nesting holes (sand martins, kingfishers)

Table A.21 (Continuation)

Mining procedure
• Detailed stipulation on the mining procedure (mining, re-cultivation and renaturation phases); mining segments as small as possible • Separate securing, storage, treatment and replacement of topsoil • Phased removal of topsoil prior to initiation of mining, and direct replacement without intermediate storage on mined-out and reconstituted surfaces • Avoidance of compacting of the soil • Avoidance of intrusion into the groundwater and lowering of the groundwater • Avoidance of percolation of pollutants into the waters (e.g. in case of accidents involving the release of substances dangerous to the water), by means of appropriate precautions • Preservation of the vegetation on the peat bed, except in case of peat milling procedure
Species protection during mining
• Creation of temporarily unused resting areas in the mining area ("migratory biotopes": temporary biotopes which develop naturally or by deliberate human action in phases of interruption of the mining process), in order to maintain the species population during the mining process • Removal of migratory biotopes due to operational necessity should be carried out as late as possible, and not at points in time unfavourable for the flora and fauna • Vegetation planted to protect species and biotic communities from impacts (e.g. material emissions, noise, disturbance) • Prevention and/or reduction of attraction of nocturnal insects by installation of appropriately designed light sources in the outdoor area (e.g. use of sodium low-pressure lamps, direction of light as vertically as possible, insects proof lamp design) • Only in isolated cases, relocation actions for certain species (e.g. amphibians, reptiles, ants) prior to the initiation of excavation, if success appears sufficiently probable • Avoidance of cliff-side de-watering embankments, especially slit trenches in peat excavation • Implementation of care measures in raised bogs which are to be excavated later, so as to preserve the re-colonization potential for renaturated areas

Table A.22

Impact avoidance and minimization measures in construction of natural gas pipelines [53, pp. 25-32]

General principles
The avoidance and minimization measures must be included in the inventory plans to the extent that they may be spatially presentable. *The goals for the landscape management measures are as follows:* • Selection of the route with the initial consideration that valuable landscape elements are to be largely protected • Bundling of routes and lines in one corridor • Limitation of the width of the operational strip, especially in forests and wooded strips • Large-scale maintenance of existing valuable vegetation elements in the area of power-line cuts • Planting of sufficient vegetation as rapidly as possible, and seeding so as to restore the appearance of the landscape • Re-creation and optimization of the functional correlations in the landscape • Orientation of offset measures (out-of-kind, offsite) for biotope development areas toward landscape typical and representative biotope types
Animals and plants
The following measures generally apply • Protection or by-passing of especially valuable biotope types and habitats as far as possible • Preservation of the site potential by appropriate restoration • Storage and horizon appropriate replacement of topsoil and subsoil of biotope areas (e.g. uncultivated areas, low nutrient meadows, damp meadows), separately from the soil of farm fields, so as to ensure rapid regeneration of the vegetation cover through succession from locally specific seed and rhizome material • Protection of vegetation on fields adjacent to the construction site from foot and vehicle traffic (construction vehicles) with construction of barriers around especially sensitive biotopes • No construction site facility areas in sensitive biotope areas.

Table A.22 (Continuation)

In order to protect copses in the farmland, the following measures are provided:

- Restriction of the operational strip
- Protection and preservation of single copses, especially valuable old trees, in the operational strip, by means of barriers
- Excavation or landfilling in the rural areas of trees and copses must be avoided. For this reason, operational strips should be installed, to the extent possible, outside the immediate vicinity of such trees and copses
- Single trees characteristic of the landscape are generally to be protected.

Measures with respect to wetland of biotopes include:

- When crossing small rows of trees along the shores of creeks, avoidance as far as possible of the removal of trees, in favour of trimming back to the trunk and protection of the roots by means of excavator support mats
- De-watering, if necessary, only in the immediate construction site area; no large-scale groundwater lowering.

Measures with regard to animals and their habitats

- Narrowing of the operational strip in the forest (reduction of effects on hollow trees, species that inhabit them), and in case of rows of hedges and groves
- No removal of trees between March and September
- Construction of facilities for the protection of amphibians during the construction period, inasmuch as spawning migration routes and occurrence of amphibians can be ascertained during the construction period, including the establishment of amphibian protection fences, and inspections in the morning

Soil

In case of open cut construction, if power lines are not laid in paved areas, the humus topsoil in the area of the operational strip is to be removed prior to the actual construction operations, and stored in an adjacent area. Immediately after completion of the construction operations on pipelines, the operational strip is to be cultivated. The various original levels are to be replaced in their original order as far as possible. The trenches will generally only be filled in with autochthonic material. All compacted soil in the operational strip is to be restored by depth loosening, using appropriate tools, in a number of diagonal procedural steps.

Additional measures for the protection of the soil include:

- No vehicular traffic on overly wet soil
- Pavement of construction roads and construction site areas are temporary; foreign material is to be placed on textile tiles and removed completely afterwards
- Geomorphological peculiarities are to be protected
- Soil protective mats and construction roads should be installed if necessary in the area of sites close to groundwater

Groundwater

The following measures are required for the protection of the groundwater:

- If possible, routes should be planned outside of areas where the groundwater will be affected.
- De-watering, if necessary, only in the immediate construction site area; no large-scale lowering of the groundwater. For this purpose, the groundwater is to be temporarily lowered in the area near the construction excavation and/or on route segments of approx. 100 m length. The water removed is to be pumped out and fed back into a local stream after muddy particles have been removed either by a series of straw bale filters or by sedimentation containers. Due to the short period of the de-watering process and the small quantities involved, there should be no significant change in the water flow of the body of water affected.
- Alternatively, broad scale land disposal and seepage of the surface water and/or the water from temporary groundwater de-watering is possible

Surface waters

The route should generally circumvent standing bodies of water.

The crossing of streams should be carried out in such a manner as to protect the body of water involved as much as possible.

- Reduction of the operational strip to the technically possible minimum
- Maintenance of the continuity of streams by temporary sufficiently dimensioned pipes, as required (considering the water flow), and appropriate to the size of the body of water to be crossed

Landscape quality

The quality of the landscape should not be affected over the long term by the pipeline, since no elements characteristic of the landscape are to be degraded or removed

Table A.23

Precautions for the mitigation of impacts in land-use and local development planning [89, pp. 46-48]

Species and biotic communities
Land-use planning
• Non-consumption of areas of special significance for the protected asset "species and biotic communities", including required buffer areas; decision in favour of the best site from a conservationist point of view • Protection of natural biotopes and landscape elements from removal and disturbance by major/minor site dislocation (e.g. avoidance of construction and moving away from the shoreline of water bodies, forest margins and special biotopes) • Modification of the project design (e.g. adaptation of construction project and methods in order to avoid lowering of groundwater)
Local development planning
• Reduction of the degree of expansion of construction (e.g. of access roads) • Concentration of supply lines; small-scale laying of line corridors (e.g. in some areas, avoidance of construction and moving away from the edges of forests and bodies of water, or in groves); avoidance of crossings of bodies of water; laying of cables underground • Installation of systems for the collection and treatment of surface water from construction sites, to prevent contamination of surface waters • Reduction of the movement of landfill masses; as much as possible, "equilibrium" between soil excavating and filling • Requirements to limit the impacts of construction operations (e.g. limitation of the construction area, securing habitats by enclosures) • Planting of vegetation for protection of species and biotic communities against intrusion (e.g. pollution immission, noise, disturbance) • Avoidance of facilities or components which may cause high risks for certain animal groups or species (such as light sources with an attraction effect, or large single-pane or reflective glass façades) • Implementation of certain measures (e.g., deforestation, filling in of bodies of water) outside of sprouting, breeding and spawning periods
Soil
Land-use planning
• Non-consumption of areas of special significance for the protected asset "soil", including required buffer areas; decision in favour of the best site from a conservationist point of view • Protection of natural and cultural historical soil and surface forms by major/minor relocation (e.g., moving away from certain relief forms, such as terraces, sunken pathways) • Modification of the project design (e.g. adaptation of the structure and the construction methods in order to avoid massive earth movement)
Local development planning
• Avoidance as much as possible of impervious coverage; use of water-permeable pavements • Storage and filling of soil, separated into topsoil and subsoil, for the restoration of the original soil structure • Avoidance of non-site-appropriate "soil improvement" (e.g. peat, fertilizer, soil-improving substrates, drainage)

Table A.23 (Continuation)

Surface waters
Land-use planning
• Non-consumption of areas of special significance for the protected asset “water/surface waters”; decision in favour of the best site from a conservationist point of view • Protection of surface waters by major/minor relocation (e.g. moving away from waterways, retention areas, flood plains, and of water crossings when building roads, paths and pipelines) • Retention of precipitation water in naturally designed catchment facilities or seepage depressions
Local development planning
• Preference for bank fortification with vegetation rather than “technical” solutions • Vegetation planting for protection against entry of pollutants into surface waters • Significant reduction in the volume of wastewater and ensuring a steady flow of wastewater effluent; improvement of the cleaning capacity of sewage treatment plants, particularly with separate sewage systems, so as to allow rainwater to seep into the soil • Adequate treatment of surface and waste water from construction areas prior to discharge into surface waters • Prevention of entry of pollutants into surface water by installing protective systems effective even in case of accidents involving the release of water pollutants, such as light material separators, quenching water catchment basins, or shallow vegetated sedimentation basins • Avoidance of excessive runoff events into surface waters of the intake area through – minimization of allowable degree of impervious coverage – collection of rainwater in plants and households, and use as water for production, open space irrigation, etc. – retention of rainwater in naturally designed retention basins and seepage depressions
Groundwater
Land-use planning
• Non-consumption of areas of special significance for the protected asset “water/groundwater”; decision in favour of the best site from a conservationist point of view • Retention of rainwater in naturally designed retention basins and seepage depressions
Local development planning
• Modification of the project design so as to avoid changes of the groundwater body, e.g. by – construction of structures without exposing of groundwater and lowering it – orientation of the foundation of the building extending into the groundwater body in line with the groundwater flow direction in order to reduce the accumulation of groundwater • In case of land use with no contamination risk for the groundwater: reduction of the degree of impervious coverage and surface runoff by using water permeable pavements • In case of land use with contamination risk for the groundwater: impervious coverage of surfaces against infiltration and installation of protective systems such as light material separators, quenching water catchment basins, or shallow vegetated sedimentation basins – Retention of rainwater in naturally designed retention basins and seepage depressions

Table A.23 (Continuation)

Air
Land-use planning
• Non-consumption of areas of special significance for the protected asset “air”; decision in favour of the best site from a conservation his point of view • Prevention of additional pollution sources in certain areas by excluding the location of polluting plants
Local development planning
• Optimization of production processes and environmental engineering measures, e.g. by reducing emissions into the environment through clean air technology • Reduction of pollutant emissions as a result of lower heating energy consumption, through the use of energy efficient building methods and windbreak vegetation • Reduction of local climatic disturbances, particularly in densely populated areas, through planting vegetation, house and roof greening, installation of seepage depressions for rainwater, and preventing of impervious soil coverage
Landscape quality
Land-use planning
• Non-use of landscape areas of special significance for nature conservation, including a sufficiently large apron; decision in favour of the best site from a conservationist point of view • Protection of landscape components typical of the natural area (relief, vegetation, use and building forms) from removal and disturbance, by means of major/minor relocation, by moving away from such elements as – shorelines – striking individual structures of the relief (e.g. hilltops, slopes, ridges, valley centres) – forest edges – exceptional single trees – rows of trees and groves adjacent to other characteristic and structuring landscape elements – copses and groves with a marked or historically significant arrangement pattern – isolated shrubbery, if it is in a visual context of characteristic and structuring landscape elements – typical examples of historic field divisions – ensemble situations – greened village edges with a connection function between populated and non-populated areas • Siting the project near – industrial and commercial areas without greening and with no design qualities typical of the natural area – rural and urban settlement areas with no regionally or locally typical designs – non-greened village edges, depending on the particular building shape (e.g. without a regionally typical appearance or a characteristic silhouette)
Local development planning
• Prevention of scale and proportion losses and atypical forms, design of the project with consideration, reproduction or continuation of the natural area, regionally or locally typical designs, particularly with regard to the characteristics and properties of the building – base/floor plan – height, width, length – shape/orientation (e.g., roof shape or tilt) – spatial arrangement (e.g. construction form, form of development, spatial orientation) – façade design – building materials/surface design – colours of the components – use of plants

Appendix 1.7

Measures for compensation of impacts

Table A.24

Compensation in connection with other goals, based on a landscape plan [40, pp. 6-7]

Clean water
Compensation measures based on extensive farming in a water protection zone may be useful not only for conservation but also for groundwater protection.
Buffering and upgrading of protected areas
If the compensation areas are located in a protected area or around valuable biotopes, the ecological value of such habitats can be considerably improved, e.g. thanks to buffering against external influences.
Improvement of residential environments
The development of compensation areas in residential areas has a positive effect on residential quality and the attractiveness of the area concerned.
Biotope network
If a compensation area is located between isolated habitats, it can contribute significantly to the strengthening of the biotope network system.
Village edge greening
Green village edges are a characteristic of historically developed villages. Such marginal areas can in many cases be restored or created anew by means of the application of the Impact Mitigation Regulation.
Recreational precautions
Compensation areas can contribute to the aesthetic enrichment of landscapes. Together with bike paths and hiking trails, they can contribute to enhancing a recreational landscape.
Implementation of care and development plans
In protected areas, too, upgrading is possible and sensible. Compensation areas can help in the imple-mentation of certain goals of care and development plans for protected areas, or maintenance plans for bodies of water.
Erosion protection
The new planning of a field hedge can also provide an important contribution to soil and erosion pro-tection.
Securing of greenbelts
If upgradable areas located between residential areas are available as compensation areas, they can be used for the permanent securing of green belts and their important functions.
Flood protection
Compensation areas near bodies of water may have an important function as retention areas for floods, in addition to their significance for protection of nature and of species.
Preservation of a variety of cultural landscapes
The variety of a cultural landscape can be improved or restored by means of compensation measures, such as hedges, tree-lined avenues, sunken pathways or particular types of farm fields.
Development of ecologically especially valuable forests
Non-site-appropriate forests are also suitable as compensation areas. They can e.g. be turned into near-natural forests with diverse stocks of species, by means of forestry measures.

Table A.25

Requirements for the ascertainment of compensation and offsetting measures [88, pp. 16-18]

General requirements
For compensation and offsetting measures, only areas can be used which are both capable of upgrading and require upgrading. When selecting areas, the following requirements and conditions should be taken into account: • The area must be suitable in terms of natural space and of site for the compensation requirement appropriate to the impact • It should be certain that the areas on which compensation is carried out are not yet the sites of, or in the vicinity of foreseeable new impacts, or otherwise subject to previous planning • Compensation measures in the impact area of the project are only permissible if the success of the measure will not be endangered by that impact • The location of the compensation areas should not be chosen purely for reasons of property ownership, or based on financial criteria.

Table A.25 (Continuation)

Biotopes
• For biotope types of Value Level III, which will be damaged or otherwise suffer significant impact, a development, if at all possible, of the same biotope type with the same characteristics (level of naturalness), and of the same sized area is required. For this purpose, possible areas with biotopes of Value Level I should be used. • If it will not be possible over the medium term (up to 25 years) to restore biotope types of Value Level III in the area affected by the impact with the appropriate characteristics, the area requirement for biotopes difficult to regenerate will be increased to a ratio of 1:2, and in the case of non-regenerable biotopes, to a ratio of 1:3. • If biotopes of Value Level II are destroyed or otherwise significantly impacted upon, it will be sufficient to develop such a biotope of the same area size using biotopes of Value Level I. If possible, a near-natural character should be developed.
Soil
• For compensation, primarily removal of impervious coverage is required. • In case of impervious coverage of soils of particular significance for the natural balance, compensation measures are to be carried out in a ratio of 1:1. For other soils, a ratio of 1:0.5 or 1:0.25 will be sufficient.
Landscape quality
• Planting of species native to the site: If available, trees and shrubs native to the site with certification of origin should be planted • The plant material to be used: saplings, twice replanted, height 150-200 cm; shrubs: light shrub, once replanted, height: 70-90 cm • The share of trees could be at least one third • The groups of trees or individual trees should be high stem trees which have been transplanted at least 3 times, and securely anchored • In case of endangerment from feeding wildlife, take appropriate measures • An at least three-year development care period; during this period, losses are to be replaced • In case of overhead lines and other structures, the compensation may under certain circumstances consist of the dismantling of existing overhead lines or other structures which disturb the appearance of the landscape. For this purpose, the new structures and those to be removed should be similar in terms of type and degree of impact. Partial improvements achieved for the landscape quality are to be credited accordingly to the compensation requirement.

Table A.26

Examples of practicable compensation and offsetting measures at the multifunctional type level

[72, p. 180]

Biotope types affected by the impact (loss)	Baseline condition (biotope type) of the compensation area	Target condition (biotope type) of the compensation area	Type of measure
1	**2**	**3**	**4**
Near-natural ditches	Non-natural streams and ditches	Renaturation to near-natural streams	Offset
	Species-poor damp meadows	Development of small bodies of water	
Reed-beds and tall sedge marshes	Non-natural standing waters	Development of reed-beds and tall sedge marshes	Offset
	Species-poor damp meadows	Development of damp tall forb fields	Compensation
Marsh and swamp forests, bog and swamp shrubbery	Species-poor damp meadows	New planting of damp forests	Offset
Coppice forests	Intensively used farmland	New planting of coppice forests	
Deciduous forests with local tree species	Intensively used farmland	New planting of deciduous forests with local tree species	
Coniferous forests and field groves with non-native species	Intensively used farmland	New planting of deciduous forests	
Bushes, hedges, forest edges with local tree species	Intensively used farmland	New planting of shrubbery with primarily local species	Compensation

Table A.26 (Continuation)

1	2	3	4
Cleared corridors	Intensively used farmland	Development of ruderal fields	
	Intensively used farmland	New planting of forb fringes in connection with wooded areas	
Semi-dry, sandy, low-nutrient nardous grassland	Species-poor meadows	Development of species-rich low-nutrient meadows	Offset
Heath	Species-poor meadows	Development of species-rich low-nutrient meadows	
Semi-dry meadows and pastures	Species-poor meadows	Development of species-rich meadows	Compensation
	Intensively used farmland	New planting of species rich meadows	
Fallow grassland in the herb stage	Species-poor meadows	Development of species-rich meadows	Compensation
	Intensively used farmland	New planting of species rich meadows	
	Intensively used farmland	Development of a ruderal field on farmland	
Orchard meadows with old high trunks	Intensively used farmland	New planting of an orchard meadow	Offset
	Intensively used farmland	New planting of a row of trees	

Table A.27

Checklist for conceiving avoidance, minimization and compensation measures [72, p. 177]

Mitigation and compensation goals
How can the threatening impacts be avoided, minimized or compensated?
Which measures are possible to avoid or minimize impacts?
Could changes of the structural/technical nature lead to a minimization of these impacts upon the animal/plant group investigated? What kind of changes?
Where is the stipulation and delimitation (construction fence?) of taboo areas (sensitive biotopes/habitats with protection-worthy populations) necessary, on which no construction site activity may be permitted?
What remaining impacts will there be?
Which compensation and offsetting measures are necessary for which impacts?
Which possibilities exist for the development of a biotope network system?
Which species is the proposed biotope network to serve? Which is it not designed to serve?
When is an impact on the habitat of the animal/plant group investigated to be compensated? When is it to be offset?
Is re-settlement from the surroundings possible? Or will a new locally important habitat arise?
Which measures are conceivable to increase the success of re-settlement and reduce the time that that will take?
Do dissemination centres exist which can serve as a point of departure for the settlement of possible compensation and offsetting habitats?
Which existing data bases are available to aid in the establishment of development goals and the biological model (species and biotope protection programmes, biotope mapping, literature, knowledgeable local actors)?
What kind of biological model might be appropriate for the animal/plant group investigated?
Which deficits exist for the population in the natural area?
Which measures are being considered by the local conservation authorities in the area under investigation?
Which spatial references should ideally exist in the landscape area for the group of animals/ plants?
Can target species and/or systems for the operationalization of biological models be defined for the group of animals/plants? Which criteria should be considered for the selection of target species within the group of animals/plants investigated?
Where could the isolating effects of barriers between habitats be reduced?
How should the new habitat be structured in order to be accepted as a compensation area? Which habitat elements must be present?
Are the site conditions of the area selected suitable for the goals set?
Is the existing stock in the selected area known? Or might conflicts arise with existing habitats and uses there which are worthy of protection from a conservationist point of view?
Is the size of the area sufficient to harbour a stable viable population?
Is the proposed site endangered by effects from adjacent areas (pollutants, optical/acoustical disturbances)?
Are suitable dissemination centres of appropriate species available in the vicinity; how is the passability of intermediate spaces to be assessed?

Table A.27 (Continuation)

Which competing uses might hamper success?
Where are habitats/biotopes worthy of protection polluted and/or endangered (other than by the planned project), and how might they be improved, extended, networked or buffered?
Should habitats be temporarily optimized or newly created prior to the implementation of the planned construction project, so that they could be settled in advance (until the compensation measures take effect) by the target species (value-determining species) involved (refuge biotopes)?
Care measures, success controls
What should the follow-up and development care be like, and when and how long should it be carried out?
Which costs will be incurred?
What should an appropriate success control and monitoring process of the measure look like?
What are the suitable guide and target species or groups for this purpose?

Table A.28

Measures for the creation of target biotopes [95, pp. 1-5]

Description of construction measures
Site preparation • Clearing and levelling the storage area • Erection, maintenance and dismantling of a safety fence • Placement, maintenance and removal of construction trailers/containers
Removal of all impervious coverage installed • Breaking up of the impervious cover (asphalt, concrete, masonry, ferroconcrete) with bulldozers and jack hammers • Piling up and loading the rubble with a wheel-loader • Loading and removal of rubble for dumping or recycling • Ripping up the surface to remove compaction; then cover with topsoil and remove.
Removal of all reinforcements in bodies of water installed • Destruction of all shoreline reinforcements, barrages, bed drops and pipe canalizations, with a bulldozer • Loading and removal of rubble for dumping or recycling.
Removal and replacement of topsoil • Moving topsoil aside appropriately to the profile, with wheel-loader or bulldozer • Dumping and seeding the biopile, or recycling the soil material • Profile-appropriate replacement of soil material with angle dozer or wheel-loader • Layer thickness approx. 10-30 cm.
Shore reinforcement using bioengineering methods • Implementation of biological shore reinforcement measures through the installation of fascines, reed logs, vegetation fascines and erosion protection mats.
Restoration of inflows and outflows • Construction of groundsills/overflows • Construction of regulatable weirs • Construction of spillways.
Deep soil loosening and land improvement liming • Chisel ploughing with tractor and heavy-duty cultivator, 35 - 40 cm deep • Deep soil loosening, 70 - 80 cm deep • Land improvement lime spreading with tractor and fertilizer spreader.
Re-wetting by reversing de-watering measures • Closing drainage ditches by landfill and introduction of binding material with wheel-loaders or bulldozers • Removal/excavation of drainages, and refilling the excavated material with additional binding soil materials, with a bulldozer • Sealing/closing of drainage pipes with loamy/clayey material from both sides, over a length of 2 m, manually.
Fencing in • Construction of a dry wall of natural stone (procurement and delivery of irregular broken stones; emplacement of broken stones, manually; fill cracks with topsoil if necessary) • Construction of cairns and stone walls • Construction of a protective fence (e. g. knot-mesh fence; wire-mesh fence; panel fence).

Table A.28 (Continuation)

Description of planting measures
Seeding • Meadow seeding with herbaceous plants • Seeding with heudrusch or hay/mulch (semi-dry/dry grassland, mountain meadows) • Underseeding, pre-seeding – procurement and delivery of seed – loosening of soil by machine if necessary – wet (spray) or dry seeding.
Planting of wild forbs (only initial planting) • Procurement and delivery of plant material • Hand planting of plant material.
Planting of shrubbery • Procurement and delivery of plant material (50/80 or 100/150), and wrapping of seedlings on site • Implementation of soil improvement measures • Plant pruning • Digging of holes and ditches for the plants, planting of bushes, filling in • Loosening of soil in planted area and mulching • Anchoring of plants if necessary • Follow-up care, watering of plantings if necessary.
Planting of single trees • Procurement and delivery of plant material (tree girth 12-18 cm), and wrapping of seedlings on site • Implementation of soil improvement measures • Plant pruning • Digging of planting holes, planting of trees and filling in • Installation of protection against browsing animals • Anchoring of plants • Follow-up care, watering of plantings if necessary.
Large-scale planting of trees and shrubs • Procurement and delivery of plant material (50/80 or 100/150), and wrapping of seedlings on site • Loosening of soil by machine if necessary, and implementation of soil improvement measures • Plant pruning • Planting of trees and shrubs at intervals of generally 1x1 m • Loosening of soil in planted area, and mulching if necessary • Follow-up care, watering of plantings if necessary
Reafforestation (coppice or medium-height forest) • Procurement and delivery of plant material (seedlings etc.), and wrapping of seedlings on site • Plant pruning • Planting of trees, generally at intervals of 1 x 1.25 m • Loosening of soil in planted area, and follow-up care.
Re-planting of semi-dry grassland • Mowing of semi-dry grassland areas and removal of sods from roll • Implementation of soil loosening and soil improvement measures by machine, levelling of terrain • Laying out and roller-pressing of sods.
Forest restructuring • Thinning of conifer stands to reduce the density • Advance planting of deciduous species • Vetting of the understands every 5 - 10 years, depending on their state of growth, with the goal of developing a stable screen of old trees • Supplementing trees stands with native deciduous species when they reach an age of 70 - 80, in accordance with the potential natural tree species composition • Fencing in of plantings if necessary.

Table A.29

Representation of the required compensation in the Land-Use or Landscape Plan

The selection of suitable compensation areas should be shown in the explanatory report of the Land-Use Plan and the Integrated Landscape Plan. This can, e.g., be done by way of the following tabular overview for each of the planned construction areas.

In addition to evaluation of the situation, and a preliminary ascertainment of the gravity of the impact, it is also possible to estimate the expected compensation requirement. However, since only the subsequent Construction Plan and the mitigation measures contained in it will determine which factors are appropriate, it is at this point only possible to ascertain a **preliminary compensation requirement**. Moreover, the recommended compensation model, i.e. the likely site of the compensation, as well as the development goals of the compensation measures, should be presented.

Form for the presentation of the preliminary compensation requirement [40, p. 7]

Planned use:	Commercial
Number in the plan:	
Field number/s:	
Size (in ha):	2131
Expected site occupancy index	>0.35 (high degree of impervious coverage)
Sensitivity level of the balance of nature and the landscape quality:	Category I (low significance)
Justification:	This is intensively used farmland. The protected assets water and local climate are not affected. The fields have been cleared out and contain no trees or shrubs. The adjoining buildings of the farming operation can be expected to account for low to medium impingement upon the appearance of the landscape.
Expected compensation factor:	0.3 – 0.5
Expected compensation requirement (in ha):	0.6 – 1.0
Recommended compensation model:	Eco-account or external offsetting area, since the municipality will in future have only few expansion possibilities for an appropriate commercial utilization, and the area should therefore be effectively used.
Recommendation for the compensation measure:	Extensification of damp meadows in the area of the former fen site (development goal: species-rich orchard meadows), or transformation of farmland in the floodplains, and reafforestation (development goal: floodplain forest)

Table A.30

Examples for the determination of compensation and offsetting measures [83, p. 22]

Examples of functional connection	
Example 1	
Functions affected	Negative impact upon the habitats of species and biotic communities, and on the landscape quality, due to the loss of a regularly pruned blackthorn hedge of considerable age in the farming landscape.
Possible compensation	No compensation possible; development period is longer than 25 years
Possible offset	Planting of a species-rich blackthorn hedge involving long-term care measures
Example 2	
Functions affected	Negative impact on the appearance of the landscape due to loss of single trees and rows of trees in the transitional zone between a settled area and uninhabited landscape
Possible compensation	Planting of a tree-lined avenue in spatial proximity to the impact
Possible offset	Planting of a tree-lined avenue within the natural area affected
Examples of spatial connection	
Example 1	
Functions affected	Impact on the habitat of a bat species due to loss of important guide structures, such as hedges and tree-lined avenues

Table A.30 (Continuation)

Possible compensation	Planting of hedges/linear tree/shrub structures in the direct spatial proximity (within the habitat area of the population)
Possible offset	Planting of hedges or tree-lined avenues suitable to function as guiding structures for bats, within the same natural spatial region
Example 2	
Functions affected	Negative impact on the outflow of a watershed area, due to impervious ground coverage
Possible compensation	Measures for the removal of the impervious coverage, or the improvement of water seepage into the soil within the entire affected watershed area
Possible offset	Measures for the removal of the impervious coverage throughout the natural area affected
Examples of temporal connection	
Impact	Clear-cutting of a 60-year-old pine forest
Functions affected	Functional expressions of general importance for the protected assets soil, water, climate/air, and species/biotic communities
Possible compensation	The development time until the functional fulfilment of an equal in-kind and equivalent condition, e.g. reafforestation, would be greater than 25 years. There are no potential reafforestation areas available in the vicinity.
Possible offset	Taking into account the pertaining regional peculiarity of a high proportion of forest land, a measure involving “ecological forestry restructuring” in a neighbouring forest in the area would meet the requirements of the impact mitigation regulation.
Examples regarding priority setting in the selection of offsetting measures	
Functions affected	Loss of habitat for the yellow hammer and the red-backed shrike by clear-cutting of field groves
Compensation impossible	No corresponding wooded structures can be implemented in the spatial vicinity
First priority: offsetting at a greater distance	The habitat functions for the yellow hammer and the red-backed shrike are to be restored by the planting of field groves in the natural area
Second priority: only similar offset nearby	The habitat function for other less endangered breeding birds is to be improved by the planting of single bushes and trees in the near vicinity
Third priority: only equivalent offsetting	The habitat function of ground breeders is to be improved by the extensification of grassland, e.g. in a bustard-protection area 20 km away

Table A.31

Compensation measures for railway projects [52, pp. 101-103]

Plants and animals
• Creation of new habitats (e.g. refuge biotopes, networking, minimum areas), prior to the initiation of the actual measure • Creation of in-kind and equivalent habitats, taking into account – minimum areas – special site conditions (abiotic site preconditions, use) – current functions of the areas – possible networking and special habitat requirements (main habitats, migration routes, etc.) – development period (and long-term care if necessary) of the measure (measures with a process over time) – creation of habitats in (close) spatial connection with the place of impact (spatial/functional context) – use of plant material of regional origin..
The functional area impacted must be restored in at least the same order of magnitude (surface area) as it is impacted upon, and/or restored in value to the same degree as it is reduced in value by the negative operational impacts and fragmentation.
Soil
• To restore the vegetation cover: Greening with indigenous trees and shrubs, landscape typical grassland seeding, or natural succession • In case of compacted soil: Loosening (mechanically, or with deep-rooters) to reduce the runoff coefficient within the landscape area (that measurement is oriented toward the runoff coefficient of the landscape area overall)

Table A.31 (Continuation)

• In case of de-watering: Re-wetting (depending on the time factor and the soil type) • In case of over-wetting: De-watering (depending on soil type) • Measures for the improvement of the soil structure (e.g. humus enrichment, planting of deep-rooters • Minimization of pollutant immission into the soil (including due to agricultural fertilization and spraying) • Soil-improvement, e.g. through vegetation or extensification of use.
In case of soil improvement measures, the condition of the soil prior to the measure must be considered (lack of disturbance of profiles, existing pollution, intensity of use, previous impacts upon the landscape area as a whole, degree of impervious coverage, undisturbed soil, etc.). Compensation measures for the development of soils only contribute to the strengthening of the ecosystem if in the case of marginal disturbance effects, areas of at least 1 ha are generally included in the measure (to preclude the effects of disturbances). Impervious coverage should basically be compensated by the removal of such coverage in a ratio of 1:1 for roads, car parks, etc., in the same landscape area. If this is not possible, measures to optimize soil functions are to be provided.
Water
Possible compensation measures for the restoration of the original groundwater conditions include: • Improvement of covering layers (e.g., topsoiling or plantation of vegetation) • Extensification of the surface use (e.g., by agriculture, and minimization of fertilizer and herbicide input) • Improvement of self-purification capacities • Minimization of existing pollution.
As a compensation measure for the negative impacts upon surface bodies of water, the upgrading of existing bodies of water (renaturation) and the minimization of existing pollution are suitable. The following compensation measures can be considered***:*** • Renaturation or near-natural development of streams, including with the dismantling of existing pipe canalization, river bottom reinforcement and uniform profiles, and ensuring of complete passability • Establishment of site-appropriate shore strips, mid-water berms etc. • Dismantling of existing burdens through improvement of self-purification capacities (richly structured streambeds, water plant stocks, breakwater stones for oxygen enrichment, etc.) • New establishment or renaturation of standing bodies of water in a near-natural structural manner.
Climate/air
Negative impact on the meso-climate: • Restoration of the relief, and greening • Creation of climate-improving structures (trees and shrubs, bodies of water, grassland).
Compensation of negative impacts on air exchange corridors theoretically possible with very high effort: • Restoration of the relief, and greening • Strengthening of fresh air systems by creation of cold air producing areas • Creation of climate improving structures (trees and shrubs, bodies of water, grassland) • Creation of new air exchange corridors for target areas, by removal of barriers (e.g. embankments, intrusive afforestations, etc.).
Negative impacts on air quality: • Planting of trees and shrubs for the purpose of minimizing pollution.
These measures may involve additional significant and permanent negative impacts upon nature and the landscape.
Landscape quality
• Landscape appropriate restoration or landscape appropriate new creation • Introduction of vegetation structures which positively change the diversity or the natural character of the landscape • Restoration of pathway connections and/or creation of new pathway connections • Enhancement of the landscape typical characteristics by dismantling of existing disturbances, e.g. possibly including reduction of perceptibility of these disturbances (e.g. through use transformation, planting of trees and shrubs, dismantling of elements alien to the landscape).

Table A.32

Measures for the care of target biotopes [95, pp. 6-7]

Clearing of trees and shrubs
• Felling of trees and bushes near the ground • De-branching by machine, and shredding • Loading and removal of the felled and cut timber • Shredding, loading, removal and recycling (composting) of the waste wood • Removal of the roots with tractors, bulldozers, angle dozers or wheel-loaders • Loading, removal and dumping or recycling of roots
Development care/care of young trees and shrubs
• Mowing of tree disk and tree/bush growth areas twice a year, for 2 - 3 years • Readjustment of anchorings • Annual shape pruning for high trunks and fruit trees • Loading, removal and recycling of mown and pruned material • Watering of trees and shrubs if necessary
Care pruning
• Care pruning of field and shoreline groves, including removal of pruned material, every 10 - 15 years • Care pruning of single trees/tree-lined avenues every three years • Tree care measures/care pruning of old trees • Implementation of large-scale rejuvenation pruning only segment by segment, to preserve areas for animals • Shredding, loading, removal and recycling of pruned material
Short rotation coppice management
• Ploughing vegetation under • Rejuvenation of coppice species by trimming back to trunk every 15 - 30 years, section by section • Vetting of coppice growth once or repeatedly • Shredding, loading, removal and recycling of pruned material • Supplementation with seeded growth after repeated cutting back to trunk
Forest restructuring
• Thinning of conifer stands three times over the course of five years (reduction of density) • Care of deciduous advance plantings (cultivation care, young growth care, trunk-thickening care • Fencing: maintenance for 10 years, and then removal
Marginal strips of farmland
• Creation of intermediate structures by abandoning use of marginal strips of farmland
Mowing
• One-time mulch mowing for initial establishment, with flail mower, including removal of matted undergrass • Mulch mowing and hay harvesting in alternate years (low nutrient and nardous grassland) • Mowing once a year, including removal of mown material • Mowing of damp and wet meadows and fresh grassland three times a year, for impoverishment • Permanent mowing of damp and wet meadows and fresh grassland once or twice a year, for hay harvesting • Permanent mowing twice a year of mountain meadows for hay harvesting, at various slope inclines • Mowing of edge areas once a year • Removal of vegetation from beds of bodies of water if excessive, every 3 - 5 years • Mosaic-type mowing of high forb fields and great sedge beds every 5 -10 years • Mosaic-type mowing of reed beds every 5 -10 years
Extensive pasturage
• Cattle pasturage: 1 head/ha/yr. • Sheep pasturage: 3-4 head/ha/yr. (in case of excessive bush growth, with a few goats if appropriate)
Sod cutting
• Cutting and removing of sods by machine • Implementation of sod cutting by section, with small segments every 15 years • Loading, removal and recycling of sods
Mud removal
• Clearing of the bed in the shoreline with a bulldozer • Implementation of clearing only in small segments, to preserve refuge areas for animals • Loading, removal and dumping of mud

Table A.33

Examples of care and maintenance measures [83, pp. 64-65]

Target biotope	Baseline situation	Care and maintenance measures	Development period (years)
1	**2**	**3**	**4**
Near-natural streams (creeks, small rivers)	Regulated, polluted streams	Mowing of non-wooded shoreline strips every 1-2 years in August; removal of mown material; additional work on shoreline if necessary; prune shoreline trees/shrubs back to the trunk if necessary, remove the waste wood	30-80
Artificial streams (non-reinforced ditches)	Farmland, grassland, reinforced ditches	Clear out every 1-3 years, section by section, in September/October; for ditches not feeding into a river, clear out every 3-5 years, spread the excavated material flat along the ditches; mow the edge strip along the ditch annually in August, and remove the mown material	6-30
Standing bodies of water which must be prevented from forming land	Ponds, meres, old branches of streams, spawning biotopes, small bodies of water	Remove the mud every 3-10 years in September/October, and spread it along the side if the size of the area permits, otherwise remove; keep shore clear of tree/shrub growth and mow every 1-2 years in August; remove mown material	1-30
Re-wetted/ renaturated bogs	Farmland, grassland, reafforestation	Remove tree growth initially, and thereafter when necessary; monitor levies (e.g. turf embankments), and heighten them if necessary	6-30
Non-wooded swamps and fens	Farmland, grassland, reafforestation	Mow every 2-3 years in August/September, remove cuttings; possible use as litter or hay for farm animals	6-30
Reed-bed areas	Damp meadow land, damn farm fields, open and reinforced ditches	Mow every 2-3 years in, remove cuttings	6-30
Extensively used damp meadow land	Farmland, intensively used meadowland, forests	Mow twice a year not before June 15; alternative: cut starting June 15, thereafter pasture use; use of mown material as hay or silage, or removal; monitor water content	6-30
Non-wooded succession areas	Farmland, intensively used meadowland, other open spaces	Clear trees/shrubs if necessary	1-30
Landscape meadows	Open spaces in residential areas	Mow once a year in August, remove mown material	6-30
Dry and semi-dry grasslands	Shallow to medium sandy sites, dry sites with major shrubbery growth, very nutrient-poor farmland and grassland	Pasturage or cutting every 1-2 years, remove mown material; if necessary, remove tree/shrub growth every 5 years; remove waste board or pilot up along the edges in loose heaps	6-80
Dwarf shrub heaths	Heath areas with initial tree/shrub growth, reafforestation, farmland, grassland	Sheep pasturage; if necessary, remove tree/shrub growth every 5 years; alternative: mow or burn off every 5 years for rejuvenation. If necessary, remove sod. Note: when mowing at the end of September, the mown material can be used as seed for new heath areas.	6-80
Single tree/shrub groups (rows of trees, tree-lined avenues, groups of trees	Edges of paths and roads, farmland, grassland, etc.	2 - 3 years development care, then shape-pruning; maintenance-pruning every 10 years, remove cuttings	30-80

Table A.33 (Continuation)

1	2	3	4
Near-natural forests and forest edges	Farmland, grassland, forests	a) Reafforestation, 5 years of development care; fencing to keep out small animals, to be maintained for 5-7 years, then removed b) Create open spaces for natural rejuvenation and succession, open up the forest soil; check development after 3 years; fencing to keep out small animals, to be maintained for 7-10 years, then removed; waste wood can be left on site	>150
Continuous planting of locally native wild trees/shrubs (field copses, field hedges, wall hedges)	Farmland, grassland	2 years of development care; cut back to the trunk every 5-10 years section only or selectively; leave waste wood on-site	80-150 (mature woods) 6-80 (young shrubbery)
Orchard meadows	Farmland, orchard plantations	2 - 3 years development care-pruning, then shape-pruning; cultivation-pruning every 3-5 years to maintain the fruit trees; mow twice a year, use the mown material as hay or silage; alternative: mow once in August and remove mown material and cuttings	80-150
Guide fences and passageways for amphibians and ground-dwelling small animals		In winter or early spring, clean and clear out the pathways or cut back growth; check for possibility and functionality, and repair if necessary	None

Table A.34

Compensation and offsetting measures for impacts affecting various protected assets
[86, M7a, pp. 1-19]

Possible impacts	Possible compensation and offsetting measures
Plants	
• Loss of vegetation and biotope structures • Changes in (remaining) stocks in adjacent areas	• Restoration or new creation of in-kind and/or equivalent vegetation and biotope structures (including their areas of effect) in affected landscape areas, taking into account the landscape development potentials • Enabling of succession developments (including their areas of effect), with the definition of the development goals • Care and development of previously impacted or development-capable vegetation and biotope structures
• Endangerment/limitation of the vitality of plants • Loss of sensitive species/ biotopes • Changes in vegetation structure (damage to plants)	• Restoration of the appropriate vegetation and biotope structures (after termination of the pollutant emissions) • New creation of in-kind and/or equivalent vegetation and biotope structures • Care and development of previously impacted or development-capable vegetation and biotope structures/removal of other disturbing effects • Strengthening of the vitality of plants and biotopes (through improvement of site conditions)
• Fragmentation/isolation of biotope structures/habitats • Barrier effects/interruption of exchange and interactive relationships	• Dismantlement of barriers in excavation areas, and in the affected landscape • Strengthening of biotope networking through the new creation or supplementation/improvement of networking elements; creation of buffer areas • Expansion of existing spaces with special biotope structures (upgrading to complete habitats of the species affected)

Table A.34 (Continuation)

Possible impacts	Possible compensation and offsetting measures
• Changes in vegetation / biotope structures in the area of the new watercourse	• Near-natural development of non-natural bodies of water, including their floodplains • New creation/restoration of structures typical of the bodies of water, taking the typology of the body of water into account
Animals	
• Loss of individuals/species • Loss/change of habitat structures • Reduction of areas to less than the necessary minimum • Loss of isolated populations • Changes in typical biotic communities	• Expansion of existing vegetation and biotope structures, or in-kind creation of new ones, taking into account species-specific requirements, and the landscape development potential
• Direct pollution (pollutants, possibly cases of accidents) • Concentration of pollutants in the food chain	• Restoration of appropriate vegetation and biotope structures (after termination of pollution emissions)
• Fragmentation/isolation of animal population/biotope structures/habitats • Barrier effects/interruption of exchange and interactive relationships • Road kill	• Dismantling of barriers • Re-creation of important connection areas (e.g. footbridges, embankments) • Expansion of existing vegetation and biotope structures, or in-kind creation of new biotopes • Strengthening of biotope networking through the new creation or supplementation/improvement of networking elements; creation of buffer areas • Expansion of existing spaces with special biotope structures
• Disturbance and displacement of sensitive individual animals and animal species	• Creation of quiet in other areas of the affected landscape by creation of large-scale undisturbed zones (e.g. elimination of pathways)
• Partial or total habitat loss	• Expansion of existing vegetation and biotope structures, or in-kind creation of new ones, taking into account species-specific requirements, and the landscape development potential
Soil	
• Loss or minimization of natural soil functions (habitat function, regulation and storage function, buffering and filtration function) and of the archive function • Loss of areas with a retention function	• Removal of impervious coverage and restoration of soil surfaces impacted upon, and/or other impervious surfaces off-site. • Introduction of farming methods especially gentle to the soil, such as conserving soil management in combination with catch crop planting / green fertilization, and mulch seeding or direct seeding procedures • Deep loosening of soil damaged by compaction (off-site), followed by farming procedures gentle to the soil (planting of deep-rooters as permanent greening in the first 1-7 years after loosening; mulching of seedlings) • Dismantling of drainages and/or de-watering measures for the purpose of rewetting • Introduction of grassland-use procedures especially gentle to the soil, by reducing mowing frequencies and pasturage • Introduction of forestry procedures especially gentle to the soil, by using tree species mixtures appropriate to the site, and horizontal and vertical structuring of the levels of the stock
• Deterioration of natural soil functions (Increased particulate immissions will, depending on the material structure of the immitant, cause changes in pH value, in soil fauna, and/or of the material balance	• Care and development of previously impacted or development-capable vegetation, and/or removal of disturbing elements, so as to strengthen the local protective function of the vegetation for the soil

Table A.34 (Continuation)

Possible impacts	Possible compensation and offsetting measures
Groundwater	
• Change in the groundwater supply due to impervious coverage and soil compaction	• Impervious coverage removal and restoration of impacted soil surfaces, or other impervious surfaces off-site • Improvement of disturbed sites in the adjacent landscape area of particular/ development-capable significance for the groundwater balance (e.g. permanent greening) • Deep loosening of affected soils in combination with subsequent planting of deep-rooters and several years' rest for the soil
• Reduction in groundwater quality through a reduction in the groundwater protection function	• Improvement of damaged sites/support of the natural soil function (especially storage and regulation function, filtration and buffering function) in the adjacent landscape of particular/development-capable significance for the groundwater balance • Restoration of vegetation structures with the protective function for the groundwater in adjacent areas • Removal of damaging effects to protect the local protective function of the vegetation for the groundwater
Surface waters	
• Change in the outflow regulation and retention function, the self-purification function and habitat functions of surface waters: Impervious coverage and soil compaction cause increased surface runoff, which rapidly flows into streams or standing bodies of water. This generally leads to aggravation of floods and increased nutrient and pollutant immissions	• Creation of retention areas, establishment of shore strips, planting of shoreline trees/shrubs (improvement of the habitat and self-purification functions) • Creation of permanent vegetation stocks in the watershed area of surface bodies of water outside the mine expansion/new excavation area, for the promotion of water retention capacity • Near-natural development of non-natural streams in order to promote their self-purification and water-retention capacity • Improvement of damaged sites/promotion of natural soil functions in the adjacent landscape (by soil loosening, use extensification, etc.) • Loosening of the soil and restoration of soil surfaces used, or other impervious surfaces off-site
Climate / air	
• Loss of areas with a significant clean air balancing function • Changes in the microclimate • Development of barriers for cold/fresh air exchange, and blockage of cold air outflow (emergence of cold air "lakes")	• Restoration or new creation of in-kind or equivalent vegetation structures in affected landscape areas, taking into account the landscape development potentials and the local assignment of compensation areas to the effect areas for the improvement of the local climate activity, e.g. new creation of woodland, creation of climatically effective guide structures (e.g. windscreen planting), removal of barriers to air passage, etc.) • Removal of barriers to air passage off-site, especially in the area of the affected landscape
Landscape quality	
• Changes in the qualitative character of segments of the landscape appearance, and hence of its experience potential • Loss of landscape segments or elements characteristic of the appearance of the landscape and/or of its cultural/historical significance • Loss of typical land-use forms • Reduction of the landscape experience and landscape aesthetics due to noise, odours or visual disturbance	• Restoration of the affected landscape elements (including their areas of effect) in the segment of the landscape affected • New creation of in-kind and/or equivalent landscape-typical elements, taking into account the development potential and requirements of the cultural landscape • Care and development of previously polluted or development-capable landscape elements/use forms, or of particular elements and their surroundings • Re-activation or new creation of significant vistas

Table A.35

Compensation measures for significant impacts upon assets and functions of nature and the landscape [62, pp. 148-151]

Potential effects	Function affected	Possible compensation measures
Species and biotopes		
Complete or partial loss (i.e., reduction in size) of vegetation, organisms and/ or other landscape elements	Species and habitat function. Biotope networking function	• New establishment of biotopes • Supplementation and improvement of existing biotopes • Population-related habitat development
Fragmentation/interruption of spaces and functional connections (here: habitats)	Biotope networking function	• New establishment of networked biotopes, e.g., stepping stones, corridors
Immissions of pollutants and/or nutrients	Species and habitat function	• Establishment of buffer zones around existing biotopes • Extensification of agricultural use • Measures for the improvement of the self-purification capacity of bodies of water • Establishment of shore strips or waterside strips as buffer zones toward adjacent utilization
Changes in the water balance (e.g. lowering of groundwater		• Improvement of abiotic site factors of biotopes, e.g. through removal of impervious coverage or wetting • Re-wetting of former wetland biotopes • New establishment of richly structured wetland areas, particularly in connection with extensification • Upgrading of non-natural streams • New establishment of near-naturally designed standing bodies of water and streams
Disturbance of animal species		• Establishment of buffer zones around existing biotopes • Visual screen plantation
Soil		
Loss of soil and its specific properties	Production function Regulation function Habitat function Archival function	• Removal of impervious coverage • Measures for erosion protection (e.g. permanent vegetation coverage of the soil) • Extensification of agricultural use • Reversal of de-watering, fertilization, liming, etc. • Humus care, soil improvement measures
Changes in soil structure		• Removal of impervious coverage • Vitalization of the soil, e.g. through loosening (mechanically, or by means of deep-rooters) • Erosion protection measures (edge planting, transformation of farmland in the forest, wooded areas, succession areas or extensive grassland on erosion-endangered sites)
Immissions of pollutants and/or nutrients	Production function Regulation function Habitat function	• Increasing the siltation and buffering capacity, e.g. through humus care and soil improvement measures • Extensification of agricultural use • Rehabilitation of contaminated soils • Minimization of pollution immissions
Change in the water balance of the soil		Re-wetting of soils Dismantling of de-watering facilities (drainages, ditches emptying into rivers etc.)

Table A.35 (Continuation)

Potential effects	Function affected	Possible compensation measures
Water		
Change in the soil structure; loss or reduction of precipitation percolation	Drainage regulation and groundwater new formation function	• Minimization of surface water drainage through impervious coverage removal and planting • Groundwater enrichment through retention and percolation facilities for precipitation water
Anthropogenic transformation/change of landscape elements (here: complete loss or partial loss [i.e., reduction in size] of flood water retention due to terrain relief changes)	Retention function	• Re-establishment of floodplain areas cut off by dikes • Renaturation of bodies of water, e.g. widening of stream profiles • Groundwater recharging by means of retention and percolation facilities for precipitation water
Climate/air		
Change in the micro- and meso-climatic conditions	Bioclimatic balancing function	• Re-creation of a climate-relevant terrain surface profile • Creation of evaporation-active structures (groves, bodies of water, grassland) • Promotion of climate-active areas with functions for cold and fresh air production and exchange
Interruption or reduction of cold air and fresh air outflow; blockage of ventilation, disturbance of air exchange		• Removal of impervious coverage • Promotion of climate-active areas with functions for cold and fresh air production and exchange • Support for air exchange by means of surfaces with low roughness (e.g. low vegetation)
Pollutant immissions		• Immissions-protection plantation • Support for air exchange of surfaces with low roughness
Complete or partial loss of vegetation and/or other landscape elements (here: air filtering stands of vegetation)	Immission protection function	• Planting of immission protection vegetation • Plantation for local climate improvement
Landscape quality		
Changes in landscape spaces due to: complete or partial loss of, or change in vegetation and/or other landscape elements	Experience function Recreational function	• Creation of near-natural forests • Implementation of renaturation measures • Removal of elements which disturb the aesthetics of the landscape • Re-creation of landscape elements typical of the natural area • Creation of areas for recreation and the experience of nature • Incorporation of structures and village edges by planting measures, provided that visual relationships are not disturbed • Greening with trees/shrubs; landscape-typical wild meadow seeding, or natural succession • Planting of visually effective large trees/shrubs
Interruption/change of visual relationships		• Locally typical design of structural facilities and open spaces • Accentuation on important visual connections, creation of new focal points in case of fragmentation
Interruption/disturbance of pathway connections important for recreation		• Re-creation of pathway connections, and/or creation of new ones
Immissions of pollutants, odours and/or noise		• Planting of immission protection vegetation • Extensive noise protection plantation

Table A.36

Specific compensation and offsetting measures for various protected assets [72, p. 181]

Soil
• Removal of impervious coverage • Measures for optimizing soil functions in connection with measures for improving soil structure – humus enrichment – seating with deep-rooters – dewatering or wetting (depending on the biotope type) – melioration, e.g. mechanical soil loosening • Minimization of utilization intensity • Minimization of pollutant, pesticide and nutrient immissions • Measures to protect against erosion by building of near-natural structures • Re-cultivation of existing, deteriorated soils (e.g. former opencast mining/quarrying areas) • Restoration of the vegetation cover • Initiation of succession stages on fallow fields
Groundwater and surface waters
• Renaturation of bodies of water by – dismantling of weirs, bankings and barriers – expansion of retention areas • Minimization of the immission of pollutants and the eutrophication of surface bodies of water by – establishment of shore strips – use extensification – measures for improvement of the capacity for self-purification • New establishment of bodies of water and shore strips • Upgrading and enlargement of standing bodies of water, stabilization of water flow-through • Upgrading of existing overly steep drainage ditches into bodies of water which are again accessible elements of the landscape, by – broadening ditch profiles – raising ditch floors • Creation of mosaic-like network structures in ditch areas • Minimization of surface runoff through removal of impervious coverage and planting • Re-wetting of de-watered formerly damp grassland
Climate/air
• Restoration of a climate relevant surface structure • Creation of climate-supporting structures (woods, waters, grassland) • Windscreen plantings • Plantings for immission protection • Plantings for local climate improvement • Increasing the evaporation from areas with functions for cold air production and cold air exchange • Removal of impervious coverage • Creation of fresh air corridors
Landscape quality
• Restoration of landscape elements typical of the natural area • Implementation of renaturation measures • Establishment of culturally/historically attested elements (e.g. tree-lined avenues) • Incorporation of buildings and village edges through planting measures • Restoration of pathway connections and/or creation of new ones

Table A.37

Examples of typical measures or uses in compensation areas [41, pp. 33-34**]**

Baseline situation	Target measure or use
Habitat and land use types creatable over the short to medium term	
Farmland, grassland, fallow land	Single trees, rows of trees, groups of trees and tree-lined avenues, development stages of hedges, bushes, groves and forest edges, young orchard meadow
Hypertrophic and eutrophic standing water bodies, farmland, grassland, opencast mining areas	Wetland biotopes (e.g. ponds, land-forming areas, reed belts, reed sweet-grass and bulrush communities)
Reinforced sources, degraded source areas	Renaturated sources and headwater fields
Piped watercourse, drainage pipes	Non-reinforced ditches, renaturated river sections
Shore areas kept free of vegetation	Reed-beds, tall forb communities, shoreline woods, unused shoreline strips
Wet areas used for agriculture	Reed-beds, flooded meadows
Farmland in valley sites	Extensively used grassland, fresh to moist sites
Farmland, grassland, opencast mining areas	Ruderal areas, succession areas
Opencast mining areas; otherwise no typical initial biotopes	Rocky and bare-ground biotopes: cairns and rock embankments, sandy, gravely and crushed rock areas
Habitat and land use types creatable over the long term	
Farmland, grassland	Development stages of ecologically especially valuable deciduous and mixed forests with characteristic species inventory
Farmland, grassland, fallow land	Species and structure-rich hedges, bushes, groves and forest edges
Farmland, grassland, orchards	Low-nutrient or extensive grassland, orchard meadows
Streams degraded by shoreline or bed reinforcement, piping or regulation	Natural stream and river segments
Small-scale (manual) peat digs	Regeneration stages of bog-typical communities
Damp grassland sites, stream banks	Development stages of tall forb communities with characteristic species inventory
Farmland and grassland on shallow soils; fallow or shrub-covered low-nutrient or semi-arid grasslands	Development stages of sandy low-nutrient or semi-arid grasslands with characteristic species inventory
Intensively farmed wet meadows	Development stages of moor grass and nard grass meadows, sedge or rush rich damp or wet meadows, with characteristic species inventory
Initial biotopes within the habitat network system specific to the animal species concerned	Habitats for the settlement of Red List vertebrates, or of highly endangered animals, in areas where introduction is sufficiently promising, due their position in the habitat network
Examples of high-quality habitat types in which compensation measures are usually excluded	
Ecologically especially valuable deciduous and mixed forests, bog, swamp, marsh and flood-plain forests, forests and scrublands of dry warm locations, ravine forests, block and colluvium forests	
Transitional peat bogs and raised bogs	
Fens and wet meadows	
Natural and near-natural river and stream sections and land-forming areas of standing waters	
Low nutrient meadows, heathland, nard-grassland, open inland dunes, thermophilic margins	
Extra-alpine rock fields	

Table A.38

Ascertainment of the significance of negative impacts and indications for the ascertainment of avoidance, minimization and compensation measures (incl. offsetting) in road building [56, pp. 12-32]

Relevance/significance of negative impacts

● Generally relevant ○ Relevant in certain cases None - Generally non-relevant

Landscape quality				
Relevance of negative impacts → Complex of causes ↓	Complete loss of landscape elements which provide a positive experience: Destruction of valuable elements of the landscape scenery	Visual disturbance or anthropogenic transformation of the landscape scenery: Disturbance, transformation and/or alienation due to elements non-typical of the landscape, including visual interruption effects	Acoustical and other impacts on the landscape experience: Negative impacts on the landscape experience due to odour, noise or pollution immissions, especially in areas free or almost free of noise and pollution, as a precondition for landscape-based recreation; recreational value of the landscape is expressly specified as protection-worthy in the Impact Mitigation Regulation	Fragmentation and impacts on the accessibility of the landscape and/or of the areas for landscape-related recreation: Interruption of pathway connections, barrier effects for recreation seekers, especially to be assessed inasmuch as the accessibility of the landscape is expressly specified as protection-worthy in the Impact Mitigation Regulation
Construction	○	○	○	○
Facility	●	●		●
Operation		●	●	●
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Type and characteristics of elements particularly marking the landscape • Incl. elevation (level, trench, embankment) • Impervious-covered surface (sq m, ha)	• Built-up area (sq m, ha) • Type, dimensions, especially height, colours etc. of buildings • Vistas	• Spatial structure of the landscape, especially immissions reducing structures (buildings, groves, forests etc.) • Existing pollution immissions	• Type and characteristics of recreation-providing landscape elements, esp. • accessibility/availability of recreational infrastructure • pathways and vistas
Avoidance and minimization	• Protection of geomorphological particularities • Preservation of striking and characteristic vegetation views • Protection of sensitive landscape segments • Adaptation to the relief, reduction of design speed	• Routing in connection with existing infrastructure • Consideration for the relief in new terrain modelling • Consideration of existing water bodies • Terrain-proximate gradients • Consideration for/preservation of important vistas • Screening structures or plantings	• Immissions protection planting and structural measures for immissions protection • Trench/box cut for the road, instead of level design	• Consideration of historic pathways • Preservation of important trails and pathway connections using green bridges, underpasses • Preservation of the infrastructure needed for nature-oriented recreation (outlooks, panoramic views, etc.) • Preservation of unfragmented spaces to the maximum extent possible

Table A.38 (Continuation)

<table>
<tr><td rowspan="4">Compensation measures</td><td colspan="4">• Restoration of landscape elements typical of the natural area (hedges, groups of trees)
• Implementation of renaturation measures
• Seeding of wild meadows typical of the region
• Use of site-appropriate native trees and shrubs
• Planting of structurally rich hedges on embankment slopes, walls and roadside strips
• Planting of new shelterbelts and forest fringes
• Planting of such culturally/historically attested elements as tree-lined avenues and rows of trees etc.
• Supplementation or development of the remains of characteristic vegetation views
• Reintroduction of landscape typical uses</td></tr>
<tr><td></td><td colspan="3">• Introduction/reintroduction of characteristic guide structures and design elements
• Accentuation of important vistas, creation of new viewpoints in cases of interruption (point de vue)
• Incorporation of structures, non-optical coverage
• Incorporation of village margins
• Creation of contrast points by means of large vegetation near buildings which cannot be incorporated</td></tr>
<tr><td></td><td></td><td>• Upgrading of hitherto non-attractive areas for landscape-related recreational use, by means of design measures
• Reduction of noise, odour and pollution immissions along other existing roads</td><td>• Restoration of original trails and pathways by means of green bridges and underpassages
• Creation of new pathway connections in order to upgrade hitherto non-attractive areas for landscape-related recreational use</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="2">Indications for determining scope of compensation measures</td><td colspan="2">• Measures which serve exclusively to compensate for the loss of experience-providing landscape elements are generally to be restored at a ratio of at least 1:1, with respect to the measurable size of the negative impacts. A more favourable ratio is to be provided only in the case of planting measures.
• The question of whether compensation goals can be achieved even through measures for the compensation of other protected assets should always be examined</td><td colspan="2">• Construction measures, particularly pathway connections, are to be carried out as broadly as necessary for the restoration or improvement of the accessibility of a new or upgraded recreational area corresponding in size to the impacted area</td></tr>
<tr><td></td><td>• Not only the required areas, but especially the correct selection and location of measures are important for achieving sufficient compensation. This is especially true for the long-distance effects caused by changes in the contour lines of the field of vision</td><td colspan="2">• The upgrading of hitherto non-attractive areas is to be carried out by suitable measures in the spatial context of the affected experience area, which is primarily impacted by noise.
• Emissions reduction measures are to be carried out at such a scope that emissions impacts on the planned road can, on balance, be compensated for</td></tr>
</table>

Table A.38 (Continuation)

Soil						
Relevance of negative impacts → Complex of causes ↓	Complete loss of function with regard to: • habitat • regulation • general production	Reduction of soil functions: due to removal and replacement, mixture, etc., i.e. not due to impervious coverage	Soil compaction: → reduction of soil functions → increase in surface water outflow	Soil erosion: → reduction of soil functions)	Change in the soil water balance: Change in site conditions → especially of habitat and production functions	Accumulation of pollutants: → negative impacts on all soil functions → negative impact on groundwater
Construction	○	●	●	○	○	●
Facility	●	●			○	○
Operation						●
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Impervious-covered surface (sq m, ha) • Type of soils affected (type and characteristics of various soil functions	• Built-up area (sq m, ha) • Type, extent (volume) of soils affected (type and characteristics of various soil functions)	• Compacted area (sq m, ha) • Type of soils affected (sensitivity to compacting)	• Vegetation-free area (sq m, ha) 14 • Type of soils affected (sensitivity to erosion)	• Type, location of dewatering measures, water quantities (cu m/unit of time) • Location, expanse of depression • Type of soils affected	• Construction materials, location and type of construction site facilities • Road drainage • Dissemination conditions • Buffering/filtering capacity of the soil
Avoidance and minimization	• Reduction of road profiles • Selection of shortest route • Construction of already reinforced road segments • Construction taboo zones,			• Restriction of construction area • Early re-greening/ intermediate seeding • Avoidance of removal and replacement of soil		
	• Protection of marginal areas • Change of type of reinforcement	• Protection of marginal areas • Change of gradients/ reduction of design speed • Adaptation to terrain level, avoidance of construction of box cuts and embankments • No replacement with soil foreign to the site	• Avoidance of driving on overly wet surfaces • Layer-appropriate storage and replacement of soils		• Avoidance of dewatering measures • Watering during dewatering measures • De-watering during wetting measures • Flow-through or flow-around structures in the groundwater area	• Reduction of pollution emissions from vehicle traffic • Traffic control measures (speed limits) • Selection of appropriate environmentally neutral maintenance measures (no herbicide use, environmentally appropriate spreading materials [sand, not salt]) • Structural immissions protection measures (e.g. incl. noise protection) or embankments • Oil and pollutant separators

Table A.38 (Continuation)

<table>
<tr><td rowspan="2">Compensation measures</td><td colspan="3">• Restoration of vegetation cover (greening with native trees and shrubs, landscape typical grassland seeding, natural succession)
• Measures for improving soil functions (humus enrichment, use extensification, soil loosening)
• Renaturation/cultivation of negatively impacted soils
At least 1 ha area size</td><td rowspan="2">• Bioengineering measures/ use of living/natural material
• Capture of water at the crown</td><td rowspan="2">• In case of wetting: de-watering measures on originally terrestrial soil
• In case of de-watering: re-wetting measures</td><td rowspan="2">• Reduction of the overall pollution immission into the soil (incl. fertilizers and agro-chemicals; use extensification)
• Rehabilitation of contaminated soils</td></tr>
<tr><td>• Impervious coverage removal (off-site)
• Restoration of original use form
• Measures for the improvement/ development of soil functions</td><td></td><td>• Soil-loosening (mechanically or with deep rooters)</td></tr>
<tr><td rowspan="2">Indications for determining scope of compensation measures</td><td colspan="2">• Check to see whether further compensation activities for other impacted functions need to be carried out on the areas which have been upgraded and/or have had impervious coverage removed (multiple functions</td><td rowspan="2">• If compacting can no longer be reversed, additional measures off-site to improve soil functions should be provided</td><td rowspan="2">• On erosion-endangered areas, with appropriate measures</td><td rowspan="2">• Measures of a scope and duration adequate to restore the original soil water conditions
• If original soil water conditions cannot be restored, additional measures off-site to improve soil functions should be provided</td><td rowspan="2">• If soils must be considered impacted in terms of both type and extent, the soil functions of other impacted soils are to be restored or improved, to at least the same extent</td></tr>
<tr><td>• In general, impervious coverage is to be offset by impervious coverage removal at an area ratio of at least 1:1 (compensation)
• If impervious coverage removal cannot be provided, measures for improvement of soil functions are to be carried out for the remaining area, at a ratio of at least 1:1</td><td>• Restoration of other currently impacted soils and site conditions at an area ratio of at least 1:1 is to be provided as a priority (compensation)
• Secondarily, measures for the improvement of soil functions at an equal or greater area ratio can be considered (offset) for the remaining impacts)</td></tr>
</table>

Table A.38 (Continuation)

Species and biotopes					
Relevance of negative impacts → Complex of causes ↓	Complete loss of habitat through removal of vegetation, reinforcement of bodies of water, etc.	Fragmentation of habitats and functional relationships: Loss of habitat segments, isolation effects, interruption of habitat connections	Killing of animals: Death through traffic accidents, overheated road surfaces, etc.	Impacts on animal behaviour and movement patterns: Disturbance by noise, light and motion	Impacts on the metabolisms of plants and animals due to the impact of pollution
Construction	○	○	○	○	○
Facility	●	●			
Operation		●	●	●	●
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Type and characteristics of habitat or biotope-determining structures (biotope types) • Occurrence of animal species and populations (area requirements, escape distances) • Type, volume and height of buildings				
	• Built-up areas (sq m, ha)	• Built-up areas (sq m, ha)	• Impervious-covered surface (sq m, ha)		• Type of construction material • Type of maintenance measures • Occurrence of sensitive plant species and communities, incl. biotope types • Occurrence of animal species and populations (position in the food chain)
Avoidance and minimization	• Change of gradients (adaptation to relief, reduction of design speed) • Construction by end-tipping method, or with already reinforced road segments • Construction taboo zones • Restriction of construction area • Protective measures along the roadway (e.g. terrain modelling, walls, embankments, protective planting) • Limitation of construction period				
	• Selection of shortest route • Protection of sensitive biotopes/ biotope structures • Protection of marginal areas	• Sufficiently dimensioned green bridges, tunnels and passageways	• Reduction of the attractiveness of biotope structures along the road (esp. feeding and breeding)	Route in box cut	• Route in box cut • Reduction in pollution emissions from vehicle traffic • Selection of appropriately environmentally neutral construction materials • Selection of appropriately environmentally neutral maintenance measures (no herbicide use, sand, not salt) • Collection and removal of surface water

Table A.38 (Continuation)

Compensation measures	Creation of biotopes/habitats of equal type and value, with consideration for: • Minimum areas; generally, minimums must be considerably exceeded • Special site preconditions • Current functions of the areas • Special habitat demands, esp. networking Creation of (new) refuge and/or replacement biotopes, if necessary, with sufficient advance time and appropriate spatial location; possibly merger with of like biotopes	
	• If, due to conditions, only offsetting is possible, equivalent biotopes are to be created • If intensive agricultural areas (farmland, intensively used grassland) are affected, and these have no further reaching significance for animals or biotopes, extensification measures and/or functional, appropriate biotope development measures are generally to be provided as compensation	
Indications for determining scope of compensation measures	• The newly created biotopes must be large enough so that their upgrading can fulfil the functions of the biotopes destroyed; generally, a newly created area will be larger than the impacted area • When planning the measure, it is important to ensure its correct selection and positioning, particularly with respect to spatial, functional and temporal contexts	
	• In case of compensation deficits due to development time, ratio increases in the size of the measure, or additional measures, are to be provided • The value of the areas upon which compensation measures are carried out is to be considered with respect to the determination of the scope; generally, the scope of the area will be enlarged • In case of planting or renaturation measures, it is important to examine whether these measures might also be suitable to compensate for other impacts on the balance of nature and the landscape (multiple function)	

Table A.38 (Continuation)

Climate/air				
Relevance of negative impacts → Complex of causes ↓	Destruction or serious impacting of the microclimate: Destruction or serious impacting of areas with balanced temperature and humidity conditions, with largely unpolluted air, or with a markedly unique local climate; cold air creation areas; follow-up effects on plants and animals	Anthropogenic transformation of the microclimate: Negative impacts on areas with balanced temperature and humidity conditions, with largely unpolluted air, or with a markedly unique local climate; follow-up effects on plants and animals	Impact upon air exchange: Negative impacts on air corridors and fresh air systems, blockage of outflow of cold air	Impact upon air quality: Negative impacts on animals and plants, or of the well-being of people in connection with experience of the landscape
Construction	○	○		
Facility	●	●	○	
Operation				●
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Built-up areas (sq m, ha) • Types of buildings • Type of climate structures affected (vegetation and uses))			• ADT values • Dispersion conditions • Sensitivity of plants and animals to air pollution • Areas of significance for experiencing the landscape, especially clean air areas
			• Type, position and size of embankments, box cuts etc. • Air exchange conditions (relief, channels	
Avoidance and minimization	Cf. indications on soil, species and biotopes			
	• Preservation of climate relevant structures		• Bridge structures	• Immissions protection plantation
Compensation measures	• Restoration of a climatically effective terrain structure • Creation of climate-supporting structures (trees and shrubs, bodies of water, grassland) • Impervious-coverage removal			• Planting of trees and shrubs for off-site pollution filtration (not for avoidance) • Reduction of pollution emissions from such other sources as agriculture (use extensification) • Impacts which only affect air quality or the atmosphere cannot be compensated
			• Creation of air exchange channels for relevant target areas by removing blockages • Creation of cold air generation areas	
Indications for determining scope of compensation measures	• Due to the close connection between these impacts and corresponding impacts upon the soil, the vegetation and to some extent bodies of water, the statements made regarding these assets apply here as well • The question of the extent to which the required measures can achieve the compensation goals relevant here must be examined		• The scope is determined in accordance with the forecast impact, and to the extent that it is useful in spatial/ functional terms	• The scope is as required for measures regarding comparable impacts upon the soil and the vegetation

Table A.38 (Continuation)

Groundwater					
Relevance of negative impacts → Complex of causes ↓	Reduction of new groundwater: Negative impacts upon water resources as habitats or sites for plants and animals; simultaneously, increase in surface water runoff	Dewatering: Negative impacts on site conditions for plants and habitats for animals, and on source fields	Disturbance of groundwater flow conditions: (barrier effects, groundwater exposure, redirection) Negative impacts on site conditions for plants and habitats for animals, and source fields	Groundwater pollution: Negative impacts on water resources as habitats or site conditions for animals and plants, impacts on groundwater outlets and source fields	Impact on groundwater-quality-relevant protective effects: Reduction or change of covering layers, negative impact on groundwater resources negative impacts on water resources as habitats or site conditions for animals and plants
Construction	○	○	●	○	○
Facility	●		●	○	○
Operation				●	
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Water quantities (cu m/yr., mm/yr.) • Impervious-covered surface (sq m, ha) • Built-up area (sq m, ha) • Compacted area (sq m, ha) • Current groundwater new formation rate (mm/yr.)	• Water quantities (cu m/time period) • Location, extent and depression • Areas sensitive to drops in groundwater level (plant communities, animal species)	• Position, dimensions, depth of barriers • Location, dimensions, depth of groundwater exposure • Construction procedure • Areas sensitive to changes in groundwater flow conditions (plant communities, source fields)	• Construction materials • Road drainage • Location and type of construction site facilities • Dissemination conditions (filtering capacity of the covering layers, groundwater flow conditions, esp. slope water and backed-up water) • Areas sensitive to changes in groundwater quality (plant communities)	• Type, location, depth and volume of covering layers removed • Filtration capacity of covering layers • Type of groundwater and distance to groundwater (free or confined aquifer, distance to surface) • Areas sensitive to changes in groundwater balance
Avoidance and minimization	• Reduction of impervious coverage • Reduction of land consumption • Reduction of artificial embankment slope areas • Reduction of the construction profile, change in the design speed and the gradients, adaptation to the terrain	• Limitation on dewatering measures • Seasonal limitation on de-watering • Construction methods protective of the groundwater (e.g. underwater concrete rather than de-watering)	• Assure flow-through capability (culverts, surface filters, light-weight embankments) • Avoid open groundwater exposure	• Immissions protection measures (planting, structural measures) • Improvement of the covering layers (e.g. through coverage or vegetation) • Cleaning the road runoff (oil and pollution separator, sewage ponds, etc.) • Enlargement of embankment base, with depression at its foot	• No exposure of groundwater • Coverage of open groundwater surfaces with groundwater-neutral material, e.g. gravel

Table A.38 (Continuation)

Compensation measures	• Seepage and infiltration of surface water with suitable technology • Removal of impervious coverage	• Watering	• Removal of existing groundwater barriers	• Extensification of surface use, esp. agricultural use • Measures for on-site compensation of impacts upon the physical, chemical and biological composition of the water (removal of existing groundwater pollution sources, e.g. toxic dumps; reduction of other groundwater-polluting emissions sources) • Improvement of covering layers	
Indications for determining scope of compensation measures	• Seepage equal in volume to the calculated reduction in new formation of groundwater • Impervious coverage removal equal to the new impervious coverage • The question of the extent to which the measures to compensate for impacts have achieved or can achieve the compensation goals	• Watering of extent and duration necessary to restore the original water balance conditions	• Equal in scope to the barriers built	• The question of the extent to which the measures to compensate for impacts can achieve the compensation goals regarding impacts on the soil must be examined	• The question of the extent to which the measures to compensate for impacts have achieved the compensation goals regarding impacts on the soil must be examined

Surface bodies of water

Relevance of negative impacts → Complex of causes ↓	Removal of surface bodies of water: as habitats and/or sites of animals and plants; simultaneously, increase in surface water runoff	Impacts upon structure of bodies of water: Negative impacts of the site conditions for plants and habitats of animals, and on the flow conditions in the body of water, incl. barrier effects	Increase in surface water outflow: with effects on the surface body of water	Impacts on flow conditions in surface bodies of water: Negative impacts on habitats of animals and/or sites of plants	Impacts on the water quality of the surface bodies of water: Negative impacts on habitats of animals and/or sites of plants
Construction	○	○		○	●
Facility	●	●	●	○	
Operation					●
Ascertainment of negative impacts Essential foundations and/or relevant factors (quantitative and qualitative)	• Type of bodies of water affected, specific qualitative, quantitative and ecosystem-related characteristics • Length, size	• Development profile/type of restructuring/type of building	• Quantity of water in-feed	• Development profile/ type of restructuring/ type of building • Quantity of water in-feed/not fed in	• Water quality (type and quantity of materials potentially polluting the water) • Point in time and duration of pollution immission

Table A.38 (Continuation)

Avoidance and minimization	• Avoidance of pipe canalization; instead, sufficiently dimensioned flow-through openings; most favourably, bridges • Change of route • Reduction of land consumption • Elevated route or bridge instead of embankments	• Avoidance of reinforcement of bodies of water	• Reduction of impervious coverage • Reduction of embankment slopes • Broadening of embankment bases • Percolation of surface water • Retention basins • Retention-effective planting	• Avoidance of reinforcement of bodies of water • Correct dimensioning and location of structures, particularly bridge pillars	• Selection of suitable environmentally neutral materials (esp. for road surfacing) • Purification of roadway runoff (sewage ponds, etc.) • Protective shoreline strips • Seasonal construction restrictions
Compensation measures	• Removal of existing pipe canalization • New creation of near-natural standing bodies of water or streams • Upgrading/renaturation or near-natural development of existing impacted standing bodies of water or streams	• Dismantling of weirs, barrages and barriers • New creation of moist areas with numerous ditches and a respective structure	• Increased construction of retention basins	• Near-natural development of bodies of water in case of impacted waters (renaturation of bodies of water	• Improvement of self-purification capacity of impacted bodies of water (near-natural structure and planting, etc.) • Extensification of land-use, esp. agriculture as the emitter of water polluting substances • Reduction of other existing water pollution sources and immitents
Indications for determining scope of compensation measures	Surface bodies of water which have been removed have had regular/special ecological functions. Hence, the scope of necessary compensation measures is determined by the spatial/functional preconditions for possible compensation, especially the habitat requirements of animals. That means it may be necessary for ecological reasons, e.g., to create a larger water surface than that of the body of water which is been removed	Compensation measures of at least the same area/ length as the impacted water structure are to be provided	Additional retention area is to be created as required by the increased outflow	Scope as necessary on the basis of spatial/ functional requirements	Measures for on-site compensation of impacts upon the physical, chemical and biological composition of the water, and as necessary on the basis of spatial/ functional requirements

Table A.39

Compensation and offsetting measures for various biotope types, for linear-type projects (construction of gas pipelines) [53, pp. 1-3]

Measures	Biotope type								
	Forests, groves, single trees	Farm-land	Grass-land	Fallow land, cleared corridors	Bushes, field hedges	Stre-ams	Shore-line strips	Reed beds, high forb stands, damp to wet	Roads and path-ways
Profile-appropriate and layered refilling of pipeline ditch with stored subsoil	●	●	●	●	●		●	●	
Subsoil loosening in the operational strip	●	●	●	●	●		●	●	●
For the entire area: Planing, replacement of the top soil so as to protect the structure	●	●	●	●	●		●	●	●
Planting of trees and shrubs at intervals of 1.5 m. When planting trees and shrubs, a width of 3 m is necessary so as to permit at least two rows of plants. Here, only shrubs should be planted. In wider strips, a scattering of second-order trees amounting to 10 - 20% of the total may be planted	●						●		
A strip of land at least 2.5 m wide on each side of the route (i.e., a total of 6 m) is to be kept clear of bushes and trees. When planting single trees outside the security strip (6 m) of the route, the same species already occurring there should be used	●						●		
For commercially managed forests: Reafforestation of the operational strip; within the cut, natural succession or new stocking	●								
Seeding with site-appropriate grassland mixture			●						
A site-appropriate standard seed mixture should be used in environments with an increased erosion risk				●		●		●	●
Planting trees and shrubs corresponding to the list of tree and shrub species in the open landscape					●				
Removal of crossings, and of the pipes installed for transferring and re-pumping water						●			
The profile of the body of water (embankment, floor, shore edges) is to be restored to its original depth by means of the construction measure						●			
Avoidance of artificial shoreline reinforcement as much as possible						●			
Removal of excess soil							●		
Planting of trees and shrubs at intervals of 1.5 m appropriate to the species in generally damp stands							●		
Natural succession, unless seeding with a site-appropriate standard seed mixture is required for reasons of erosion protection								●	
Restoration of impervious or partially impervious surfaces									●

Table A.40

Type and scope of compensation and offsetting measures for opencast mining and quarrying projects [90, pp. 128-130]

In order to ascertain the type and scope of compensation measures, it is first necessary to distinguish between the Basic Framework and the Supplementary Framework of compensation.

The Basic Compensation Framework is used if the areas affected by the mining/quarrying project include no protected assets of special significance, i.e. no areas of Value Level III for biotopes, soil, groundwater and landscape quality, or any areas with occurences of plant and/or animal species of Value Level III.

The Supplementary Compensation Framework is used if protected assets of special significance are affected, i.e. Value Level III areas for:

- Biotope types and occurrences of plant and animal species
- Soils of special significance
- Areas of special significance for the groundwater, and/or
- Areas of special significance for landscape quality.

Basic Compensation Framework: The compensation for the impact can be implemented on-site if the entire mining/quarrying area will, following conclusion of the excavation process, be developed in accordance with the goals of conservation, i.e.:

- With a design and implementation typical of the natural area and of the site, and
- With a natural development/succession, or, if that is more urgent from a conservationist point of view, extensive land-use, afforestation; no recreational activities with negative impacts upon the goal of conservation-appropriate development.

Supplementary offset measures will be necessary:

1. In case of dry mining: For an area share with intensive follow-up use in a ratio of 1:1 off-site (in areas with biotope Value Levels I-II)
2. In case of wet mining (in or outside of floodplains): For area shares with intensive follow-up usage in the ratio of 1:0.5 off-site (in areas with biotope Value Levels I-II)
3. In case of wet mining in floodplains (nutrient-rich mine water): If water surfaces deeper than 5 m occur at the mean water level, the following procedure is used:
    - The scope of required compensation areas is in a ratio of 1:0.5 to the water surface deeper than 5 m remaining after termination of mining and restoration.
    - Moreover, at the beginning of the land consumption process, permanent compensation is to be implemented off-site to an extent equal to the operational terrain permanently reinforced during the excavation process (e.g., as a shoreline strip, other marginal strip, external lots, etc.)
    - The remaining requirement for compensation in order to reach an area ratio of 1:0.5 can generally be achieved on-site in the floodplains, given the average deposit and overburden thicknesses.
    - Included in the calculation are, first, all embankments and berms in the range between the mean high water level of the lake to 1 m below the mean low water level of the lake; and
    - Second, other areas within the mining site (dumps, slag heaps and storage areas and embankments for the excavated material) above the mean high water level of the lake, inasmuch as these areas are to be left to their natural development, or developed for other purposes in accordance with the goals of conservation.

Particular remaining compensation deficits may be covered by off-site/out of kind compensation measures (e.g. additional marginal strips, dismantling of operational facilities and removal of impervious coverage, as well as the development of the goals of conservation).

Supplementary Compensation Framework for various protected assets

1. Biotope types of Value Level III

For biotope types of Value Level III, which might be destroyed or significantly damaged by the mining process, the development of equal/in-kind biotope types of Value Level III is required (in-kind compensation measures).

If this is not possible in the medium-term, similar and equivalent biotope types of Value Level III are to be developed (offsetting measures). For this purpose, both on-site and off-site areas can be used. If off-site areas are used, they must contain biotope types no higher than Value Levels I-II.

The required ratio between the impacted area and the compensation area is as a rule:

- 1:1, in case of the destruction of biotope types which can be regenerated only under certain conditions
- 1:1.5-1:2, in case of the case of destruction of biotope types which are difficult to regenerate, and
- 1:2-1:3, in case of biotope types which are extremely difficult or impossible to regenerate.

For biotope types of Value Level III which may be significantly impacted by the long-distance effects of an adjacent mining project (e.g. groundwater lowering or groundwater flow blockage, or removal of shading protection for trees in the interior of forests), the development of in-kind or equivalent biotope types on Value Level I-II areas of equal size is required.

2. Occurrence of plant and animal species of Value Level III

If occurrences of plant and animal species of Value Levels III are affected by a mining/ quarrying project, a special investigation is necessary into the type and scope of the measure to be used to achieve the development of the site and habitat conditions which are the preconditions for the occurrence of respective species and biotic communities.

Here, it may be acceptable to create the preconditions for the development of other species of Value Level III, if this is justifiable by the conservationist goals for the area (e.g. the Landscape Framework Plan or the Care and Development Plan). Necessary compensation areas may also be located on-site after conclusion of the mining/quarrying project if the necessary site and habitat conditions can be achieved there. In particular cases, these measures may also be implemented at shifting places on-site during the course of the mining/quarrying project.

For areas with Value Level III species, including bird breeding areas, the necessary compensation areas must as a rule correspond in size to that of the habitats of the respective populations destroyed or otherwise significantly damaged. A smaller area may be sufficient if better site and habitat conditions can be created on the compensation area than those that existed on the impacted area concerned.

For migratory bird habitats, it is as a rule necessary to develop areas of the same size, character and freedom from disturbance as those which have been affected by the impact (e.g. by the creation of disturbance-free areas).

3. Soils of Value Level III

In case of the destruction or considerable damage (including long-distance damage, such as groundwater lowering) of soils of special significance, e.g. the following measures must as a rule be implemented off-site in a ratio of 1:1:

- on hitherto intensively used soil, including temporarily fallow fields:
  - succession
  - extensive use
  - plantation of permanent vegetation to reduce the outflow of water (e.g. for the further development of near-natural soils, for the improvement of the regulatory function, buffering and filtration function, and the habitat function)
- Re-wetting of de-watered soil, or impoverishment of eutrophied soil.

4. Areas of special significance for drinking water supply of Value Level III

In case of quarrying in areas in which this can be authorized only on a case-by-case basis:

- In case of dry mining/quarrying: follow-up succession or forest development (with site-appropriate and indigenous species) on the entire mining/quarrying site
- in case of wet mining/quarrying:
  - Extensive utilization protective of bodies of water
  - With approval on a case-by-case basis, suitable compensation and offsetting measures such as succession or forest development on hitherto intensively used other areas off-site of special significance for groundwater supply
  - Protective ditches and plantings.

5. Areas of special significance for landscape quality of Value Level III

In case of destruction or considerable damage to areas of special significance for landscape quality: landscape-appropriate new creation and rehabilitation of mining/quarrying areas corresponding to the typical natural characteristics of the areas affected by mining.

Inasmuch as only Value Levels I-II are achievable on the mining/quarrying area, compensation measures off-site are required for the corresponding area shares: in a ratio of 1:1.5.

Appendix 1.8

Compensation factors

Table A.41

Examples for the ascertainment of compensation factors for various negative impacts, and the corresponding compensation measures for the protected asset Soil [83, p. 34]

Measures	Compensation factor			
	Completely or partially impervious coverage		Coverage was natural soil or excavated soil	
	Functional characteristics of soil			
	General	Special	General	Special
Impervious coverage removal	1,0 / 0,5	2,0 / 1,0	0,25	0,5
Planting of trees and shrubs, at least 3 rows, or 5 m wide, minimum area: 100 sq.m	2,0 / 1,0	4,0 / 2,0	0,5	1,0
Transformation of farmland into extensive grassland	2,0 / 1,0	4,0 / 2,0	0,5	1,0
Transformation of intensive grassland into extensive grassland	3,0 /1,5	6,0 /3,0	0,75	1,5
Creation of an edge strip on farm fields, at least 15 m wide	3,0 /1,5	6,0 /3,0	0,75	1,5
Re-wetting of fens	1,5 / 1,0	3,0 / 1,5	0,4	0,75

Table A.42

Examples for the ascertainment of compensation factors for various negative impacts, and the corresponding compensation measures for the protected asset Biotopes [83, p. 60]

Biotope type (total loss)	Possible compensation measures	Compensation factor
Bodies of water		
Near-natural streams and sources	• Renaturation of non-natural streams and sources	2,5 – 6,0
Largely non-natural streams and sources	• Development of small bodies of water on species-poor grassland (with at least 5 m-wide buffer strips)	1,0 – 2,5
Near-natural standing bodies of water	• Renaturation of non-natural standing bodies of water • Development of small bodies of water on species-poor grassland (with at least 5 m-wide buffer strips)	2,5 – 6,0
Reed beds		
Reed bed communities and sedge reeds	• Development of reed beds and sedge reeds in non-natural standing bodies of water • Development of damp high forb fields on species-poor grassland	2,0 – 6,0
Forests		
Non-natural deciduous and coniferous forests (not site-appropriate, or non-native species)	• Afforestation (new) with native deciduous or coniferous trees • Restructuring of forests into natural forest communities	1,0 – 2,5

Table A.43

Orientation values for determining the scope of compensation for biotope loss [72, pp. 213-216]

Biotope type with an impact intensity of 100%	Possible compensation measures	● Compensation ☐ Offset	Compensation factor
Near-natural or semi-near-natural sources and streams	Renaturation of non-natural streams	☐	1:4 – 1:7,5
	Development of small bodies of water on species-poor damp meadows		1:8 – 1: 12 (1:15)
Ditches with few or no near-natural structural elements	Renaturation of non-natural streams, or near-natural design of appropriate ditches	●	1:1
	Development of small bodies of water on species-poor damp meadows		1:1,5 – 1:2,5
Large reed beds or large sedge reeds	Development of large reed beds or large sedge reeds on non-natural standing bodies of water	☐	1:2
	Development of damp high forb fields from species-poor damp meadows		1:4 – 1:8
Floodplain forest and floodplain shrubbery	Development of floodplain forest and floodplain shrubbery along non-natural streams	☐	1:4 – 1:8 (1:10)
	New development of damp forests on species-poor damp meadows		1:12 – 1:15
Deciduous forest (also coniferous or mixed forest) and field groves with locally native tree species:	New planting of deciduous forests with locally native tree species, on farmland		
• with poll wood		●	1:1
• with small to medium trees		☐	1:1 – 1:3
• with large or old trees		☐	1:5 – 1:6
Cleared corridor	Development of ruderal fields on farmland	●	1:2,5
	New establishment of a forb margin on farmland, in connection with trees and shrubs		1:1
Fallow grassland	Development of species-rich meadows on species-poor meadows	●	1:2,5
	New creation of species-rich meadows on farmland		1:1
	Development of ruderal field on farmland		1:2,5
Farmland with wild herbaceous fringes, and fallow fields	Development of farm fields or fallows with wild herbaceous fringes	●	1:2
	Development of bushes with a forb margin on farmland		1:1
Park/green facility with no old trees	New planting of tree hedges or forest edges with primarily locally native trees and shrubs, on farmland	●	1:1
	New planting of deciduous forests with locally native trees on farmland		1:1
Park/green facility with old trees	New planting of tree hedges or forest edges with primarily locally native trees and shrubs, on farmland	☐	1:3 – 1:5
	New planting of deciduous forests with locally native trees on farmland		1:3 – 1:4

Appendix 1.9

Balance of impacts and their compensation

Table A.44

Example of an accounting of compensation measures and areas [69, p. 87]

Affected asset or function. Type of impact	Extent of impact (sq.m)	Compensation measures		Period/ success of compensation	Offset required (sq.m)
		Type	Extent (sq.m)		
Construction-caused. Soil compaction					
Soil. Floodplain soil. Reduction of pore volume/ permeability; increase of soil bulk density	12,000	Soil loosening after conclusion of construction measures	12,000	Compensated <1 year	-
Facility-caused. Impervious coverage					
Floodplain soil. Loss of soil/soil function	600	Renaturation of a landfilled floodplain area	300	Compensated <5 years	300
Landfill soil. Loss of soil	2000	Removal of impervious coverage and loosening	500	Partially compensated <5 years	1500
Species and biotopes. Ruderal areas; biotope loss	2200	Set aside of farmland and succession	2000	Partially compensated <5 years	200
Tall forb swaps. Biotope loss	200	Non-compensable (restoration time>10 years)			200
Landscape quality. Buildings in floodplain landscape	1000	Roof greening	1000	Compensated <1 year	-
		Creation of floodplain-typical landscape elements	300	Compensated 2-10 years	-
		Additional planting and maintenance of shoreline vegetation	1700	Compensated <10 years	-
Operationally caused. Groundwater withdrawal					
Species and biotopes. Changes in biotope structure	500	Re-wetting	1200	Compensated <10 years	-
Groundwater. Negative impact on groundwater supply	1.5 cu.m/ for 2000 sq.m, total 3000 cu.m/yr	Rain water seepage (from roof gutters)	800 cu.m/yr	Partially compensated <1 year	600 cu.m/yr
		Rain water seepage (purified runoff from impervious coverage surfaces)	1600 cu.m/yr		

Table A.45

Impact compensation accounting [83, p. 62]

Presumed significant negative impacts				Mitigation measures	Compensation/offsetting measures				
Description	Scope	K_k	F_k		Type	Description	Scope	Location of measure Implementation schedule	Assessment of compensability; Remaining deficits
Loss of species-rich wet meadow Permanent, facility-caused	1300 sq.m	3	3900 sq.m	Relocation at the edge of the area, so that there is no fragmentation of the wetland	Compensation	Renaturation of a landfilled floodplain;	500 sq.m	Spatial proximity Restoration <10 years	Partially compensable; compensation deficit: 2000 sq.m
						Extensification of intensively used pastureland	1400 sq.m		
					Offset	Development of wet meadow after re-wetting of farm field	1500 sq.m	Pool of compensation areas in the natural area	Compensation deficit partially offsettable; offset deficit: 200 sq.m
						Planting of hedges and deciduous shrubbery around edge of facility	300 sq.m	Close of impact After termination of impact	
Loss of softwood floodplain forest; drainage Permanent, facility-caused	200 sq.m	4	800 sq.m		Offset	Development of floodplain forest at a non-natural stream on the field	800 sq.m	Pool of compensation areas in the natural area Beginning of impact	Not compensable, but offsettable; no deficit
Disturbance of meadow breeders Construction and operationally caused	3400 sq.m	1	3400 sq.m	Interruption of construction during breeding periods	Compensation	Renaturation of habitat	500 sq.m	Close to impact	Compensation deficit: 1500 sq.m
						Extensification of use in habitat	1400 sq.m		
					Offset	Renaturation of habitat	1500 sq.m	Major focal point for meadow breeders	Compensation deficit offsettable; no deficit
Impervious coverage of floodplain soil (soil with special site properties) Permanent, facility-caused	1500 sq.m	2	3000 sq.m	Relocation to edge of the area	Compensation	Renaturation of landfilled floodplain	500 sq.m	Close to impact; At beginning of impact	Partially compensable Remaining offset deficit: 1100 sq.m
						Extensification of use	1400 sq.m		
					Offset	Renaturation of drained and intensively used soil	1500 sq.m	Natural area At beginning of impact	Offsettable; no deficit
Lowering of groundwater by 0.5-1 m Negative impact on function Construction-caused	1900 sq.m	1	1900 sq.m	Seasonal limitation	Compensation	Improvement of seepage capacity by renaturation of landfill	500 sq.m	Close to the impact; At beginning of impact	Compensation deficit 1400 sq.m
					Offset	Improvement of the water balance of the landscape	1400 sq.m	Natural area (prioritized measure)	Compensation deficit offsettable

Notes. K_k – Compensation factor; F_k – Required size of compensation area

Table A.46

Account of impacts and compensation: The example of a gas pipeline [reduced after 53, pp. 1-7]

Biotope impacts					Biotope compensation				Biotope value difference
Biotope type, existing stock	Biotope value, value points/ sq m	Upgrading/ devaluing	Area, sq m	Total value, existing stock, value points	Biotope type, planning	Biotope value, value points/ sq m	Area, sq m	Total value, planning, value points	
Beech forest with acidic soil	58		980	56,840	Reafforestation of beach before canopy is completed	33	723	23,859	-32,981
Mixed oak forests	41	-6	7590	265,650	Reafforestation of oak before canopy is completed	33	6714	221,562	-44,088
Stream alder-ashwood forest	59		1379	81,361	Planting of new floodplain, marshland, willow/ softwood floodplain forests	36	1094	39,384	-41,977
Cleared corridors, natural rejuvenation	32		8426	269,632	Reafforestation of oak before canopy is completed	31	7392	229,152	-40,480
Cleared corridors, natural rejuvenation	32		1829	58,528	Reafforestation of coniferous trees before canopy is completed	26	1675	43,550	-14,978
Low coppice forests	63	-10	1002	53,106	Reafforestation of oak before canopy is completed	33	1002	33,066	-20,040
Fully developed shrubbery and hedges, fringes with native species	41		160	6560	Planting of native hedge shrubbery	27	160	4320	-2240
Rapid streams (upper reaches)	69		125	8625	Rapid streams (upper reaches)	59	151	8909	284
Fallow and ruderal meadows	39		5329	207,831	Seeding for near-natural grassland	31	6705	207,855	24
Nutrient-rich damp meadows	47		2860	134,420	Extensively used fresh meadows	44	2960	130,240	-4180
Intensively used fresh meadows	27		3100	83,700	Extensively used fresh meadows	44	3100	136,400	527,00
Fallow farmland, unused more than one year	23		4600	105,800	Seeding for near-natural grassland	31	4500	139,500	33,700
Total			**37,380**	**1332053**			**36,176**	**121,7797**	**-114,256**

Table A.47

Example of impact compensation accounting [62, pp. 78-79]

Juxtaposition of negative impacts and precautions for preventing them, with compensation and offsetting measures

Planning: Construction (impact) 45.8 ha; additional need for space for compensation and offsetting off-site: 8.7 ha

Protected assets / functions and values affected		Expected impact	Precautions to prevent negative impacts	Compensation measures	Offsetting measures
Asset	Character, size, value of affected areas (Value Level S)				
1	2	3	4	5	6
Species and biotic communities (Types of biotopes/endangered animal and plant species)	• 0.8 ha species-rich old stands of trees; S=1; • 1.7 ha ruderal fields; S=2; • 33.2 ha farm fields; S=3; • 7.1 ha fallow farm fields (green fallows); S=3; • 3.0 ha grass fields; S=3. In none of the biotope types do endangered species occur	**Clearing and restructuring of vegetation** • 1.7 ha ruderal fields before: S=2; after: S=3;significant impacts • 33.2 ha farm fields before: S=3; after: S=3; no significant impacts • 7.1 ha fallow farm fields before: S=3; after: S=3; no significant impacts • 3.0 ha grass fields before: S=3; after: S=3; no significant impacts	Preservation of 0.8 ha of species rich, old groves in the construction area; distance of construction from this area at least 50 m; in this separation area, the compensation measure described to the right can be implemented.	Development of 1.7 ha of farmland (Value Level 3) to ruderal fields (Value Level 2) on-site. Restoration is possible on-site over the short term.	
Soil	• 0.8 ha weakly anthropogenically transformed natural soil; S=1; • 45.0 ha strongly anthropogenically transformed natural soil; S=2	**Impervious coverage** • 40.0 ha strongly transformed natural soil before: S=2; after: S=3; significant impacts	Limitation of impervious coverage through the use of water permeable surface pavement (compensation measures required)	Development of ruderal fields, fallow fields and groves in residential areas with species native to the local site on 12.0 ha of farmland of Value Level 2; of that, presumably 3.3 ha can be realized on-site; the remaining 8.7 ha off-site	

Table A.47 (Continuation)

1	2	3	4	5	6
Water	• 45.8 ha of impacted groundwater situation; S=2	**Impervious coverage** • 40.0 ha impacted groundwater situation before: S=2; after: S=3; significant impacts	Limitation of impervious coverage through the use of water permeable surface pavement; retention of precipitation water in near natural basins on-site; other preventive effects through compensation measures for the protected asset «soil» (see above) (compensation measures required)	Compensation achievable via compensation measures for the protected asset «soil»	
Air	• 45.8 ha minimally impacted areas; S=2	**Clearing and restructuring of vegetation, impervious coverage, construction** • 40.0 ha minimally impacted areas before: S=2: after: S=3; significant impacts	Same preventive precautions as for the protected asset «water» (compensation measures required)	Compensation achievable via compensation measures for the protected asset «soil»	
Landscape quality	• 45.8 ha impacted areas; S=2	**Clearing and restructuring of vegetation, construction** • 45.8 ha impacted areas before: S=2; after: S=3; significant impacts	Preservation of 0.8 ha of species-rich groves on-site: greening of the site with locally native deciduous trees (compensation measures required)	Do the type and size of the buildings, no compensation can be achieved (offsetting required)	Planar off-site improvement and development of the appearance of existing land-use through the expansion and new establishment of expressly natural biotope types and landscape elements typical for the natural area. A landscape area of at least 45.8 ha must be improved by at least one Value Level (here: from 3 to 2). In the present particular case, this can be achieved through compensation measure for the protected asset «soil» on an 8.7 ha off-site area, since this measure will have an appropriately large-scale positive effect on the quality and appearance of the landscape. (Establishment of a network of linear, expressly natural biotopes and landscape elements typical of the natural area within a «cleared-out» agricultural area.)

Table A.48

Preparation of impact/compensation accounting for mining operations and assessment of additional need in areas
(realization of measures are marked in bold italics) [reduced after 90, pp. 132-138]

Affected area			Significant impacts		Compensation and offsetting measures				
Type	Area, ha	Value level	Type	Area, ha	Type	Area, ha		Value level in 25 years	Long-term goal of development
						Main	Additional		
Sand recovery using the dry method									
Sand recovery by the dry method. Total area 15 ha. Mining operations 13.4 ha up to the horizon 2 m higher than ground water level. Buffer zone 1.6 ha for economic use. After operations: buffer zone 1.6 ha – succession; dry bench (slope 1:5) 8.2 ha – succession; dry bottom 5.2 ha – reforestation									
Species and biotopes									
Farmland	15	I	Sand recovery, working and economic areas	13.4	Ruderal vegetation	8.2		II	Impacts of biotopes compensate measures for soil
				1.6	Young deciduous forests	5.2		I	
					Ruderal vegetation in buffer zone	1.6		II	
Soils									
Soils of general value	15	II	Sand recovery	13.4	***Natural development and reforestation on wet soils***		***13.4***	***I***	***Long-term compensation of impacts – development of soils resulted from natural succession or development of forest***
			Working and economic areas	1.6	***Natural development***		***1.6***	***II***	
Landscape quality									
Landscape quality of general value	15	II	Entire territory	15	Development of area typical of this locality	15		II	Impacts of landscape compensate measures for soil
Area of impacts	**15**	**Area for compensation and offsetting measures**					**15**		

Gravel extraction in the river floodplain using the wet method									
Gravel pit 20 ha, additional area 2 ha. Thickness of overburden rocks 2 m. Depth to groundwater 2 m. After completion of work 11 ha of water surface will be >5 m deep. At the beginning of work, creation of areas for extensive agricultural use (18 ha) beyond the site. Removal of impervious coverage (2 ha) after completion of work for agricultural use. Creation of stagnant reservoir (18 ha) at the site of the gravel quarry)									
Species and biotopes									
Farmland on clay soils	4	I	Hard surface of additional areas	2	Removal of impervious coverage and former use	2		I	Agricultural use. Compensated by measures for soil
			Gravel extraction	2	Ruderal vegetation on slopes	2		II	

Table A.48 (Continuation)

Affected area			Significant impacts		Compensation and offsetting measures				
Type	Area, ha	Value level	Type	Area, ha	Type	Area, ha		Value level in 25 years	Long-term goal of development
						Main	Addi-tional		
Farmland on clay soils	18	I	Gravel extraction	18	***Lake shoal***	***4***		***II***	***Development of aquatic vegetation (reed, cattail, etc.)***
					Lake at the site of depleted gravel quarry	***14***		***I***	***Creation of stagnant reservoir rich in species***
Soils									
Soils of general value	22	II	Hard surface of additional areas	2	***Removal of impervious cover-age***	***2***		***II***	***Agricultural use***
			Gravel extraction	16	***Soil development beyond the site***		***7***	***II***	***Creation of areas for extensive agricultural use***
			Remaining deepwater zones of gravel pit (>5 m deep)	2			***11***	***II***	
			Benches and berms within gravel pit catchment zone	2	***Levelling and strengthening by vegetation***	***2***		***I***	***Creation of gentle permeable slopes***
Landscape quality									
Landscape quality of general value	22	II	Gravel extraction, addition-al areas	22	Development of area typical of this natural environment	22		II	
Area of impacts	**22**		**Area for compensation and offsetting measures**			**22**	**18**		

Limestone quarrying									
Limestone quarrying – total area 22 ha, quarry 14.5 ha, additional areas (piles, rock processing, access roads, buffer zones) 7.5 ha. Work period 25-30 years. After completion of mining operations – substitution of farmland 22 ha beyond the site, including the area of extensive use 2 ha, stony vegetation on slopes 1.2 ha, creation of new habitats for skylark 8.5 ha and blue poppy 0.1 ha									
Species and biotopes									
Farmland on fertile soils taken out of use for a long time	20.5	II	Quarry, additional areas, roads, piles, etc.	20.05	Extensive farmland, planting of trees and bushes, ruderal vegeta-tion communities, anthropogenic stony vegetation communities	20.5		I	Impacts of biotopes compensate measures for soils
Farmland of extensive use	1.0	I	Quarry	1.2	***Anthropogenic stony vegetation communities on rocks***	***1.2***		***I***	***Development of area typical of this location; natural development or extensive use***
Grove	0.2	II							

Table A.48 (Continuation)

Affected area			Significant impacts		Compensation and offsetting measures				
Type	Area, ha	Value level	Type	Area, ha	Type	Area, ha		Value level in 25 years	Long-term goal of development
						Main	Addi-tional		
Ruderal vegetation communities	0.1	II	Additional areas, roads, piles, etc.	0.1	***Ruderal vegetation communities at the site***	***0.1***		***II***	
Mesophilic bushes	0.1	III		0.1	***Planting of vegetation beyond the site***		***0.2***	***II***	***Compensation coefficient 1:2***
Meadow on alkaline soils	0.1	III		0.1	***Pioneer stage of meadow resulted from filling of stones***		***0.2***	***II***	
Specially protected species									
Skylark, 15 breeding sites	8.5	I	Quarry	8.5	***Creation of new habitats for birds inhabiting extensive farmlands and groves***	***8.5***		***I***	***Development of area typical of this location; natural development or extensive use***
Blue poppy	0.1	I	Piles	0.1	***Seeding on compensated areas, extensive use of farmlands***	***0.1***		***I***	
Soils									
Soils of special value	1.0	I	Quarry	1.0	***Development of similar soils beyond the site***		***1.0***	***I***	***Development of area typical of this location; natural development or extensive use***
Soils of general value	21	II	Quarry, additional areas, roads, piles, etc.	18	***Development of similar soils beyond the site. Removal of impervious coverage from access roads***		***18***	***II***	
				2.0	***Extensive use for farmland***		***2.0***	***II***	
Landscape quality									
Landscape quality of general value	22	II	Entire territory		Development of area typical of this location				Landscape impacts compensate measures for soils
Area of impacts	**22**	**Area for compensation and offsetting measures**				**9.9**	**21.4**		

Table A.49

Preparation of impact / compensation account at the level of the local development plan. Example of a verbal-argumentative presentation of the protected assets Animals / Plants and Landscape Quality [76, p. 54]

Description of the impact	Mitigation precautions	Compensation measures	Conclusion
Animals / plants			
Negative impacts and endangerment of a protected biotope	Maintain distance of structure from the biotope	Creation of approx. 5-10 m wide buffer strip around the biotope	No remaining significant negative impacts
Loss of buffer function, barrier effect	Avoidance of routing roadways along the biotope complex	Securing of a compensation area between the biotope and the rail line as an extensively used grassland; removal of storage area followed by seeding for a meadow	No remaining significant negative impacts
	Preservation of the watercourse with a broad shoreline as a networking corridor for the biotope	Near-natural structuring of the shoreline, with extensive care	
Removal of hedges	Preservation of hedges and succession areas in the area of the powerline cut	Planting of new hedges with adjacent fringes and succession areas	No remaining significant negative impacts
Removal of orchard meadows with an area of approx. 1.2 ha	Avoidance of construction of thoroughfare roads in the surroundings of compensation areas (installation of concrete-plate pathways, in order to minimize fragmentation)	New planting of orchard meadows on an area of approx. 1.2 ha	No remaining significant negative impacts
Reduction of extensively used habitats for animal and plant species	None	Extensive roof greening of flat roofs (esp. garages) in order to increase habitat diversity for plant and animal species	
Landscape quality			
Changes of the landscape appearance due to buildings and associated facilities	Compliance with stipulated building heights	Thorough greening with landscape-appropriate trees and shrubs, to incorporate area into the landscape	No remaining significant negative impacts
	Reduction of construction in the buffer zone of the biotope and along the course of the stream	Mandatory planting on private green space along the eastern edge of the village	
		Façade greening	
		Extensive roof greening	
Loss of a row of poplars which were a marked feature of the landscape	None	New planting of a row of large-crowned deciduous trees	Long-term compensation by new planting
Disturbance of the appearance of the landscape in the central part of the area through the installation of the roadway embankment in the valley, perpendicular to the contour of the valley	Maintenance of a broad green zone along the ditches on both sides of the roadway	Loose planting of trees and shrubs along the roadway	Compensated in the context of other greening measures

Appendix 1.10

Monitoring the implementation and effectiveness of compensation measures

Table A.50

Examination catalogue for the compensation concept [59, pp. 3-11]

Formal examination of the completeness of the documentation
1. Explanatory report
1.1. Does the explanatory report include the following points: • A project description and a representation of the impact factors/project impacts? • An ascertainment and evaluation of the existing condition? • A conflict analysis? • A documentation of avoidance and minimization measures? • A derivation of compensation and offsetting measures? • An accounting of impacts and compensation? • A directory of measures, with a measures sheet? 1.2. Is a cost estimate included, and is it broken down by: • Protective measures? • Route design measures? • Landscape care measures remote from the route? • Land acquisition for landscape care measures? 1.3. Is the text portion complete? 1.4. Are the references to figures and tables correct? 1.5. Are source references and a bibliography included?
2. Maps
2.1. Is the planning documentation complete, and do the map scales correspond to those on the techni-cal draft map? • Inventory map, generally 1:5000 • Map of the conflict situation, generally 1:5000 • Overview map of the measures, generally 1:5000 • Measures map, generally 1:1000/1:2000 2.2. Have the information blocks on the maps been completely and correctly filled in? 2.3. Is the map presentation comprehensible and legible? 2.4. Does the presentation of the existing situation, of the conflicts, and of the measures correspond to the sheet lines? 2.5. Can the conflict and measure numbers in the text be clearly assigned to the conflicts and measures on the maps? 2.6. Have all measures been clearly represented, down to the lot boundaries? 2.7. Is the situation of areas adjoining the area of the measure shown on the measures map? 2.8. Have the measures also been included in the land acquisition map and directory, and do these documents correspond?
Substantive examination
1. Stipulations
1.1. Have the existing laws, ordinances and regulations been complied with? 1.2. Have the technical stipulations regarding existing plans been complied with (e.g. landscape framework plan, landscape plan, EIS, spatial planning decision)? 1.3. Have agreements (including those regarding delimitation of the area of investigation and the establishment of the scope of investigation) between the party submitting the plan and the authority responsible for road-building, the conservation authority and other government offices concerned, been taken into account? 1.4. Is there assurance that the areas of the measure have not already been reserved for the purposes of other planned projects (compensation or offsetting measures)??
2. Representation of the impact factors to be considered
2.1. Have all • facility-caused, • construction-caused, and • operationally caused • impact factors been ascertained, and have they been represented in their full dimensions (type, intensity, spatial extent)?

Table A.50 (Continuation)

2.2. Have impact zones been delimited, and been justified/elucidated on the basis of certain knowledge, with references to the literature?
3. Delimitation of the area of investigation
3.1. Has the area of investigation been agreed upon and accordingly implemented? Have any deviations from the agreements been sufficiently justified? 3.2. Has the area of investigation been delimited in such a way that all facility, construction and operationally caused impact factors which could result in significant or permanent impacts, can be ascertained, especially in terms of their spatial extent? 3.3. Has a delimitation in accordance with the sensitivity and spatial/functional relationship within the affected landscape area been undertaken?
4. Ascertainment and evaluation of the existing situation
4.1. Depending on the type of project and of the landscape area, have all value and functional elements of the natural balance and of landscape quality relevant for the ascertainment of the expected significant impacts been ascertained? 4.2. Was the ascertainment and evaluation of the natural balance and the landscape quality carried out with consideration for previous pollution impacts? 4.3. Has a biotope type mapping been carried out, and is it sufficient for the evaluation of the impact situation? 4.4. Beyond the above, has a more detailed mapping procedure of the vegetation been carried out for the ex-tent of at least one vegetation period? 4.5. Was an ascertainment of the stock of fauna carried out? 4.6. Beyond the above, has a more detailed mapping procedure of fauna been carried out for a period permitting a species-specific assessment? 4.7. Have groups of animal species been ascertained which, based on the type of project and of the landscape area, have an indicator function for the impacts being assessed? 4.8. Beyond the above, have the abiotic landscape factors Soil, Water and Climate/Air been sufficiently ascertained? 4.9. Has the landscape quality been sufficiently ascertained? 4.10. In ascertaining the impacts and the scope of compensation, were the value and functional elements of the natural balance and the quality of the landscape differentiated with regard to general and special significance, respectively? 4.11. Was the original condition of the compensation areas outside the area of investigation ascer-tained and evaluated using the same methodology as had been used on the other areas? 4.12. Were the methods, places, times and periods of ascertainment, and the bases of data and information documented? 4.13. Is the overall ascertainment of the situation sufficient and plausible? 4.14. Does the cartographic representation of the existing situation depict all value and functional elements of the natural balance and of landscape quality necessary for the evaluation, the conflict analysis and the measurement planning processes, in accordance with their type and scope?
5. Avoidance and minimization measures
5.1. Have the mitigation measures listed in the EIS been addressed or implemented? 5.2. Has the route been carried out in order to avoid facility-caused negative impacts (fragmentation of animal habitats)? 5.3. Is there sufficient justification for the non-implementation of substantively necessary and reason-able mitigation measures? 5.4. Have stipulations been formulated regarding the mitigation of construction-related impacts with respect to limitation of the construction area (taboo areas), the order in which stages of the project are implemented, or time related limitations on certain construction measures (e.g. during the mating/ breeding periods of certain animal species)? 5.5. Do the measures provided serve the stated purpose, and are they suitable for the mitigation of sub-stantial and permanent negative impacts?
6. Ascertainment of unavoidable negative impacts
6.1. Have all significant negative impacts been ascertained and addressed, in accordance with the re-spective project type? 6.2. Have the impacts upon the natural balance and the landscape quality (information on type, location, intensity, spatial scope, and duration of the event) been represented, broken down by facility, operationally and construction-caused impacts? 6.3. Have the thresholds of significance and permanence been defined with respect to the importance/sensitivity and type, intensity and scope of the impacts?

Table A.50 (Continuation)

6.4. Have the impacts upon biotope types of general and special significance been completely ascertained and represented?
6.5. Have the impacts upon the value and functional elements of special significance of the fauna, the soil, the water and the climate/air been separately ascertained and represented?
6.6. Is the assessment of the intensity of impacts and the spatial scope of these impacts comprehensible?
6.7. Has and assessment of the compensability of impacts been carried out, taking into account:

- the development time required for the restoration of impacted value and functional elements?
- the degree of certainty of success for the achievement of in-kind restoration?
- the presence of suitable and development-capable sites and biotopes in the spatial/functional con-text of the impact site?
- the availability of appropriate sites?

6.8. Have non-compensable impacts, especially upon protected biotopes and habitats, and on habitats of endangered animal and plant species, been emphasized as factors of special consideration?
6.9. Have the impacts described been comprehensibly evaluated in terms of their significance and permanence, and also with respect to their dimensions?
6.10. Can a special-case-referenced description of impacts be found in the impact compensation ac-count and in the measure sheets?
6.11. Does the conflict map show all impacts upon the balance of nature and the landscape quality in accordance with the type and scope (site determination; spatial delimitation of the scope of the impact, where possible)?

7. Identification of the scope of compensation

7.1. Has the order of priority of impact mitigation regulation been complied with (avoidance → mini-mization → compensation → offsetting → offset payment)?
7.2. Have compensation and offsetting measures been derived for all non-avoidable impacts on the balance of nature and the landscape quality?
7.3. Have compensation and offset measures been distinguished in terms of their compensation

- in-kind?
- within an appropriate period?
- in a spatial/functional context?

7.4. Has a separation between the design measures belonging to the construction project and the compensation/offsetting measures been effected?
7.5. In the context of these measures, will it be possible to restore the affected value and functional elements in-kind (compensation) and/or equivalently (offsetting), and will there then, after implementation, be no remaining significant or permanent impacts upon the balance of nature?
7.6. Have compensation measures been planned not only for the biotope types, but also for fauna-related functions and for abiotic value and functional elements of special significance, and was refer-ence made to multifunctional compensation and offsetting in connection with other measures (type, number)?
7.7. Do the corresponding measures assure the landscape appropriate restoration or new design of the landscape after completion of the project?
7.8. Do the planned measures serve their purpose, are they sufficiently justified and technically implementable, and are they proportionate to the ascertained impacts? Examination based on:

- biotic and abiotic site conditions (technological requirements for restoration)
- development possibilities of the areas, and requirements for their care and development
- previous and additional impacts on the areas
- current functions of the areas for the natural balance and the quality of the landscape.

7.9. Are the compensation and offsetting measures located off-site, and do they have any spatial/ functional connection with the impact area?
7.10. Are on-site compensation and offsetting measures justified?
7.11. Was the scope of compensation derived via:

- the area of the function impacted upon?
- the value of the impacted area and its functions?
- the development time and the degree of assurance of success?
- the type and intensity of impact?
- the value of the compensation measure?
- the value of the compensation area of the measure?
- the point in time of implementation of the measure?

7.12. Has the period in which the measures are to be implemented been sufficiently determined?
7.13. Is the care and development of the compensation and offsetting measures assured?

Table A.50 (Continuation)

7.14. Is scheduled functional monitoring provided for any measures the success of which cannot be conclusively determined by care and development? 7.15. Have the areas for the compensation and offsetting measures been permanently secured by means of: • secured collateral? • purchase of the lots? 7.16. Have the handling of the property rights with regard to the areas and the future responsibility for maintenance under the measures been largely assured?
8. Accounting of impacts and compensation
8.1. Is the impact/compensation accounting comprehensible and plausible? 8.2. Is the impact/conflict situation sufficiently described with respect to: • Number and location of conflicts? • Description and qualitative/quantitative assessment of impacts with respect to mitigation? • Compensability of the impacts? • Conservationist significance and sensitivity of the impacted value and functional elements? 8.3. Are the landscape care measures sufficiently described with respect to: • Number, type (compensation/offsetting) and location of the measures? • Description and differentiation of the compensation and offsetting measures? • Description of the original condition of the compensation areas and the planned target biotope/ function? • Possibilities for multifunctional compensation measures for impacts of various value and functional elements (prospects for success, do they serve the purpose?)? 8.4. Have all significant and lasting conflicts and the corresponding measures been listed in the ac-counting, and can these be found in the conflict plan, the measures sheets and the measures plans, by means of a corresponding reference system? 8.5. Is the impact/compensation accounting comprehensible? 8.6. Have non-compensable impacts, particularly impacts upon the habitats of threatened plants and animals, been represented?
9. Measure sheets
9.1. Have the landscape care measures been juxtaposed to the impact situations, and described with sufficient detail? 9.2. Have the goals, such as the target biotope and the target function, and the type, size and develop-ment periods of the measures been represented? 9.3. Has the implementation of the measures been adequately described?: • Costs of the establishment of the measure • Care and development measures (type, schedule, estimated time periods of development care) • Site-appropriate selection of plants and seed • Plant qualities and intervals • Point in time of implementation of the measure (prior to start of construction, at start of construction, at conclusion of construction) 9.4. Are instructions for follow-up controls (establishment and success monitoring) included?

Table A.51

Protected biotopes: Recommendations for the contents and intervals of controls [84, pp. 12-13]

Creation of legally protected biotopes	Implementation control (possible goals of monitoring)	Functional control (possible goals of monitoring)
Creation of near-natural non-reinforced segments of creeks and rivers, from reinforced, non-natural stream segments	After completion, implementation control (implementation according to the plan)	From 3rd through 5th years, monitoring of condition of the water (water level, nutrient content of the water)
Damp meadows, from shrub covered damp meadows or intensively used fen sites	During the first year, monitoring to ensure that tree growth has been removed and mowing functionality created	In the 3rd and 7th years, monitoring of the composition of plant species, as well as the water levels and nutrient contents
Small bodies of water with land-forming areas (reed-beds)	After completion, implementation control	From 5rd through 8th years, monitoring of reed-cutting, density of stock; from 10th through 12th years, monitoring of reed-cutting, density of stock

Table A.51 (Continuation)

Creation of legally protected biotopes	Implementation control (possible goals of monitoring)	Functional control (possible goals of monitoring)
Bogs, swamps, tall-sedge marshes/reed-beds, from damp farmland or intensive grassland fields	During the first year, control of initial planting, and if necessary, of the abandonment of use in the area; also, extensification of the surroundings	In the 3rd and 9th years, monitoring of the development of the stock, as well as the water levels and nutrient contents
Near natural source fields, from anthropogenically transformed sources (reinforced springs, or heavily used surroundings)	After completion, implementation control	In the 3rd year, and from the 6th through 8th years, monitoring of the surroundings and of the use intensity, as well as the water outflow and nutrient contents
Dry grasslands, semi-dry grasslands or nardous grasslands, from intensively used farmland	After completion, or during the first year, monitoring to ensure that the site has been prepared (e.g. topsoil removal), and whether seeding has taken place; in case of succession: whether the utilization purpose has been carried out	In the 3rd and 6th years, monitoring of the care condition, species composition and nutrient content of the soil
Dry grasslands, semi-dry grasslands or nardous grasslands, from shrub fallows	Monitoring to ensure that shrub removal and initial mowing have been carried out	In the 3rd and 6th years, monitoring of the care condition, plant species composition and nutrient content of the soil
Dwarf-shrub and juniper heaths, from fallow heaths	After initial restoration, monitoring to ensure that trees have been cleared and other initial restoration measures have been carried out	In the 3rd year, monitoring of biotope development (plant species composition); In the 6th year, monitoring to determine whether trees have grown and may need to be cleared; in both cases, also monitoring of nutrient content of the soil
Bush and tree groves of dry/warm sites, from areas used for agriculture	After completion, monitoring of species, plant quality, and protective fencing	In the 3rd year, monitoring of development and vitality; In the 10th year, monitoring of development of the stand (plant species composition)
Orchard meadow stands, from areas used for agriculture	After completion, monitoring of species, plant quality, and tree binding	In the 3rd year, monitoring of vitality; in the 7th and 15th years, monitoring of vitality and structure of crowns
Swamp, bog, floodplain and slope forests, and other remaining stocks of natural forest communities, through reafforestation	After completion, monitoring of species, plant quality, and fencing, if necessary	In the 3rd year, monitoring of development of the stand; from the 8th through 10th years, monitoring of development of the stand (plant species composition), and whether the fence is still necessary; in both cases, monitoring of nutrient content of the soil, and of water levels, if necessary

Table A.52

Work steps for the demonstration of an appropriate control management [49, pp. 82-83]

Work step	Content	Examples
Quality assurance in planning	**Examination of the results, documentation of selection and results of consultation**	**Examinations/documentation, e.g. on the basis of checklists/forms and examination reports.**
Analysis/evaluation of the probability of occurrence of impacts and the fulfilment of the functions of measures	Compilation / systematization on the basis of reviews of the literature, scenario techniques, follow-up observation of concluded projects, interviews with experts, and communications with the responsible authorities	Identification of critical paths with regard to the legal and planning framework: • with reference to effects, e.g. forecast traffic volume • with reference to protected animal species, e.g. relevant survival conditions, experiential knowledge with regard to the restoration possibilities of corresponding habitats (selection criteria)

Table A.52 (Continuation)

Work step	Content	Examples
Concretization of risks; evaluation/ measurement of risks	• Identification of the spatially referenced concrete existing risks • Concretization of the risks in accordance with the knowledge obtained from the ascertainment of the existing situation	• Concretization e.g. of any previous pollution, spatial development • Ascertainment of any local marginal conditions which could hamper or promote the local development
Establishment of a control management strategy	• Establishment of the strategy for handling identified risks • Definition of criteria for success of the measure • Development of the control programme	• Avoidance of (partial) risks, e.g. by avoiding implementation of especially critical project and measure elements • Risk dispersion, selection of various techniques for implementation of the measure with different levels of risk • Risk minimization, e.g. by means of technology optimization (use of the latest/best measure technology) • Establishment of a cost/benefit relationship appropriate to the problem • Distribution of impact/measure implementation on various non-simultaneous subpopulations
Quality assurance of implementation and development	**Examination and documentation of initial establishment and development**	**Examination/documentation, e.g. based on checklists/forms and examination reports**
Monitoring of suitable indicator factors	In order to ensure the development of the measure as desired, monitoring may be necessary even during the construction phase. Can generally only be ascertained on the basis of direct terrain examination	• Measurement of the water level • Nature of key habitat factors • Monitoring for the occurrence and breeding success of indicator species
Handling mistaken development / control	Establishment of suitable control and correction measures	• Switch from pasturage to mowing • Change in the mowing schedule • Supplemental establishment of a ban on night-time construction

Table A.53

Examination sheet for Terrain investigation during success monitoring of implemented compensation measures [83, p. 66]

General data on the project and the compensation measure	
Data on the project	
Project	
Section/project segment	
Party carrying out the project developer	
Data on compensation or offsetting measure	
Measure no. (from landscape management plan, etc.)	
Point in time of measure implementation	
Original condition (biotope type)	
Target condition (biotope type)	
Location (municipality)	
Data for monitoring	
Date of monitoring	
Image no.	
Data for field monitoring	
Target	**Result of monitoring**
Location (parish, section, lot); overview plan as appendix for on-site monitoring	
Area size	

Table A.53 (Continuation)

Planting/installation measures	
Landscaping measures	
Planting measures: Species, strains	
Planting measures: Plant qualities	
Planting measures: Planting pattern; copy as appendix, for on-site monitoring	
Follow-up care	
Other measures	
Permanent care measures: (specify only after completion of follow-up care)	
Evaluation of examination results	
Creation – completeness. Has the compensation or offsetting measure been implemented, and if so, to which extent?	
Creation – quality. Was the measure appropriately implemented (plant quality, completion)? Indication as to how many seedlings died	
Care - completeness, quality. To what extent were the care measures implemented, or did an appropriate implementation take place? Indication how many care measures were not carried out	
Overall result: e.g., in 5 steps	

Table A.54

Requirements for the implementation and control of measures [83, p. 68]

Creation measures	Care measures	Implementation controls	Functional controls
Development of site-appropriate deciduous forests		Baseline situation: Farmland, grassland, barren land	
Usual situation: • New afforestation by planting of deciduous trees • Fencing in afforestation to prevent destruction by feeding animals	Follow-up and development care	After follow-up and development care, monitoring of species, plant quality and fencing	Monitoring of development of the forest stand after approx. 10 years
Additional measures: • Roosts for birds of prey to combat rodents • Attachment of tree stakes • Removal of coniferous trees			
Planting of single trees, planting of tree rows and tree-lined avenues		Baseline situation: Farmland, grassland, barren land	
Usual situation: • Tree planting • Attachment of tree stakes	**Usual situation:** Follow-up and development care	After follow-up care, monitoring of species, plant quality, tree binding, and, after development care, monitoring of vitality	Monitoring of development of the stand after approx. 10 years
Other measures: • Protection by fencing or wire mesh • Mulching	**Other measures:** Pruning of trees		
Development of tall forb fields		Baseline situation: Farmland, grassland	
Usual situation: Succession	**Usual situation:** Mowing and removal of the mown hay	None, provided the succession has developed	Monitoring of species composition after approx. 5 years
Other measures: Fencing Planting of tall forbs Clearing of trees not local to the site			
Development of extensively used grassland		Baseline situation: Farmland	
Usual situation: Seeding	**Usual situation:** Mowing and removal of the mown hay	Monitoring to make sure seeding takes root	Monitoring of species composition after approx. 6 years
Other measures: Soil impoverishment (alternative: removal) Abandonment of use, succession			

Appendix 1.11

Documents for the development and accompaniment of compensation measures

Table A.55

Typical documentation for an impact compensation plan [65, p. 81]

Site sketch and site map	• Excerpt from topographical map, 1:25,000 or 1:10,000 • Cadastral map: 1:1000 to 1:5000
Map of existing situation (minimum of 1:5000)	• Current use types and facilities on the plot of land; if necessary, description of their actual function • Legally binding conservation, forestry and clean water provisions applicable to the area (protected areas, existing compensation requirements, forests, and water protection areas) • If appropriate, excerpt from the community landscape plan • Presence of specially or strictly protected species, breeding areas or strictly protected bird species • If necessary, yield figures for areas in usable as farmland • Photos of the existing stock
Compensation plan	• Area designation; future uses and design of plots of land • Impacts of the project on nature and the landscape (including negative impacts due to construction, facility and operational causes, e.g. the effects of fragmentation or climate impacts) • In-kind/on-site compensation and out-of-site/off-site offset measures (including situation, type, extent and point in time of implementation), and measures required for permanent assurance of functionality;
Compensation calculations	• Accounting of effects statement of use changes, including listing of non-compensated negative impacts • If necessary, additional evaluation with significant negative impact upon the quality of the landscape, e.g. due to utility poles, or widely visible project segments • If necessary, additional evaluation of interruption of pathways of specially protected migratory bird species
Justification/ explanation in text form	• Description of the project impacts (negative impacts due to construction, operation and facilities; point in time, duration, dimensions, structures, colour, drawings) • In case of major or conspicuous projects: photo compilations, lateral views • Justification for type and extent of negative impacts • Statements regarding alternatives, justifications of alternative selected • Description and justification for compensation measures, including type and scope

Table A.56

Model structure for project documentation in road construction (evaluation of impacts and determination of compensation measures) [49, pp. 84-88]

Topic	General instructions
1. Introduction	• Overview of the contents of the Landscape Management Plan (German: LBP) • Reference to the general methodological framework • Brief description of special features • Brief outline of the planning history
2. Evaluation of the existing situation	• Introduction to the landscape area and the delimited reference areas
2.1. Reference area 1	• Detailed ascertainment of the existing situation, structured by reference area (not by protected asset)
2.1.1. Definition and justification of the functions and structures relevant for planning	• Due to their far-reaching significance as indicators, aspects of the habitat function of animals and plants often have priority in the analysis of the efficiency and functionality of the balance of nature - in addition to the quality of the landscape. • If other or additional functions and structures are relevant to the planning for the respective reference area, i.e. functions and structures which are not covered via the habitat function, or if the habitat function itself is not the decisive factor, these other factors must be ascertained and described

Table A.56 (Continuation)

2.1.2. Description and evaluation of the functions and structures relevant for planning	• Description and evaluation of the significance and protection-worthiness of each function in the reference area under investigation. • Structures are to be presented in terms of their site factors (biotope and soil types, water balance, etc.) and the determinant functions for the particular site (material and energy flows, biotic and abiotic interaction relationships between living things and their environment, etc.).
2.2 Other reference areas	See point 2.1
2.3. Spaces outsite the reference areas	• Inasmuch as spaces for the implementation of measures are provided outside the reference areas relevant for the conflict ascertainment process, they are to be described and evaluated in their current state as additional reference areas, in the context of their potential for upgrading.
2.4. Protected areas	• Informational overview of protected areas and protected objects in the effect area of the project (e.g. habitat areas, natural protected areas, landscape protected areas, protected landscape elements, water protection areas)
2.5. Summary of the ascertainment of the existing situation	• Overview of the landscape area • Summary of reference areas and their relevant functions • Explanation of the essential reasons for the selection of the specific characteristics • Overview of protected areas and protected objects
3. Documentation on avoidance and minimization of negative impacts	• Avoiding negative impacts upon nature and the landscape is an essential duty. • The primary duty is complete avoidance; the secondary duty is partial avoidance or minimization of negative impacts
3.1. Engineering-based avoidance measures	• Establishment of engineering-based avoidance measures (particularly such construction measures as tunnels, expansion of bridge structures, wildlife passages, green bridges and passageways for amphibians and small animals, guide facilities, protective fences against wildlife, etc.), coordinated with the engineering planning. Conceptually, the avoidance measures are an essential component of the landscape management plan (German: LBP) • However, the engineering-based avoidance measures are a component of the draft road-building plan
3.2. Avoidance measures during implementation ofthe construction process	• Avoidance measures include measures for the protection of temporary endangerment to nature and the landscape. These include such measures as fencing in areas, protection of bodies of water and groves of trees, and protective planning in the context of the construction operations. • The derivation of avoidance measures includes in particular observance of the precautionary measures for the prevention of damage necessary for the purpose of protection of species (e.g. regulation of contraction periods)
4. Conflict analysis	• The conflict analysis refers to the selected and described structures and functions relevant for the planning process
4.1. Project related impact factors	• The project impacts and impact factors relevant for the environment are to be identified from the concretized engineering planning process according to type, intensity, spatial extent and duration of occurrence. • Construction related, facility related and operationally related negative impacts are to be distinguished according to their causes and/or their project phases
4.2. Summary of negative impacts	• Since the detailed description of the conflicts for the derivation and justification of the required measures is stated in the measure sheets, it is at this point sufficient to explain the methodological procedure and to supply an area overview of the essential conflicts in tabular form • The prognosis of the negative impacts of the natural balance and the landscape quality occurs within the reference areas • Analogously to the ascertainment of the existing situation, it is necessary to describe all negative impacts on functions of the natural balance • Moreover, the negative impacts on the quality of the landscape must be ascertained

Table A.56 (Continuation)

5. Planning of compensation measures	• The project developer must be made to assume the obligation to compensate for unavoidable negative impacts by means of conservationist and landscape-care measures (in-kind/on-site compensation measures) as a priority, or to compensate them in some other manner (out-of-kind/off-site offset measures) • In determining the type and extent of the measures, it is necessary to take the relevant programmes and plans into account
5.1. Development of the measures plan	• Since the goal of the measures is described and justified in detail in the measure sheets, it is sufficient at this point to elucidate the methodological framework of the planning of measures, and to provide an area overview of the essential compensation goals within the particular reference/measure areas, in tabular form • The measures plan should be developed on the basis of nature conservation principles, derived on the one hand from the goals and measures of landscape planning and other professional plans, and on the other from the profile of protection worthiness and the current functional characteristics in the particular reference areas
5.2. Overview of measures	• Drafting of an overview table of all measures, with a brief description (title), and the size of the area
6. Comparative juxtaposition	The comparative juxtaposition of negative impacts and compensation must have the following contents: • Designation of the reference area concerned • List of the significant conflicts/negative impacts, with an emphasis on the main conflict • Scope of the significant negative impacts • Description of the goals/justification of the complex of measures and/or of the particular measures • Assignment of the complexes of measures and/or particular measures to the conflicts described; list of the planned measures (in-kind/on-site and out-of-kind/off-site offset) • Scope of the compensation measures
7. Overall evaluation of the impacts of a project	• Conclusive statement as to whether the negative impacts of the balance of nature can be compensated in the same manner in-kind/on-site, or offset equivalently out-of-kind/off-site, and whether the landscape quality can be appropriately restored, or newly designed • If the measure planning framework still has a compensation deficit, information regarding the provision of any compensation payment should be made at this point
8. Directory of literature and sources	
9. Appendices	
Directory of measures	• The measure sheets must contain detailed justification and description of the measures with regard to the derivation of the respective relevant planning functions (conflicts), and the goals of the measures • The measure sheets describe the type, location and scope of the landscape management measures • With reference to the functions affected by the project, which are to be restored by the appropriate measures, a justification of the selection of the particular measures will be carried out on the basis of the goals strategy of the measure planning process, the requirements placed upon the site preconditions, and the existing situation of the area in which measures are to be implemented
Documentation of the decision-making process for the analysis of the planning area. Since the planning relevant structures and functions are also determined along with the analysis of the planning area (delimitation of the area of investigation, delimitation of the reference areas, requisite mapping, limitation to particular species/groups of species, etc.), the result of the determination of the investigation framework will have essential effects on the contents of the Landscape Management Plan (German: LBP). For the sake of clarity and also with regard to the objections in the plan approval procedure, these decision-making processes must be documented	

Table A.57

Sample measures sheet form [82, pp. 95-96]

Party implementing the project _____ **Construction project designation** _____ **Planning segment** _____	**Measures Sheet**	**Measure No._____** of the site map plan of the landscape care measures Location of the measure:

Brief project designation:

Conflict/impact no.: (from the as-is map and the conflict map)

Description
(Type, intensity, taking into account significance/sensitivity of the protected assets)

Biotopes/plants _____	Animals _____	Soil _____
Water _____	Climate/air _____	Landscape quality _____

MEASURE

☐ Protective measure ☐ Design measures ☐ Compensation measure ☐ Offset measure

Justification/goal:
Target biotope, target function

Description of the measure
- Baseline situation of the measure area (initial value, previous impacts)
- Implementation of the measure, incl. statements on plant species
- Spatial/functional context of the impact area
- Area size of particular areas and measures
- Development period
- Statements on multifunctional compensation

Biotope development and care concept/controls
- Maintenance care and/or operational stipulations
- Care and development concept, through achievement of the development goal
- Schedule of measures to be regularly implemented
- Stipulation of functional monitoring

Point in time of implementation
The points in time of the schedule are to be stated as precisely as possible, e.g.:
- Outside the vegetation period (during the period from ___ to ___)
- Outside the breeding period (during the period from ___ to ___)
- … months prior to start of construction (on … at the latest)
- … months after completion of the project (on … at the latest)

☐ Prior to construction start ☐ At construction start ☐ During construction ☐ After completion of project

Impact

☐ minimized	☐ Fully compensated via measure no.___	☐ Non-compensable
☐ avoided	☐ Fully offset via measure no.__	☐ Non-offsettable
☐ compensated	☐ Multifunctional compensation via measure no.____	
☐ offset		

Lots affected and stipulation provided

☐ Publicly owned land	___ ha	Future owner _____
☐ Land owned by third parties	___ ha	
☐ Temporary land use	___ ha	
☐ Land acquisition necessary	___ ha	Future party responsible for maintenance _____
☐ Use restriction	___ ha	
Area size of measure	___ ha	

Table A.58

Sample measures sheets for various impacts and protected assets [59, pp. 6-13]

Project designation Construction of federal highway Landscape Management Plan (LBP), here:	**Measures Sheet**	**Measure No.___** Location: Construction-km 3+250 – 3+750

Brief designation of the measure: Restoration of landscape quality

Impact/Conflict no.: (from conflict map)

Description (Type, Intensity**)**

In the context of the new construction of the federal highway, an interchange is planned. The district road is to pass over the highway on an embankment. The following impacts on the landscape quality are to be expected as a result:
The loss of structuring and life-giving tree and bush structures, particularly tree hedges, groves and bushes of high significance for landscape quality
Visual irritation as a result of the installation of a bridge and an embankment more than 3 m in height
Total loss of tree and shrub structures: 2.51 ha
Fragmentation due to embankments and bridges: 500 m

MEASURE

☐ Protective measure ☐ Design measure ☐ Compensation measure ☒ Offset measure

Justification/goal:
The goal of the measure involves the planting of new tree hedges, in order to upgrade the landscape quality in the area of the highway route, and to minimize the irritating factors caused by the structures which disturb the landscape aesthetics

Description of the measure:
A 7-row hedge of trees is to be developed along a 10 m wide strip on hitherto intensively used farmland. The structure of the hedge consists of first and second-order trees, and also shrubs. First-order trees could account for approx. 10 to 20% of the total, and second-order trees approx. 20 to 25%. Generally, locally typical species are to be used. First-order trees are to be planted singly as achiever; the shrubs are to be planted in groups of 5 to 7 plants

Biotope development and care concept/ controls
Hedge of trees: 3.8 ha
The area of the seedlings is to be mown once or twice a year to remove wild growth, until the seedlings are capable of competing. Approx. every 10 years, one third of the shrubs should be rejuvenated by vetting or being pruned back to trunk; such care measures should be carried out in small segments throughout the entire length of the hedge. The waste wood should be removed. The permanent protection of achiever trees should be planned; they should be developed at intervals of between 10 and 40 m. No pruning should be carried out between March and September.
The hedge of trees consists of 7 plots, with a plot size of between 0.3 and 0.8 ha each

Implementation of the measure

☐ Prior to construction start ☐ At construction start ☐ During construction ☒ After completion of project

Impact

☐ minimized	☐ Fully compensated via measure no.___	☐ Non-compensable
☐ avoided	☐ Fully offset via measure no.__	☐ Non-offsettable
☐ compensated	☐ Multifunctional compensation via measure no.____	
☒ offset		

Lots affected and regulation provided

☐ Publicly owned land	___ ha	Future owner _____
☐ Land owned by third parties	___ ha	
☐ Temporary land use	___ ha	
☒ Land acquisition necessary	3,8 ha	Future party responsible for maintenance _____
☐ Use restriction	___ ha	
Area size of measure	**3,8 ha**	

Table A.58 (Continuation)

Project designation Construction of federal highway Landscape Management Plan (LBP), here:	**Measures Sheet**	**Measure No.___** Location: Entire project

Brief designation of the measure: Renaturation of impervious-covered and compacted soil

Impact/Conflict no.: (from conflict map)

Description (Type, Intensity**)**

The new road building project will include the impervious coverage of a total of 3.33 ha of previously uncovered and biotically active soil surface, resulting in the loss of all ecological soil functions, the transformation of existing soil structures, a change in surface runoff of precipitation, and compacting of the soil

MEASURE

☐ Protective measure ☐ Design measure ☒ Compensation measure ☐ Offset measure

Justification/goal:

The goal of the measure is the restoration of used soil sites, in order to compensate for a portion of the new impervious coverage

Description of the measure:

All road services of the old federal highway, the old state road and the old entry/exit ramps which are no longer needed are to be completely removed. The entire upper structure, the anti-freeze layer, the carrying layer and the covering layer, is to be removed. Compacting of the subsoil is to be removed by loosening with a subsoiler or catch hook. Existing trees and shrubs along the dismantled roadway are to be protected. Excavated areas are to be filled in with subsoil up to 25 cm below the terrain level. The upper 25 cm are to be covered with topsoil

Biotope development and care concept/ controls

The planting of the area is to be carried out in the context of measure no. …

Implementation of the measure

☐ Prior to construction start ☐ At construction start ☐ During construction ☒ After completion of project

Impact

☐ minimized ☐ Fully compensated via measure no.___ ☐ Non-compensable

☐ avoided ☐ Fully offset via measure no.__ ☐ Non-offsettable

☒ compensated ☐ Multifunctional compensation via measure no.____

☐ offset

Lots affected and regulation provided

☒ Publicly owned land	1,3 ha	Future owner _____
☐ Land owned by third parties	___ ha	
☐ Temporary land use	___ ha	
☐ Land acquisition necessary	___ ha	Future party responsible for maintenance _____
☐ Use restriction	___ ha	
Area size of measure	**1,3 ha**	

Table A.58 (Continuation)

Project designation Construction of federal highway Landscape Management Plan (LBP), here:	**Measures Sheet**	**Measure No.___** Location: Entire project

Brief designation of the measure: Renaturation of impervious-covered and compacted soil

Impact/Conflict no.: (from conflict map)

Description (Type, Intensity**)**

The new road building project will include the impervious coverage of a total of 3.33 ha of previously uncovered and biotically active soil surface, resulting in the loss of all ecological soil functions, the transformation of existing soil structures, a change in surface runoff of precipitation, and the compacting of the soil

MEASURE

☐ Protective measure ☐ Design measure ☐ Compensation measure ☒ Offset measure

Justification/goal:

The goal of the measure is improvement of the ecological soil functions by extensification and upgrading of previously intensively used farmland and/or previously overbuilt areas. The avoidance of the use of fertilizer and agricultural chemicals and the formation of a complete vegetation cover will improve the quality of the groundwater, the percolation rate and storage capacity of precipitation, and the microclimatic situation

Description of the measure:

At the former western connection point, two extensive orchard meadows and one extensive grassland field are to be planted. These areas are to be used as storage space during the construction period, and cleared off during the course of the completion of the road construction project. For the orchard meadows, high trunk apple trees of various historic local strains are to be used (for a list of species, see Appendix). The interval between plants in the plantation is to be 15 m. Under the fruit trees and in the area of extensive grassland, meadow areas are to be developed by means of seeding with an appropriate seed mixture adapted to the regional site factors. Alternatively, mown material from nearby local grasslands can be distributed onto the area. The relationship between the harvested area and the area upon which the mown material is to be applied is 1:4. This procedure will ensure an indigenous spectrum of herbaceous material.

Long-term land-use and management is to be carried out by an agricultural business, in order to ensure appropriate utilization of the fruit and the mown material

Biotope development and care concept/ controls

Fruit trees: 41 trees. During the planting process, a pruning is to be carried out. In order to protect against browsing wildlife, trunk protection stands are to be installed. The trees are to be anchored firmly. The ties to the trees are to be checked annually, and the stands to be removed five years after planting. During the first five years after planting, shape pruning of the young trees is to be carried out annually. Thereafter, maintenance pruning is to be carried out every 2 to 5 years, for the purpose of preserving species specific crowns, and of the correction of mistaken development. Especially for young trees, regular monitoring of disease and pests is necessary; if necessary biotechnological or organic plant protection measures should be used. All pruning measures are to be carried out only between September and February.

Extensive meadow areas under the fruit trees – 1.2 ha. The meadow areas are to be mowed once a year after Sep. 15.

Extensive grassland area – 1.1 ha. The grassland areas are to be mowed twice a year, once after June 15 and once after Sep. 15.

For the mowing, sickle-bar or rotary mowers should be used; under no circumstances should flail mowers with suction devices be used. Mown material must be left on the ground for a minimum of one day. Neither fertilizer nor agricultural chemicals may be used

Implementation of the measure

☐ Prior to construction start ☐ At construction start ☐ During construction ☒ After completion of project

Impact

☐ compensated ☐ Multifunctional compensation via measure no.____ ☐ Non-compensable

☒ offset ☐ Non-offsettable

Lots affected and regulation provided

☒ Land acquisition necessary	2,3 ha	Future owner _____
☒ Use restriction	2,3 ha	Future party responsible for maintenance
Area size of measure	**2,3 ha**	_____

Table A.58 (Continuation)

Project designation Construction of federal highway Landscape Management Plan (LBP), here:	**Measures Sheet**	**Measure No.___** Location: Construction-km 2+500 – 3+200

Brief designation of the measure: Protection of the aquifer

Impact/Conflict no.: (from conflict map)

Description (Type, Intensity**)**

In this section, the route runs parallel to the slope, in a trench, and crosses an important aquifer. Toward the slope, this makes drainage facilities and dewatering measures necessary, which will lead to a drop in the groundwater above the roadway; the exact extent of the area affected cannot be ascertained as yet. Moreover, there is increased danger of operationally induced pollutant immissions into the groundwater

MEASURE

☐ Protective measure ☐ Design measure ☐ Compensation measure ☒ Offset measure

Justification/goal:

The goal of the measure is to improve groundwater quality in order to compensate for the negative impacts of the exposed aquifer, and the increased danger of groundwater pollution. The avoidance of the use of fertilizer and agricultural chemicals and the creation of complete vegetation cover will improve the groundwater quality

Description of the measure:

Several connected, intensively used farm fields in the area of the Water Protection Zone III are to be transformed into extensively used grassland. Long-term land use and management by an agricultural operation is to continue

Biotope development and care concept/ controls

Meadow area – 1.50 ha. The meadow areas are to be mowing once a year after Sep. 15. Neither fertilizer nor agricultural chemicals may be used

Implementation of the measure

☐ Prior to construction start ☒ At construction start ☐ During construction ☐ After completion of project

Impact

☐ minimized ☐ Fully compensated via measure no.___ ☐ Non-compensable

☐ avoided ☐ Fully offset via measure no.__ ☐ Non-offsettable

☐ compensated ☐ Multifunctional compensation via measure no.____

☒ offset

Lots affected and regulation provided

☐ Publicly owned land	___ ha	Future owner _____
☐ Land owned by third parties	___ ha	
☐ Temporary land use	___ ha	
☐ Land acquisition necessary	___ ha	Future party responsible for maintenance _____
☒ Use restriction	1,5 ha	
Area size of measure	**1,5 ha**	

Table A.58 (Continuation)

Project designation Construction of federal highway Landscape Management Plan (LBP), here	**Measures Sheet**	**Measure No.___** Location: Construction-km 6+000 – 6+200

Brief designation of the measure: Restoration of animal habitats

Impact/Conflict no.: (from conflict map)

Description (Type, Intensity**)**

The construction of the federal highway, including the intersection with the state/district road and the associated operational strip will lead to the loss, isolation and fragmentation of polecat habitats in the area of the ditches. This will lead to the destruction of the exchange relationships between the habitats, due to a total loss of habitat along the ditch, which will lead to a reduction in genetic exchange potential. In addition to the polecats, an indicator species for these structures, various other amphibians and small mammals will be affected by the measure. Total loss of habitats: 5.3 ha.; Length of cut leading to fragmentation: 200 m

MEASURE

☐ Protective measure ☐ Design measure ☐ Compensation measure ☒ Offset measure

Justification/goal:

The goal of the measure is to upgrade densely covered polecat habitat areas near to bodies of water, or to create new ones. Small mammals and amphibians are the food base of the polecat. A suitable site factor combination for restoring such structures is provided by the ditch, which also has a close spatial connection to the impacted structures, and is in a location which will be largely unaffected on the planned federal highway.

In addition to this total loss, fragmentation effects which cannot be quantified are likely, and must be compensated for. Therefore, taking the expected development period through achievement of complete functionality of the secondary habitat into account, the area subject to extensification has been increased in size in relationship to the area affected by the impact

Description of the measure:

The unstructured segment of the ditch is to be left to undergo natural development, so that, depending on the amount of water it carries, an edge strip as long and as natural as possible will develop. Shoreline strips of 1500 m in length and 15 m in width are to be provided on both sides of the ditch, and are to be developed into shoreline forb areas by means of succession. Sporadically, groups of trees and shrubs with a total area of 10% are to be planted. Moreover

Biotope development and care concept/ controls

Shoreline trees and shrubs: Alder: 200 trees; willow: 400 trees. The interval between plants in the rows is to be 3 m for the willows and 5 m for the alders. In each section, a single row of plants of the same species is to be planted. During the first five years, the herbaceous layer under the trees is to be mown twice a year, in order to prevent the seedlings of being overgrown. Mown material can be left on the ground. With increasing age of the trees, one third of the trees are to be vetted or cut back to trunk every 5 to 10 years in sections.

Area covered by trees and shrubs: 0.7 ha The interval between the seedlings is to be 1 x 1 m. Each species is to be planted in groups of 3 to 7 plants, so that even after vetting, an equal distribution of all species throughout the entire area will be provided. The area around the seedlings is to be mown once or twice a year to control the wild growth until the seedlings are capable of competing. Every 5 to 10 years, half the shrubs should be vetted or cut back to trunk. This measure is not to be carried out by section, but rather throughout the entire planted area.

Controlled succession areas: 6.2 ha Depending on site development, succession areas are to be mown for the first time after two years. Thereafter, they should be mown every 3 to 5 years, always after September 15, with a cutting height of > 10 cm; removal of mown material after 1 to 3 days; care of measures are to be staggered in time and place; old grassy areas should in some cases be left as they are. Non-destructive mowing is to be ensured by the use of sickle-bar or rotary mowers without suction devices

Implementation of the measure

☒ Prior to construction start ☐ At construction start ☐ During construction ☐ After completion of project

Impact

☐ compensated ☐ Multifunctional compensation via measure no.____ ☐ Non-compensable
☒ offset ☐ Non-offsettable

Lots affected and regulation provided

☒ Land acquisition necessary	7,2 ha	Future owner _____
☐ Use restriction	___ ha	Future party responsible for maintenance
Area size of measure	**7,2 ha**	

Table A.59

Measures sheet [73, pp. 84-85]

Measure	
Transformation of farmland into extensively used grassland in the shore area of a creek	
Type of measure	
Compensation measure in-kind/on-site Offsetting measure out-of-kind/off-site	
Assessment of the impact; conflict situation	
1. Loss of soil function due to additional impervious coverage area:	12,220 sq.m
2. Loss of percolation surface area due to impervious coverage area:	12,220 sq.m
3. Loss or considerable limitation of habitat functions through consumption of higher value biotope structures:	
• Other damp grassland area:	210 sq.m
• Intensively used permanent grassland area:	945 sq.m
• Intensively used farmland area:	3190 sq.m
• Traffic areas, partially impervious, sporadic vegetation area:	2430 sq.m
Reason for the measure, goals	
• Mitigation of impacts of the soil and water balance • Creation of minimally used biotope structures in open country • Optimization of the biotope network function along the affected creek • Landscape appropriate new structuring	
Current use	
Intensively used farmland	
Implementation of the measure	
The harvested farm field is ploughed up, and even meadow level created, and the aufwuchs containing seeds, or a meadow-seed mixture appropriate to the site, is applied. When using freshly mown grass, a meadow should previously be selected for growing the seed which is similar to the area to be used for the measure in terms of species inventory and site factors. It is to be mown in three staggered segments within a vegetation period, and the mown crop is to be applied to the area of the measure, where it is to be distributed as an initial seeding across an area 4 to 8 times larger than the mown area. Additional levelling and shoreline embankment installation (sporadic) should be carried out to create a variegated small-scale relief	
Requirement for land	Area of approx. 4000 sq.m
Instructions for maintenance care	
Mowing once or twice a year (start not before mid-June, or in coordination with the responsible conservation authority)	
Use restriction	
No fertilization or pasture use	
Responsible entity	
Municipality, environmental associations	

Appendix 1.12

Inventory of compensation areas and measures

Table A.60

Reporting of compensation and offsetting areas for recording in the compensation areas register [41, p. 20]

Compensation area No. _____		
Area _____ ha	Lot number _____	Parish _____
Municipality _____		District _____
Property owner _____	Several property owners _____	
Provision of the compensation area ☐ for a development plan for a project ☐ for a local compensation development plan Designation of the plan _____		
Development goals of the compensation area, as per local development plan		
☐ Stream	☐ Herbaceous and forb field	☐ Trees, field groves, shrubbery
☐ Standing body of water	☐ Extensive farmland	☐ Extreme sites, dwarf shrub heaths, raw soil sites
☐ Shore/land forming area	☐ Extensive grassland	☐ Biotope of zoological ignifycance for:
☐ Bogs/wetlands	☐ Forests	☐ Other:
Attachments		
Additional information		

Table A.61

Minimum content of a register for compensation and offset measures [72, p. 189]

Information about the project	
• Designation and location of the project	• Party implementing the project
• Type of project and legal basis	• Approval authority
Information about the stipulated areas	
• Location of the area	• Authorized user of the property
• Size of the area	• Reference to other areas for compensation and offset measures for the same project
• Original condition of the area	
• Owner of the property	
Information about the compensation and offset measures, and the goals targeted by the measure	
• Type of measure (precautions for mitigation, compensation measures, offset measures)	• Completion times and warranty requirements
• Description of the measure and its goals	• Care measures and care intervals, management stipulations
• Preconditions to be established for the achievement of the goal	• Long-term securing of the areas, and stipulated care measures if necessary
• Target date of completion of measure	• Authority implementing the measure
Information about establishment and functional controls (including regularly scheduled monitoring compliance with care and management stipulations)	
• Monitoring authority	• Results of monitoring
• Point in time of implementation	• Consequences
Information about the stipulated offset payment	
• Amount of payment	• Payment date
• Recipient of payment	
In addition to the minimum contents listed, the following information may be ascertained	
Information about areas particularly suited for the implementation of compensation and offset measures, or which are already being reserved for such measures in the planning process (e.g. mu-nicipal compensation pools)	

APPENDIX 2

GLOSSARY OF GERMAN TERMS

Balancing / consideration of interests

Balancing of interests under the conservation law: Examination step in the process of the Impact Mitigation Regulation, to be carried out for all unavoidable and non-compensable negative impacts of a project. Here, the responsible authorizing authority examines whether the interests of the conservation of nature have priority over other public interests or not. If the decision is negative with regard to the priority of the interests of conservation, the project will be authorized, with the stipulation of offsetting measures.

Balancing of interests under the construction law: In the preparation of land-use plans (preparatory and binding), the municipality must consider the duty to balance the various interests in accordance with the Building Code, and to weigh public and private interests fairly. This consideration of interests also encompasses the stipulations of the Impact Mitigation Regulation.

Impact

Legal term under the Federal Nature Conservation Act for changes in the form or use of areas of land, or changes in the groundwater level connected with the upper soil level, which may have a significant negative impact upon the efficiency and functionality of the balance of nature or of the quality of the landscape

Impact-compensation account

Conclusive, protected-asset-specific juxtaposition of environmental impacts with the planned compensation measures. It is a certification that all unavoidable significant negative impacts are likely to be compensable through appropriate compensation and offsetting measures.

Impact Mitigation Regulation

Element of the Federal Nature Conservation Act, as a contribution of the conservation of nature to other sectoral plans (planning for transport routes, mining/quarrying, etc.). By means of a decision-making cascade, the Impact Mitigation Regulation stipulates the sequence of examination and decision-making steps (avoidance → minimization → compensation → offsetting → offset payment). The implementation of the Impact Mitigation Regulation under conservation law is generally carried out in the context of the landscape management plan, or in the course of the land-use planning process in the landscape, green space or local development plan.

Significance of negative impacts

Largely undetermined legal term from the Federal Nature Conservation Act. The significance of an impact depends both on the intensity, spatial extent and duration of an impact, and on the sensitivity of the protected assets and functions affected. An impact is considered significant if it clearly has negative effects on certain functions and values of the natural balance or of the landscape quality, and as a result, functions and values of a different nature, or change in landscape appearance, is likely to develop. Impacts can also be considered significant if their negative effects last longer than five years, i.e. are effective over the long term.

Pool of compensation areas and measures

Stocking of compensation areas and measures in expectation of future impacts.

Pool of compensation areas: A collection of potential compensation areas on which future impacts can be compensated by means of conservationist measures.

Pool of compensation measures: If measures are implemented on such land areas in expectation of later impacts, it is called a «measures pool».

Compensation Umbrella term for measures which, in the context of the application of the Impact Mitigation Regulation, serve to compensate unavoidable negative impacts either naturally or monetarily.

Natural compensation: Implementation of on-site, in-kind compensation and/or off-site, out-of-kind offsetting measures, *in natura*.

Monetary compensation: Syn.: *Offset fee, offset payment*. Payment which the party responsible for an impact must render to a fund to be used for conservation purposes and landscape care. Offset payment is not an alternative to natural compensation, but rather a «last resort» for impacts that are so serious that their consequences cannot be compensated.

Compensation concept Development of a compensation concept (landscape management plan) in the context of the Impact Mitigation Regulation under conservation law. The stipulations of landscape planning and the biotope network for the preservation or restoration of spatial/ functional contexts are to be integrated into a spatially coherent, well-founded overall concept. The compensation concept also serves to concentrate single measures.

Compensation measure Collective term for compensation and offsetting measures.

On-site compensation measures are designed to compensate in kind the negative effects caused by an impact. Such a compensation measure must have a close spatial, temporal and functional relationship to the impact.

Off-site offsetting measures become necessary if significant negative impacts cannot be compensated on-site and in-kind, but the project nonetheless receives priority over the interests of conservation in the course of the balanced consideration of interests. Offsetting measures have the purpose of creating similar, at least equivalent compensation for the functions of the balance of nature and of the landscape quality affected. The spatial, temporal and functional relationship to the functions affected by the impact is, however, less strict.

Eco-account Type of management of a measures pool. As with a normal bank account, the pre-initiated measures are “booked” onto the account, and if they are used as compensation for an impact, they are “withdrawn” from the account. The stocking of measures is often initially carried out at the expense of the municipality. The refinancing is carried out by the party responsible for the impact who wants to use these measures to satisfy his compensation requirement.

Re-cultivation Syn.: *reclamation*. Restoration to use and re-development of land which was formerly subject to intensive commercial use, e.g. gravel quarries, waste dumps, or open cast mine areas, and their integration into the surrounding landscape, with the goal of agricultural, silvicultural or recreation-oriented follow-up use. Unlike renaturation, this involves economically related rehabilitation. The re-cultivation plan encompasses all measures for the restoration of mining/ quarrying areas. Depending on the respective goal, the plan may include renaturation, compensation and/or offsetting measures.

Renaturation Transformation of anthropogenically changed habitats into a near-natural condition. Large-scale renaturation involves the development of formerly intensively commercially used land, such as dumps or opencast mines, into natural conservation areas. Unlike re-cultivation, this is a conservation-oriented rehabilitation measure.

Mitigation The duty of mitigation (avoidance and minimization) may mean the complete rejection of a project. Generally, long-term and/or technological optimization of the project is involved. Mitigation measures have priority over compensation and offsetting measures.

Restoration of use The duty of restoration of use under mining law refers to the surface land directly affected by mining use. Restoration of use does not necessarily mean the complete restoration of the condition which existed on the surface prior to the initiation of the mining project. It is sufficient to restore the area in such a way as to make it suitable for a planned follow-up use.

Time lag effect The time lag up to the achievement of the target condition. Often, decades of development time can pass between the implementation of compensation and/or offsetting measures, and the achievement of full ecological effectiveness. During that period, the functional characteristics removed by the impact may not yet pertain. This time lag is taken into account by additional compensation requirements.

The most common terms are given in the Glossary [33, 48, 72, 91]. The meaning of other German terms unknown to readers is explained in the following books published, within the framework of the Russian-German cooperative effort:

Оценка воздействия на окружающую среду и экологическая экспертиза: российско-германское методическое пособие // Изд-во Института географии СО РАН: Иркутск - Берлин – Бонн 2008, – 199 с. [24]

Assessment of environmental impacts and Ecological Expertise: Professional experience of EIA issues in Russia and Germany. – Irkutsk, Dresden, Berlin, Bonn, Dessau: Publishing house of the Sochava Institute of Geography of the SB RAS, 2012. – 76 p.

Ландшафтное планирование и охрана природы: немецко-русско-английский словарь справочник // Изд-во Института географии СО РАН: Бонн-Берлин-Ганновер-Москва-Иркутск, 2006. – 192 с. [48]

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10. О защите зеленых насаждений / Закон города Москвы № 17 от 5.05.1999 г.

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