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**SECRETARY OF STATE
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**GENERAL DIRECTORATE FOR
ENVIRONMENTAL QUALITY AND ASSESSMENT**

STRUCTURE AND GENERAL CONTENT OF THE ENVIRONMENTAL DAMAGE REMEDIAL PROJECTS

TECHNICAL COMMISSION FOR THE PREVENTION AND REMEDIATION OF ENVIRONMENTAL DAMAGES

This document is a summary in English of the original version of the document published on the section on Environmental Liability of the website of the Ministry for the Ecological Transition and the Demographic Challenge.

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1 INTRODUCTION

Law 26/2007, of October 23, on Environmental Liability, established a regime of environmental administrative liability, based on the precautionary and the "polluter pays" principles.

The remediation of the environmental damage caused is a central element of the environmental liability normative. The operators of the activities listed in Annex III, must inform the competent authority that environmental damage or an imminent threat of damage has occurred, and take the necessary remedial measures, in addition to the preventive and avoidance measures.

The same obligations are established for operators not included in Annex III of the law, although in this case they would only be required to adopt the remedial measures when they have been at fraud, fault or negligence, or when they have not implemented the appropriate measures of prevention and avoidance.

The remediation of the damaged natural resources and services will be based on a proposal of remediation project prepared by the operator, based on the criteria established in Annex II of the law, and which will have to be approved by the competent authority. Although operators, in accordance with their obligations, must immediately adopt the provisional measures necessary to repair, restore or replace damaged natural resources and services once the damage has occurred.

The objective of the remedial measures is to generate, through the so-called **primary remediation**, the same type, quantity and quality of natural capital that has been lost due to environmental damage. In addition, it is foreseen the need to determine the **compensatory and complementary remedial measures** that compensate, respectively, both the temporary and permanent loss of the natural resources that have been damaged until they completely recover their baseline conditions prior to environmental damage.

Section 2 of Chapter III of Law 26/2007, of October 23, establishes the obligations of the operators regarding the remediation of environmental damage, some considerations on the way of implementing the remedial measures and the administrative powers of the competent authorities.

Moreover, Annex II of Law 26/2007, of October 23 contains the requirements regarding the remediation of environmental damage, that are completed with those established by Chapter II and Annexes I and II of its Regulation of Partial Development, which establishes a methodological framework to evaluate the environmental damage that has occurred and, depending on its scope, to design the necessary primary, compensatory and/or complementary remediation in each case.

The Annex II of the law defines the different types of remedial measures:

- "Primary remediation": Measure which returns the damaged natural resources or impaired services to baseline conditions.
- "Complementary remediation": Measure adopted in relation to the natural resources or services to compensate for the fact that the primary remediation does not result in fully restoring of the damaged natural resources or services.
- "Compensatory remediation": Measure adopted to compensate the interim losses of natural resources or services that occur from the date of damage occurring until primary remediation has achieved its full effect. It does not consist in a financial compensation.
- "interim losses". Losses which result from the fact that the damaged natural resources and/or services are not able to perform their ecological functions or provide services to

other natural resources or to the public until the primary or complementary measures have taken effect.

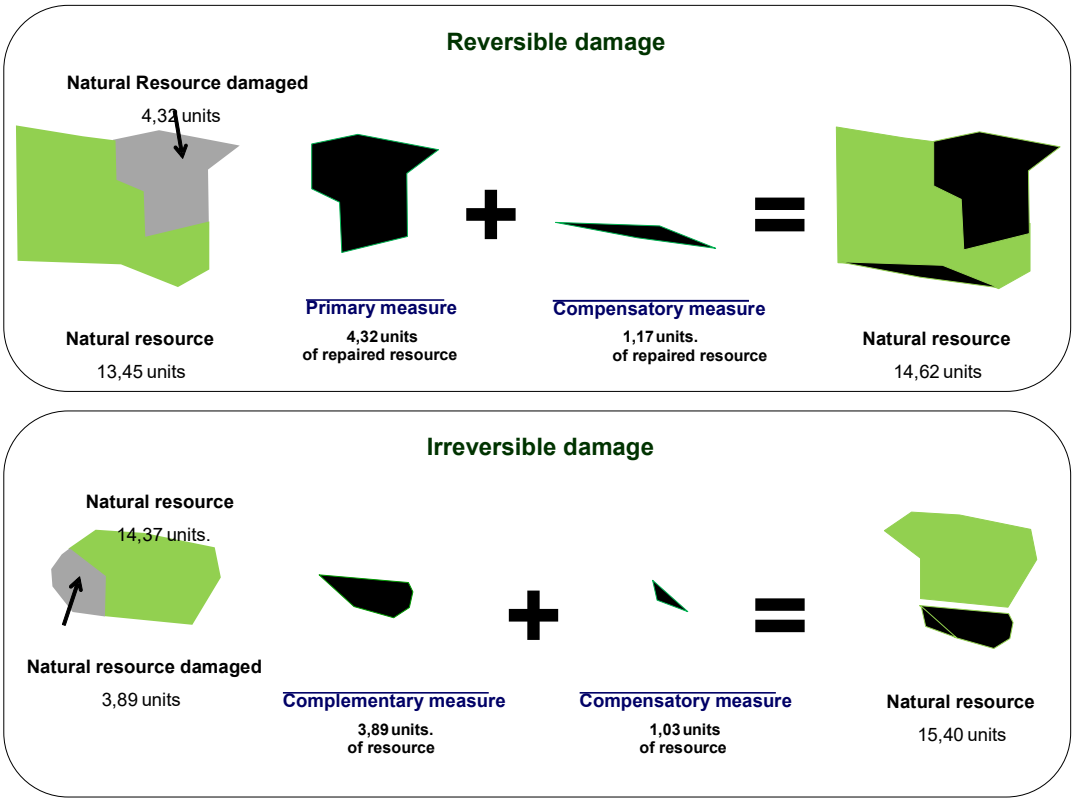

Figure 1. Types of remedial measures according to environmental liability legislation

The introduction of the compensatory and complementary remediation, based on the application of the Resource Equivalency Methods[1], which determines the amount of compensatory and complementary restoration, is a novelty in relation to the remediation requirements within the environmental liability regulation. This methodology uses equivalence criteria between the resources and services damaged, and those generated by repair, based on which the type and scope of the remedial measures that are necessary to recover natural resources, and the services they provide, that have been damaged are defined.

Annex II of Law 26/2007 establishes the assumptions in which each equivalence criterion must be applied (resource-resource, service-service, value-value, value-cost), being the resource-resource and service-service the criteria that have priority, since they guarantee a greater degree of substitution between the damaged resources and services and those that can be obtained through remediation.

[1] The Resource Equivalency Methods are based on REMEDE Project (*Resource Equivalency Methods for Assessing Environmental Damage*), financed by the Sixth Framework Programme of the European Commission (2002-2006), that proposes the Resource Equivalency Analysis as a standar tool to facilitate Member states compliance with the guidelines established by Annex II of Directive 2004/35/EC, of April 21, to determine the compensatoty and complementary remedial measures. More information about REMEDE project on http://www.envliability.eu/.

This approach is used to determine the amount of repair in biophysical terms, which is subsequently translated into the remediation project, with its associated total cost, needed to compensate for the entire loss of resources and environmental services that has occurred.

The Technical Commission for the prevention and remediation of environmental damages, as a body for technical cooperation and collaboration between the Central Administration and the regional and local authorities, to exchange information and advice on the prevention and remediation of environmental damage, has promoted the development of documents and tools that help operators to comply with the requirements related to the remediation of environmental damage and the preparation of the remediation project, as it is established in Law 26/2007.

This document provides a description, according with Law 26/2007 and its Regulation for Partial Development, of the structure and content that the operator must consider for the preparation of the proposal of remediation project to be submitted to the competent authority. The document provides guidelines on the phases that comprise the remediation project and the technical aspects that must be considered.

On the other hand, Annex 1 offers an explanatory index of the parts in which the remediation project should be structured[2].

This document aims to facilitate the operator the submission of the remediation project, and set out a common structure of the remediation projects to facilitate the procedure for evaluating and approval by the competent authorities.

To this effect a structure and content (basic o general) of the remediation project are established, in order to complying with the requirements of the normative on environmental liability.

Furthermore, MORA methodology and its IT tool developed by the General Directorate of Environmental Quality and Assessment of the Ministry for the Ecological Transition and the Demographic Challenge, constitutes a comprehensive assistance tool for monetise the environmental damage within the scope of Law 26/20017, of October 23. Its main purpose is to support the operator in the monetization of the environmental damage within the procedure of calculating the amount of financial security, as well as to implement an adequate environmental risk management. Nevertheless, MORA can offer a guidance, once the damage has occurred, to identify the most suitable remedial measures according to the combination of agent causing the damage and natural resource affected.

The guidelines established in this document to design the remediation project are in line with the protocol of action in case of incident and environmental liability proceeding drawn up within the Technical Commission for the prevention and remediation of environmental damages.

[2] The original version of the document (in Spanish) includes as well an annex 2 with a series of forms that help to systematize all the information required from the operator to draw the project up., besides an annex 3 that offers the remediation techniques catalogue of the IT tool MORA and the selection procedure for the techniques recommended by this model. The document is completed with a practical case that illustrates what is proposed in it.

2 OBJECTIVES AND SCOPE OF THE REMEDIATION PROJECTS

Article 20 of Law 26/2007, of October 23 establishes that:

> *"1.* […] *where environmental damages have occurred, the operator will, without delay and without the need for a warning, request or prior administrative act:*
>
> *a) Adopt all those provisional measures necessary to immediately repair, restore or replace the damaged natural resources and natural resources services, in accordance with the criteria set provided by Annex II, notwithstanding the additional criteria established for the same purpose by the autonomous communities. Moreover, the operator will inform the competent authority of the measures taken.*
>
> *b) Submit to the approval of the competent authority, in accordance with the provisions of Chapter VI, a proposal of remedial measures for the environmental damage caused prepared in accordance with the provisions of Annex II, notwithstanding the additional criteria established for the same purpose by the autonomous communities.*
>
> *2. Whenever possible, the competent authority will enable the operator so it can choose among different suitable measures or among different forms of implementation.*
>
> *3. Where several environmental damages have occurred in such a manner that it is not possible that the necessary remedial measures are taken at the same time, the resolution will set the order of priority to be observed.*
>
> *To that effect, the competent authority will take into account, among other aspects, the nature*, *the extent and the severity of each environmental damage, as well as the possibility of natural recovery.*
>
> *In any case, the measures aimed at eliminating risks to human health will have preferential character in its application."*

On the other hand, article 20 of the Regulation of Partial Development of Law 26/2007 establishes the purpose of the repair:

> *"1.* […] *return the natural resources and the services of the damaged natural resources to their baseline condition, for which the type, quantity, duration and location of the necessary remedial measures will be identified.*
>
> *In the case of repairing damage to the soil, the necessary measures will be taken to guarantee, as a minimum, that the harmful substances, preparations, organisms or microorganisms in question are eliminated, controlled or reduced, so that the contaminated soil no longer pose a significant threat of adverse effects on human health or the environment.*
>
> *2. The determination of the remedial measures will be specified in a remediation project that will be prepared in accordance with the criteria established in Annex II of Law 26/2007, of October 23, this section, Annex II of this regulation and autonomous normative applicable.*
>
> *3. The remediation project may include one o more types of primary, compensatory or complementary remedial measures."*

There are two previous stages that are unavoidable to draw up the remedial measures and to adjust them to the magnitude of the environmental damage, complying with the principle of proportionality between the amount of damaged natural resources and services they provide and the amount to be generated applying the remedial measures.

The Regulation considers a first stage called *"determination of the environmental damage"* (article 7) that includes identifying the agent causing the damage and the natural resources and services affected, quantifying the damage (in terms of extent, intensity and time scale) and the assessment of the significance.

Following, in a second stage and once the significance of the damage has been verified, the baseline condition of the natural resources must be determined (article 19). The baseline condition of natural resources and the services they provided before they were damaged represents the reference situation to be achieved with the implementation of the primary, compensatory and/or complementary remedial measures.

3 REMEDIATION PROJECT PLANNING

As it mentioned above, strict environmental liability is imposed on operators listed in Annex III of Law 26/2007, of October 23, that are required to undertake the repair obligations regardless of any fraud, fault or negligence that may have existed in their behaviour. Nevertheless, these obligations will extend to any other professional activity not listed in Annex III in the event that it is fraud, fault or negligence in the occurrence of the environmental damage.

The law establishes in its articles 9, 19 y 20 the responsibilities and obligations of the operators in relation to the remedial measures of environmental damage. These responsibilities and obligations consist in take and implement the remedial measures and cover their costs whatever their amount, when they are responsible for the damages.

The operator will also inform immediately the competent authority of the environmental damages or the imminent threat of such damages, as well as collaborate in the definition of the remedial measures and in the implementation of measures to be approved by the competent authority. In any case, and in accordance with article 21 of the law, the competent authority may require the operator to supply additional information regarding the damages caused, and reserves the right to provide instructions to the operator on the urgency and characteristics of the remedial measures, or, finally, to execute subsidiarity such measures when some of the circumstances provided for in articles 23 and 47 of the law concur.

It is worth remember that the obligation for the operator to immediately report the event to the competent authority extends to all activities regardless of whether or not they are included in Annex III of Law 26/2007, as well as the obligation to carry out the necessary prevention and avoidance measures. Likewise, an operator whose professional activity is not included in Annex III who would have failed to comply the obligations relating to the preventive and avoidance measures would also be obliged to implement the remedial measures.

Figure 2 illustrates the relationship between the different measures - prevention, avoidance and remedial – provided by the environmental liability regulations in the absence of damage, and in the context of an emergency situation in the face of an imminent threat of damage and environmental damage.

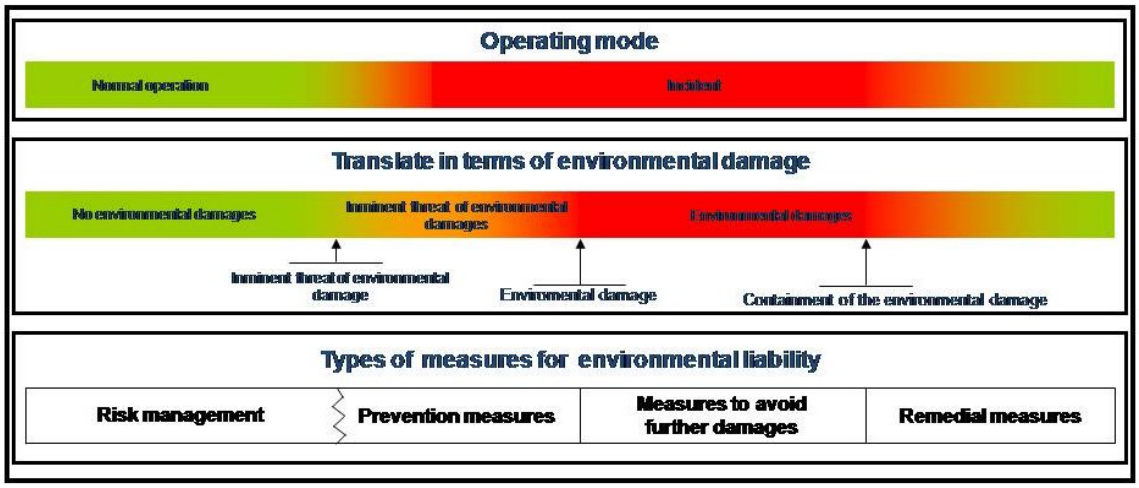

Figure 2. Scheme of the relationship between the mode of operation of a facility, imminent threats of environmental damages, environmental damages and measures to be implemented in the context of the environmental liability normative.

Figure 3 presents an outline of the steps involved in the definition of the remedial measures. In summary, and in accordance with Articles 9 and 19 of Law 26/2007 and Chapter II of the Regulation, in conjunction with Annexes I and II, the operator must determine the environmental damage that has occurred and, depending on its scope, establish a proposal for the necessary remedial measures in each case. The proposal of remediation project must identify and justify the type of remedial measure to be applied.

This proposal must be submitted to the competent authority, which will be responsible for formally approving them and, when appropriate prioritizing the order in which this measures should be implemented.

The methodology for quantifying complementary and compensatory remedial measures is based on the application of Resource Equivalence Analysis between damaged resources or services, and those that can be obtained through the aforementioned remedial measures (resource-resource, service-service, value-value, value-cost). This methodology is described in Annex II of the Regulation of Partial Development of Law 26/2007, of October 23.

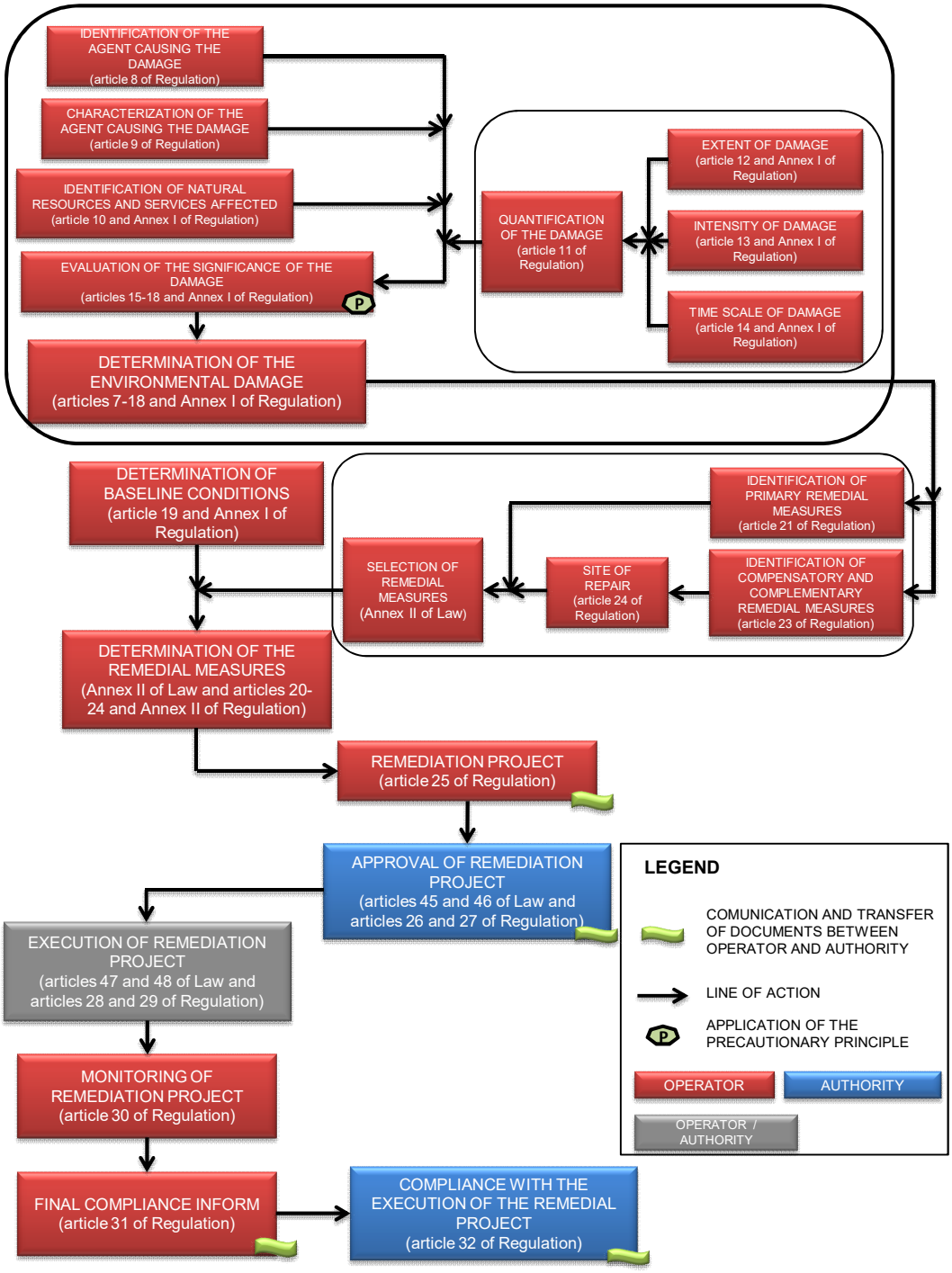

Figure 2. Decision process, planning and compliance of the remedial project.

From quantification of the environmental damage (natural resources and services lost), in biophysical units, the Resource Equivalence Analysis calculates compensatory and/or complementary remedial measures (natural resources and services gained), where the adoption of the resource-resource or service-service equivalency criteria is preferred over any other valuation approach. Its application requires using the same unit of measure to determine, respectively, the resources or services earned and those expected to be obtained through the remedial project.

Consequently, the result of the Resource Equivalence Analysis is to provide, through the remediation project, the same type and quantity of resources or services that have been lost since the damage occurred until the primary or complementary repair takes effect, moment in which the resources and services affected by the damage will have recovered their baseline conditions.

The following figure provides relevant information on the most important stages of the Resource Equivalence Analysis.

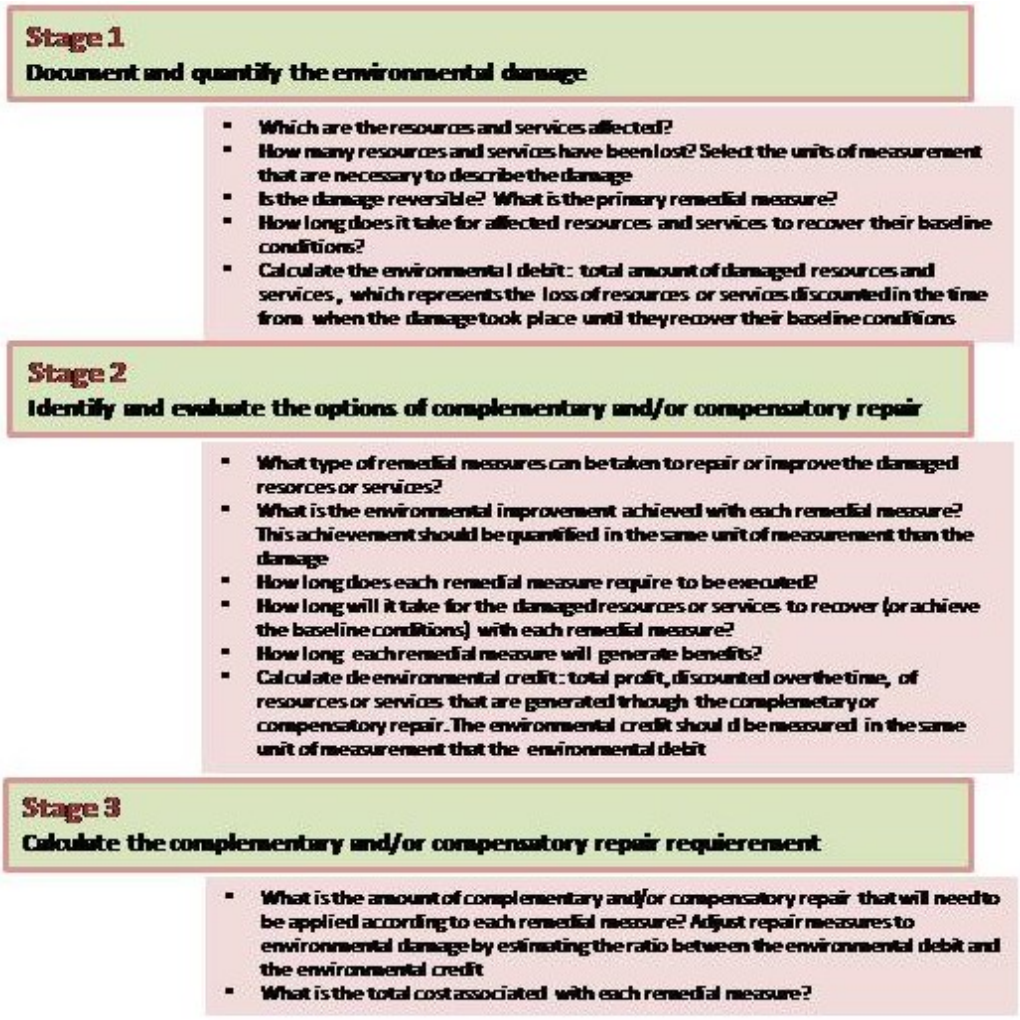

Figure 4. Stages of the Resource Equivalence Analysis. Elaborated from Lipton et al. (2008)[3] and European Commision et al. (2015)[4]

[3] Liptons, J., LeJeune, K., Calewaert, JB., Ozdemiroglu, E. (2008) *Toolkit for Performing Resource Equivalency Analysis to Assess and Scale Environmental Damage in the European Union* (REMEDE). Deliverable Nº 13. Disponible en http://www.envliability.eu/pages/publications.htm

[4] European Commision, Eftec, Stratus Consulting (2015) *Environmental Liability Directive (ELD). Two – Day Training Session*. Disponible en http://ec.europa.eu/environment/legal/liability/eld_training.htm

The need for more or less compensatory and/or complementary remediation depend on the scope of the primary remediation. In any case, the remediation project must contemplate all the necessary remedial measures (primary, compensatory and/or complementary) that are adequate for the complete restitution of the natural resources and services that they provide to their baseline conditions.

4 KEY ELEMENTS TO CONSIDER

4.1 Identification of natural resources and services affected

Law 26/2007, of October 23, differentiates the following natural resources within its scope: water, soil, seashore and estuaries, and wild species and habitats.

4.1.1 Water

The article 2.1.b) of Law 26/2007 includes within de resource water inland waters (surface water, whether natural, artificial or heavily modified, and groundwater), transitional waters, coastal waters and marine waters.

The Water Law establishes the following definitions in its article 40 bis:

"a) Inland water: all the water on the surface of the land, and all groundwater on the landward side of the baseline from which the breadth of territorial waters is measured"

b) Surface water: inland water, except groundwater; transitional waters and coastal waters and, as far as the chemical state is concerned, so are territorial waters.

c) Groundwater: all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil."

This same Water Law, in Article 16 a.1, defines coastal and transitional waters:

"Are transitional waters, the bodies of surface water near of river mouths which are partly saline as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.

Are coastal waters, the surface waters on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters."

Moreover, the marine waters, including seabed, subsoil and natural resources, subject to Spanish sovereignty or jurisdiction, as established by Law 41/2010, which include coastal waters, are included in the scope of Law 26/2007.

4.1.2 Soil

Law 26/2007, of October 23 defines in its article 2.7 as: *"The upper layer of the earth's crust, located between the rocky bed and the surface, composed of mineral particles, organic matter, water, air and living organisms and which forms the interface between soil, air and water, which gives it the ability to perform both natural and use functions. Those permanently covered by a sheet of surface water will not have such consideration"*.

4.1.3 Seashore and estuaries

Law 26/2007, of October 23, defines the resource seashore and estuaries as the maritime-terrestrial public domain assets regulated in article 3.1 of Law 22/1988, of July 28, of Coasts which includes:

a) The maritime-terrestrial zone or space between the heeling low line or the equinoctial living high tide, and the limit up to where the waves reach in the greatest known storms or, when it exceeds it, that of the equinoctial living high tide line. This area also extends along the banks of the rivers to the place where the effect of the tides becomes noticeable.

   The marshes, lagoons, estuaries and, in general, the low lands that are flooded as a result of the ebb and flow of the tides, waves or seawater filtration are considered included in this area.

b) Beaches or areas where loose materials are deposited, such as sands, gravels and pebbles, including escarpments, berms and dunes, whether or not they have vegetation, formed by the action of the sea or the sea wind, or other natural or artificial causes.

4.1.4 Wild species

The definition of the resource "wild species" included in article 2.4 of Law 26/2007, of October 23, can be summarized considering the legislation on protection of wild species, in which all species of wild fauna, except those affected by other sectoral legislation on forests, water, hunting, fishing or health, and the species of flora included in the List of Wild Species in Special Protection Regime, according to the Law 42/2007, of December 13, on Natural Heritage and Biodiversity are considered protected species, and, therefore, wild species can be considered as a resource in the scope of environmental liability.

On the other hand, in section II of the preamble of Law 26/2007, of October 23, it is stated that: "*Not all natural resources are protected by this law. Only those that have a place in the concept of environmental damage are, namely: damage to water; soil damage; damage to the seashore and estuaries; and damage* ***to species of wild flora and fauna present permanently or temporarily in Spain*** *[…]* ".

4.1.5 Habitats

Article 2.5 of Law 26/2007, of October 23, limits the consideration of a territory as a habitat to that which is protected by community, national, autonomous or international legislation. However, Law 42/2007, of December 13, on Natural Heritage and Biodiversity extends protection to all habitats present in Spain, as is established in its article 54.1: "*The Administration of the State and the autonomous communities, within the scope of their respective powers, will adopt the necessary measures to guarantee the conservation of the biodiversity that lives in the wild, preferably attending to the preservation of their habitats and establishing specific protection regimes for those wild species whose situation requires it […].*"

Additionally, section II of the preamble to Law 26/2007, of October 23, which has been cited in the discussion of the resource wild species ends with the following statement: "[…], *as well as the habitats of all the native wild species* ".

Ultimately, all wild species and habitats affected by significant damage in the context of environmental liability regulations must be considered as affected resources.

The definitions of wild species and habitats may raise the question of how to consider, whether wild species or habitat, a plant species that defines a habitat, such as a pine forest, a beech forest, etc. If the plant species is not included in the List of Wild Species under Special Protection Regime, it would only be possible to define that resource as habitat; on the other hand, if the plant species has been endowed with a special protection regime, it could be defined as a wild species or as a habitat. In any case, it can be concluded that the decision on whether environmental damage to a plant species should be treated as damage to a species or to a habitat is merely conceptual, having no influence on the approach or result of the remediation project: in both cases, the remediation techniques would consist of, for example, reforesting the affected forest.

4.2 Quantification

The quantification of damage is a necessary step to determine its significance on the one hand and, on the other hand, once that significance has been established, adequately size the measures of primary, compensatory and/or complementary remediation.

According to article 11 of the Regulation of Partial Development of the Law 26/2007, of October 23, the operator must quantify the damage, identifying, describing and evaluating its extent, intensity and time scale.

The result of this quantification is the numerical expression, in biophysical units, of the damage experienced by natural resources or its services. For this purpose, the operator must characterize the damage in terms of its extent (amount of affected resource generally measured in units of mass, volume or area), intensity (severity of the effects experienced by the affected resource as a result of the agent (s) causing damage) and time scale (duration, frequency and reversibility of the effects). The Annex I of the Regulation offers a series of guidelines and technical criteria that help characterize the damage in the terms set forth.

The extent of the damage provide an estimate of the amount of resource or service affected measured in biophysical units. For its estimation the type of agent causing the damage and the characteristics of the resource affected must be taken into account, including the means of diffusion or transport of the contamination.

In the majority of cases in which the damage has taken place, its extent can be determined by direct observation and measuring evidence, such as the number of individuals of each affected species, or the volume of soil or contaminated water.

Additionally, and when the agent causing the damage is a genetically modified organism, a case-by-case study will be carried out to determine its extension, taking into account the provisions of the specific sectorial legislation.

The intensity of the damage refers to the measurement of the severity of the effects that the agent causing the damage causes on the receiving environment. When the agent causing the damage is chemical, the intensity is estimated using the limit dose or the toxicity threshold (*Curves Toxicity Distribution*, CTD).

The limit dose of a substance or CTD establishes the relationship between a certain concentration of a substance, the time of exposure during which the living organism (plant or animal species) has been exposed to that substance, the route of exposure for which there is a risk of toxicity at that concentration (air, water, soil, ingestion, etc.) and the severity of the effect on the affected receptor as a consequence of the exposure. The Annex I of the Regulation establishes different levels of intensity when the agent causing the damage is of a chemical type - acute, chronic and potential – that can be determined from the CTD of a substance. This

is possible because each CTD is always referred to a specific level of intensity. Therefore, if a substance reaches a concentration in the receptor medium (*Predicted Environmental Concentration (PEC)*) higher than a certain CTD or toxicity threshold (in other words, when the PEC / CTD risk ratio is greater than one), and that CTD is referred to a specific level of intensity, it can be stated with sufficient confidence that the damage caused by that chemical agent on that receptor medium is associated with said level of intensity or severity of damage.

In the event that the agent causing the damage is of a physical type, the calculation of the intensity of the damage may be estimated, where possible, from the variation in the environmental quality experienced by the damaged receptors.

If the agent is biological, specifically a genetically modified organism, the intensity of the damage caused by an accidental release should be characterized taking into account the level of confinement required to be handled (Annex I of the Regulation and specific sectorial legislation).

The time scale of the damage describes the time in which the adverse effects caused by the agent causing the damage on the natural resource or service are in force. The duration or time horizon, its frequency (especially relevant in intermittent episodes of contamination) and the reversibility of the effects are the parameters that describe the time scale.

In cases where the agent causing the damage is chemical, the biodegradability of the substance will be the indicator providing more information on the time scale of the damage.

Consideration of irreversible damage will inevitably lead to the application of a complementary remedial measure aimed at generating an equivalent amount of the natural resources or services that have been lost indefinitely due to the damage, regardless of the need to apply a compensatory remedial measure that compensates the time in which said primary or complementary reparation takes effect.

In any case, and in accordance with Article 22 of the Regulation, those who meet the following conditions will be considered irreversible damages:

- That it is not possible to return the resources or services to their baseline conditions only through primary remediation.
- That the term for the primary remediation to take effect is not considered reasonable.
- That the cost of primary remediation is disproportionate with respect to the environmental benefits that would be obtained through the remediation project. This aspect must be accredited in an economic report that justifies it.

4.3 Assessment of the significance of the damages

The assessment of damage significance is the key element that enables the implementation of the environmental liability regime. The drafting of the remediation project requires that the environmental damage has been considered significant.

Assessment of significance, which can be addressed on the basis of different criteria as set out in Law 26/2007 and its Regulation of partial development, may require a lot of information, sometimes difficult to obtain or even non-existent. However, under the “precautionary principle”, and in the face of the scarcity or absence of precise data, no scientific certainty is required that the potential damage will exceed the threshold of significance.

The determination of significance is carried out by the operator and the data and criteria based on which certain damages were considered significant will be collected in the remediation project.

It should be borne in mind that the competent authority may also, in certain cases, assess the significance of the environmental damage.

The General Directorate of Environmental Quality and Assessment of the Ministry for the Ecological Transition and the Demographic Challenge has prepared a guidance document on the assessment of significance of the environmental damage to facilitate the determination of the significance to the operators and competent authorities. This document, as well as a summary version in English. is available on the web page of the Ministry: https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/responsabilidad-mediambiental/procedimiento_exigencia_responsabilidad/determinacion-signficatividad.aspx

4.4 Determination of the baseline condition

The definition of baseline condition established in article 2.19 of Law 26/2007 is "*the one where, had the environmental damage not occurred, natural resources and services would have been found at the time they suffered the damage, considered from the best information available"*

Therefore, the determination of the baseline condition should be strictly oriented to determine the remedial measures for environmental damage, that is, it should be estimated on the basis of the characteristics and properties of the resources and/or services that have been modified as a result of the agent that caused the damage. For this reason, under no circumstances should be the baseline condition assimilated to an ideal state of conservation, unless it is shown that this had been the state in which the receiving environment was before the environmental damage.

It is important to highlight that indicators measuring the baseline condition may serve as a reference unit of measure for resources or services that have been lost and that are subject to repair (environmental debit and credit). The idea is to select the indicators that best describe the environmental damage and the baseline condition to size the corresponding repair. Some of these indicators may derive directly from the quantification of the damage (for example, number of ichthyofauna individuals affected by a chemical spill into a channel). On other occasions, the indicators will allow defining certain characteristics of the remediation measures

They can be used as indicators from measurements such as vegetation density, population density, or the number of affected individuals, to the concentration of the pollutant in the receiving environment, among many others. The following is a proposal for these indicators:

- Vegetation density, coverage or biomasa measures, whether the vegetation turns out to be the main support of life and other functions and services provided by the affected territory. Depending on the type of services that are expected to be lost, totally or partially, it is desirable that the vegetation indicators include the proportion (percentage) of the key species and/or that considered as essential to conserve the attributes of the ecosystem, the above-ground biomass of the dominant species (for example in the case of grasslands and wetlands), the seed density (if it turns out that the affected area constitutes an important seed reservoir), or, also, an index of the structural diversity of the vegetation, as a reference indicator in cases, for example, where the damage has led to a simplification of the vegetation structure of the habitat.

- The “days of habitat use” is an indicator that it is beginning to become more present in some works on valuation of environmental damages (REMEDE, 2007[5]), especially in cases where the damage has affected the availability or accessibility of the habitat, causing both birds and other wildlife to be limited in reproductive behaviour (less availability of reproduction and breeding areas) and /or food (lower food availability). This indicator should therefore be accompanied by field work in the affected areas, as well as in the areas used as reference scenarios, in the event that there is not population data from the affected species.
- In the case of Fauna, indicators related to population density, the count of casualties (deaths) due to damage and the capacity of the remaining individuals to reproduce or maintain the population equivalent that existed before the damage are useful. This last indicator would be related to ecosystem resilience, defined as the capacity of the ecosystem to return to balance by itself alter experiencing a disturbance. In addition, other more conventional indicators such as sex ratio, the distribution of age classes or the seasonal variation of population are also relevant to determine the baseline condition.
- Proportion and categories of lost services estimated from the level of intensity of the damage, that is, of the times that it exceeds the concentration in the medium of a pollutant (PEC) in relation to the admissible concentration limit of that substance (CTD) –Risk Ratio--. This indicator involves both the application of pollution diffusion models and the collection of specific information on the sensitivity of the receiving medium to the exposure to the pollutant in question.
- Indicators that carry implicit information on the resulting conservation status based on probabilistic risk studies on the effects of a certain concentration and exposure of the pollutant in the receiving environment.
- Quality levels established by regulatory environmental standards for each of the receiving media under study - water, soil, wild species and protected habitats.
- Indicators of service provision that imply implicit acceptance of certain levels of environmental quality. For example, U.S. Departments of Agriculture regularly use multiple indicators that define the quality of grasslands encompassing up to a dozen ecological variables or attributes related to soil stability, the hydrological function or the ability of the soil to preserve the structure of its populations, which is decisive for the provision of environmental services.

A static baseline condition will be selected, preferably. However, in accordance with article 19 of the Regulation for partial development, the operator may determine a dynamic baseline condition provided that there is reliable information justifying it or a change of use of the territory is foreseen.

4.5 Selection of remedial techniques

Article 20.1. b) of Law 26/29007 indicates that the operator must:

> *“b) Submit to the approval of the competent authority, in accordance with the provisions of Chapter VI, a proposal for remedial measures for the environmental*

[5] REMEDE (2007) *Deliverable No. 6ª: Review report on Resource Equivalence Methods and Applications*. Resource Equivalence Methods for Assessing Environmental Damage in the EU.

damage caused prepared in accordance with the provisions of Annex II, notwithstanding to the additional criteria established by the autonomous communities with the same objective."

Annex II of Law 26/2007, of October 23, establishes the need to identify different remedial measures, whether primary or complementary and compensatory, to restore the natural resources and services to their baseline condition, to provide alternative natural resources and services or to compensate for interim lost, respectively.

Once the different alternatives of primary, complementary and compensatory remedial measures have been identified, the same Annex II of the Law indicates that they should be evaluated using the best available techniques, taking into account the following criteria:

"The effect of each measure on public health and safety.

The likelihood of success of each measure.

The extent to which each measure will serve to prevent future damage and avoid collateral damage as a result of its implementation.

The extent to which each measure will benefit each component of the natural resource or environmental service.

The extent to which each measure will take into account the corresponding social, economic and cultural concerns and other relevant factors specific to the locality.

The period of time required for environmental damage repair to be effective.

The geographical linkage to the damaged site.

The cost of implementing the measure."

Annex II of Law, does not define a specific procedure to select among the different alternatives for primary, complementary and compensatory remedial measures, it only establishes that the selection must meet the criteria set out above.

This document proposes two selection procedures for remedial alternatives, with the purpose of illustrating such selection.

The first procedure is described bellow:

1st. The operator will set the weights of the criteria (the list of criteria appears in the "criteria" field in Table 3), taking into account, for each case, the particular circumstances of the damage. The degree of compliance with each criterion is decided in its reference unit, which is collected for each project in the 'Unit' field (percentage, class, years and euros).

2nd. The criteria, quantified in four different ways (field "Unit") can be homogenised as a percentage in order to have a common unit of measure:

- *Class*.- The fields in this unit are named into categories that can be translated into percentages based on the proposal included into the fields in the "comment" column of Table 3.
- *Years*.- For each alternative, the ratio between its duration and the longest-lasting option will be made, expressing it as a percentage. This way, the value of the option with the longest duration will be 100 and the rest of the alternatives will be calculated in relation to it.

– *Euros*.- The fields in this category can be expressed in percentage by performing the same process as with the category “years”. In this case, it will take the value 100 the option with the highest cost and the remaining percentages will be set in line with this reference level.

Criterion	Unit	Sense	Comment
The effect of each measure on public health and safety	CLASS	Minimize	Percentage of effect [Null (0%), low (25%), intermediate (50%), high (75%), very high (100%)]
The likelihood of success of each measure	%	Minimize	1 – Likelihood of success (whole number between 0 and 100)
The extent to which each measure will serve to prevent future damage and avoid collateral damage as a result of its implementation.	%	Minimize	1 – Likelihood of success (whole number between 0 and 100)
The extent to which each measure will benefit each component of the natural resource or environmental service.	%	Minimize	1 – Likelihood of success (whole number between 0 and 100)
The extent to which each measure will take into account the corresponding social, economic and cultural concerns and other relevant factors specific to the locality	%	Minimize	1 – Likelihood of success (whole number between 0 and 100)
The period of time required for environmental damage repair to be effective.	YEARS	Minimize	Duration of each project in relation to the longest duration, expressed in percentage (the longest will have 100%)
The extent to which each measure manages to repair the site of environmental damage.	%	Minimize	1 – Likelihood of success (whole number between 0 and 100)
The geographical linkage to the damaged site.	CLASS	Minimize	Geographical linkage [None(0%), of use (75%), functional (50%), functional connected (75%), at the damaged site (100%)]
The cost of implementing the measure.	EUROS	Minimize	Cost of each project in relation to the highest cost, expressed as a percentage (the most expensive will have 100%)

Table 1. Criteria for selecting remedial alternatives.

3rd. They must all have the same sense in order to be able to operate with them. The decreasing direction has been chosen “better if they decrease”. The criteria named in classes, years and euros have already been calculated in a decreasing sense, according to the procedure described in the previous item. Nominees in percentage are made decreasing by calculating the complementary criterion (one less the probability, as shown in the fields of the column 'Comment' in Table 3).

4th. The quantification of each criterion (homogenized in a decreasing sense as described in the previous item) is multiplied by the weight given to it. The sum of the homogenised and weighted quantification of the all criteria will result in the number of points of each remedial alternative.

5th. The remedial alternative with the fewest points is selected.

Below is a practical case of applying this procedure for selecting repair techniques.

Table 4 shows the technical characteristics of each of the alternatives from which the most appropriate one must be selected for the remediation of a certain environmental damage.

	Technique 1	**Technique 2**	**Technique 3**
Likelihood of success	100%	90%	60%
Execution time	2 years	2 years	1 year
Extent of repair	100%	80%	100%
Geographical linkage	At the site of damage	At the site of damage	At the site of damage
Cost (€)	50.000	45.000	120.000

Tabla 2. Technical characteristics of the primary remedial techniques identified for the remediation of an environmental damage.

The example that is developed below to illustrate the procedure for selecting the remedial technique is built on three primary remedial techniques (therefore, the three have the same geographic linkage with respect to the site where the damage occurred).

Techniques 1 and 2 have similar parameters: a high likelihood of success, the same execution time, a similar extent of repair (somewhat lower in technique 2) and a very similar cost. In contrast, Technique 3 manages to fully repair the damage in half the time, but with a significantly lower likelihood of success and a much higher cost.

The characteristics of the three identified alternatives are complemented by additional criteria set out in Annex II of Law 26/2007, of October 23. Table 5 shows the valuation made of each of the identified alternatives; in this example it has been chosen to give the same weight to each of the nine criteria established by the environmental liability normative for evaluating the alternatives of remedial techniques.

The assessment made in the following table shows that none of the identified techniques have effects on public health and safety, all achieve a high degree of prevention of future and collateral damage, and seem adequate for the remediation of the damaged natural resource, taken into account that they all get the maximum benefit from each component of the natural resource or environmental service.

Criterion	Weighting	Valuation			Weighting Valuation		
		Technique 1	Technique 2	Technique 3	Technique 1	Technique 2	Technique 3
The effect of each measure on public health and safety	1,00	0%	0%	0%	0,0000	0,0000	0,0000
The likelihood of success of each measure	1,00	0%	10%	40%	0,0000	0,1000	0,4000
The extent to which each measure will serve to prevent future damage and avoid collateral damage as a result of its implementation.	1,00	0,05%	0%	0%	0,0005	0,0000	0,0000
The extent to which each measure will benefit each component of the natural resource or environmental service.	1,00	0%	0%	0%	0,0000	0,0000	0,0000
The extent to which each measure will take into account the corresponding social, ecomonic and cultural concerns and other relevant factors specific to the locality	1,00	50%	25%	0%	0,5000	0,2500	0,0000
The period of time required for environmental damage repair to be effective.	1,00	100%	100%	50%	1,0000	1,0000	0,5000
The extent to which each measure manages to repair the site of environmental damage.	1,00	0%	0%	0%	0,0000	0,0000	0,0000
The geographical linkage to the damaged site.	1,00	0%	0%	0%	0,0000	0,0000	0,0000
The cost of implementing the measure.	1,00	42%	38%	100%	0,4200	0,3800	1,0000
Score					**1,9205**	**1,7300**	**1,9000**

Table 3. Example 1 of remedial alternatives evaluation.

The process of selecting alternatives, remembering that the sense of assessment is 'the less, the better', results in the choice of Technique 2 as the most appropriate, taking into account all the criteria required by the regulations on environmental liability. It is the lowest-cost alternative, with a high likelihood of success and that adequately caters to the social, economic and cultural interests of the environment in which the damage has occurred.

Another alternative valuation procedure could consist of ranking the different alternatives for each criterion compared to the identified alternatives, indicating with 1 the alternative that best meets a certain criterion and with an "n" the alternative that worst meets that criterion, where "n" is the number of identified alternatives. When several alternatives reach the same degree of achievement of a certain criterion, both will obtain the same valuation, applying to the following alternatives in the consecutive order (if there are three alternatives and two of them have the same cost, which is the lesser, both would obtain a score 1 and the third, 2).

The alternative with the lowest sum obtained from the evaluation carried out in each of the criteria, would be the alternative to choose. Again, in this procedure for valuating alternatives, the operator can attribute, in a duly justified manner, a different weight to certain criteria by applying a coefficient on them.

Table 6 shows the valuation of the same remedial alternatives analysed in the previous practical example. Again, Technique 2 is the one selected, although the valuation or score of Techniques 1 and 3 is reversed.

As mentioned above, the environmental liability regulations do not establish the procedure for the selection of the remedial alternatives, indicating only the criteria on which such selection is to be based. The operator may make said selection using one of the proposed procedures or any other selection method, whenever the criteria set out in Annex II of Law 26/2007, of October 23, are taken into account. The procedure for selecting remedial alternativesused by the operator, must apply to both primary and complementary and compensatory remedial measures.

Criterion	Weighting	Valuation			Weighting valuation		
		Technique 1	Technique 2	Technique 3	Technique 1	Technique 2	Technique 3
The effect of each measure on public health and safety	1,00	0%	0%	0%	1	1	1
The likelihood of success of each measure	1,00	0%	10%	40%	1	2	3
The extent to which each measure will serve to prevent future damage and avoid collateral damage as a result of its implementation.	1,00	0,05%	0%	0%	2	1	1
The extent to which each measure will benefit each component of the natural resource or environmental service.	1,00	0%	0%	0%	1	1	1
The extent to which each measure will take into account the corresponding social, economic and cultural concerns and other relevant factors specific to the locality	1,00	50%	25%	0%	3	2	1
The period of time required for environmental damage repair to be effective.	1,00	100%	100%	50%	1	1	2
The extent to which each measure manages to repair the site of environmental damage.	1,00	0%	0%	0%	1	1	1
The geographical linkage to the damaged site.	1,00	0%	0%	0%	1	1	1
The cost of implementing the measure.	1,00	42%	38%	100%	2	1	3
Score					**13**	**11**	**14**

Table 4. Example 2 of remedial alternatives evaluation.

4.6 Resource Equivalency Analysis (REA)

The success of the resource equivalency analysis depends on the unit of measurement selected to quantify, over time, both the losses of damaged natural resources or services (environmental debit) as well as the benefits of said resources and services that may be obtained through remediation (environmental credit). Such a unit of measure will in turn be conditioned by the level of affection of the resources or services that have experienced the damage. In any case, the selection of the unit of measurement that describes the debit and the credit will determine the equivalence criterion (resource-resource, service-service, value-value, value-cost) that must be applied to estimate the requirement of complementary and/or compensatory remediation in each case.

The IT application MORA (Modelo de Oferta de Responsabilidad Ambiental) offers the operator comprehensive assistance to carry out, through the application of a resource-resource equivalence criterion, a tentative identification of the remedial measures that could be applied in each case, as well as the estimation of their cost. The Modelo de Oferta de Responsabilidad Ambiental uses an equivalence criterion of resource-resource to calculate the compensatory and/or complementary remedial measures, a criterion that, along with the service-service one, prevails over the use of other approaches such as value-value and value-cost, as established Law 26/2207, of October 23.

In any case, a conservative approach will always be adopted as a reasonable assumption in all stages of the resource equivalency analysis, and as the guiding principle of any technical decision, thereby favouring any decision aimed at maximizing the benefits that could be obtained with the remediation of environmental damage.

4.6.1 Illustrative example for the application of a resource-resocurce equivalence criterion

The resource-resource and service-service equivalence criteria involve the use of the same biophysical unit of measurement (non-monetary) to calculate the losses of resources due to the damage (environmental credit) and the benefits generated by the remediation project (environmental credit). Under this approach the debit and credit are expressed, respectively, in terms of unit of resource affected or generated (such as number of individuals affected, soil mass or volume of water, etc.)

The resource-resource approach is applied when the damage assessment is simplified by disaggregating the damage in the effects that have been caused on the affected resources that make up the ecosystem rather than the habitat as a whole (in which case a criterion of service-service equivalence where the resource unit would be replaced by a unit of measurement of surface or spatial extent).

A simple example of the application of a resource-resource equivalence criterion could be used in the event of the death of a number of fish of the same species as a result of an eventual discharge into a river. Table 6 shows the procedure for calculating the environmental debit for this hypothetical and simplified event in which the damaged resource is restored naturally and, therefore, the resource equivalence analysis is carried out to determine the compensatory remedial measure for the time it has taken the fish population to reach its baseline condition.

Column (a) shows the number of individuals that have died due to the discharge. In this case, the first year a number of 500 fish are lost, which decreases while the population recovers naturally (from 500 to 0 lost fish). Column (b) includes a multiplier that represents the discount factor, having used the traditional method and a discount rate of a 3 percent. The product of

columns (a) and (b) represents the annual environmental debit of the damaged resource, the sum of which constitutes the total environmental debit. The unit of measurement is 'fish lost year' (net present value of the number of dead fish discounted over time).

Year	Number of dead fish (a)	Discount factor[6] (b)	Debit (a x b)
2017 (base year)	500	1	500
2018	300	0.97	291
2019	100	0.94	94
2020	0	0.92	0
Total environmental debit (fish lost · año)			885

Table 5. Example of calculation of environmental debit according to a resource-resource equivalence. Source: Own elaboration from REMEDE (2008)

Table 8 shows the calculation of the environmental credit or benefits, in resource units that will be generated by the compensatory remediation the following year. It is assumed that 500 fish of the same species to the damaged one and of reproductive age are introduced (column a). Applying the same discount factor as for the calculation of the environmental debit, the multiplier of the resources gained over time is obtained (base year 2017), assuming that a year is enough to generate the 500 individuals that had been lost due to the environmental damage.

Year	Number of fish introduced (a)	Discount factor[7] (b)	Credit (a x b)
2018	500	0.94	470
2019	0	0.92	0
Total environmental credit (fish introduced · year)			470

Table 6. Example of calculation of environmental credit according to a resource-resource equivalence. Source: Own elaboration from REMEDE (2008)

In accordance with the provisions of section VI of Annex II of the Regulation for partial development of Law 26/2007, of October 23, the adjustment of the debit and credit that has been previously calculated in Tables 6 and 7, respectively, is carried out using the quotient between total debit and total credit, thus: debit / credit = 885/470 = 1.88 units or replicas of the environmental credit that will be required as a compensatory remediation. That is, 1.88 x 500 = 941 fish that will ultimately have to be introduced so that this amount is equal to the net present value of fish that has been lost during the three years it would take for the population to recover naturally. This action will have associated the costs of the corresponding remediation project, which are not reflected in the calculations of the resource equivalency analysis itself.

[6] Discount factor = 1/ (1 + discount rate) (year – base year)

[7] Discount factor = 1/ (1 + discount rate) (year – base year)

It is important to remember that the Resource Equivalence Analysis is a very versatile tool that supports the introduction of other variables in the calculation of environmental debit and credit, provided that the unit of measurement is the same in both cases, which best describe the type and quality of resources that have been lost as a result of the damage and those that will be generated through remediation.

4.6.2 Illustrative example for the application of a service-service equivalence criterion

Table 9 illustrates the procedure for determining, in a simplified and hypothetical case, the environmental debit using a service-service approach, according to the provisions of section IV of Annex II of the Regulation for partial development of Law 26/2007, of October 23, based on the REMEDE Project, 2008. Column (a) shows the surface that has been damaged. Column (b) represents the percentage of the level of service provision lost by said area due to damage. In this case, the first year a percentage of 50 percent is lost, which decreases to 0 percent as the habitat recovers thanks to the effects of the primary remediation. Column (c) includes a multiplier that represents the discount factor, having used the traditional method and a discount rate of a 3 percent. The product of columns (a), (b) and (c) represents the annual environmental debit of the damaged habitat, the sum of which constitutes the total environmental debit. The unit of measurement is "service·hectare·year" (hectares multiplied by the lost service and discounted over the time)

Year	Spatial extent (Ha) (a)	Percentage of lost service (%) (b)	Discount factor[8] (c)	Debit (a x b x c)
2017 (base year)	100	50	1	50.00
2018	100	50	0.97	48.50
2019	100	50	0.94	47.00
2020	100	50	0.92	45.76
2021	100	50	0.89	44.42
2022	100	40	0.86	34.50
2023	100	30	0.84	25.12
2024	100	20	0.81	16.26
2025	100	10	0.79	7.89
2026	100	0	0.77	0.00
2027	100	0	0.74	0.00
Total environmental debit (Ha · discounted service · year)				319,5

Table 7. Example of calculation of environmental debit according to a service-service equivalence. Source: Own elaboration from REMEDE (2008)

Table 10 illustrates the procedure to be followed to estimate the environmental credit that would be generated by the remediation project in one hectare (column a) within a temporary period of 55 years (section V of Annex II of the Regulation). Column (b) represents the services that

[8] Discount factor = 1/ (1 + discount rate) (year – base year)

would be obtained through the remediation project in each consecutive year per hectare. Applying the same discount factor as for the calculation of the environmental debit, the multiplier of the services gained over time per hectare is obtained (column c), which allows estimating the increase in the level of service provision over the baseline condition originated by the remediation project in present value (base year 2007).

Year	Remediation unit (number of Ha) (a)	Percentage of service gained (%) (b)	Discount factor[9] (c)	Credit (a x b x c)
2018	1	10	0.94	0.09
2019	1	20	0.92	0.18
2020	1	30	0.89	0.27
2021	1	40	0.86	0.35
2022	1	50	0.84	0.42
…	…	…	…	…
2069	1	50	0.21	0.10
2070	1	50	0.20	0.10
2071	1	50	0.20	0.10
2072	1	50	0.19	0.10
Total environmental credit per hectare of restored surface (Ha · discounted service · year/ Ha)				12,08

Table 8. Example of calculation of environmental credit according to a service-service equivalence. Source: Own elaboration from REMEDE (2008)

The estimation of the debit and credit may take into account, respectively, both the irreversible losses of resources or services as well as the maintenance of the resources and services generated by remediation over time. In this case, a discount rate could be applied that contemplates indefinite maintenance of a certain level of resources or services over time.

In accordance with the provisions of section VI of Annex II of the Regulation, the adjustment of the debit and credit that has been previously calculated in Tables 9 and 10, respectively, is carried out using the quotient between total debit and total credit, thus: debit / credit = 319,5 / 12,08 = 26,5 units (hectares) that will be required as compensatory or complementary remediation and that must be kept available for a period of at least 55 years (2018-2072).

4.6.3 Illustrative example for the application of the value-value and value-cost criteria

The application of value-value and value-cost equivalence criteria involves the use of a monetary and non-biophysical unit of measurement. The calculation of the total environmental debit is identical in the application of the value-value and value-cost equivalence criteria, being the calculation or adjustment of the final amount of remediation required the only difference between both approaches.

This example assumes that a fish population in a river has been significantly affected by a chemical spill. The effects of the damage have been reflected in the loss of a number of 600

[9] Discount factor = 1/ (1 + discount rate) (year – base year)

recreational fishing trips over a three-years period, that is, 200 fishermen who could have fished a year for three years, and who will no longer be able to enjoy this environmental service with the consequent loss of value for the use of space and their well-being.

The usage value of each displacement that has been cancelled as a result of the spill is 25 euros. In the same way, it is calculated that another 100 displacements for fishing continue to have an effect but that the experience gained is given less value due to the loss of environmental quality associated with the discharge (15 euros for each of these displacements of lesser quality). The values of 25 and 15 euros, respectively, have been calculated from the distribution of a questionnaire to a significant sample of the fishermen affected by the spill, by which the value of the loss of well-being associated with the cancellation was directly asked from a trip, or depending on the case, to a trip with a lower level of enjoyment.

Table 11 presents the corresponding debit calculations, with the first half referring to the value of the services lost due to the displacements that were cancelled (14,567 euros), and the second half refers to the value lost due to the displacements that were made but that have a lower quality of the recreational experience associated (4,370 euros). The sum of both service losses represents the well-being lost by the corresponding loss of the value of the recreational use of the space (14,567 + 4,370 = 18,937 euros).

Year	Number of displacements canceled (a)	Value of the lost displacement (b)	Discount factor[10] (c)	Debit (a x b x c)
2017	200	25	1	5.000
2018	200	25	0.97	4.854
2019	200	25	0.94	4.713
2020	0	25	0.92	0
2021	0	25	0.89	0
Total value discounted for lost displacements (€)				14.567
2017	100	15	1	1.500
2018	100	15	0.97	1.456
2019	100	15	0.94	1.414
2020	0	15	0.92	0
2021	0	15	0.89	0
Total value discounted for lower quality displacements (€)				4.370
Total environmental debit (€)				18.937

Table 9. Example of calculation of environmental debit according to a value-value or value-cost equivalence. Source: Own elaboration from EC *et al.* (2013)

In a value-value approach the operator should carry out a remediation project based on different types of remedial techniques, for example, introducing fish into the river, improving the public access to the fishing areas or improving the riverside habitat. In this way, the value of the benefits generated through the remediation project will be based on the value that fishermen give to the benefits of applying the remedial techniques (rather than on the economic value of the damage itself)

[10] Discount factor = 1/ (1 + discount rate) (year – base year)

In other words, a value-value criterion must ensure the equivalence between the debit and the credit assuming that the amount of final remediation that will be required is based on an increase in quality and, consequently the value (improvement of environmental quality equivalent to debit also measured in monetary units) of the environmental services provided by the remediation project. Consequently, economic valuation techniques (travel cost, avoided costs, production function, contingent valuation, etc.) should be used to apply this criterion of equivalence when determining the environmental benefit generated by the remediation project and it must be equivalent to the total environmental debit.

In the case of a value-cost equivalence criterion, the remediation project should have a budget of 18,937 euros, equivalent to the total environmental debit, which would have to be fully invested in one or more remedial techniques that have been mentioned above, all of them aimed at improving the experience of recreational use in the affected area. In this way, the amount of remediation required will have associated a remediation project whose cost is equivalent to the environmental debit. This approach, unlike the value-value equivalence criterion, is associated with a lower level of complexity since it is not necessary to apply the valuation techniques offered by economic analysis to estimate environmental credit.

4.7 Remediation site

Primary remediation, by definition, is implemented in the same site where the damage has occurred. However, and in accordance with article 24 of the Regulation for partial development of Law 26/2007, complementary and/or compensatory remedial measures may be implemented in an alternative location geographically linked to the affected receptor when it is not possible to execute them at the place of damage, or as close as possible to the location of the natural resources and natural resource services affected.

In the event that complementary and/or compensatory remediation are implemented in an alternative location, but having an ecological, territorial or landscape connection with the damaged place, the operator shall take into account in particular two provisions:

- (i) The application of a remedial measure in a place other that the one where the damage occurred must in any case result in the improvement of services provided by the natural resources in the damaged place (article 24.3 of Regulation).
- (ii) The characteristics of the damage, the resilience of the resources and services affected, and the interests of the population affected by the damage and of those who would benefit from the repair (article 24.4 of Regulation).

The final decision about the location of the complementary and/or compensatory remediation project will also depend on the equivalence criterion that has been adopted in each case, and therefore, on the possibilities of generating through the remediation the same resources or services that have been lost.

Any decision in this regard must be duly justified in the remediation repair project.

4.8 Factor and discount rate

The Resource Equivalence Analysis needs to incorporate in its calculation a factor and discount rate to add and compare, in the present time, the total loss of resources or services that has occurred since the environmental damage took place and the accumulated gains with each remedial alternative during a certain time interval, when both variables, losses and gains, a time interval occurs that necessarily does not have to match.

The discount allows losses of resources or services associated with damage, which are assimilated to costs, and the accumulated gains from repair, which are assimilated to benefits, in different periods, can be expressed and contrasted in a common metric (environmental debit and environmental credit). The influence of the decision on the adequacy on carrying out a primary, compensatory and/or complementary remedial before or after and, therefore, the speed with which recovery targets are achieved, is incorporated into the Resource Equivalence Analysis through this factor and discount rate. If this discount is not included, it would not matter to repair the damage in the present or at any time in the future.

The Regulation of partial development establishes that, in general, the operator will take a reference value of the discount rate of 3 percent and will use an exponential discount method (Annex II, section III.4 of the Regulation).

Annex I. INDEX OF THE ENVIRONMENTAL DAMAGE REMEDIAL PROJECTS

This annex contains an index of an environmental damage remediation project. The **boldly** highlighted headings are part of the **minimum content** that any environmental damage remediation project must cover according to article 25 of the Regulation for Partial Development of Law 26/2007.

The other proposed headings are included in the index in order to provide additional information to enable a better overall understanding of the incident that has caused environmental damage, as well as actions carried out by the operator and by the administration.

An explanation of its contents is included in each of the headings, with the aim of offering both the operator and the competent authority useful criteria for, respectively, completing or evaluating the remediation project.

I. BACKGROUND OF ENVIRONMENTAL DAMAGE

Although this chapter of the project is not considered "minimum content", it is considered useful to include a chapter in which the operator presents the information available both on the incident from which the need to prepare a remediation project arises and on the environmental liability requirement procedure associated with it.

I.1 Summary of environmental damage

As an introduction, the operator may include a brief description of the incident and its consequences on the natural resources.

I.2 Aspects to highlight in relation to the environmental liability requirement procedure

The presentation by the operator of a remediation project constitutes one of the final stages of the environmental liability requirement procedure. In this section the operator can describe the actions and procedures prior to the presentation of the project.

I.2.1. Incident management

The operator will describe the incident that caused the environmental damage: causes and consequences of the incident, actions carried out (implementation of prevention and/or avoidance measures, communications with the competent authority, emergency services and/or, where appropriate, the insurer, etc.) and completion of the incident.

The operator shall describe the prevention and/or avoidance measures of further damage carried out and shall set out the assessment of their success.

I.2.2. Phase of environmental liability administrative procedure opening

The operator will explain in this section the steps followed during the processing of the environmental liability requirement procedure: requests for information by the competent authority, signing, where appropriate, binding agreements between the competent authority and the operator, etc.

I.3 Initial Evaluation

The operator will summarize the situation derived from the incident up to the moment of the presentation of the remediation project: characterization and initial assessment of the environmental damage (quantities of substances discharged, surface or volume of affected resource, etc.) and measures for prevention and avoidance of new damages applied.

II. LOCATION AND TEMPORAL SCALE OF THE ENVIRONMENTAL DAMAGE

Article 25 of the Regulation sets out the minimum content of the remediation project, the first heading of which is to refer to spatial and temporal location of environmental damage. The operator will provide the basic cartographic information (topographic map, orthophoto, etc.) of the environment in which the incident was generated and the affected natural resources. It shall also indicate the date and time when the incident occurred, when the incident management was completed and whether, between the completion of the incident and the presentation of the project, the situation of the natural resources affected has changed significantly.

The competent authority shall verify that the information provided makes it possible to locate the damage caused by the incident and to know when it occurred, when the management of the incident ended, and changes in the situation of the natural resources affected between the end of the management of the incident and the presentation of the project.

III. CHARACTERIZATION OF THE ENVIRONMENTAL DAMAGE

Article 25 of the Regulation requires the characterization of environmental damage as the second section of the minimum content of a remediation project, taking into account Section 1 of Chapter II of the Regulation itself. This characterization must consist of a compilation of information, the determination of environmental damage and the determination of the baseline condition of the affected natural resources.

The operator will identify the combinations agent causing damage-natural resource concerned that will define environmental damage to which the remediation project will refer. The following table, derived from Annex III to the Regulation, compiles the agents causing damage and natural resources concerned on which the relevant combinations of agent causing the damage-natural resource affected will be built.

Agent causing damage	Affected natural resource
Chemical – (*broken down for each substance with toxicity threshold in a given receiving medium*)	
Physical - Extraction or disappearance of natural resources	Marine water
Physical – Damage by water	Surface continental water
Physical – Inert waste	Groundwater
Physical – Damage by land	Continental and seabed
Physical – Damage by temperature	Soil
Physical – Electromagnetic fields	Seashore and estuaries
Physical – Others	Vegetable species
Fire	Animal species
Biological – Genetically modified organisms	Habitats
Biological – Invasive alien species	
Biological – Pathogenic microorganisms	
Biological – Others	

As an example, a discharge of an insoluble and less dense liquid pollutant than water into a channel in a protected natural space would result, among others, the following combinations agent causing damage-affected natural resource:

- Chemical – (name of the substance) / Surface continental water
- Chemical – (name of the substance) / Animal species
- Chemical – (name of the substance) / Habitats

Article 8 of the Regulation establishes the following agents causing damage:

- Chemical, associated with the release of a substance at a concentration higher than the toxicity threshold of that substance in a given receiving medium.
- Physical, referred to the excess or defect of a substance that does not have associated a level of toxicity, such as water, inert waste, soil, temperature or electromagnetic fields.
- Biological, among others, genetically modified organisms, invasive alien species and pathogenic microorganisms.

Within this classification, the damage caused by the extraction or disappearance of the affected natural resource and the damage caused by fires have been explicitly broken down.

For its part, the competent authority will evaluate that the agent causing damage-affected natural resource combinations identified by the operator are correct, taking into account the nature of the incident and the affected natural resources.

III.1. Information gathering

Article 6 of the Regulation obliges operators to collect, the information necessary to determine the magnitude of the damage. In this section the operator will offer, at least, a list of the information collected, and may develop said information in the following sections of the project.

The agent causing damage-affected natural resource combinations identified in the previous section will define the type of information that the operator must gather to determine the magnitude of the damage.

Continuing with the previous example, for the combination agent causing damage-affected natural resource Chemical - (name of the substance) / Surface continental water, the operator may indicate that the following information, among others, has been collected:

- The safety sheet of the discharged substance
- Hydrological data of the affected channel (flow, width of the channel, water speed, presence of infrastructures that allow the containment of the discharge, ecological, chemical and global status of the affected water body and the parameters that define them)

The competent authority will evaluate that the information related to this section is sufficient to determine the magnitude of the damage in subsequent sections.

III.2. Determination of the environmental damage

According to article 7 of Regulation, the determination of the environmental damage will consist of the identification of the agent causing damage and of the natural resources and services concerned, the quantification of the damage and the assessment of its significance.

III.2.1. Identification and characterization of the agent causing damage

Article 9 of Regulation sets out, for each type of agent causing the damage, the variables necessary for its characterization. The following table shows, for each agent, the variables necessary for the characterization of the damage, in addition to others considered relevant (indicated in italics). In any case, the operator, will consider any other variable that is relevant to characterize the agent causing the damage.

The variables necessary to characterize each of the agents causing the damage will depend not only on the nature of the agent but also on its interaction with the natural resources and services affected.

Type of agent		Variables for characterization
Chemical		Amount discharged that has come into contact with the natural resource Safety sheets (toxicological and ecotoxicological properties and other physico-chemical properties that determine its dangerousness, transport and persistence)
Physical		Amount, quality and/or density of the agent Other relevant properties for characterization
	Temperature	*Temperature difference between discharge and receiver*
Fire		*Fire intensity and duration* *Way of propagation to the natural resource (contact, radiation, etc.)* *Type of fire (surface, active or passive cups, etc.)* *Fire spread*
Biological		Taxonomic definition or specific nomenclature
	Genetically modified organisms	Genetic modification of the organism and how it has been carried out Specific nomenclature Survival capacity Dissemination way Dominance Genetic evolution when interacting with other organisms
	Invasive alien species	Introduced specie Amount of individuals introduced Ability to threaten biological diversity by interference in population dynamics (ability to contaminate chemically and genetically, compete, prey, or transmit diseases to native species) Others
	Pathogenic microorganisms	Specie Danger Genetic stability Ability to interact with other native fauna and flora species Others

The competent authority shall assess that the operator has adequately characterized each of the agents causing the damage previously identified.

III.2.2. Identification and characterization of the natural resources and services affected

Article 10 of Regulation requires operators to identify all natural resources affected by the agent causing the damage, directly or indirectly, including in the analysis the means of dissemination through which the agent causing the damage is released and the potential receivers. This identification of affected natural resources will pay special attention to the resources that are most vulnerable or sensitive to changes in their environment or that affect the stability of the ecosystem.

In this identification and characterization of the affected natural resources, it is not necessary to expose the state of the natural resources, but only refer the resources unambiguously affected (code of the affected water body, geographical location of the contaminated soil and/or the affected habitat, specific name of the species that have suffered the damage, etc.). The status of the affected natural resources will be detailed in the section dedicated to determining the baseline condition (Chapter III.3 of the remediation project).).

In parallel, the operator must identify the level of service provision provided by the affected natural resources, identified above.

For its part, the competent authority must assess that the natural resources identified and characterized are those indicated by the operator and that the information it provides regarding them is correct. Likewise, the competent authority will confirm that the provision of services indicated by the operator corresponds to that provided by the affected resources and, where appropriate, may indicate the existence of more adequate information regarding said provision, which the operator must subsequently correct.

III.2.3. Quantification of damage in terms of location and extent, intensity and time scale

Article 11 of Regulation determines that operators must quantify the damage, which consists of estimating the degree of exposure by the affected recipients to the agent causing the damage and measuring the effects that occur. The quantification of the damage will consist of the identification, description and evaluation of the extent, intensity and time scale of the damage of resource or service affected.

The extent is the amount of resource or service affected (article 12 of Regulation). It will be measured in biophysical units of the resource and its measurement will take into account the properties of the agent causing the damage, the characteristics of the receiving media and the changes that the media and receptors will experience due to the action of the agent causing the damage.

The intensity measures the degree of severity of the effects caused on the natural resources or services affected (article 13 of Regulation).

The time scale of the damage refers to the duration, frequency and reversibility of the effects caused on natural resources (article 14 of Regulation)

III.2.4. Assessment of the significance

Only in the event that the damage caused by the incident has been considered as significant, the competent authority may demand the preparation of a remediation project. In other words, the assessment of the significance of the damage must have been carried out before the drafting of the remediation project began, so the assessment that was previously carried out will be compiled in this section, focusing especially on the damages that were evaluated as significant.

The evaluation of the significance can be a very demanding task in terms of information, even being able to go so far that, with the information available, it is not possible to determine the significance of the damage according to some of the criteria established in the environmental liability normative. In these cases, the application of the "precautionary principle" will allow the damage to be considered as significant and, therefore, it would be necessary to prepare a remediation project.

III.3. Determination of baseline conditions

The determination of the damage supposes, in addition to its quantification, the assessment of its significance by reference to the basic state of the natural resources that have been affected. The baseline condition also acts as the reference objective that the damaged natural resources (and the services they provide) must achieve after having carried out the corresponding remedial measures (Annex II of Law 26/2007, of October 23).

IV. STATEMENT OF THE MAIN REMEDIAL ALTERNATIVES AND JUSTIFICATION FOR THE SELECTION OF THE REMEDIATION PROJECT

IV.1 Identification of the primary remedial measures

In accordance with Annex II of Law 26/2007, of October 23, the operator must identify different alternatives for primary remediation. For this, a reference must be incorporated, at least, to the following factors:

- The ecological considerations necessary for the conservation of natural resources and services that have been affected
- The degree of intervention associated with each remedial technique (total, partial or based on natural recovery)
- Preliminary estimate of the provisional loss of resources or services associated with each remedial alternative
- Assessment of the feasibility of the remedial technique
- Preliminary estimate of the costs of each remedial alternative

IV.2 Assessment of the need to establish complementary and compensatory remediation measures

Article 22 of Regulation, establishes the assumptions by which complementary or compensatory reparation measures must be carried out. This situation occurs when it is not possible to establish a primary remedial measure, or it is not possible to return natural resources (and the services they provide) to their baseline condition only through a primary remediation without generating loss of resources or relevant services.

IV.3 Identification and description of different complementary and/or compensatory remedial alternatives

The complementary and compensatory remedial measures are aimed at establishing the corresponding actions to compensate the existing losses (irreversible or provisional, respectively) of natural resources or services until said resources or services recover their baseline condition.

V. GENERAL DESCRIPTION OF THE ALTERNATIVE SELECTED FOR THE REMEDIATION PROJECT

In this heading, the operator must describe the objectives, scope, type and characteristics of the proposal for primary, complementary and/or compensatory remedial measures that have been selected to return the natural resources and the services they provide to their baseline condition.

V.1. Characterization of the remediation project

According to article 25 of Regulation, the remediation project must contain, at least, the description of the following aspects:

- Remediation objectives and actions consisting of the primary, complementary and compensatory remediation measures
- Type and quality of natural resources or services generated through remediation
- Rate and degree of recovery of natural resources or services
- Time horizon until natural resources or services recover their baseline condition
- Site where the remedial measures are carried out
- Project cost
- Efficacy and feasibility of the remediation project

V.2. Evaluation and justification, if applicable, of the decision that the remediation project be submitted to an environmental impact assessment

It is possible that the remediation project may be subject to an environmental impact assessment according to the regulatory framework established by Law 21/2013, of December 9, on environmental assessment. In this case and according to article 27 of the Regulation for Partial Development of Law 26/2007, of October 23, the operator must adopt the measures to avoid further damage and may request the urgent processing of said evaluation based on reasons of public interest to be assessed by the competent authority.

V. MONITORING PROGRAM

Article 30 of the Regulation establishes the obligation to evaluate the degree of compliance with the remediation project and identify the problems that may arise during its execution and, where appropriate, the possible corrective measures adopted.

This heading establishes the aspects of the project that, as a minimum, the operator must contemplate in the monitoring program to provide relevant information on the execution of the remediation project to the competent authority with the periodicity established in said program.

VI. REFERENCES

All bibliographic references that have been used and, therefore, cited in the report will be included.

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DE ESPAÑA

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Y EL RETO DEMOGRÁFICO

SECRETARY OF STATE
FOR THE ENVIRONMENT

DIRECTORATE GENERAL FOR ENVIRONMENTAL QUALITY AND ASSESSMENT

TECHNICAL COMMISSION OF PREVENTION AND REMEDIATION OF ENVIRONMENTAL DAMAGES