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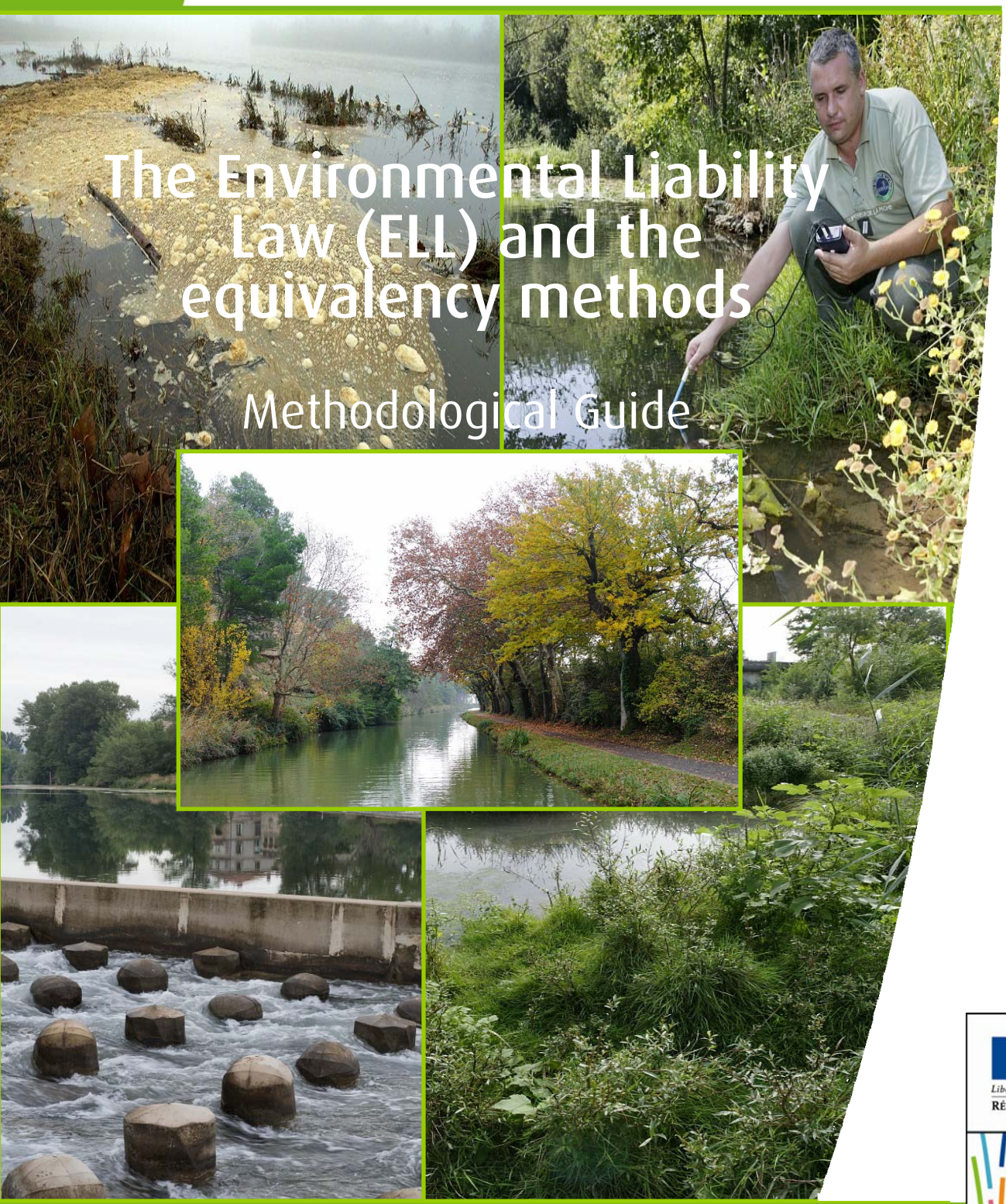

The Environmental Liability Law (ELL) and the equivalency methods

Methodological Guide

Economy, evaluation and integration of sustainable development Service

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Abstract

The Environmental Liability Law (ELL), adopted on 1 August 2008, and its implementing decree of 23 April 2009, transpose Directive 2004/35/EC (ELD) into French law, which establishes a framework of environmental liability that is founded on the "polluter pays" principle, and thus creates a new environmental liability mechanism. An operator liable for damage concerned by the ELL should remedy the damage caused "in nature", i.e. by identifying and carrying out remedial operations on the site, at a "*reasonable cost to society*". Any financial compensation is explicitly excluded.

This law preventing and remedying environmental damage has been in force since 27 April 2009. It shall be the subject of a statute of limitation if the event giving rise to the damage dates back more than thirty years or if it arises from an activity that definitively ceased before 30 April 2007.

For stakeholders potentially concerned by the ELL, such as, government services, local authorities, operators, experts (scientists, insurance companies, lawyers, etc.), environmental protection associations, etc., the Ministry of Ecology has drafted a two-part methodological guide:
- the first part covers the presentation of the legal and regulatory framework from the law;
- the second part describes the methods for evaluating environmental damage recommended by the law and by the European Commission's REMEDE working group, as well as the process to follow to determine the remedial measures that should be implemented. It is illustrated using the example of an **actual** situation but **prior to the entry into force of the law.**

Part I

Presentation of the legal and regulatory framework from the Environmental Liability Law

What damage is concerned?

(damage that is exclusively accidental, examples of which are given on pages 22 and 23)

It concerns **"pure"** environmental damage, i.e. **measurable direct or indirect impairments that adversely affect certain natural resources, ecological services and public services.** Personal injury, material and economic damage to property and/or people are therefore not concerned.

In order to be remedied, the damage has to be **qualified as significant** although neither the Directive (ELD) nor the Law (ELL) define the threshold or level of gravity.

Some instances of damage, such as damage arising from a natural phenomenon of exceptional and inevitable character, are excluded from the scope.

The damage concerned:

- *"creates a significant risk of human health being adversely affected as a result of land contamination";*
- *"significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential of the waters"* (mentioned in the Water Framework Directive)*;*
- *"has significant adverse effects on reaching or maintaining the favourable conservation status"* of certain species and certain natural habitats (mentioned in the Habitats and Birds Directives);
- adversely affects certain ecological services.

For more information, see in the guide:
p. 20: Characterisation and nature of the damage
Summary sheet no. 1: is the damage concerned by the Environmental Liability Law?

Which operators and activities are concerned?

The term "operator" has a very broad meaning: *"any natural or legal, private or public person who operates or controls a lucrative or non-lucrative occupational activity".* Thus, for example, a local authority may be affected by the framework but a non-professional private individual shall never be affected. The operator cannot rely on compliance with an administrative authorisation covering his activity in order to be exempt from his obligations.

In addition, the definition of the term "operator" shows that there are a large number of activities potentially concerned which are not limited solely to installations classified for environmental protection (ICPE).

The Environmental Liability Law is characterised by a **mixed liability mechanism:**

- **liability "without fault"** when the activity in question is listed in the ELL (dangerous or potentially dangerous occupational activities). The operator is then held financially liable for the environmental damage that he causes, irrespective of whether he is or is not at fault or negligent.
- **liability "for fault"** for other occupational activities. The damage caused shall be prevented or remedied **only in the case of fault or negligence by the operator** and **only in the case of damage caused to protected natural habitats and species**.

Some instances of damage are, however, excluded from the mechanism, in particular, those arising from an event coming under a compensation or liability mechanism laid down by certain International Conventions, providing that the latter have been ratified by France (for example, case of the International Convention of 1992 on Civil Liability for Oil Pollution Damage).

For more information:
p.27: Operators and activities concerned
p.28: A mixed liability mechanism
p.29: Exceptions and exemptions
Summary sheet no. 1: is the damage concerned by the Environmental Liability Law?

Who is the competent administrative authority?

Most of the time the competent administrative authority is the departmental **prefect** of the location where the damage occurred or the location where the threat is occurring but there are a number of exceptions. Depending on the situation, the texts lay down that the competent prefect shall ask the opinion of other administrative authorities (if the activity is subject to an authorisation mechanism or if the damage affects or is likely to affect the territory of another Member State) **= > (Summary sheet 2).**

This authority shall play a central role in implementing the liability mechanism, the study on its applicability (can it be implemented) up to signing of the order of requirement for remedial measures and monitoring the implementation of these measures.

For more information:
p.32: The competent administrative authority
Summary sheet no. 2: determination of the competent administrative authority and special cases

Which measures may be required?

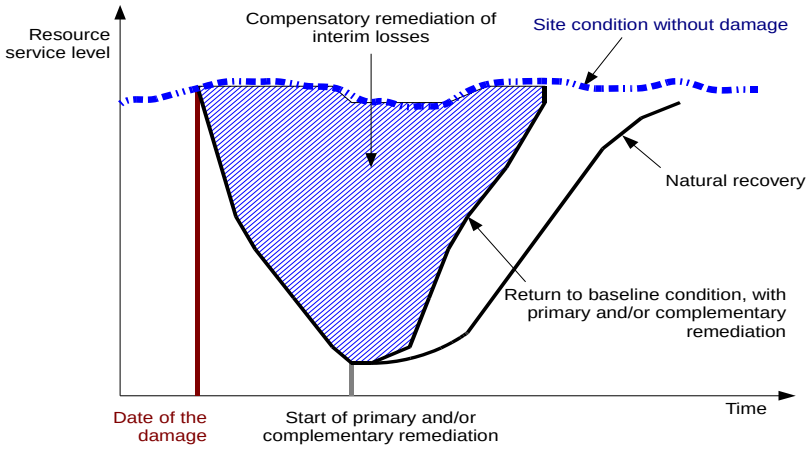
Two types of measures may be implemented:

- **"preventive" measures** occur on two occasions. **In the event of imminent threat of damage,** these measures prevent the damage from occurring or minimise its effects **(=> Summary sheet 5)** and **in the event of damage,** they stop its causes, and prevent or limit its aggravation and impact.
- **remedial measures** are taken following an instance of damage and refer to "*any action or combination of actions, including mitigating or interim measures to* ***restore, rehabilitate or replace natural resources and/or impaired services, or to provide an equivalent alternative to*** *those resources or services".*

Under the global term of "remediation", there are three categories of remediation for damage affecting waters or species and natural habitats (see diagram):

- primary remediation is any action taken to return the damaged environment to its baseline condition,
- complementary remediation is any action taken when primary remediation does not return the environment to its baseline condition or when this return is too slow, i.e., for example, when this return exceeds the time required by a species to complete its life cycle,
- compensatory remediation is any action taken to compensate for the interim losses of resources and/or of services that occur from the time the damage occurs until the time the environment returns to its baseline condition.

The last two remedial measures (complementary and compensatory) may be implemented either on the damaged site (*in situ*), or on a similar site (*ex situ*).



Graphical representation of the loss of resources or services, natural recovery and the three remedial categories for the damaged environment (REMEDE, 2007)

For more information:
p. 29: Exceptions and exemptions
p. 36: Preventive measures
p. 36: Remedial measures
Summary sheet no. 3: logic diagrams of the process for preparing an order of requirement for remedial measures
Summary sheet no. 4: implementation of measures (remedial or preventive)
Summary sheet no. 5: competent administrative procedure relating to the imminent threat of damage and special cases

When should this mechanism be implemented?

Practical application of the Environmental Liability Law may occur in two stages:

- in the event of **imminent threat of damage or immediately after damage has occurred**. These are "preventive" measures which **are implemented immediately.** In addition, it should be ensured that accurate and detailed reports are drafted stating the facts and observations made *in situ* when the damage occurred.
- once **the emergency has been managed,** the primary and/or complementary then compensatory **remedial measures** shall be studied and proposed by the operator according to the methodology explained in part 2. As soon as it has sufficient information, the administrative authority "*sets out the deadline within which the operator submits the suitable remedial measures for its approval*".

For more information:
p.35: Time scale for application of the ELL

Who does what (summary)?

 Operator (s) liable for the damage	 Competent administrative authority
- in the event of **imminent threat of damage**, the operator shall immediately implement the preventive measures aiming to prevent damage from occurring or minimise its effects **(Summary sheet 5)**; - in the event of **damage,** the operator shall immediately implement the measures aiming to stop its causes, and prevent or minimise its aggravation; - he shall immediately inform the competent administrative authority **(Summary sheet 2)** and send it the necessary information; - if requested by the administrative authority, he may carry out his own evaluation on the nature and consequences of the damage; - he shall prepare the file formalising the suitable remedial measures and submit his instruction to the competent administrative authority for approval, using the methodology implemented in part 2; - he shall implement the remedial measures laid out in the order of requirement **(Summary sheet 4)**. - he shall monitor these measures and draft a follow-up report, for the administrative authority.	- in the event of **imminent threat of damage** or in the event of **damage,** the competent administrative authority may at any time ask the operator to provide any necessary information; - in the event of **damage**, it shall check whether, due to its nature, the damage falls within the scope of the environmental liability mechanism; - it shall establish the causal link between the damage and the activity (ies) of an operator (or several operators); - it shall check the liability (without fault or for fault) mechanism application conditions and collect any elements that prove that the operator is at fault or negligent in the event of liability "for fault" **(Summary sheet 1)**; - it shall define the share of responsibility of each operator where appropriate; - it shall evaluate the nature and consequences of the damage; - it shall study each request for formal notice of this mechanism from an environmental protection association or a person directly concerned **(Summary sheet 3)**; - it shall instruct the remedial file filed by the operator and prepare the order of requirement for remedial measures. **(Summary sheet 3)**; - it shall monitor the implementation of the preventive and remedial measures **(Summary sheet 4).** - it shall assess whether the objectives have been achieved (and therefore the end of the process) and, if necessary, may decide to implement corrective measures (within a period of 30 years after the damage has occurred).

In practice, the design then the proposal of remedial measures, although under the operator's responsibility, may be prepared within the framework of a partnership process (see diagram below) with the competent administrative authority, in particular if the latter sets up an advisory committee. Such a committee, although not specified in the texts, shall constitute a decision-making tool for the administrative authority and may also help the operator liable for the damage to design the most suitable remedial measure.

Operator

"Remedial file" design tool

Advisory committee

Exchanges - Sharing of information and knowledge

Administrative authority

Decision-making tool

For more information:
p.32: The competent administrative authority
Summary sheet no. 3: logic diagrams of the process for preparing an order of requirement for remedial measures
Summary sheet no. 4: implementation of measures (remedial or preventive)
Summary sheet no. 5: procedure relating to the imminent threat of damage

Part II

Determination of remedial measures and use of equivalency methods

The second part of the guide deals with the **design and proposal of compensatory remedial measures** and, when required, **complementary remedial** measures, based on accurate evaluation of the environmental damage caused. These remedial measures shall only be considered in the event of **damage affecting waters or protected species and natural habitats** (mentioned in the ELL). They do **not apply to damage affecting land.**

For this, the ELL recommends using two types of approaches: **equivalency approaches** ("first choice" approaches) and **value approaches** (more conventional but also more controversial environmental recovery methods). **These controversial recovery methods shall only be used by default**, when equivalency methods cannot be used, for example, due to lack of information (such as the baseline condition of the environment before the damage, etc.)

The end purpose of these approaches is to size (over time or space) a remediation project (within the meaning of "ecological remediation", see glossary) for implementing the compensatory and/or complementary remedial measures laid down by law through the process for determining remedial measures for the damaged environment.

What do these approaches represent and what do they do?

Equivalency approaches = equivalency methods
Equivalency methods provide damaged resources and/or services of the **same quantity, quality and type** as the initial resources and/or services (before the damage). **Two equivalency methods** exist: - the **HEA (Habitat Equivalency Analysis) method** is preferably applied to an **ecosystem that is *complex in terms of number of species and variety of habitats.*** This involves reasoning in habitats (integrated view of the species/environment interaction) and in related ecological services. The HEA method establishes a **service-to-service equivalency.** - the **REA (Resource Equivalency Analysis) method** is more suitable in the case of an ***ecosystem comprising an endemic species, a heritage species*** *(rare, protected or threatened),* i.e. a species that is highly representative of the environment because it is found in several ecosystems *or in* ***fairly non-complex ecosystems,*** comprising few species or groups of species (example: Landes forest). In both cases, the reasoning is based on a species or group of species. This involves compensating for the losses caused by the consequences of an instance of damage mainly concerning **an animal or plant species or a group of animal or plant species**. This approach establishes a **resource-to-resource equivalency**.
Value approaches
In value approaches, the methods used to evaluate welfare losses are those based on individual preferences. In addition, a remediation project from these approaches does not provide restored resources and/or services of the same type and quality as those initially provided by the environment (as with equivalency methods), but resources and/or services of **comparable type and quality** (for example, the blue tit and marsh tit, two species of the same genus, living in similar habitats). The terminology "value approaches" actually groups: **- the value-to-value approach:** the welfare losses suffered by the population affected by the damage and the welfare gains arising from remediation projects should be equal; **- the value-to-cost approach**: the welfare losses are converted into monetary values (euros) and correspond to the cost of the remediation project.

Which approach should I use?

1st choice. The equivalency approach (one of the two HEA or REA equivalency methods)

=> but if this is not possible, based on the available information:

↓

2nd choice. The value-to-value approach

=> but if this is not possible:

↓

3rd choice. The value-to-cost approach

The main common points of the various approaches are:

- the use of a biological/ecological indicator (called proxy) that is representative of the habitat or species affected by the damage;
- a 7-phase process for determining remedial measures;
- the use of discounting.

For more information:
p.62: Equivalency methods and value approaches: what are they?

Which process should be used to determine the remedial measures?

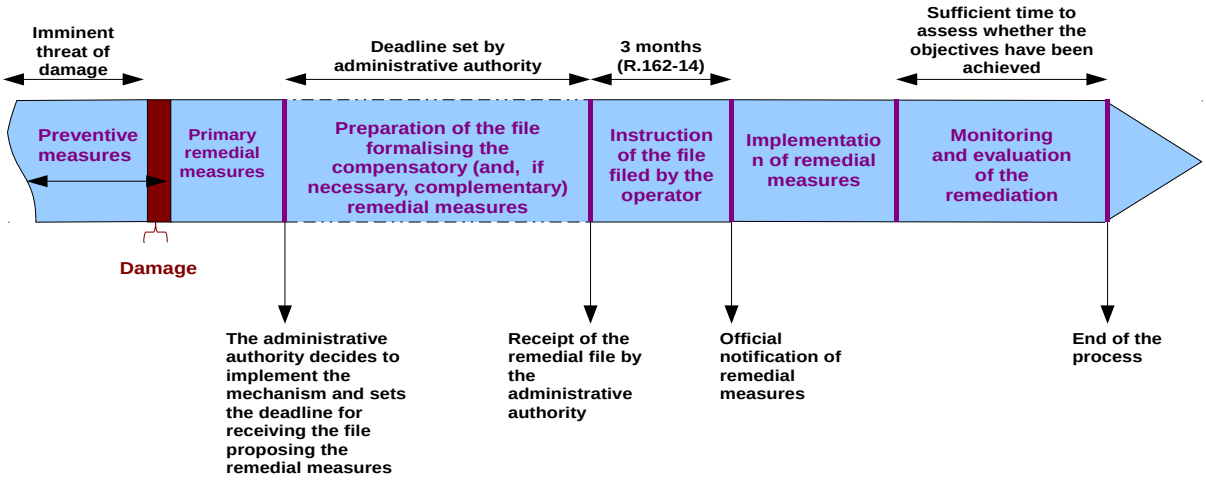
The process for determining measures can be broken down into seven phases summarised below:

Phase	Title	Tasks to be carried out/result of the phase
Phase 1	Identification of the event causing the damage	1. Description of the event causing the damage *Describe the overall circumstances of the accident, retrace the history of events that occurred before and after the instance of damage, repeat the preventive and primary remedial measures already implemented where appropriate.* 2. Pre-identification of resources, ecological services and related damaged functions *Quantitatively and qualitatively describe the direct impacts observed using as a priority the reports drafted at the time of the events.* 3. Reminder of the causal link between the event that occurred and the environmental impacts identified *Repeat all of the elements justifying the causal link between the event giving rise to the damage and the environmental impacts identified.* **For more information: p.66**
Phase 2	Determination of the site's baseline condition before the accident and accurate identification of the damage	1. Data collection: an essential preliminary stage for determining the baseline condition level of the damaged resource or service. *Collect any available information on the damaged site then sort it (keep any information that can be used).* 2. Choice of the proxy and determination of its baseline condition level (unit of reference for estimating the baseline condition, losses and gains). *List the proxies that can be used. Only keep the most suitable proxy in ecological terms (the most representative for the environment for example) and whose site information is available and determine its level before the damage occurred.* 3. Assessment of the nature and gravity of the damage with regard to the baseline condition *The nature and gravity of the damage are assessed with regard to the baseline condition based on elements defined in the regulations (analysis of impairments).* **For more information: p.69**
Phase 3	Identification and analysis of various potential remediation projects	1. Identification of potential remediation projects *Identify remediation projects that are suitable for the damage that occurred (preferably using existing schemes plans or programmes for the territory in question).* 2. Comparative analysis of the various projects *Compare the projects listed based on various criteria (e.g.: likelihood of success, implementation costs, time necessary for remediation, geographical link with the damaged site, etc.).* **For more information: p.81**

Phase	Title	Tasks to be carried out/result of the phase
Phase 4	Choice of scaling approach	1. Determination of the rate and pace of natural recovery (the time necessary for the environment to return to its baseline condition before the accident) *Determine a rate and pace of natural recovery in order to make the calculations expected in phase 5.* 2. Scaling approach (this involves selecting the method to be implemented: HEA method, REA method or value approaches, at a reasonable cost) **For more information: p.83**
Phase 5	Scaling of the complementary and compensatory remediation project and estimation of the remediation costs	1. Estimation of interim losses *Calculate the discounted interim losses adding up the discounted yearly losses throughout the entire period of impact (i.e. until the environment has been returned to its baseline condition before damage).* 2. Estimation of the gains per unit of remediation *Calculate the discounted gains obtained for a restored unit by adding up the discounted yearly gains throughout the entire period of impact (positive) of the remediation project.* 3. Scaling of the remediation project *Produce a ratio between determination of the losses and determination of the gains in order to size the remediation project. Regardless of the approach used, the reasoning is the same, only the scaling unit varies (hectares to be restored, years during which compensatory, and where appropriate, complementary, remediation is implemented)* 4. Estimation of the remediation costs **For more information: p.87**
Phase 6	Sensitivity analysis	*Vary in turn each parameter that was the subject of an assumption in order to assess its influence on the scaling result obtained.* **For more information: p.104**
Phase 7	Monitoring and evaluation of the remediation	1. Preparation of a remediation plan and execution of the work *Prepare a remediation and work execution plan in order to schedule the operations to be carried out on the site and to anticipate the monitoring actions that shall have to be implemented in order to assess whether the operation has been successful.* 2. Monitoring and evaluation - Follow-up report - Checking whether the objectives have been achieved and end of the process **For more information: p.108**

The guide **illustrates** each of these 7 phases **based on the example carried out on accidental contamination of a waterway** (the Gave d'Aspe in Pyrénées-Atlantiques) **in June 2007, i.e. before implementation of this mechanism**.

The diagram below **summarises** the **entire** process for determining the remedial measures dealt with **in this guide**, from the imminent threat of damage or its occurrence to the monitoring and evaluation of these measures.



In addition:

Acronyms, glossary and bibliography

Annex A - Law no. 2008-757 of 1 August 2008 on environmental liability (Title 1)

Annex B - Decree no. 2009-468 of 23 April 2009 on preventing and remedying certain damage caused to the environment

Annex C - Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

Important:

The recommendations stated in this guide are given to facilitate practical implementation of the law. They have no legal value and concern anyone who is likely to be concerned by application of the ELL. More specifically, they aim to assist the liable operator with the designing of the "remedial file" and guide the Administrative authority with its decisions, as it is ultimately responsible for choosing the remedial measures to be retained.

The Environmental Liability Law (ELL) and the equivalency methods

Methodological Guide

Part I

Presentation of the framework from the Environmental Liability Law (ELL)

Part II

Determination of the remedial measures through the use, firstly, of equivalency methods

Contents

Introduction

The Environmental Liability Law (ELL), adopted on 1 August 2008, and its implementing decree of 23 April 2009, transpose Directive 2004/35/EC (ELD) into French law, which establishes a framework of environmental liability that is founded on the "**polluter pays**" principle, and thus creates a **new environmental liability mechanism**. An operator liable for damage concerned by the ELL should **remedy the damage caused "in nature"**, i.e. by carrying out the remedial operations on the site. **Any financial compensation is explicitly excluded**.

This law for preventing and remedying environmental damage has been in force since 27 April 2009 (that is the day after publication of its implementation decree in the French Official Journal). It shall be the subject of a statute of limitation if the event giving rise to the damage dates back more than thirty years or if it arises from an activity that definitively ceased before 30 April 2007.

The damage concerned should be **significant** and **of three types**:

- damage caused to land *if there is a significant risk of human health being adversely affected*;
- damage caused to **waters** mentioned in the **Water Framework Directive;**
- damage caused to **protected species and natural habitats** mentioned in the **Habitats and Birds Directives**.

To remedy this damage, the ELL recommends three different remedial operations:

- **primary remediation** corresponds to any actions implemented to return the damaged environment **to its baseline condition**;
- **complementary remediation** is implemented **when primary remediation does not return the environment to its baseline condition or when this return is too slow.**
- **compensatory remediation** is implemented to **compensate for the interim losses** of resources and/or of services that occur from the time the damage occurs until the time the environment returns to its baseline condition.

Complementary and compensatory remedial measures are sized by specific and innovative approaches, such as, equivalency methods and value approaches. They have never been implemented in France because, to date, (1 July 2012) no damage has been concerned by application of the ELL.

> *N.B.: The reader's attention shall be drawn to the fact that here the terms "equivalency" and "compensatory remediation" mean "**ex post**", i.e. **within the meaning of the Environmental Liability Law**. **No confusion should be made with** the notion of **compensatory measure in the sequence "prevent - reduce - compensate"** which means "**ex ante**" and which may result from highlighting residual impacts during the studies carried out upstream of the authorisation of a project or adoption of the planning document*

Since 2008, the MEDDE has conducted several studies aiming to disseminate these methods (see bibliography) using examples of damage occurring before implementation of the law and the work by the European Commission working group on the subject (REMEDE). It is now essential to guide the potential stakeholders concerned by the ELL, such as, government departments, local authorities, operators, experts, (scientists, insurance companies, lawyers, etc.), environmental protection services, etc., on the strictly regulatory and procedural aspects and on the part related to the scaling of remedial measures. Such is the purpose of this two-part guide.

The first part covers the presentation of the framework from the law and is illustrated with help sheets for reading the regulations in force (summary sheets).

The second part describes the methods to be used and the process to be followed to determine the remedial measures that shall be implemented after ecological damage has occurred. It is illustrated, in the case of compensatory remedial measures, through the application of each approach (equivalency methods and value approaches) on an accident that occurred in the Pyrénées-Atlantiques in 2007, **i.e. before implementation of this mechanism**.

> *N.B.: This second part does not cover damage that "creates a significant risk of human health being adversely affected as a result of land contamination" mentioned in Article L.161-1 I 1° of the Environmental Code. Effectively, the remedying of this damage uses land decontamination techniques that do not require the use of equivalency methods or value approaches, discussed in this guide.*

> *N.B.: The recommendations stated in this guide are given to facilitate practical implementation of the law. They have no legal value and concern anyone who is likely to be concerned by application of the ELL. More specifically, they aim to assist the liable operator with the designing of the "remedial file" and guide the Administrative authority with its decisions, as it is ultimately responsible for choosing the remedial measures to be retained.*

Presentation of the framework from the Environmental Liability Law (ELL) Part I

Legal and regulatory context

This paragraph is used to know where, when and how to apply the ELL and who decides on the measures?

The texts[1]

The "Environmental Liability Law" (ELL) of 1 August 2008 is the transposition into French law of the Directive no. 2004/35/EC of the European Parliament and of the Council of 21 April 2004, with regard to environmental liability (ELD). This law concerns the prevention and remedying of environmental damage. It establishes an environmental liability framework based on the **"polluter pays" principle** in the aim of **preventing and remedying** environmental damage at a *"reasonable cost to society"* (L.160-1), following, for example, an industrial accident.

In addition to the remedial costs, this cost includes the cost **of the studies** for estimating the damage and its remedying and the **monitoring and evaluation costs**.

The implementing decree of the ELL, no. 2009-468 adopted on 23 April 2009 completes the process of transposing the directive into French Law. It provides complementary elements on the scope (lays down the principles for evaluating the damage and the conservation status of habitats and species, etc.), the liability mechanism (principles, preventive or remedial measures for instances of damage) and states the usual criminal provisions.

The Environmental Liability Law has been in force **since 27 April 2009.**

Scope

Characterisation and nature of the damage

1) Pure and significant environmental damage: definitions and examples

The Environmental Liability Law concerns the instances of **"pure" and significant environmental damage**:

Environmental damage

Environmental damage is defined as being "*measurable direct or indirect impairment of the environment*" which adversely affects certain natural resources (protected species and natural habitats, waters and land - see p.24) and the services related to those resources.

[1] The texts mentioned are collated in the annex of this guide and unless mentioned otherwise, all of the articles cited in the guide refer to the Environmental Code.

"Pure" environmental damage

"**Pure**" environmental damage concerns **damage caused to nature, ecological services and public services**. Therefore, this excludes personal injury, material and economic damage to property and/or people (material or non-material damage) already taken into account by the civil liability mechanism (L.162-2).

On the other hand, the purpose of the Environmental Liability Law is to remedy the environmental damage that shall have been caused **in nature** (see second part of this guide) and **not in the form of financial compensation.** This remedying occurs based on a **remediation project** (see glossary)**,** proposed by the operator.

Example of financial compensation

Within the scope of the Erika process, the Tribunal de Grande Instance (Regional Court) then the Cour d'appel de Paris (Paris Court of Appeal) granted to the parties who requested it, compensation for "loss arising from environmental damage", in addition to compensation for their material and moral damage. Although **still under cassation**, the judgement pronounced on 16 January 2008 estimated this damage at 1.3 million euros in favour of the sub region of Morbihan (1 million euros) and the League for the Protection of Birds (300,000 euros). In its Order of 30 March 2010, the Court of Appeal extended the "loss arising from environmental damage" to all of the local authorities. Eleven municipalities, two sub regions and three associations were finally granted a total of 5 million euros for this loss.

The Environmental Liability Law also covers damage adversely affecting land when "land contamination comprises a significant risk of adverse effects on human health".

Significant environmental damage

Pure environmental damage shall only be concerned by the Environmental Liability Law if **qualified as significant[2].** Although the ELL does not define thresholds, scales, or durations of gravity of an instance of damage, (the latter can only be estimated locally and on a case-by-case basis), gravity shall be qualified with regard to the environmental characteristics and the contamination according to the criteria defined in Articles R-161-1, R.161-2 and R-161-3 (for example, ecological, chemical or quantitative status of the waters, conservation status of a protected species or natural habitat, concentration, level of danger and possibility of dispersion of the contaminants, etc.). The second part of the guide on the application of equivalency methods to the accidental contamination of the Gave d'Aspe, illustrates, on a concrete case, these various elements.

2 Sometimes the gravity of the damage can only be correctly understood a long time after the occurrence of the event giving rise to the damage.

A few examples of damage that could have been qualified as significant if they had occurred after the entry into force of the provisions transposing the ELD (27 April 2009 in France)

In France

- On 8 June 1988, a fire in the Protex plant (chemical plant) in Auzouer, Touraine (37) caused massive contamination of the Brenne river, then of the Cisse and the Loire river (i.e. more than 40 km of waterways). 20 tonnes of fish, aquatic or terrestrial mammals, were destroyed. A high phenol index was reported in the Loire river: drinking water abstraction points were stopped depriving the 200,000 residents of Tours and its region of water for 8 days.

- On 6 August 1996, a fire in a plant products company caused the accidental spillage of 450 m^3 of polluted fire extinguishing water into a small stream. The pollution then spread to two rivers, the Meurthe then the Moselle. The damage observed corresponded to the death of 2 tonnes of fish species and near-total destruction of the fauna and flora according to the sector damaged.

- On 5 April 1997, the rupture of a pipe in a paper mill caused discharge by runoff of 21 m^3 of sodium hypochlorite in the Courant de Mimizan. The damage resulted in destruction of the fauna and flora over 4 km downstream of the discharge and a fish mortality evaluated at 25 tonnes.

- On 5 June 2007, a road accident in the Pyrénées-Atlantiques caused the spillage of 17,000 litres of potassium hydroxide into the Gave d'Aspe destroying all of the aquatic fauna over 4 kilometres and resulting in a fishing ban for 3 to 5 years.

In Spain

- On 25 April 1998, the dike of a waste disposal basin of a pyrite mine collapsed over 50 m following a landslide, at Aznalcollar. 4 million tonnes of acid water and 3 million tonnes of sludge entered the RIO AGRIO then the GUADIAMAR, which overflowed by 200 to 300 m over 20 km. The toxic flow threatened Doñana National Park. A proportion of the pollutants entered the GUADALQUIVIR delta, 80 km downstream of the mine, and contaminated the beaches in the Gulf of Cadiz. The accident caused the death of 30 t of fish, tens of thousands of birds (geese, storks, etc.), 220 kg of shellfish, frogs, horses and goats, etc. Hunting, fishing and water use (irrigation, drinking water abstraction, etc.) were banned for several weeks. The mine, closed 12 months after the accident, ceased all activity in September 2001.

Here are a few examples of damage qualified as significant following transposition of the ELD

In Hungary

- On 4 October 2010, in Kolontar, a tank of red sludge on an aluminium production site burst over 50 m releasing 1 million m^3 of highly alkaline sludge, adversely affecting the Danube river. The Hungarian academy of science reported traces of cadmium, chromium, mercury, nickel, lead, arsenic and zinc. The Hungarian government ordered the plant to be closed down, declared a state of emergency in 3 out of the country's 19 sub regions, banned the use of wells, fishing, hunting and the consumption of plants and qualified the accident as an "ecological disaster".

In Romania

- On 30 January 2010, in a gold tailing processing plant in Baia Mare, a settling tank burst following the formation of a 25 m long break. Almost 300,000 m^3 of waste containing cyanide and heavy metals contaminated 14 ha of land and polluted the SASAR, the LAPUS, the SZAMOS, the TISZA and the DANUBE. Romania, Hungary, Yugoslavia, Bulgaria and Ukraine were affected. Water use and fishing activities were banned. Fauna and flora were destroyed over hundreds of km: 1,200 t of dead fish were recovered for Hungary alone and thousands of animal carcasses were found (swans, wild ducks, otters, foxes, etc.).

An example of damage qualified as not significant subsequent to the entry into force of the ELL:

In France

On 8 July 2011, a tank filled with 600 m3 of sodium burst on the site of a paper pulp production plant at Saillat-sur-Vienne (87) causing significant spillage of a volume of sodium into the waters of the Vienne river. The installation of a conventional emergency system with a floating dam enabled the pollution to be contained effectively. This action combined with a high watercourse flow rate spared the flora and fauna serious consequences.

A few examples of damage that would have been qualified as not significant if they had occurred after the entry into force of the provisions transposing the ELD

In France

- On 30 September 2008, a release of dirty water from a drinking water production plant (clarification sludge) polluted the Meurthe river at Varangeville (54). It was reported that the aquatic flora was covered with the deposit from suspended materials contained in the discharge but no fish mortality was observed.

- On 16 March 2008, a pipe leak caused the spillage of an estimated 400 tonnes of heavy fuel oil during the loading of a vessel at the Donges refinery (44). Recovery operations at sea and in the estuary were promptly organised. On 17 March, a prefectoral order banned occupational and recreational sea fishing. These bans were lifted on 4 April 2008. Observations made by the ONCFS (French National Hunting and Wildlife Agency) and the LPO (League for the Protection of Birds) showed that the proportion of oiled birds decreased as the clean-up operations advanced. No serious consequence to the environment was therefore retained.

Furthermore, Article R-161-4 qualifies as significant the damage caused to protected species and natural habitats (mentioned in the ELL), damage "*with a proven effect on human health*".

Excluded damage

Article R. 161-5 lists the measurable impairments to protected species and habitats that may not constitute damage under this law:

- impairment due to a natural phenomenon of exceptional, inevitable and irresistible character (for example, a storm, a tidal wave, an earthquake, a landslide, etc.),
- negative variation inferior to natural fluctuations considered as normal for the species or habitat concerned,
- impairment disappearing over a limited time without human intervention, the populations of species or habitats being restored, by their natural dynamics, to their natural condition at the time of the damage or to a more favourable condition and,
- impairment arising from an intervention in the natural environment or landscape created by the operator within the scope of the scenarios mentioned in 4° of the article[3].

[3] Either in accordance with a management document that applies to its occupational activity and appears on the list drafted by order of the Ministry of Ecology, or in compliance with the objectives for the conservation of protected species and habitats, or is part of the usual management methods associated to the habitat concerned and that has contributed to its conservation.

2) Natural resources concerned

The damage concerned (L.161-1.I):

- *"creates a significant risk of human health being adversely affected as a result of land contamination",*
- *"significantly adversely affects the ecological, chemical or quantitative status and/or ecological potential of the waters".*

To define the meaning of "waters", reference should be made to the Water Framework Directive (WFR) 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy, **i.e. inland surface waters, transitional waters, coastal waters and groundwater.**

Definition of the various categories of water concerned by the WFD (definitions used by the Order of 12 January 2010):
Inland surface waters means all standing or flowing 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, transitional waters and coastal waters, except in respect of their chemical status for which they shall also include territorial waters. **Transitional waters** are "*bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.*"
Groundwater means "*all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil*". **Coastal waters** means "*surface water on the landward side of a line, every point of which is at a distance of one nautical mile* (i.e. approximately 2 km) *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 water*".

- *"significant adverse effects on reaching or maintaining the favourable conservation status" of certain protected species and certain natural habitats mentioned in the Habitats and Birds Directives, the details of which figure in Table I.*

Brief reminder of the "Habitats" (HD) and "Birds" Directives (BD)

Natura 2000 is a **European ecological network** initiated in 1992 by the so-called "Habitats" Directive[4]". Its main aim is to promote the maintenance of biodiversity "*taking account of economic, social, cultural and regional requirements*" thereby contributing to sustainable development.

The network is formed by sites of high heritage value, hosting the natural habitat types and habitats of certain species identified as being of **community importance**. It comprises the sites designated by the Member States pursuant to the "Birds[5]" Directive of 1979 (special protection areas - SPA) and to the "Habitats" Directive (sites of community importance - SCI and special areas of conservation - SAC).

In 2012, the **Natura 2000 terrestrial network** covered 12.5% of French mainland territory; overseas departments and regions being excluded from this terrestrial network.

Table I: Species and habitats concerned by the Environmental Liability Law

PROTECTED SPECIES (mentioned in the ELL)	- Species of Annex I of the Birds Directive or BD - Regularly occurring migratory bird species, not listed in Annex I of the BD - Species of Annex II of the Habitats Directive or HD (these are animal or plant species of community interest whose conservation requires the designation of special areas of conservation) - Species of Annex IV of the HD (these are animal and plant species of community interest in need of strict protection)	**Examples**: Certain chiroptera such as the greater horseshoe bat (*Rhinolophus ferrumequinum*) or the barbastelle (*Barbastella barbastellus*), certain amphibians such as the great crested newt (*Triturus cristatus*) or the yellow-bellied toad (*Bombina variegata*), certain fish such as the European brook lamprey (*Lampetra planeri*) or the bullhead (*Cottus gobio*), certain insects such as the hermit beetle (*Osmoderma eremita*), certain mammals such as the otter, certain plant species such as the *Omphalodes littoralis*, the lady's slipper orchid (*Cypripedium calceolus*), and certain birds such as the Purple Heron (*Ardea purpurea*), the Corn crane (*Crex crex*), etc.*
PROTECTED HABITATS (mentioned in the ELL)	- Habitats of Annex I of the HD (natural habitat types of community interest whose conservation requires the designation of special areas of conservation) - Habitats of the species of Annex I of the BD - Habitats of regularly occurring (breeding, moulting and wintering areas and staging posts along their migration route) migratory bird species not mentioned in Annex I of the BD - Habitats of the species of Annex II of the HD - Breeding sites and resting places of the species of Annex IV of the HD	**Examples:** Estuaries, reefs, certain salt meadows, certain fixed or moving dunes, certain types of lawns, grasslands or forests, etc.*

The reader shall refer to the following website to have access to the "habitats records" (summary sheets on the habitats and species mentioned in Annexes I and II of the HD): http://natura2000.environnement.gouv.fr/habitats/cahiers.html

4 "Habitats" Directive (HD) of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

5 "Birds" Directive (BD) 79/409/EEC of the Council of 02 April 1979 on the conservation of wild birds codified by Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

N.B.: Any damage adversely affecting a habitat and/or a species mentioned in Table I is likely to be concerned by the Environmental Liability Law, regardless of whether the species and/or habitat in question is located or not within a Natura 2000 site. Conversely, damage affecting a protected species in French national law but not mentioned in this same Table I is not concerned by the Environmental Liability Law.

3) Ecological services concerned

According to Art L.161-1. I, 4°, damage that "*affects ecological services, i.e. functions ensured by the land, waters and species and habitats mentioned in 3° for the benefit of one of these natural resources or for the benefit of the public, with the exception of the services provided to the public by developments carried out by the operator or the owner*" also fall within the scope of the ELL.

Ecological services (also called ecosystem services) reflect the benefits that man may gain from biodiversity and which contribute to his social welfare. They are the processes at the origin of the production of these services which represent ecological functions.	**Ecosystem** ⇩ **Ecological functions** ⇩ **Ecological services**

International work on the Evaluation of Ecosystems for Millennium Ecosystem Assessment or MEA 2005 led to classification of the ecological (or ecosystem) services into 4 categories. The first category comprises supporting services that include support services not used directly by man.

Three other categories arise from these supporting services:

- provisioning services,
- regulating services,
- cultural services.

Table II: Services obtained from ecosystems (source: MEA, 2005[6])

	Provisioning services *Products obtained from ecosystems* - Food - Fresh water - Fuel wood - Fibres - Biochemicals - Genetic resources
Supporting services *Services necessary for the production of all other ecosystem services* - Soil formation - Nutrient cycling - Primary production	**Regulating services** *Benefits obtained from regulation of ecosystem processes* - Climate regulation - Disease regulation - Water regulation - Water purification
	Cultural services *Non-material benefits obtained from ecosystems* - Spiritual and religious - Recreation and ecotourism - Ecological beauty - Inspiration - Educational - Sense of place - Cultural heritage

Careful observation of these services show that the scope of resources potentially concerned is finally extremely broad.

> *N.B.: As opposed to damage affecting natural resources, Article L.161-1 I, 4° does not require the damage affecting the ecological services to "significantly" adversely affect them.*

Operators and activities concerned

The law lays down the prevention and remedying of damage caused to the environment by an operator's activities:

"*Operator means any natural or legal, private or public person who operates or controls a lucrative or non-lucrative occupational activity*" (L. 160-1). Non-professional private individuals who cause damage covered within the scope of this mechanism are therefore not concerned.

[6] It should be noted that REMEDE 2007 gives examples of the services obtained by type of environments likely to be damaged: land, surface waters, groundwaters, sediments, aquatic environments, terrestrial resources, www.envliability.eu/pages/eld.htm

In addition, the definition of the term "operator" shows that there are a large number of activities potentially concerned which are not limited solely to installations classified for environmental protection (ICPE).

=> See Summary sheet no. 1

> *N.B.: the Environmental Liability Law does not force potential polluters to obtain a financial guarantee (insurance, bank guarantee) which would cover the costs arising from the environmental liability. However, to help the operator cover his liabilities incurred in virtue of the prevention and remedying obligations, a certain number of mechanisms (insurance, caution, etc.) exist.*

A mixed liability mechanism

The Environmental Liability Law is characterised by a **mixed liability mechanism:**

- **without fault (or strict or objective**). The operator of one of the activities listed in Article R.162-1 (see Annex B) is subjected to the **liability without fault** system. If his activity causes damage, the operator shall be held responsible **irrespective of whether he is or is not at fault or negligent**.
- **for fault. This mechanism concerns occupational activities other than those listed in Article R.162-1 and only** in the event of damage caused to protected species and habitats (mentioned in the ELL). The damaged caused shall be prevented or remedied **only in the event of operator fault or negligence.**

=> See Summary sheet no. 1

Exceptions and exemptions

1) Exceptions

The Environmental Liability Law provides for a certain number of environmental liability exception situations. These exceptions are summarised in the table below:

Exceptions

According to Article L.161-1 II 1°, damage that may result from **the implementation of development, works or installation projects** in a natural environment are excluded **as soon as they have been authorised or approved** by the competent authorities under the conditions defined in Article L.414-4 (subject to assessment of Natura 2000 adverse effects) or pursuant to Articles L.411-2 and L.411-3 (derogation to the ban on destruction of protected species) as soon as the requirements arising from these articles have been respected.

According to **Article L.161-2**, environmental liability shall not cover environmental damage or the imminent threat of damage:

- 1° *Caused by an act of armed conflict, civil war or insurrection*,

- 2° *Arising from activities the main purpose of which is to serve national defence or international security* (except if the activity is subject to authorisation or declaration under structures, works and activities listed in Article L.214-1 or under Installations Classified for the Protection of the Environment),

- 3° *Caused by a natural phenomenon of exceptional, inevitable and irresistible character*,

- 4° *Arising from activities the sole purpose of which is to protect from natural or major hazards or natural disasters*,

- 5° *Arising from an event subject to a liability or compensation mechanism provided for in the International Conventions mentioned in Annex IV of the Environmental Liability Directive, as of their entry into force on the territory of the French Republic,* i.e.[7]:

  a. The International Convention of 27 November 1992 on Civil Liability for Oil Pollution Damage

  b. The International Convention of 27 November 1992 on the Establishment of an International Fund for Compensation for Oil Pollution Damage

  a. The International Convention of 23 March 2001 on Civil Liability for Bunker Oil Pollution Damage

  d. The International Convention of 3 May 1996 on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea

  e. The Convention of 10 October 1989 on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels.

- 6° *Arising from activities covered by the Treaty establishing the European Atomic Energy Community or caused by an incident or activity falling within the scope of the conventions listed in Annex V of the Environmental Liability Directive,* more specifically[8]:

  a. The Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention of 31 January 1963

7 This list is subject to change according to the possible ratifications of supplementary conventions.

8 This list is subject to change according to the possible ratifications of supplementary conventions.

b. The Vienna Convention of 21 May 1963 on Civil Liability for Nuclear Damage

c. The Convention of 12 September 1997 on Supplementary Compensation for Nuclear Damage

d. The Joint Protocol of 21 September 1988 relating to the Application of the Vienna Convention and the Paris Convention

e. The Brussels Convention of 17 December 1971 relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material

- 7° *caused by pollution of a diffuse character,* unless a causal link is established between the damage or threat of damage and the activities of individual operators.

Environmental liability also does not apply if the event giving rise to the damage:

-occurred before 30 April 2007

-arises from an activity that definitively ceased before 30 April 2007.

Statute of limitation

In accordance with Articles L.161-4 and 5, the mechanism shall be subject to a thirty year liability period (if the event giving rise to the damage dates back more than 30 years).

N.B.: The exceptions (provided for in Article L. 161-2) shall only be applicable if the relevant convention has been ratified by France.

Status of ratification in France of the conventions cited in 5° and 6° of Article L.161-2

When the convention is not in force in French law (i.e. if France has not ratified it), the exception shall not apply and consequently the environmental liability mechanism shall apply.

International Convention	Ratification by France	Date of entry into force in France
The International Convention of 27 November 1992 on Civil Liability for Oil Pollution Damage	yes	30/05/1996
The International Convention of 27 November 1992 on the Establishment of an International Fund for Compensation for Oil Pollution Damage (IOPC Fund)	Yes	30/05/1996
The International Convention of 23 March 2001 on Civil Liability for Bunker Oil Pollution Damage	yes	20/04/2011
The International Convention of 3 May 1996 on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea	No	No
The Convention of 10 October 1989 on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels.	No	No
The Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy and the Brussels Supplementary Convention of 31 January 1963	yes	01/04/1968
The Vienna Convention of 21 May 1963 on Civil Liability for Nuclear Damage	yes	01/11/1977
The Convention of 12 September 1997 on Supplementary Compensation for Nuclear Damage	No	No
The Joint Protocol of 21 September 1988 relating to the Application of the Vienna Convention and the Paris Convention	No	27/04/1992
The Brussels Convention of 17 December 1971 relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material	yes	15/07/1975

2) Exemptions

Article L.162-23 stipulates that the operator shall not have to bear the cost of the measures mentioned in Articles L.162-4, L.162-8 and L.162-9, if he demonstrates that he was not at fault or negligent and that the environmental damage was caused by an event, activity or any manner of using a product which is not likely to cause environmental damage according to the state of scientific and technical knowledge at the time of the event giving rise to the damage (**"development risk" exemption**).

According to Article L.162-22, the operator can recover from the liable persons the cost of the preventive or remedial measures that he has undertaken when he can prove that the damage or its imminent threat:

- was caused by a third party and occurred despite the fact that appropriate safety measures were in place (for example, this is the case in the event of a malicious act),
- resulted from compliance with an order or instruction emanating from a public authority (other than an order or instruction consequent upon an emission or incident caused by the operator's activities).

However, the operator shall not be entitled to correct compliance of a prefectoral order (e.g. prefectoral operation order, prefectoral authorisation order, etc.) or a national or European authorisation (e.g. authorisation for placing a product on the market) to exempt him from his obligations. This possibility of exemption (**"permit risk" exemption)** authorised by the Environmental Liability Directive and left at the discretion of the Member States, **was not retained during the transposition by France**.

The competent administrative authority

Most of the time, the competent administrative authority, in the case of environmental liability covered by the Environmental Liability Law, is the **sub regional departmental prefect** of the location where the damage occurred or the location where the threat is occurring (R. 162-2), but there are a certain number of exceptions.

=> See Summary sheet no. 2

The competent administrative authority plays a central role in implementation of the environmental damage preventive and remedial mechanism. Its prerogatives and obligations are vast.

To put in very simplified terms, the administrative authority is responsible for:

- **demonstrating the causal link** between the damage and the activities of an operator (or several operators) (L.162-I 2°) and collect the elements proving the negligence or fault of the operator in the case of liability "for fault";

> **The causal link, a key element of the "event giving rise to the damage = > damage = > causal link" liability triangle:**
>
> The causal link is **essential** for application of the "polluter pays" principle and shall result in the following observation: the damage observed is clearly a result of the accident identified.
>
> Any reports drafted at the time of the accident should be used to demonstrate that environmental damage occurred after the event and that a chain of events exists, that should be compared, in the case of pollution affecting a waterway, the area downstream of the accident and upstream, etc. The vicinity of the operator's place of activity with the damage identified, the correspondence between contaminating substances and components used by an operator if these elements contribute to establishment of a causal link, may also be suggested.

- **defining the liability of each operator** where appropriate (L.162-18);
- **evaluating the nature and consequences of the damage**. On this point, the administrative authority may also ask the operator who caused the damage to carry out his own evaluation (L. 162-6). It is likely that, in practice, the damage shall be evaluated more often "in consultation" between the administrative authority, the liable operator (s) and where appropriate the other stakeholders concerned by the damage;

- studying **each request for implementing preventive and remedial measures emanating from an environmental protection association or a person directly concerned** or who runs the risk of being affected by damage or an imminent threat of damage (R.162-3 and R.162-4);
- **preparing the order of requirement for remedial measures** (referred to in L.162-11) following proposals issued by the operator in the file under his responsibility (and after requesting the opinion of the local authorities, public bodies and environmental protection associations). The **remedial file instruction** mechanism is described in more detail in Summary sheet no. 3.

=> See Summary sheet no. 3

The administrative authority, through prerogatives that are conferred upon it that fall under the responsibility of the administrative police, has the possibility of:

- establishing the requirements and,
- imposing sanctions.

Administrative actions and criminal sanctions[9]

Administrative actions:

- the first of the measures that may be taken by the administrative authority is an **Order of formal notice (AMD)** in accordance with Article L.162-14 (this is an administrative police measure). This procedure may, for example, be applied if an operator has not implemented the prescribed remedial measures.

- if the operator has not implemented the prescribed measures before the deadline set at the time of the formal notice, various possible administrative sanctions are offered to the administrative authority:

1° **Oblige the operator to deposit with a public accountant a sum** covering the amount for the prescribed preventive or remedial measures, etc.

2° **Automatically proceed with execution of the measures at the cost of the operator**.

=> See Summary sheet no. 4

Criminal sanctions:

Criminal sanctions may complete the administrative sanctions (L.163-4 and L.163-5): one year of imprisonment and a fine of 15,000 euros in the event of stakeholders standing in the way of exercising the measures mentioned in L.162-13 and L.163-1 and six months of imprisonment and a fine of 75,000 euros for failure to comply within the period defined in the formal notice.

[9] It should be noted that administrative and criminal repression, applicable in terms of environmental remediation, shall be modified after 1 July 2013, pursuant to Order no. 2012-34 of 11 January 2012 on the simplification, reform and harmonisation of the provisions of the administrative police and of the legal police of the Environmental Code (JP of 12/01/2012). With reference to this, the guide shall therefore have to be updated.

*N.B.: Under no circumstances shall the administrative police powers substitute existing special police powers. In this case, the police for water, classified installations, waste and protection of the fauna and flora shall mainly be concerned and may come under the same administrative authority. However, other activities mentioned in the ELL come under a different administrative authority (e.g.: the Ministry for Agriculture for placing plant protection products or genetically modified plants on the market, the Ministry for Research for the contained use of genetically modified micro-organisms for research purposes). In practice, this means that the authorities having special police powers, may also, issue requirements and sanctions (L.164-1: The application of provisions relating to the prevention and remedying of certain damage caused to the environment "**shall not stand in the way of the implementation of any special police mechanism**"). However, coordination of the various polices shall be unavoidable when seeking efficiency of the measures (laid down in Article R.162-2 VI).*

Practical advice: implementation of an advisory committee to guide the administrative authority in its decisions

Without prejudice to Articles L-162-10 and R-162-3, the constitution of **a sub regional/local advisory committee** may prove very useful when preparing the file, in particular when the local context is sensitive. Such a committee may, for example, provide clarity during the process for determining remedial measures described in the second part of this guide.

Such a consultation engages the constituent members in a **dialogue** on **the assumption to be retained** as the determination of the measures advances and provides transparent information and good **local acceptability of the measures** *in fine* **proposed**.

In practice, the regulations do not impose the establishment of such a committee. Its creation is therefore optional. The initiative on its constitution and the determination of its composition (number of members and competence criteria to be adapted according to the type of damage that has occurred and its magnitude), remain under the responsibility of the **competent administrative authority**.

The advisory committee may, under the presidency of the Prefect, include the members mentioned below (non-exhaustive list):

- panel of government administrations, public bodies and organisations,
- panel of interested local/regional authorities, and their groups,
- panel of professionals, associations and users,
- panel of experts and scientists (e.g.: representative of the CSRPN (Regional Scientific Committee for Natural Heritage), lawyers, etc.).

In the assumption where such a structure would be implemented, it is important that the person liable for the damage attends the working sessions of this committee.

The various reports drafted following the working sessions are used to keep a record of the discussions on the assumptions put forward. The work carried out within this committee shall effectively help and guide the administrative authority and the person liable for the damage in the determination of the remedial measures.

Time scale for application of the ELL

Practical application of the Environmental Liability Law may occur and take place in two stages:

The emergency and crisis situation response time

In the event of imminent threat of damage or immediately after damage has occurred, "preventive" measures (aiming to prevent damage from occurring or minimise its effects and those aiming to stop the causes of the damage or minimise its aggravation) **are implemented immediately** (see Summary sheet no. 5). Summary sheets no. 1 and 2 are used to check whether the damage or threat of damage is potentially concerned by the ELL and, where appropriate, to determine the competent administrative authority.

Most of the time, damage management involves intervention of the French Interservice Defense and Civil Protection (SIDPC) and the provisions laid down in the Environmental Liability Law are not the only provisions to be applied. The SIDPC therefore intervenes under the authority of the Prefect to ensure coordination of the government's decentralised services and any services engaged in the contingency plan.

In order to subsequently facilitate qualification and quantification of the damage, it is **essential to ensure that accurate and detailed reports are drafted** relating to the facts and observations made *in situ* when the damage occurred. The reports may be repeated over time (e.g.: every two hours for 12 to 24 hours) or be drafted in several different locations (e.g.: on the site of the damage affecting a waterway, 5 km downstream, then 10 km upstream).

Once the preventive measures have been taken, primary remedial measures can then be implemented (p.36).

The time for thinking about and scaling remedial measures

Once the emergency has been managed and the primary remedial measures have been implemented, compensatory remedial measures then need to be thought about and sized. As soon as it has sufficient information, the administrative authority "*sets out the deadline within which the operator submits the suitable remedial measures for its approval*" (R. 162-11). In the case of the Gave d'Aspe example (described in the second part of the guide), 6 months were necessary to identify the remedial measures that would have been taken if the ELL had been applied. In practice, it is obviously more reasonable to think that this deadline shall be much longer and shall vary between six months to one year. This is the time necessary for conducting the study including the stage for drafting the specification if a service provider is used and to arrange the consultation phases, etc.

Once the administrative authority has received the measures proposed by the operator, it shall have three months to ensure instruction of the file. However, a derogation case exists which enables (by reasoned order) a new deadline to be set if a decision cannot be made during these first three months.

Preventive measures and remedial measures

Preventive measures

Two types of preventive measures exist (L.162-3 and 4):

- **in the case of imminent threat of damage**, all of the measures aiming to prevent the damage from occurring or minimise its effects,
- **in the case of damage, all measures aiming to stop its causes, prevent or minimise its aggravation and its impact on human health and on ecological services.**

If the operator does not take effective measures or in the case of persistence of the threat, **the competent administrative authority may force the operator to take the necessary preventive measures**. It may also give him instructions as regards the measures to take or assume this task in order to take said measures.

=> See Summary sheet no. 5

If the operator has to implement preventive measures in private properties, he should obtain prior "*written authorisation from the owners, holders of real rights, their claimants or, where appropriate, holders of rights of use", etc.* "*Failing amicable agreement or in the event of an emergency, authorisation may be given by the president of the tribunal de grande instance (court of first instance) or a magistrate designated by the latter*" (L. 162-5).

Examples of preventive measures:

- containment of effluents that are or likely to be polluting effluents, diversion of the latter towards retention tanks,
- installation of floating dams and sorbent booms downstream of the area of pollution,
- pumping of the polluted water and removal to an approved waste processing plant,
- recovery of polluting substances, etc.

Example

In the case of a cargo vessel shipwrecked off the coast of the Island of Oléron on 22 July 2011, the Norwegian owner was given formal notice by the maritime prefecture and requested to intervene within three days "*to stop the risk of pollution constituted by the products contained in the oil and fuel bunkers*".

Remedial measures

Remedial measures following an instance of damage refer to "*any action or combination of actions, including mitigating or interim measures to* ***restore, rehabilitate or replace natural resources and/or impaired services, or to provide an equivalent alternative to*** *those resources or services as foreseen in Annex II of the Directive".*

The remedial measures are not necessarily preceded by preventive measures in the event of imminent threat of damage.

In accordance with Articles L.162-8 and R.162-9, when damage has been caused to land, the remedial measures shall target elimination of significant risks of human health being adversely affected, taking the current or planned use of the site into account, as defined by the town planning documents in force when the damage occurred. The possibility of natural recovery shall be considered.

For damage affecting waters or protected species and natural habitats, the Environmental Liability Law defines three types of remedial measures to be taken into consideration (L.162-9):

- **Primary remediation** corresponds to any actions implemented to return the damaged environment **to its baseline condition**. It may consist of a simple natural recovery;

- **Complementary remediation** is implemented **when primary remediation does not return the environment to its baseline condition or when this return is too slow** (existence of **residual losses)** "to *provide a similar level of natural resources and/or services as would have been provided if the damaged site had been returned to its baseline condition*". It may be implemented on the damaged site (*in situ)* or on a similar site (*ex situ*) and it shall always be remedied "in nature". It cannot take the form of financial compensation;

- **Compensatory remediation** is implemented to **compensate for the interim losses** of resources and/or of services that occur from the time the damage occurs until the time the primary and/or compensatory remediation enables the environment to be returned to its baseline condition. It may be implemented on the damaged site (*in situ)* or on a similar site (*ex situ*) and also cannot take the form of financial compensation.

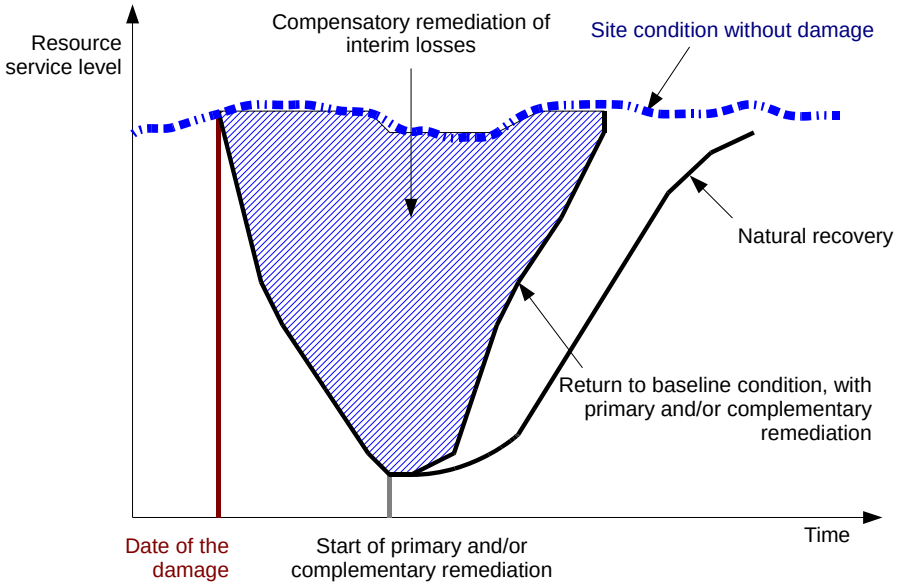


Figure 1: Graphical representation of the loss of resources or services, natural recovery and the three remedial categories (REMEDE, 2007)

When primary remediation does not return the natural resource affected to its baseline condition, complementary remediation shall be such that **the residual losses are compensated for**. Compensatory remediation shall be scaled such that **the residual losses are compensated for** (see Figure 1).

Implementation of these two categories of remedial measures (complementary and compensatory) shall therefore begin with the definition of compensatory, and where appropriate complementary, remediation projects; this then involves **scaling them over time and space in order to obtain equality between the interim losses caused by the damage and the gains obtained from the remedial measures** (see Figures 2 and 3).

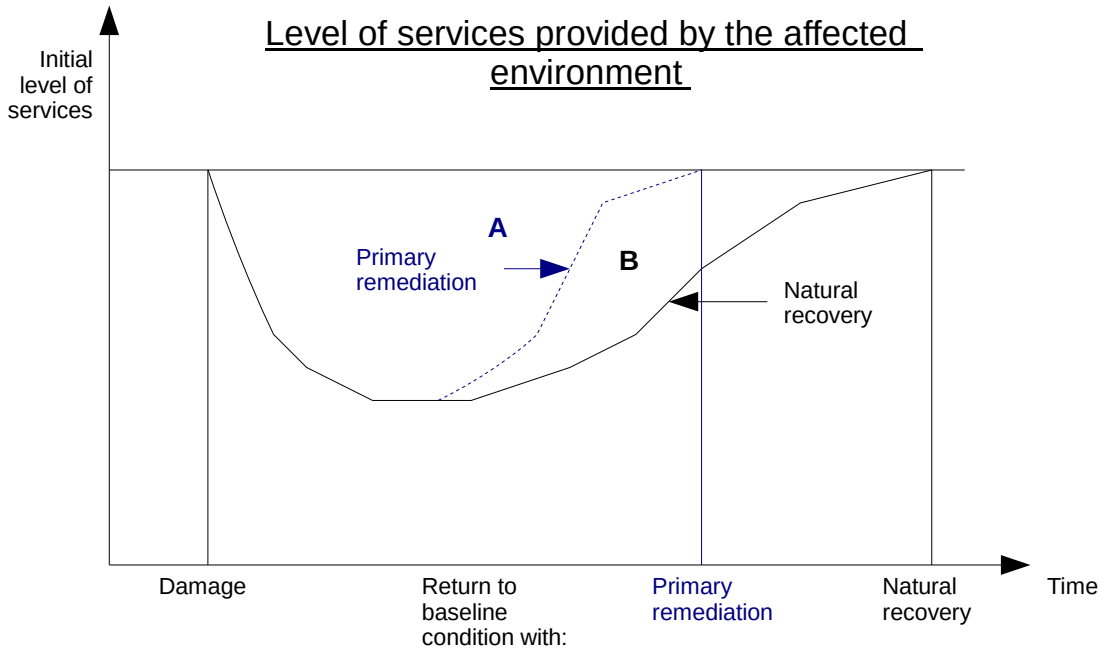


Figure 2: Level of services provided by a damaged environment according to the remediation stages (Bas, 2009)

If primary remediation is not implemented, the sum of areas A and B represents the ecological services lost from the time the damage occurs until the time the environment returns to its baseline condition. However, if primary remediation is implemented, it shall accelerate the environment's return to its baseline condition, thereby reducing the losses of ecological services to area A.

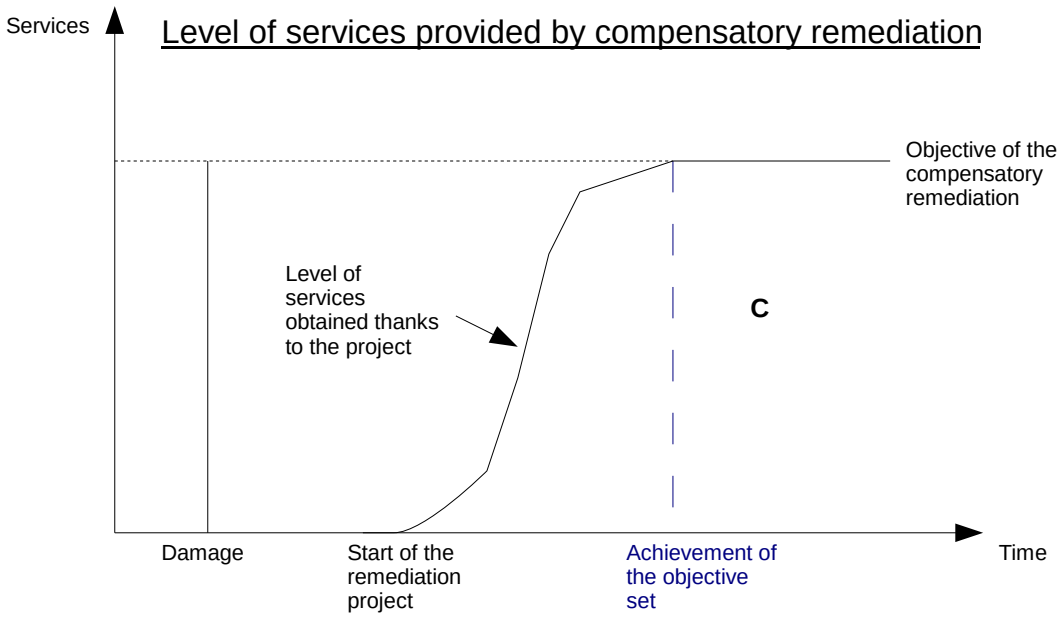


Figure 3: Relationship between primary and compensatory remediation (Bas, 2009)

This second graph characterises the level of services provided by compensatory remediation of the damaged site or a similar site. It is presumed that primary remediation has taken place and that compensatory remediation is implemented on the same damaged site and that this produces gains in services equal to area C. The losses of ecological services are compensated for when area C is equal to area A. If primary remediation is not implemented, the losses are compensated for when area C is equal to area A + B.

Two types of approach are used to estimate the scaling of the remediation projects:

- **equivalency approaches**: **service-to-service (HEA) and resource-to-resource (REA) approaches**. They enable environmental damage to be compensated for in nature. Damaged resources and/or ecological services shall be compensated for by resources and/or services of the same type, same quality and same quantity, hence the term "equivalency";
- **value approaches** which correspond to monetary valuation methods[10]. These value approaches are applied when the remediation project does not provide restored resources and/or services of the same type and same quality as those initially provided by the environment, but provides resources and/or services of similar type and quality (for example, species of the same genus and similar in terms of habitat or consuming the same prey).

According to Article R.162-10, the remedial measures for the damage are determined and evaluated in accordance with 1° of Annex II of the Environmental Liability Directive (see Annex C), to which the law refers. This annex stipulates that **the service-to-service and resource-to-resource equivalency methods shall be considered first.** Value approaches are to be used when equivalency methods cannot be applied (second choice option), for example, due to lack of information (such as baseline condition before damage).

[10] The value of an environmental good is related to welfare, i.e. the level of satisfaction that individuals receive from the consumption of this good. This value is measured by the maximum amount that private individuals are willing to pay for the good which may be expressed in monetary units and also in units of resources or services.

"Reasonable cost to society"

The notion of "reasonable cost" appears several times in the reference texts:

- in Article L.160-1 of the law (*"... the conditions under which damage caused to the environment by an operator's activity is prevented or remedied, pursuant to the polluter-pays principle and at* ***a reasonable cost*** *to society."*);
- in Annex II of the ELD (§1.2.3). When the first choice approaches (the equivalency methods) cannot be applied, "*if valuation of the lost resources and/or services is practicable, but valuation of the replacement natural resources and/or services cannot be performed within a reasonable time-frame or at a* ***reasonable cost****...*";
- in Annex II of the ELD (§1.3.1). The **cost of implementing** the remedial option is one of the criteria mentioned for evaluating a **reasonable remedial option**.

In practice, the assessment of the "reasonable cost to society" is up to the decision-making authority responsible for prescribing the remedial measures. This assessment may be difficult in some cases. In addition, the decision-making authority may need arguments to have grounds for (and possibly justify) its decision (see p.82, comparative analysis of remediation projects).

Summary help sheets for the implementation of the ELL

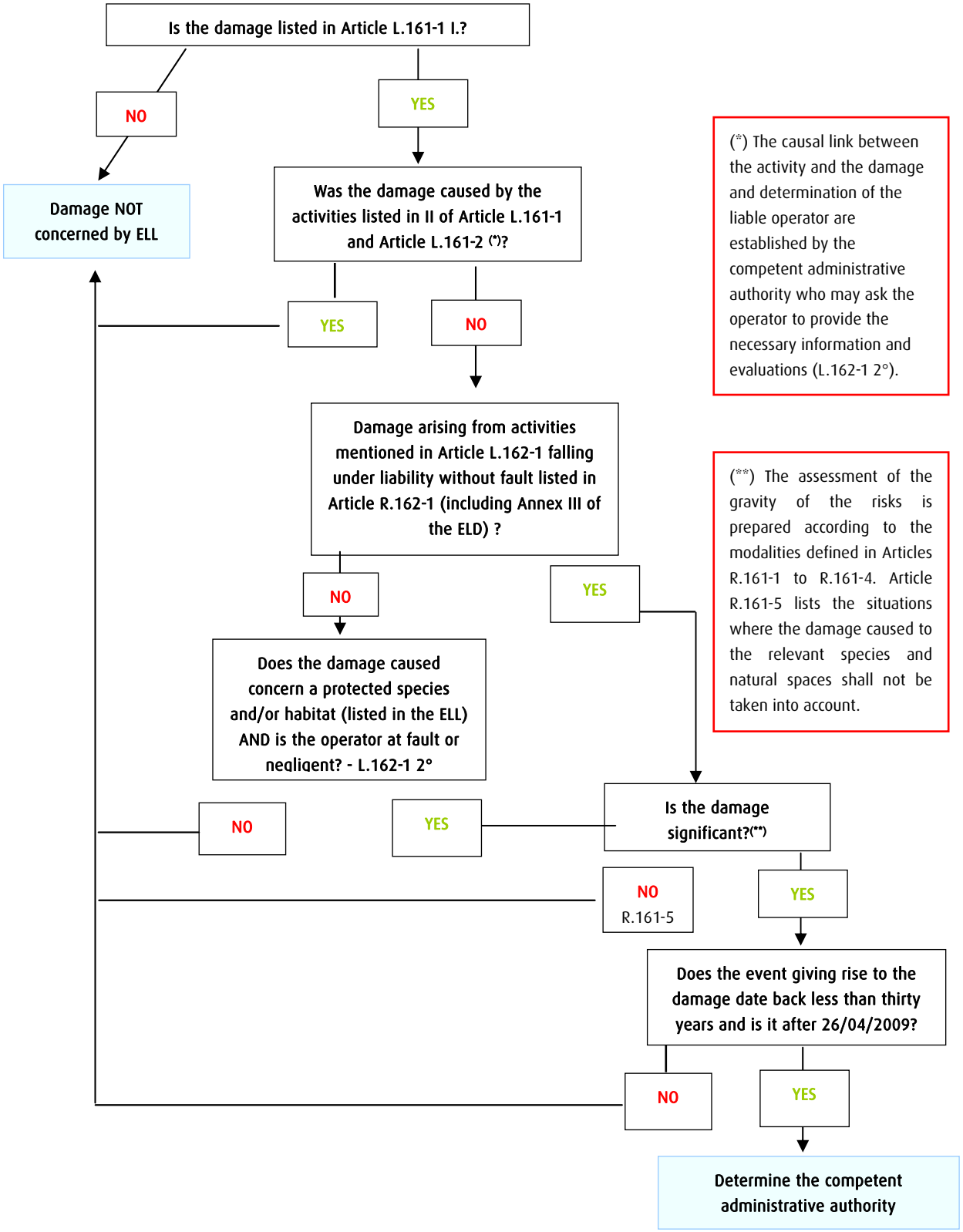
This paragraph provides a schematic view of the regulations in force and of the procedures related to the implementation of the ELL using logic diagrams

These sheets focus purely on the regulations and translate the various regulatory texts in the form of logic diagrams in order to facilitate the sequence of procedures in the event of damage or imminent threat of damage.

- **Summary sheet no. 1**: is the damage concerned by the **Environmental Liability Law** (ELL)? Sheet accompanied with the list of activities referred to in Annex III of the Directive and for which strict liability (without fault or negligence) applies,
- **Summary sheet no. 2**: determination of the competent administrative authority and consideration of special cases,
- **Summary sheet no. 3**: process for preparing an order of requirement for remedial measures for certain instances of damage,
- **Summary sheet no. 4**: implementation of preventive or remedial measures,
- **Summary sheet no. 5**: special procedures in the event of an imminent threat of damage.

Summary sheet no. 1

Is the damage concerned by the Environmental Liability Law (ELL)?



LIST OF ACTIVITIES FOR WHICH STRICT LIABILITY (without fault or negligence) APPLIES

according to Article R.162-1, paragraph 1° of the ELL

(see point 1 of Annex III of the Environmental Liability Directive[11])

1. **Energy industries**

1.1. Combustion installations with a rated thermal input exceeding 50 MW (1).

1.2. Mineral oil and gas refineries.

1.3. Coke ovens.

1.4. Coal gasification and liquefaction plants.

2. **Production and processing of metals**

2.1. Metal ore (including sulphide ore) roasting or sintering installations.

2.2. Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour.

2.3. Installations for the processing of ferrous metals:

a) hot-rolling mills with a capacity exceeding 20 tonnes of crude steel per hour;

b) smitheries with hammers the energy of which exceeds 50 kilojoules per hammer, where the calorific power used exceeds 20 MW;

c) application of protective fused metal coats with an input exceeding 2 tonnes of crude steel per hour.

2.4. Ferrous metal foundries with a production capacity exceeding 20 tonnes per day.

2.5. Installations:

a) for the production of non-ferrous crude metals from ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes;

b) for the smelting, including the alloyage, of non-ferrous metals, including recovered products, (refining, foundry casting, etc.) with a melting capacity exceeding 4 tonnes per day for lead and cadmium or 20 tonnes per day for all other metals.

2.6. Installations for surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m3.

3. **Mineral industry**

3.1. Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day.

3.2. Installations for the production of asbestos and the manufacture of asbestos-based products.

3.3. Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day.

3.4. Installations for melting mineral substances including the production of mineral fibres with a melting capacity exceeding 20 tonnes per day.

3.5. Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m3 and with a setting density per kiln exceeding 300 kg/m3.

4. **Chemical industry**

Production within the meaning of the categories of activities contained in this section means the production on an industrial scale by chemical processing of substances or groups of substances listed in Sections 4.1 to 4.6.

4.1. Chemical installations for the production of basic organic chemicals, such as:

a) simple hydrocarbons (linear or cyclic, saturated or unsaturated, aliphatic or aromatic);

b) oxygen-containing hydrocarbons such as alcohols, aldehydes, ketones, carboxylic acids, esters, acetates, ethers, peroxides, epoxy resins;

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[11] Point 1 of Annex III of the ELD refers to Annex I of Directive 96/61/EC, known as the "IPPC" Directive, amended by Directive 2008/01/EC. After 2014, the latter shall be replaced by the "IED - industrial emission directive", Directive no. 2010/75/EU. Within the framework of transposition of this last directive, ICPE "3000" sections shall be created.

c) sulphurous hydrocarbons;

d) nitrogenous hydrocarbons such as amines, amides, nitrous compounds, nitro compounds or nitrate compounds, nitriles, cyanates, isocyanates;

e) phosphorus-containing hydrocarbons;

f) halogenic hydrocarbons;

g) organometallic compounds;

h) basic plastic materials (polymers synthetic fibres and cellulose-based fibres);

i) synthetic rubbers;

j) dyes and pigments;

k) surface-active agents and surfactants.

4.2. Chemical installations for the production of basic inorganic chemicals, such as:

a) gases, such as ammonia, chlorine or hydrogen chloride, fluorine or hydrogen fluoride, carbon oxides, sulphur compounds, nitrogen oxides, hydrogen, sulphur dioxide, carbonyl chloride;

b) acids, such as chromic acid, hydrofluoric acid, phosphoric acid, nitric acid, hydrochloric acid, sulphuric acid, oleum, sulphurous acids;

c) bases, such as ammonium hydroxide, potassium hydroxide, sodium hydroxide;

d) salts, such as ammonium chloride, potassium chlorate, potassium carbonate, sodium carbonate, perborate, silver nitrate;

e) non-metals, metal oxides or other inorganic compounds such as calcium carbide, silicon, silicon carbide.

4.3. Chemical installations for the production of phosphorous-, nitrogen- or potassium-based fertilizers (simple or compound fertilizers).

4.4. Chemical installations for the production of basic plant health products and of biocides.

4.5. Installations using a chemical or biological process for the production of basic pharmaceutical products.

4.6. Chemical installations for the production of explosives.

5. **Waste management**

Without prejudice of Article 11 of Directive 75/442/EEC or Article 3 of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste (1):

5.1. Installations for the disposal or recovery of hazardous waste as defined in the list referred to in Article 1 (4) of Directive 91/689/EEC, as defined in Annexes II A and II B (operations R1, R5, R6, R8 and R9) to Directive 75/442/EEC and in Council Directive 75/439/EEC of 16 June 1975 on the disposal of waste oils (1), with a capacity exceeding 10 tonnes per day.

5.2. Installations for the incineration of municipal waste as defined in Council Directive 89/369/EEC of 8 June 1989 on the prevention of air pollution from new municipal waste incineration plants (2) and Council Directive 89/429/EEC of 21 June 1989 on the reduction of air pollution from existing municipal waste-incineration plants (3) with a capacity exceeding 3 tonnes per hour.

5.3. Installations for the disposal of non-hazardous waste as defined in Annex II A to Directive 75/442/EEC under headings D8 and D9, with a capacity exceeding 50 tonnes per day.

5.4. Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25 000 tonnes, excluding landfills of inert waste.

6. **Other activities**

6.1. Industrial plants for the production of:

a) pulp from timber or other fibrous materials;

b) paper and board with a production capacity exceeding 20 tonnes per day.

6.2. Plants for the pre-treatment (operations such as washing, bleaching, mercerization) or dyeing of fibres or textiles where the treatment capacity exceeds 10 tonnes per day.

6.3. Plants for the tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day.

6.4. a) Slaughterhouses with a carcass production capacity greater than 50 tonnes per day.

b) Treatment and processing intended for the production of food products from:

— animal raw materials (other than milk) with a finished product production capacity greater than 75 tonnes per day,

— vegetable raw materials with a finished product production capacity greater than 300 tonnes per day (average value on a quarterly basis).

c) Treatment and processing of milk, the quantity of milk received being greater than 200 tonnes per day (average value on an annual basis).

6.5. Installations for the disposal or recycling of animal carcases and animal waste with a treatment capacity exceeding 10 tonnes per day.

6.6. Installations for the intensive rearing of poultry or pigs with more than:

a) 40,000 places for poultry;

b) 2,000 places for production pigs (over 30 kg), or

c) 750 places for sows.

6.7. Installations for the surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, scaling, painting, cleaning or impregnating, with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year.

6.8. Installations for the production of carbon (hard-burnt coal) or electrographite by means of incineration or graphitization.

6.9. Capture of CO2 streams from installations covered by the Directive of 15/01/2008, for the purposes of geological storage in accordance with Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide (21).

LIST OF ACTIVITIES FOR WHICH STRICT LIABILITY APPLIES

according to Article R. 162-1, paragraphs 2° to 12° of the ELL

"Constitute the activities laid down in 1° of Article L. 162-1, when they are of a professional nature:

....

2° The waste collection, transport, recovery and disposal operations governed by Title IV of Book V and the provisions made for its application. Those operations shall exclude the spreading of sewage sludge from urban waste water treatment plants carried out under the conditions defined in Articles R. 211-25 to R. 211-47;

3° The management of waste from extractive industries governed by Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006;

4° The discharges into waters subject to prior authorisation pursuant to Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community and to Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances;

5° The discharge of pollutants into surface waters or groundwater subject to a permit, authorisation or registration in virtue of Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy;

6° The operation of installations or works, the exercising of activities and work subject to authorisation pursuant to Article L. 214-3, mentioned in Title I and sections 3.1.1.0, 3.1.2.0, 3.1.3.0, 3.1.4.0, 3.2.2.0, 3.2.5.0, 3.2.6.0 of Title III of the table appended to Article R. 214-1;

7° The manufacture, use, storage, processing, conditioning, discharge into the environment and transportation on site;

a) Chemical substances and preparations governed by Title II of Book V of this code and meeting the physico-chemical and toxicity criteria listed in Articles L. 1342-2 and L. 5132-2 of the Public Health Code;

b) Biocide substances and products governed by Title II of Book V of this code;

c) Plant protection products governed by the provisions in Chapter III of Title V of Book II of the Rural Code;

8° The land, sea or air transport and the port handling of hazardous or polluting goods governed by:

a) The regulations on the carriage of dangerous goods by rail and Annex C "Regulations concerning the International Carriage of Dangerous Goods by Rail (RID)" of the Convention concerning International Carriage by Rail;

b) The regulations on the carriage of dangerous goods by road and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR);

b) The regulations on the carriage of dangerous goods by inland waterways and the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN);

d) The regulations on the safety of ships and Chapter VII of the International Convention for the Safety of Life at Sea (SOLAS), established in London on 1 November 1974, on the carriage of dangerous goods;

e) The regulations on the carriage and handling of dangerous goods in maritime ports and the International Convention for the prevention of pollution by ships established in London on 2 November 1973, as amended by the protocol of 17 February 1978, and in particular its Annexes I, II and III;

f) The regulations on the conditions of use of civil aircraft in general aviation and Annex III of the Council Regulation (EEC) no. 3922/91 on the harmonization of technical requirements and administrative procedures in the field of civil aviation;

g) The regulations on the technical conditions of operation of helicopters by a public airline companies (known as OPS 3);

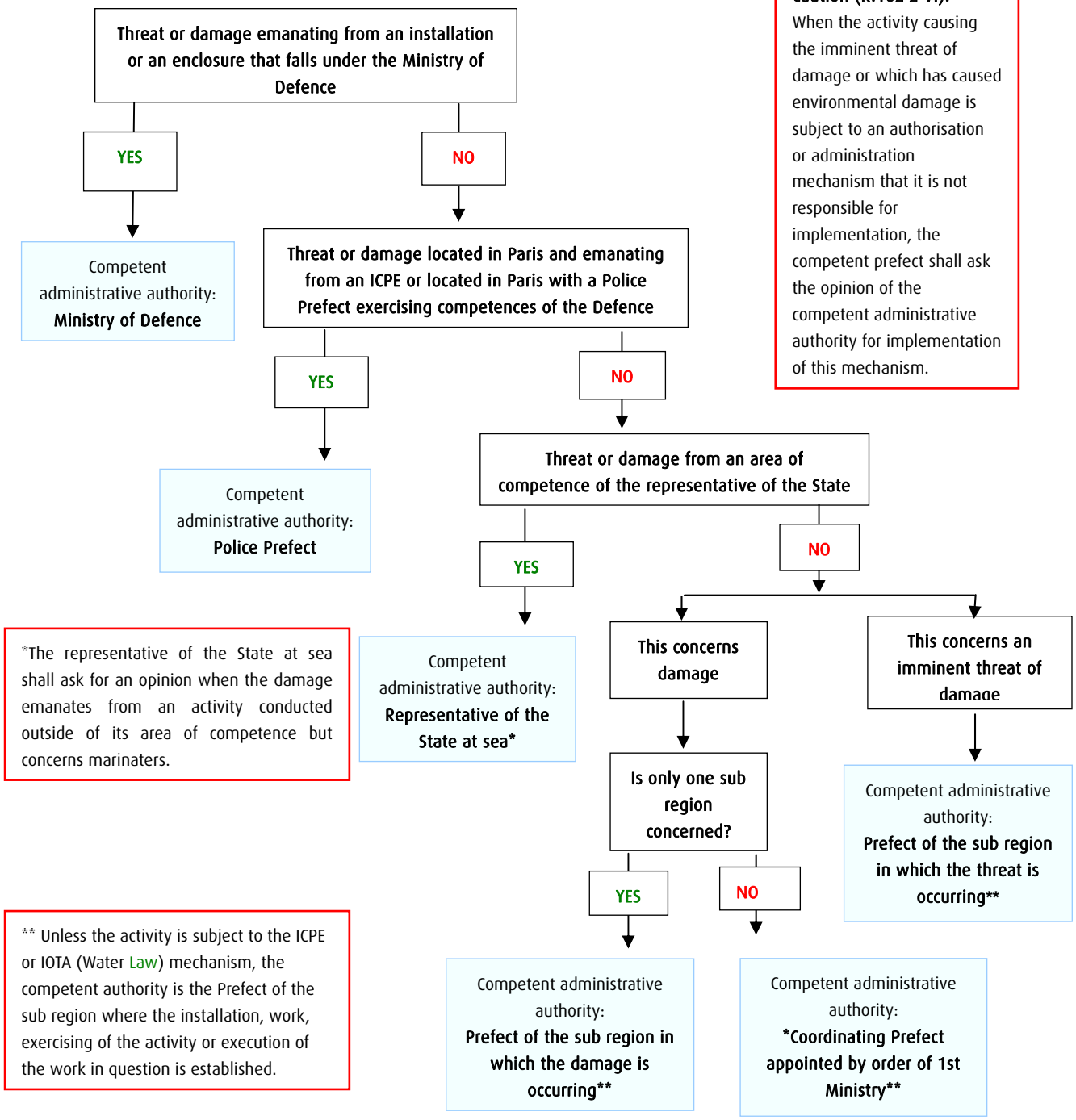
9° The operation of installations subject to authorisation in virtue of Council Directive 84/360/EEC of 28 June 1984 on the combating of air pollution from industrial plants concerning any polluting substances covered in this directive;

10° The contained use of genetically modified micro-organisms subject to approval under Articles L. 515-13 or L. 532-3;

11° The placing on the market and deliberate dissemination of genetically modified organisms in the environment subject to authorisation under Articles L. 533-3, L. 533-5, L. 533-6 or of Regulation (EC) no. 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed for animals;
12° The operations related to cross-border movements of waste into and out of the European Union governed by Articles L. 541-40 to L. 541-42 and by the provisions of Regulation (EC) no. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste subject to the transient provisions laid down in its Article 62;
13° The operation of carbon dioxide geological disposal sites in accordance with Section 6 of Chapter IX of Title II of Book II;
14°The pipeline transport of natural gas, liquid or liquefied hydrocarbons or chemical products."

Summary sheet no. 2

Determination of the competent administrative authority and special cases (R. 162-2)



Caution (R.162-2 VI):
When the activity causing the imminent threat of damage or which has caused environmental damage is subject to an authorisation or administration mechanism that it is not responsible for implementation, the competent prefect shall ask the opinion of the competent administrative authority for implementation of this mechanism.

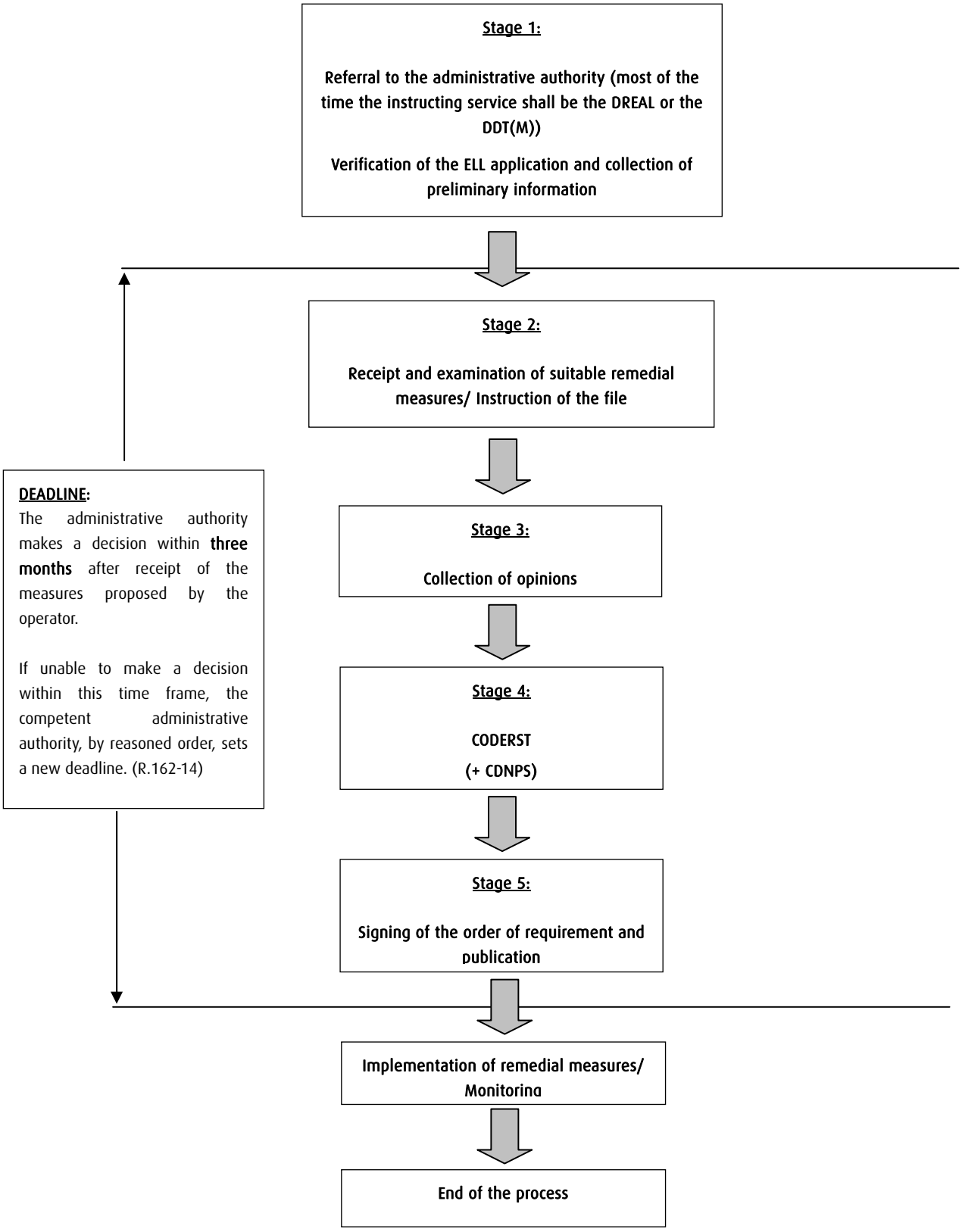
*The representative of the State at sea shall ask for an opinion when the damage emanates from an activity conducted outside of its area of competence but concerns marinaters.

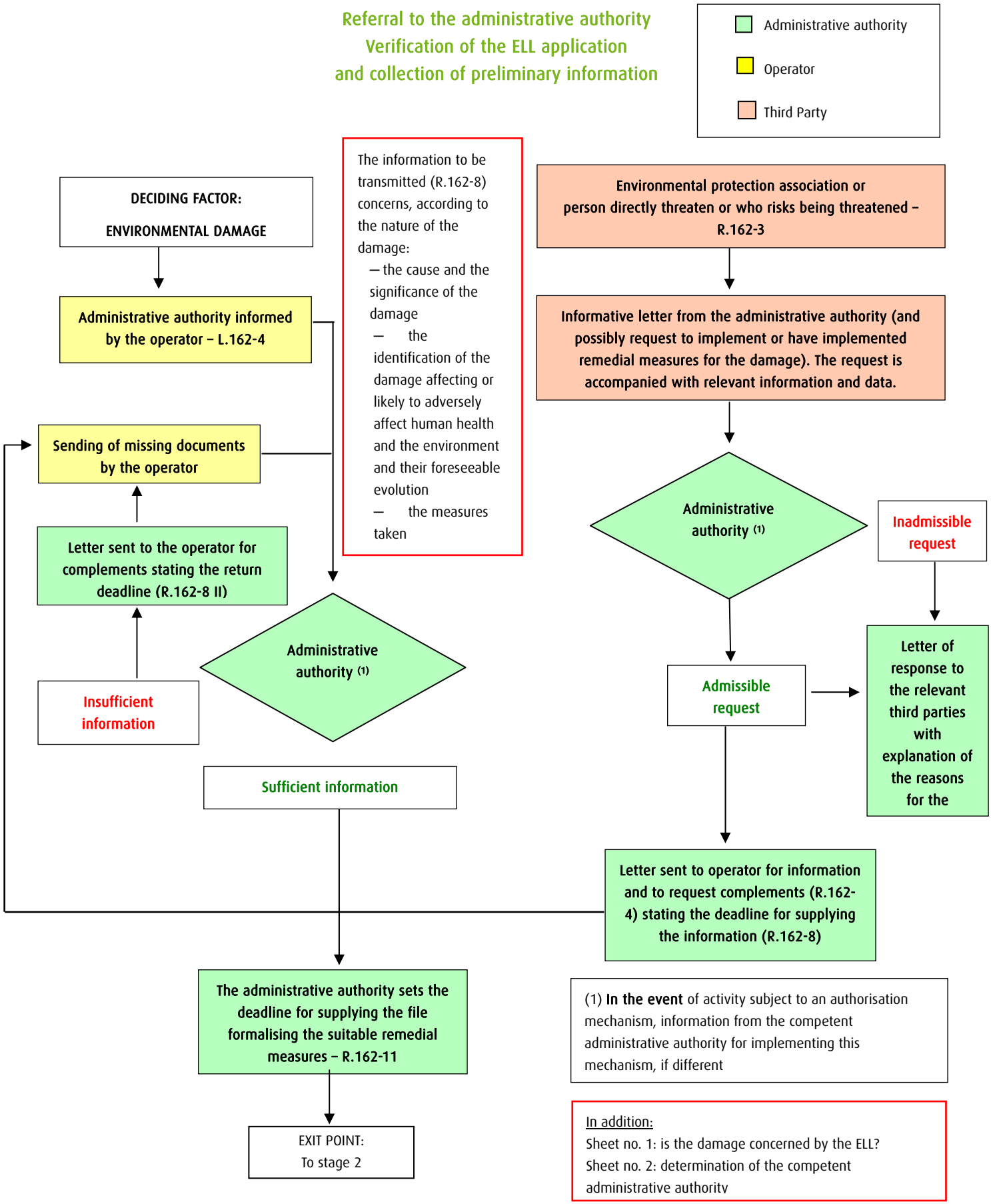
** Unless the activity is subject to the ICPE or IOTA (Water Law) mechanism, the competent authority is the Prefect of the sub region where the installation, work, exercising of the activity or execution of the work in question is established.

Member State information (R.162-5):
If damage affects or is likely to affect the territory of other Member States, the competent administrative authority shall inform the Ministry of Foreign Affairs and, in the event of an emergency, the competent authorities of the relevant States. This information states in particular the preventive or remedial measures planned or already implemented.

Summary sheet no. 3

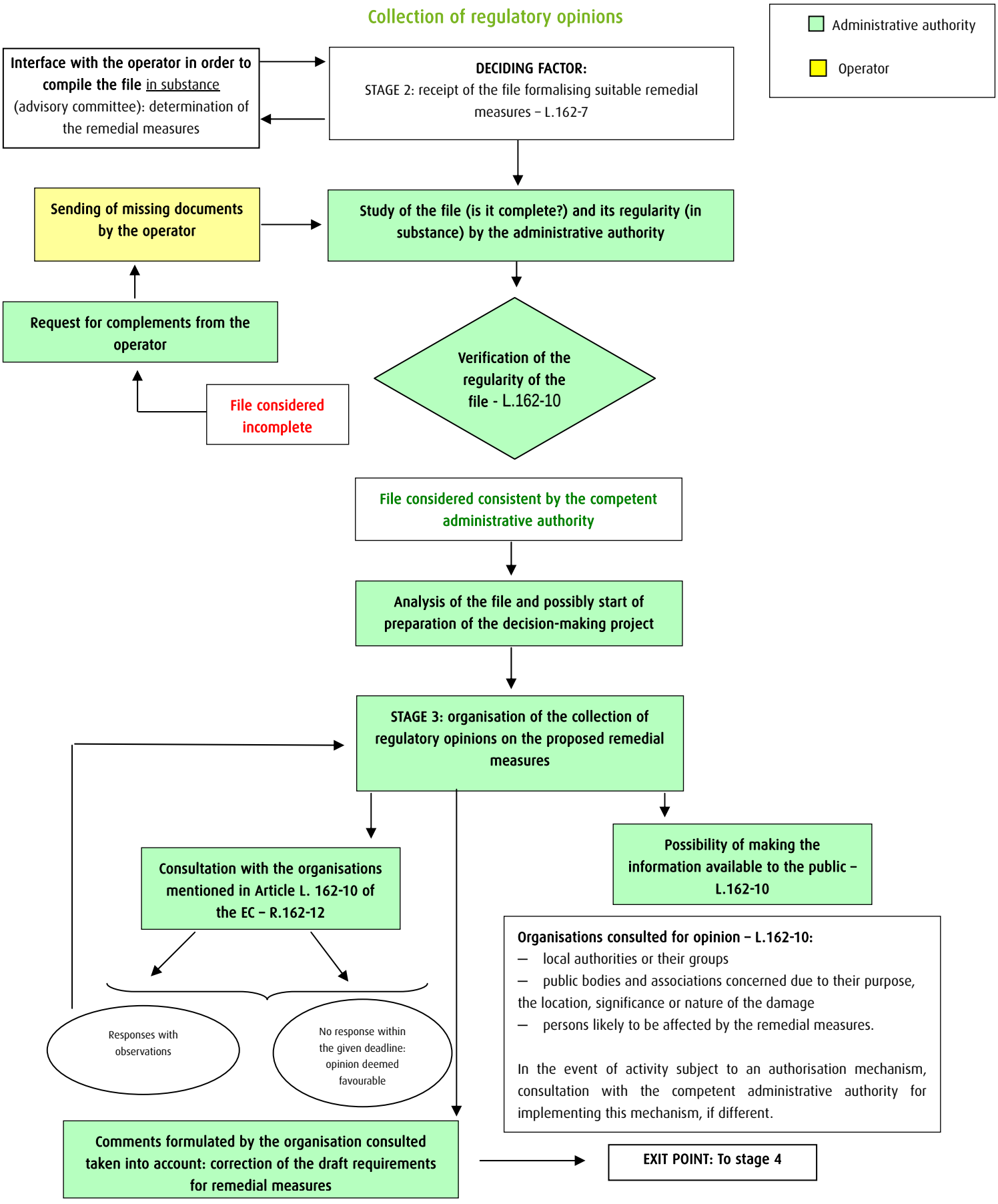
Logic diagrams of the process for preparing an order of requirement for remedial measures




Referral to the administrative authority
Verification of the ELL application
and collection of preliminary information
Administrative authority
Operator
Third Party
DECIDING FACTOR:
ENVIRONMENTAL DAMAGE
Administrative authority informed by the operator – L.162-4
The information to be transmitted (R.162-8) concerns, according to the nature of the damage:
— the cause and the significance of the damage
— the identification of the damage affecting or likely to adversely affect human health and the environment and their foreseeable evolution
— the measures taken
Environmental protection association or person directly threaten or who risks being threatened – R.162-3
Informative letter from the administrative authority (and possibly request to implement or have implemented remedial measures for the damage). The request is accompanied with relevant information and data.
Sending of missing documents by the operator
Letter sent to the operator for complements stating the return deadline (R.162-8 II)
Insufficient information
Administrative authority (1)
Administrative authority (1)
Inadmissible request
Admissible request
Letter of response to the relevant third parties with explanation of the reasons for the
Sufficient information
Letter sent to operator for information and to request complements (R.162-4) stating the deadline for supplying the information (R.162-8)
The administrative authority sets the deadline for supplying the file formalising the suitable remedial measures – R.162-11
EXIT POINT:
To stage 2
(1) In the event of activity subject to an authorisation mechanism, information from the competent administrative authority for implementing this mechanism, if different
In addition:
Sheet no. 1: is the damage concerned by the ELL?
Sheet no. 2: determination of the competent administrative authority

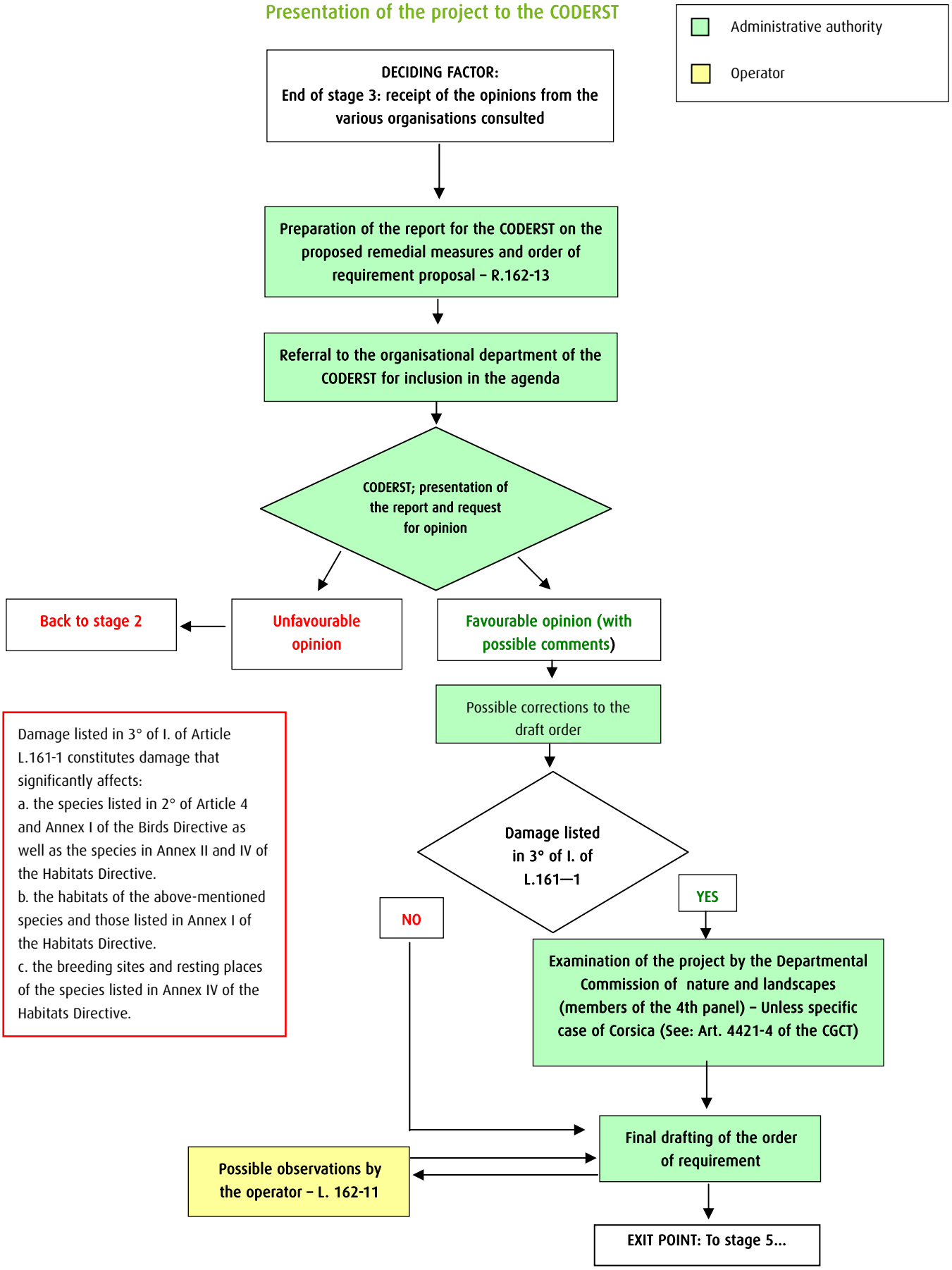
Stage 2 and 3

Instruction of the file defining suitable remedial measures
Collection of regulatory opinions



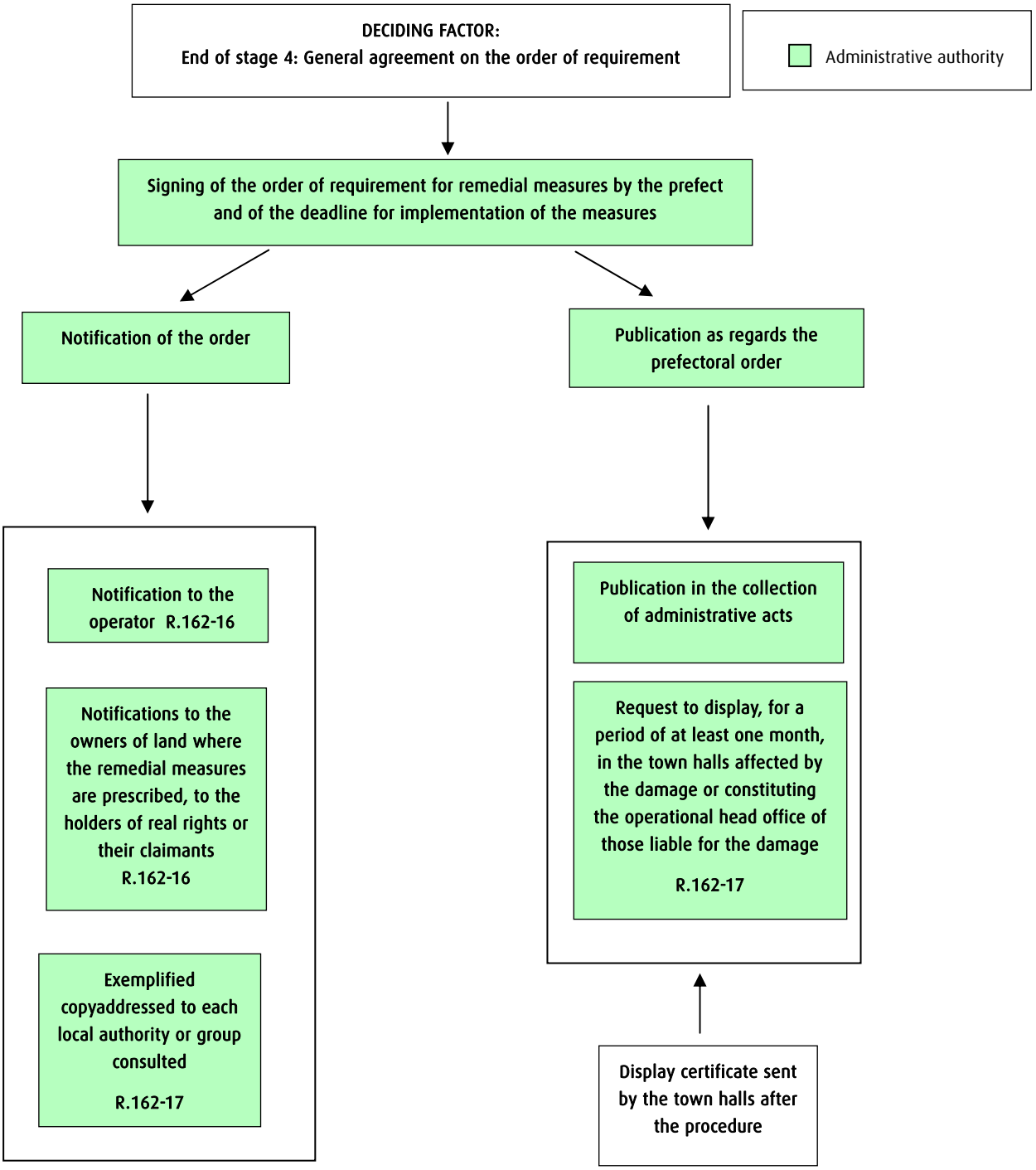
Stage 4

Presentation of the project to the CODERST



Stage 5

Signing of the order of requirement and publication

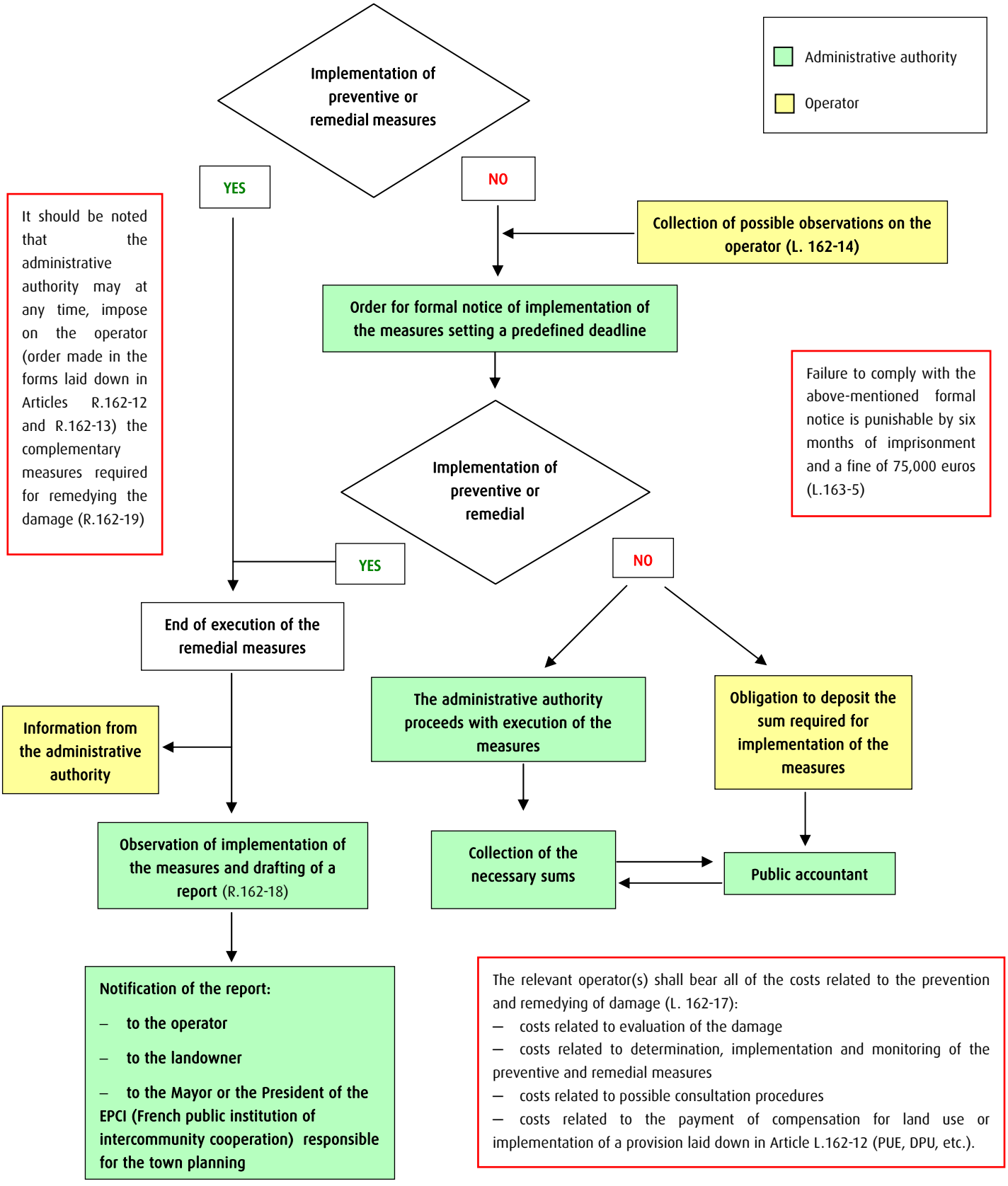


Complementary procedures that may be implemented if remedial measures are prescribed in private properties (L.162-12):

- Law of 29/12/1892 on damage caused to private property due to the execution of public works
- Institution of public utility easements (PUE) in accordance with Articles L.515-9 to L.515-11
- Request for declaration of public utility (DPU) of the remedial work, in accordance with L. 541-3.

Summary sheet no. 4

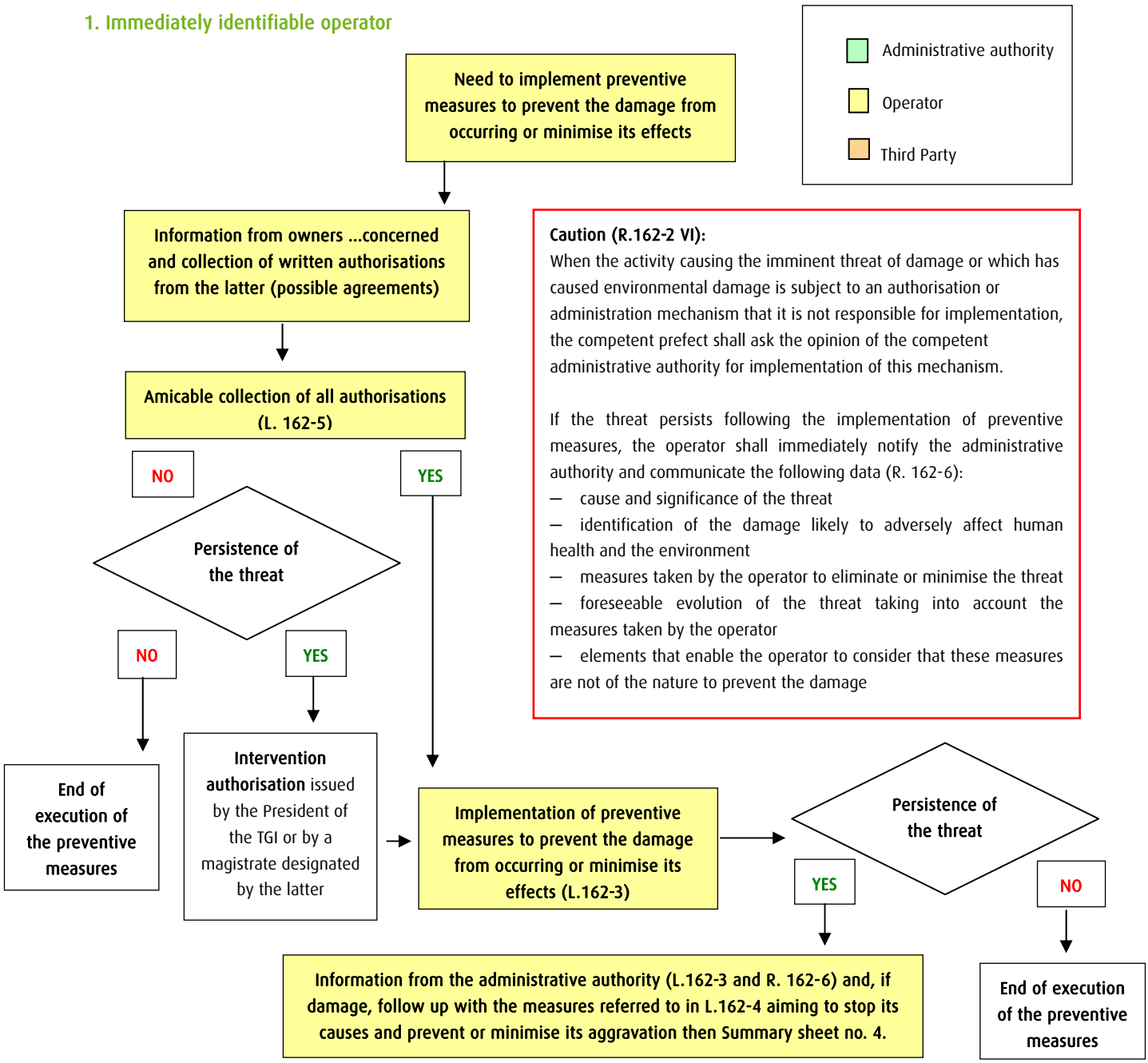
Implementation of measures (remedial or preventive)



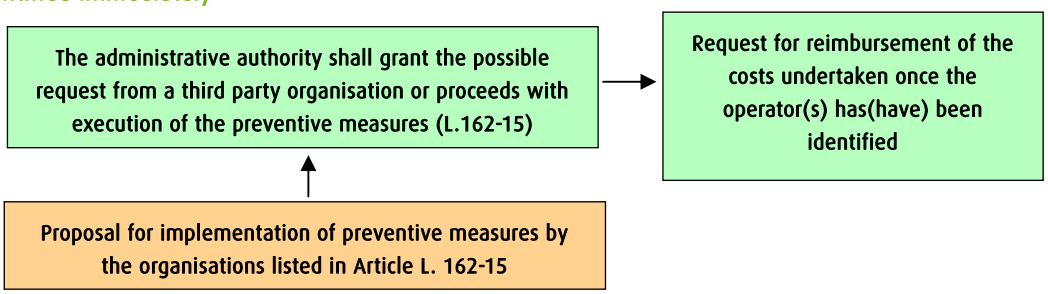
Summary sheet no. 5

Procedure relating to the imminent threat of damage

1. Immediately identifiable operator



2. Operator that cannot be identified immediately



Determination of the remedial measures through the use, firstly, of equivalency methods Part II

Preamble: linking the first and second part of the guide

This preamble explains how the two parts of the guide link together and presents the methods to be applied to determine the remedial measures.

The first part of the guide covered the framework of the ELL (types of damage, relevant operators and activities, determination of the competent administrative authority and the various categories of remedial measures of the damaged environment to be considered) and looked into its methods of implementation and the procedures to follow.

Faced with an imminent threat of damage or with the occurrence of damage, the most important aspects of the first part of the guide explained:

- the scope of the ELL,
- and in the event of environmental damage falling within the scope of the ELL, the link between preventive measures (emergency response measures immediately following the accident) and remedial measures.

The second part of the guide deals with the procedures to be implemented when damage concerned by the ELL has occurred, when preventive measures as well as primary remedial measures have been implemented to return the environment to its baseline condition. It is also necessary to **design and propose compensatory remedial** and, where appropriate, **complementary remedial measures**[12] based on accurate evaluation of the environmental damage caused to waters or to protected species and natural habitats covered in the ELL. The operator liable for the damage shall be responsible for this work.

[12] Compensatory remediation shall be required systematically to compensate for the interim losses. This is not the case of complementary remediation.

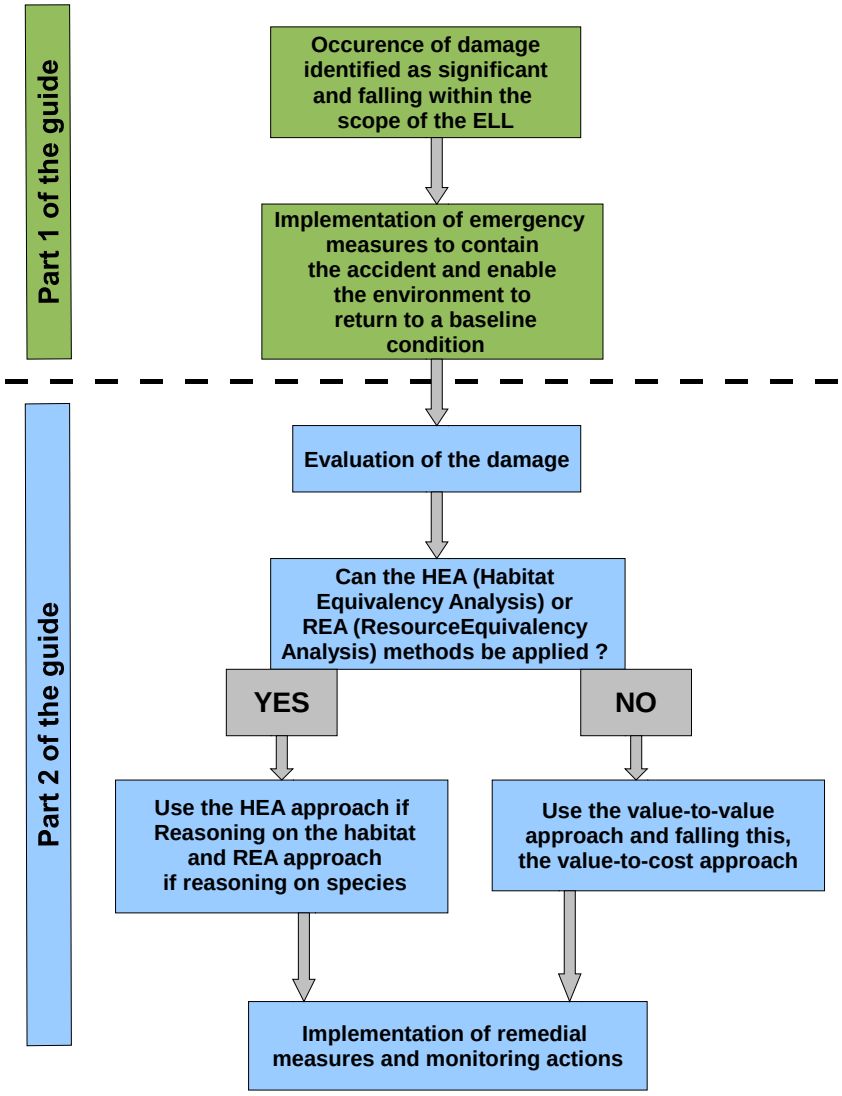


Figure 4: Link between parts 1 and 2 of the guide (source: CGDD)

The ELL recommends two types of approaches (equivalency approaches and more conventional monetary valuation methods including the value approaches mentioned in p.36):

- **1) service-to-service and resource-to-resource equivalency approaches**. These are the **equivalency methods** used for restoring damaged resources and/or services of the **same quantity, quality and type** as the initial resources and/or services (before the damage). The ELL recommends using **equivalency methods first.**

There are **two equivalency methods (the HEA and REA methods),** according to the type of damaged ecosystems:

- *the damaged ecosystem is complex in terms of number of species and variety of habitats.* It is therefore recommended to reason in habitats (integrated view of the species/environment interaction) and in ecological services related to it. This refers to the **HEA method (Habitat Equivalency Analysis)**. This approach establishes a **service-to-**

service equivalency: the scaled remediation project shall seek to provide **ecological services** with the same type, quality and quantity as the services initially provided by the environment before the accident.

- *the ecosystem comprises an endemic species, a heritage species (rare or protected or threatened)*, i.e. a species that is highly representative of the environment because highly dependent on it *or the ecosystem is not very complex, comprising few species or groups of species* (example: Landes forest). In both cases, the reasoning is based on a species or group of species. This is the **REA method (Resource Equivalency Analysis)**. This involves compensating the losses caused by the consequences of an instance of damage mainly concerning **an animal or plant species or a group of animal or plant species**. This approach establishes a **resource-to-resource equivalency**. The project shall provide resources with the same type, quality and quantity as the resources initially provided by the environment.

The REA method based on a species or group of species requires significant mobilisation of scientific data and information. Locally, this can hinder its application.

- **2) Value approaches** (in terms of welfare felt by society). According to the ELL's recommendations, value approaches shall only be used **by default**, when HEA or REA cannot be applied (for example, due to lack of data on the land to estimate the environmental conditions before damage). Effectively, the remediation project following these approaches does not provide restored resources and/or services of the same type and quality as those initially provided by the environment, but resources and/or services of **comparable type and quality** (for example the blue tit and marsh tit, two species of the same genus, living in similar habitats). Which seems less satisfactory from a strictly ecological point of view. In addition, in value approaches, the methods used to assess welfare losses are those based on individual preferences.

Monetary valuation methods, that give an economic value to an environmental good such as the methods based on preferences stated by individuals (willingness to pay, joint analysis) and on revealed preferences (transport costs, hedonistic prices) may be used in the case of value approaches. This is never the case for equivalency approaches.

The terminology "value approaches" actually groups:

- **the value-to-value approach:** the welfare losses suffered by the population affected by the damage and the welfare gains arising from remediation projects should be equal;
- **the value-to-cost approach:** the welfare losses are converted into monetary values (into euros) and correspond to the cost of the remediation project.

The ELL recommends using preferably the value-to-value approach instead of the value-to-cost approach, except if the value-to-value approach cannot be applied within reasonable time frames and/or costs.

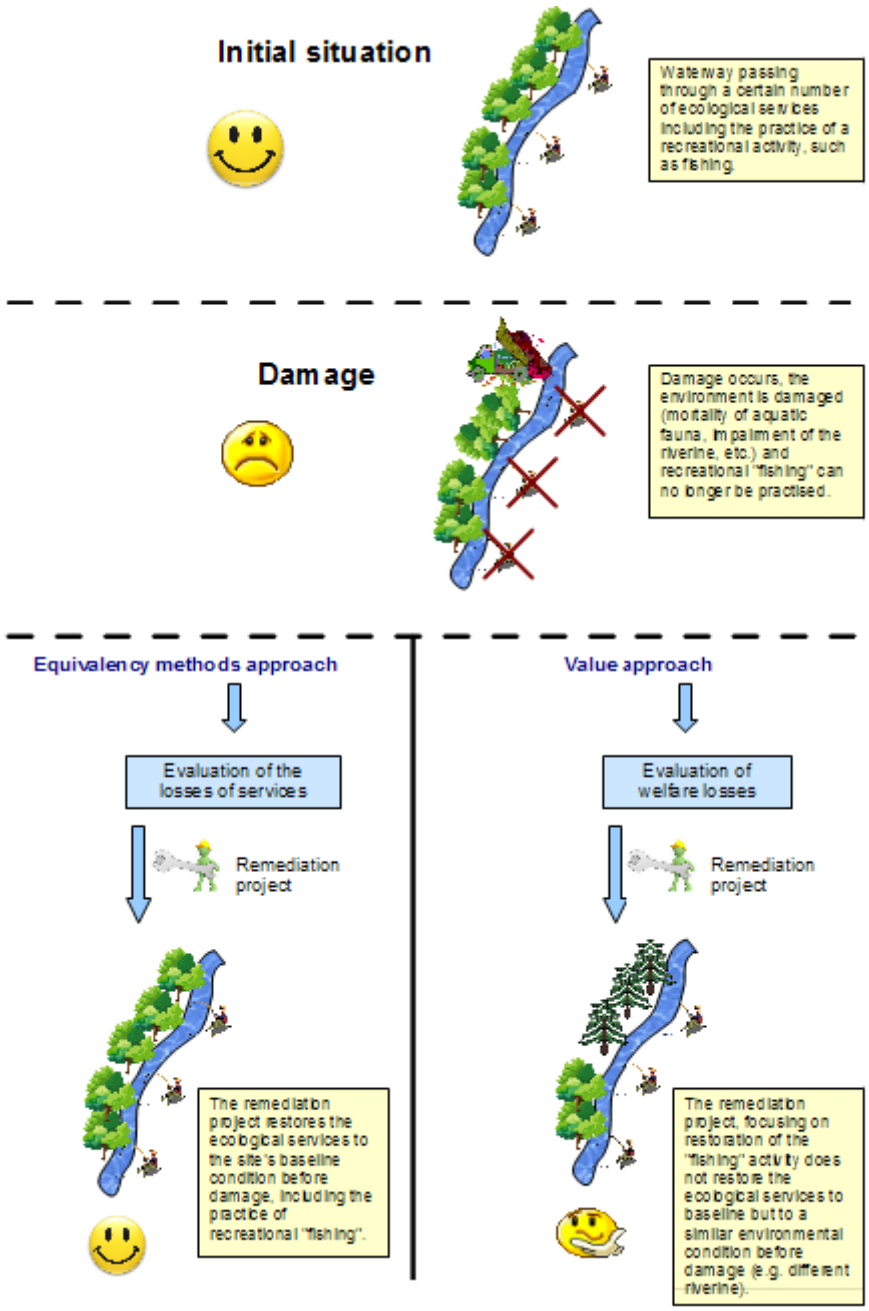


Figure 5: Schematic comparison of the remedying of the damaged environment according to the approach used (equivalency methods or value approaches) (source: Pioch, 2010 and CGDD)

This second part is divided into 2 chapters:

- the first chapter deals with general information and common points of the equivalency methods and value approaches;
- the second chapter describes, in addition to the 7-phase process for determining the remedial measures of the damage environment, each of the two types of approaches via their application to the same accidental pollution situation of a waterway (the Gave d'Aspe in Pyrénées-Atlantiques) in June 2007 (**i.e. prior to the entry into force of the ELL on 27 April 2009**).

Reminder: this part does not cover the damage that "creates a significant risk of human health being adversely affected as a result of land contamination" mentioned in Article L.161-1 I 1°.

Equivalency methods and value approaches: what are they?

This paragraph covers the main characteristics of equivalency methods and value approaches and explains how they are integrated into the process for determining remedial measures.

General information

Following environmental damage affecting waters or protected species and natural habitats (mentioned in the ELL), three types of remedial measures may be implemented: **primary remediation** (which in particular includes the measures taken immediately after an instance of damage), **complementary remediation** and **compensatory remediation**. No methodological tools exist for identifying primary remedial measures, therefore **equivalency methods and value approaches refer to complementary and compensatory remediation.**

Reminder: Complementary remediation compensates for residual losses (losses that primary remediation has not been able to recover) whereas compensatory remediation compensates for interim losses (all of the losses between the occurrence of the accident and returning the environment to baseline condition, before damage) (see figure 1, page 37). ***This second part highlights compensatory remediation.***

Origin of equivalency methods:

- In the United States, the remediation of "pure" environmental damage has been practiced for the last thirty years in virtue of two laws[13] concerning the problems of restoring ecosystems damaged by hazardous substances (CERCLA) or by oil pollution (OPA). Equivalency methods have emerged through these two mechanisms.

- To help Member States apply the various types of recommended approaches, the European Commission has appointed a research group (REMEDE) to develop a guide on these methodological tools. The MEDDTL has also published three documents (and a forth is underway) on equivalency methods and value approaches (see bibliography) that repeat the recommendations issued by REMEDE and explains them through examples of industrial accidents in France and abroad. This guide is based on these three reports and the REMEDE work.

Several principles and assumptions refer to the use of these approaches. Although sometimes simplistic, they do however help with simplified use of these methods:

- **the substitutability of resources and services:** it shall consider that the value of the initial resources and services is identical to that of the restored resources and services (therefore there is no preference between use of the initial resource and use of the restored resource). In other words, equivalency exists between the

[13] The CERCLA Act (The 1980 Comprehensive Environmental Response, Compensation, and Liability Act) and OPA Act (The 1990 Oil Pollution Act).

losses and gains, i.e. the gain sought must be equal to the losses from the damage[14]. This principle remains valid in the case of irretrievable loss or in the case of harm to an endemic species, which obviously is not accurate.

- **the stability of the value of the environmental assets over time**; however, after damage has occurred, the quality and quantity of an asset is likely to reduce and consequently, its value is not the same as its value before the damage occurred.

- and in the case of value approaches, **the homogeneity of individual preferences**, based on the idea that an individual living, for example, close to a natural park, places the same value on this park as an individual living 100 km away from it.

Common points of the equivalency methods and value approaches

Definition of an indicator that is representative of the damaged site

When a natural site is damaged, damage to the site is, in general, multiple and may concern both **animal and plant species** and **ecological services**. Moreover, the ecosystem functioning and the interactions between species are complex. This is why, not all of the losses experienced by the damaged site can be determined.

The solution therefore involves choosing **a biological/ecological indicator**, called a **proxy**, that is representative of the habitat or species concerned by the damage. This may concern fish and vertebrate biomass, a representative species, the diversity of taxons, the plant cover, the density of stems for a plant species, sediments, the primary productivity of an environment, the first link in the food chain, etc. This indicator is used as a **unit of reference** to characterise the baseline condition of the site, and the losses and gains from the remediation project.

In some cases, it may be wise to use a **composite proxy** which takes several variables into account at the same time. To characterise a complex habitat correctly, it may be important, for example, to use several types of species or ecological services in order to better take into account the diversity of the damage environment.

Methodological process

To determine the remedial measures, 7 phases (summarised in Table III) can be identified (see REMEDE group work). This process takes place between stage 1 and stage 2 of Summary sheet no. 3 "logic diagrams of the process for preparing an order of requirement for remedial measures" (first part of the guide).

The file to be prepared by the operator and showing the appropriate compensatory remedial measures may follow these 7 phases.

[14] This amounts to applying a multiplying factor (or ratio) of 1 for 1 (1 restored unit = 1 lost unit).

Table III: The 7 phases for determining the remedial measures (source: (CGDD)

Phase	Title	Tasks to be carried out/result of the phase
Phase 1	Identification of the event causing the damage	1. Description of the event causing the damage 2. Pre-identification of resources, ecological services and related damaged functions 3. Reminder of the causal link between the event that occurred and the environmental impacts identified
Phase 2	Determination of the site's baseline condition before the accident and accurate identification of the damage	1. Data collection: an essential preliminary stage 2. Choice of proxy and determination of its baseline condition level 3. Assessment of the nature and gravity of the damage with regard to the baseline condition
Phase 3	Identification and analysis of various potential remediation projects	1. Identification of potential remediation projects 2. Comparative analysis of the various projects
Phase 4	Choice of scaling approach	1. Determination of the rate and pace of natural recovery (the time necessary for the environment to return to its baseline condition before the accident) 2. Scaling approach (this involves selecting the method to be implemented: HEA method, REA method or value approaches, at a reasonable cost)
Phase 5	Scaling of the complementary and compensatory remediation project and estimation of the remediation costs	1. Estimation of interim losses 2. Estimation of gains per unit of remediation (a hectare, kilometre, a unit of resource, a unit of leisure created) 3. Scaling of the remediation project 4. Estimation of the remediation costs
Phase 6	Sensitivity analysis	Vary each parameter that was the subject of an assumption in order to assess its influence on the scaling result obtained.
Phase 7	Monitoring and evaluation of the remediation	1. Preparation of a remediation plan and execution of the work 2. Monitoring and evaluation - Follow-up report - Checking whether the objectives have been achieved and end of the process

Use of discounting

In these methods, the gains from remediation projects are estimated over several years. These annual gains should therefore be added up based on the following principles:

- the use of discounting is used to establish an explicit "rate of change" between the present and the future, bringing future financial flows in line with currently perceived equivalent flows. For example, with a 4% rate, it is considered that individuals do not see the difference between receiving 100 euros a year and 96 euros the following year.

- the discounting of the monetary flows is based on the assumption that individuals do not put the same value on having one euro today or one euro tomorrow because:
  - individuals prefer the present (impatience);
  - due to risk aversion felt by individuals. This "cost of the risk" reflects the fact that one euro today is worth more than one euro tomorrow, which is desired but uncertain.

Discounting is not only reserved for financial and monetary flows but **also applies to natural asset flows**. The losses of ecological resources and services related to damage and gains from the remediation shall persist over time. To be able to add up gains or losses at different dates, it is necessary to discount future values.

Within the framework of natural resources and ecological services, the discount rate **reflects the level of preference** that individuals have for present or future resources/services. In other words, the discount rate **corresponds to the level of substitution between the current and future consumption of resources and services**.

The discount rate in France:

It is determined by the Lebègue report and is theoretically revised every five years (the last revision dates back to 200515). The annual discount rate is set at 4% for the first thirty years then decreases continuously to reach 3% over one hundred years and drops to 2% over five hundred years.

The approximation of the discount rate is given by the following formula:

$r_t = 0{,}04$ if $t \leq 30$ ans

$r_t = \sqrt[t]{1{,}04^{30} 1{,}02^{t-30}} - 1$ if $t > 30$ ans

The discount factor is calculated in the following way: $1/1+r_t^{t-T}$ where t represents a given year and T the reference year chosen to start the discounting.

The Gollier report (*Le calcul du risque dans les investissements publics - CAS - Rapports et documents n°36*) (Calculating risks in public bodies - CAS - documents no. 36) published in July 2011 issues a specific number of recommendations. In particular, it recommends revising the discount rate by not integrating the risk premium.

The reader should refer to the *Études & documents* publication no. 42 (May 2011) of the CGDD entitled "*taux d'actualisation et politiques environnementales: un point sur le débat*" (discount rate and environmental policies: focus on the debate) for precision regarding the subject.

[15] Before 2005, the discount rate was set at 8% for the first thirty years.

Phase	❶	❷	❸	❹	❺	❻	❼

7-phase process for determining remedial measures

This paragraph successively covers each of the seven phases of the process for determining remedial measures. The methodological aspects are illustrated by the test carried out on the Gave d'Aspe accident (in shaded box).

The process for determining remedial measures is carried out according to the 7 stages presented in Table III. These stages are described below.

Phase 1: Identification of the event causing the damage

This phase must describe the overall circumstances of the accident and retrace the history of events, describe the impacts observed and highlight the causal link between the event that occurred and the environmental impacts identified.

Description of the event causing the damage

The first phase starts logically with the description of the event causing the damage. This involves **describing the overall circumstances of the accident**, if possible providing the following elements: date, time and place of the accident, source and known causes, etc.

The **history of the events** that occurred immediately before and after the accident must therefore be retraced.

If preventive measures (according to the ELL) and/or primary remedial measures were taken and implemented, it is worth mentioning them here by describing them and indicating why they were implemented (also identify the partners consulted and stakeholders where appropriate).

Phase	❶	❷	❸	❹	❺	❻	❼

Identification of the event causing the damage and preventive measures in the case of the Gave d'Aspe accident:

The accident retained concerns a Spanish tanker transporting potash lye "leaving the road" on 5 June 2007 early evening. The lorry was travelling along the road linking Spain to France and entered the Somport tunnel before joining route nationale 134, along the Aspe valley in Pyrénées-Atlantiques. At the time of the accident, the tanker was partially punctured and became suspended over the edge of the road rapidly causing part of its contents to pour into the Gave d'Aspe located fifty metres below. Operations to recover the contents of the tanker before lifting it were in vain and almost all of the potash lye remaining in the tank also flowed into the Gave (i.e. a total of approximately 17,000 litres).

The following preventive measures were implemented:

- clean-up operations by removing and treating animal (fish) carcasses,

- waterway leaching operations. The damage was attenuated and controlled mainly by several releases of water from the dams located upstream. Due to the effect of flushing, this action helped to dilute the pollution.

According to the definitions in the "environmental liability" law, these measures constituted preventive measures (measures that stop the damage, its causes, prevent or minimise its aggravation and its impact). In the case of the Gave d'Aspe accident, the operations to remove fish carcasses and clean the waterway were also identified as primary remedial measures because they contributed to returning the environment to its baseline condition, consequently reduced interim losses and thereby lowered the magnitude of the future remediation project.

Other primary remedial measures may be considered:

- cleaning and protection against other pressures on the damaged environment (protection against invasive species for example)

- temporary development work for provisional remediation of certain functions

- re-introduction of harmed animal or plant species.

Pre-identification of resources, ecological services and related damaged functions

The pre-identification of resources, ecological services and related damaged functions must **establish initial understanding of the gravity of the damage and therefore check that the situation does indeed fall within the scope of the ELL.** It subsequently **facilitates the work of the following phases** (in particular phase 2), by focusing on finding the elements that will help to accurately qualify and quantify the damage (evaluation of the nature of this damage, its consequences and assessment of its gravity).

N.B.: According to the ELL, damage is defined as being "a measurable adverse change in a natural resource or measurable impairment of a natural resource service which may occur directly or indirectly".

Phase	❶	❷	❸	❹	❺	❻	❼

Here, this should be restricted to **describing the direct impacts observed** and only those. These direct impacts include the mortality of certain animal species in the accident area (e.g.: dead fish in a waterway), vegetation covered with any pollutant, etc.

The description is meant to be **qualitative** (which species? which habitat?) but also **quantitative** (number of individuals concerned, spatial extent). This pre-identification is preferably based on the reports established when the damage occurred.

Pre-identification of impacts in the case of the Gave d'Aspe accident:

- The identification of resources, ecological services and related damaged functions was determined based on various minutes and reports drafted by several stakeholders and/or rapporteurs of the facts (government services, associations, industrialists, press releases and newspaper articles) when the damage occurred in order to cross-check the sometimes inconsistent information on the qualification and quantification of the damage;
- The mortality observed and reported concerned trout as well as a Pyrenean brook salamander individual, which is an endemic urodele amphibian of the Pyrenees mountain torrents. From the accident area and extending downstream, the mortality of the fish populations appeared to be total over the first 4 kilometres then declining over the following kilometres (over which blind but alive trout individuals were observed).

Determination of the causal link between the event that occurred (the event giving rise to the damage) and the environmental impacts identified (the damage)

Determination of the **causal link** between the event giving rise to the damage, and identification of the liable person are **essential** and shall be at the administrative authority's expense (see p.32).

However, all of the elements establishing the causal link should be reminded here.

Causal link between the event giving rise to the accident and damage observed at the time of the Gave d'Aspe accident:

- The cause and effect relationship was therefore irrefutable: spillage of the contents of the tanker (potassium hydroxide, a white, odourless and caustic, solid substance, K + OH-) which by dissolving in the water of the Gave caused a very high increase in the waterway's pH, which actually caused the subsequent physico-chemical imbalances (while the level of pH usually for this waterway is around 8, values of pH 12 could be measured on the evening of the accident).
- Furthermore, bibliographical data on the effects of an increase in pH of water on aquatic flora and fauna corroborated the immediate effects observed on the Gave d'Aspe: for the fish populations, visible damage to the eyes, skin, gill filaments resulting in death when the pH is above 9 and for the flora, reduction in the capacity to absorb nutrients and deficiency phenomena.

Phase	❶	❷	❸	❹	❺	❻	❼

Phase 2: Determination of the site's baseline condition

This phase must determine the site's baseline condition before the accident (through the collection of existing data and selection of an indicator) and accurately identify the damage (nature and gravity).

Data collection

Data collection constitutes an essential stage which, through the collection of available elements, shall help determine as objectively as possible **the baseline condition of the resource or service affected**.

Any information available at the impact site is of particular value:

- databases of the parameters that are regularly monitored,
- baseline condition data appearing in the impact analysis of the ICPE file where appropriate, which is very important when the data is fairly recent,
- baseline condition data appearing in certain impact analyses, for which the operator is not the petitioner (collection of this type of data shall require the collaboration of the administrative authority),
- areas present on the territory and related scientific monitoring, ZNIEFF (natural areas of ecological, faunistic and floristic interest) forms,
- baseline condition of documents of objectives (DOCOB), elements appearing in standard data forms (SDF), case of Natura 2000 sites.

The document of objectives (DOCOB) is a planning document produced for all French Natura 2000 sites and defining the objectives for maintaining and restoring natural habitats and species that motivated the site's designation. It systematically includes a description and analysis of the baseline condition and objectives related to the site.

The standard data form (SDF) is a form completed for each Natura 2000 site containing, in addition to the site's general information (location, surface area, description elements, etc..), the list of habitats in Annex I of the Habitats Directive (HD) present on the site (with information on their representativeness, their conservation status and the overall evaluation of the site's value with regard to conservation of the relevant types of natural habitats) and the species mentioned in Article 4 of the Birds Directive (BD) or Annex II of the HD (with information on the populations and the site's value for these species).

In order to correctly interpret the information supplied in this form, reference must be made to the explanatory note relating to it: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/standarddataforms/notes_fr.pdf

N.B.: According to REMEDE, if data collection on the impact site is not possible, delicate or incomplete, the baseline condition may therefore be established by comparison with a neighbouring reference that has the same biotic and abiotic conditions as the damaged site and if necessary, baseline condition simulation models may be used.

The available **data should subsequently be sorted** in order to keep only the data used for identifying a proxy and determining a baseline condition.

Phase	❶	❷	❸	❹	❺	❻	❼

Data mobilised in the case of the Gave d'Aspe accident:

Four types of data could be and were used:

- impact notices of the transparency operations conducted annually by EDF in order to restore the solid transit blocked by the Anglus and Peilhou dams. These reports contain information on the overall hydrological functioning of the waterway and on the monitoring carried out on an annual basis (IBGN[16] monitoring and electrical fishing).

- the standard data form (**SDF**) since the sector harmed by the damage is a site of community importance. It provides information on the list of habitats and species justifying the site's designation and gives evaluation criteria.

- information from the Adour-Garonne basin water data portal (structures existing on the waterway, surveillance control network (RCS) and operational control network (RCO) points of the WFD monitoring programme).

- the contents of the Departmental Plan for the Protection of aquatic environments and fish resource management (**PDPG**) which provides precisions on fish species theoretically and effectively present in the waterway.

Various **databases** that can be used by experts. For information purposes, here is a non-exhaustive list:

Databases concerning aquatic environments

- The BRGM (French Geological Survey) database may be useful for obtaining data on groundwater.
http://www.brgm.fr/brgm/ref_fr_site.htm
- The French Water Agencies have set up a document database called the Water Framework Directive.
http://www.lesagencesdeleau.fr/v2/pages/?lang=en
- The European Environment Agency has developed a certain number of databases on water: http://www.eea.europa.eu
- The French National Service for Water Data and Common Repositories Management (SANDRE) provides several databases. The BD Carthage (Thematic Mapping database for French Water Agencies and Ministry of Environment) is an example. It comprises a cartographic representation describing the water systems in France.
http://www.sandre.eaufrance.fr/?lang=en
- The *Eaufrance* portal, a point of entry to the French water information system (SIE):
http://www.eaufrance.fr/

Databases concerning the habitat and biodiversity

- The Natura 2000 database is useful for understanding the characteristics of each site listed in a Natura 2000 area.
http://www.developpement-durable.gouv.fr/-Natura-2000,2414-.html
- The National Inventory of Natural Heritage (INPN) collects data on habitats and species
http://inpn.mnhn.fr/accueil/index?lg=en.
This site provides access to the Standard Data Form (SDF) based on a query on a species, habitat or the code of the Natura 2000 site. As the query by municipality is not planned, it is better to have the code or name of the Natura 2000 site before accessing this inventory.

Other databases

- Corine Land Cover is a geographical database providing a biophysical inventory on land use.
http://www.statistiques.developpement-durable.gouv.fr/donnees-ligne/liste/1825/1097/occupation-sols-corine-land-cover.html
- The French National Forestry Inventory is a public organisation responsible for the analysis of forestry resources. http://www.ifn.fr/spip/?rubrique67

[16] The standardised global biological index (*indice biologique global normalisé*) (AFNOR standard of 20/11/1992) evaluates the overall quality of a waterway using analysis of benthic macro-invertebrates which is considered as a summary expression of this overall quality.

Phase	❶	❷	❸	❹	❺	❻	❼

Choice of proxy and determination of its baseline condition level

The proxy is a biological/ecological parameter that represents the habitat or species that is used as a **unit of reference** to estimate the baseline condition of damaged natural resources, the losses and gains and the scaling of the remediation.

Choice of proxy in the case of the Gave d'Aspe accident:

Based on the data collected, the proxy retained was a **composite proxy** grouping several species or groups of species likely to represent the damaged habitat:

- the **Pyrenean Desman** (*Galemys pyrenaicus*): a semi-aquatic insectivore, endemic to the Pyrenees
- the **Pyrenean brook salamander** (*Calotriton asper*): an endemic amphibian
- two groups of species firstly consisting of **benthic invertebrates** (constituting one of the first levels of the food chain) and secondly **fish populations** (including the Brown trout (*Salmo trutta*) population) of the relevant section of the waterway.

> *N.B.: A few recommendations for choosing the proxy:*
> - *do not go beyond 5 species/groups of species.*
> - *preferably choose species representing various divisions, different trophic levels within the same community, with a very different ecological niche (e.g.: a Lepidoptera, an Odonata, a plant species found with the target habitat).*

Baseline condition is defined in Article L. 162-9 of the ELL law: "*The baseline condition means the condition at the time of the damage of the natural resources and services that would have existed had the environmental damage not occurred, estimated on the basis of the best information available*".

Case of damage that "significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential of the waters" (I 2° of L.161-1)

According to Article R.161-2, the gravity of the damage to the waters "*is assessed when the risk or damage occurs in relation to the ecological, chemical or quantitative and/or ecological potential of the waters, according to the methods and criteria determined by the orders laid down in Article R.212-18*".

This formulation refers to the French Law on Water and Aquatic Environments (LEMA) of 30 December 2006, transposition of the Water Framework Directive of 30 October 2000. The LEMA sets out among other things:

- the creation of an inventory in order to identify the bodies of water for which the objective of good status may not be achieved in 2015,
- the implementation of a water status monitoring programme (in progress since 2007) based on the monitoring of a number of substations throughout France and carried out under the responsibility of the French Water Agencies.

Phase	❶	❷	❸	❹	❺	❻	❼

The purpose of the orders referred to in Article R.161-2 is to define the various categories of bodies of water and the methods and criteria used to characterise the various ecological and chemical statuses or the ecological potentials for each of these categories and define the list of pollutants to be taken into account and the corresponding environmental quality standards. In particular, this concerns:

- the Order of 12 January 2010 relating to the methods and criteria to be implemented to define and classify bodies of water and address the inventory (laid down in Article R.212-5 of the Environmental Code),

  http://www.legifrance.gouv.fr/jopdf/common/jo_pdf.jsp?numJO=0&dateJO=20100202&numTexte=2&pageDebut=01953&pageFin=01980

- the Order of 25 January 2010 relating to the methods and criteria for assessing the ecological or chemical status and/or the ecological potential of the surface waters taken pursuant to Articles R.212-10, R.212-11 and R.212-18 of the Environmental Code:

  http://www.legifrance.gouv.fr/jopdf/common/jo_pdf.jsp?numJO=0&dateJO=20100224&numTexte=9&pageDebut=03429&pageFin=03475

The annexes of this last order describe the quality elements to be taken into account for classification of the ecological status of the surface waters and the modalities for evaluating and establishing standards for the various categories of bodies of water.

For example, the following elements should be taken into account for the ecological status of a waterway:

Ecological status
Biological status
Composition and abundance of benthic invertebrate fauna (IBGN)
Composition and abundance of aquatic flora (including Biological Diatom Index, IBD)
Composition, abundance and age structure of fish fauna (Biological Fish Index)
Hydromorphological elements supporting the biological elements (hydrological regime, river continuity, morphological conditions)
Chemical and physico-chemical elements supporting the biological elements
General elements (thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions)
Specific pollutants (specific synthetic pollutants other than priority substances)

The aggregation of these elements results in classification of the body of water into one of **five existing categories** (very good, good, average, mediocre and poor status) and is characterised by **a deviation from the reference conditions**.

Phase	❶	❷	❸	❹	❺	❻	❼

The chemical status of a body of water is evaluated based on the concentration of certain pollutants and environmental quality standards (EQS) defined for each substance or group of substances (Annex 8 of the Order of 25 January 2010). If all of the EQS for these pollutants are respected, the measuring station is considered as having a good chemical status. If one of the EQS for these pollutants is not respected, the measuring station is considered as having a poor status. The status may also be considered as "unknown" if it has not been possible to determine one of the EQS.

The very large number of analyses carried out (4.6 million in 2007) have been made available for the public via the French water information system (SIE), managed by the ONEMA. A database under development (Naïades) shall eventually collect data on the quality of waterways and shall replace the various databases existing on the subject.

The ecological status of a waterway may serve as a proxy. The baseline condition may be defined based on its status class (globally or for each criterion according to the particularities of the waterway or of the damage).

The following table gives an indicative representation of the correspondence that may be established between the ecological status class of the waterway (qualitative) and the level of services (quantitative) that can be deduced.

Status class established for the body of water affected by the damage	Baseline condition of services (in%)
Very good status	80%
Good status	from 60 to 80%
Average status	from 40 to 60%
Mediocre status	from 20 to 40%
Poor status	< 20%

Source: CGDD

Phase	❶	❷	❸	❹	❺	❻	❼

Case of damage that "has significant adverse effects on reaching or maintaining the favourable conservation status" of species, habitats, breeding sites and resting places, mentioned in I 3° of L.161-1

To simplify, **the notion of baseline condition may be compared with the notion of conservation status of the damaged habitat or species** before the damage occurred.

Determination of the conservation status **must be based on the assessment criteria defined in Article R. 161-3** of the Implementation decree of the ELL. This article gives the definition of a conservation status of a species as favourable if it meets four criteria (see Table IV below):

- the population dynamics data on the species concerned (1st criterion) indicate that it is maintaining itself on a long-term basis,
- the range of the species (2nd criterion) is not being reduced,
- the change in this range (3rd criterion) is not likely to be reduced for the foreseeable future,
- the size of the natural habitat (4th criterion) is sufficiently large to maintain this species on a long-term basis.

Table IV: Assessment criteria for the conservation status of a species

(the terms of Article R.161-3 appear in blue, completed with subsequent terms, in black).

	Highly favourable (++)	Favourable (+)	Unfavourable (-)	Highly unfavourable (- -)
Population dynamics data (process that characterises the fluctuations in numbers and the structure of a population as a function of time or even their spatial distribution)	Is maintaining itself on a long-term basis as a viable component of its natural habitat		Hypothetical long-term maintenance	Very difficult or even impossible long-term maintenance
Natural range of the species[17]	Increasing	Stable – Is not reducing	Regressing slightly	Regressing significantly
Change in the natural range of the species in the foreseeable future	Increasing	Stable – Is not likely to be reduced	Regressing slightly	Regressing significantly
Size of the habitat hosting the species and guaranteeing the populations of the species on a long-term basis	Size of the habitat much larger than sole maintenance of the species	Sufficiently large habitat	Habitat not quite large enough	Habitat too small

Source: CGDD

[17] Area defining the geographical range of a living species or any other taxonomic unit including all of its populations.

Phase	❶	❷	❸	❹	❺	❻	❼

Article R 161-3 also defines a conservation status of a favourable natural habitat through five criteria (see Table V below):

- the natural range of the habitat (1st criterion) and areas it covers within that range (2nd criterion) are stable or increasing,
- the structure and functions which are necessary for maintenance of the habitat (3rd criterion) exist,
- this structure and its functions will continue to exist for the foreseeable future (4th criterion),
- the conservation status of the typical species hosted by this habitat (5th criterion) is favourable.

Table V: Assessment criteria for the conservation status of a natural habitat

(the terms of Article R.161-3 appear in blue, completed with subsequent terms, in black).

	Highly favourable (++)	Favourable (+)	Unfavourable (-)	Highly unfavourable (--)
Natural range of the habitat	Increasing	Stable	Regressing slightly	Regressing significantly
Areas covered within the natural range of the habitat	Increasing	Stable	Regressing slightly	Regressing significantly
Existence of the specific structure and functions which are necessary for the maintenance of the habitat	YES		NO	
Continuation of these conditions in the foreseeable future	YES		NO	
Conservation status of its typical species	The percentage retained is an average of the percentages obtained for each species taken into consideration in Table IV.			

Source: CGDD

However, the criteria defined in this article are qualitative. To make them quantitative, experts carrying out the study are asked to **score each criterion between 0 and 100 (in%)** based on the **available bibliographical data.** More often, the scoring may follow the rule of correspondence (purely conventional) proposed below:

Conservation status (of a species or of a natural habitat)	Corresponding level of services or resources
Highly favourable	From 75 to 100%
Favourable	From 50 to 75%
Unfavourable	From 25 to 50%
Highly unfavourable	From 0 to 25%

Source: CGDD

Phase	❶	❷	❸	❹	❺	❻	❼

- concerning a species, when its natural range is considered as "stable", the level of resources is 62.5% by default, in the middle of the "favourable" class [50% and 75%]. This level is 87.5% (in the middle of the "highly favourable" class [75% and 100%] when its range is "increasing". Similarly, when its natural range is "regressing slightly", the level of resources is 37.5% by default, in the middle of the "unfavourable" class [25% and 50%].
- concerning the conservation status of a natural habitat, when its range is considered as "increasing", the percentage of services rendered is 87.5% by default, in the middle of the "highly favourable" class [75% and 100%]. This level is 62.5% (in the middle of the "favourable" class [50% and 75%] when its range is "stable".

An **arithmetic mean** is then calculated based on the four criteria defining the conservation status of the species and on the five criteria characterising the habitat. This mean respectively corresponds to the initial level of resources and the level of services.

Determination of the baseline condition level applied in the case of the Gave d'Aspe accident

To calculate the conservation status of the composite proxy retained, the conservation status of each species constituting it should be evaluated (see table below).

1. Conservation status of species and groups of species

	Pyrenean Desman *(Galemys pyrenaicus)*	**Pyrenean brook salamander** *(Calotriton asper)*	**Benthic invertebrates**	**Fish population**
Population dynamics data	Very little data on the subject. Populations seem to be stabilised but are qualified as being under latent danger according to the red book (**Not evaluated)**	Species that can live up to 20 years, sexual maturity at 2-3 years old but low rate of reproduction - Species not very compatible with trout which are their greatest predator. Under these conditions, long-term maintenance of the species is assumed to be hypothetical (**37.5%)**	Maintaining itself on a long-term basis as a viable component of its natural habitat (**75%**)	The PDPG indicates that the fish context of the sector is disturbed at 30% (**level therefore set at 70%**[18])
Natural range of the species	Stable overall range but tendency for fragmentation of population within the basin areas **(50%**[19]**)**	The good general conservation status of high habitat seems to be a good guarantee of stability for the species but also sometimes indicated as in decline (**50%**)	Stable (**62.5%**)	The PDPG indicates that the fish context of the sector is disturbed at 30% (**level therefore set at 70%**)

[18] In some of the documents collected by the experts, the conservation status of a species or of a habitat had already been calculated. This percentage was then repeated identically in the study case.

[19] When the data that the experts had was contradictory, for example, for a species, one document could indicate an unfavourable range and another document could indicate a favourable range, by default these experts gave the upper and lower limit value of each class (in our example, unfavourable and favourable), i.e. in this situation 50%. This principle was applied every time the available data was debatable, either because it was contradictory, or because it did not indicate the same conservation status classes.

Change in the natural range of the species in the foreseeable future	Comparable with the natural range of the species **(50%)**	Comparable with the natural range of the species **(50%)**	By assuming that current policies are producing results (good ecological status of waterways, etc.), improved water quality and an increase in the range of the most pollution-sensitive invertebrates is possible (**87.5%)**	The PDPG indicates that the fish context of the sector is disturbed at 30% (**level therefore set at 70%**)
Size of the habitat hosting the species and guaranteeing the populations of the species on a long-term basis	Very little data on the subject. Mention in the bibliography of one individual per km² (value of 2.8 to 5.5/km²). As the species is highly sensitive to variations in water flow, it is possible to imagine that anthropic disturbances have gradually reduced the habitat of choice of the species and therefore that currently it is not quite large enough to maintain the populations of the species on a long-term basis **(50%)**	The habitat seems to be sufficiently large to maintain the populations of the species on a long-term basis (**62.5%**)	Sufficiently large habitat (**75%**)	The habitat seems to be sufficiently large to maintain the populations of the species on a long-term basis (**62.5%**)

The average level of conservation for the 4 species or groups of species is 61.5%.

2. Conservation status of the natural habitat

Natural range of the habitat	Stable for both habitats (62.5%)
Areas covered within the natural range of the habitat	Stable for both habitats (62.5%)
Existence of the specific structure and functions which are necessary for the maintenance of the habitat	YES. Representativeness qualified as excellent in the SDF (75%)
Continuation of these conditions in the foreseeable future	YES no significant modifications envisaged, rate allocated identical to the previous one (75%)
Conservation status of its typical species	Percentage of 61.5% (see previous table)

The average initial level of services is 67.3%, rounded up to 70%. This figure of **70%** is subsequently used in the calculations and represents the baseline condition of ecological services provided by the Gave d'Aspe.

Phase	❶	❷	❸	❹	❺	❻	❼

Assessment of the nature and gravity of the damage with regard to the baseline condition

For the damage affecting the surface waters, the gravity of the damage may be assessed by measuring the deviation from the situation after the damage occurred with the baseline condition level which is used as a reference (see p.71).

For damage that "has significant adverse effects on reaching or maintaining the favourable conservation status" of species, habitats, breeding sites and resting places mentioned in I 3° of L.161-1, evaluation of the damage results in **analysis of direct or indirect impairments** (see Tableau VI below) found when comparing with the site's initial conservation status as mentioned in Article R.161-3 III.

The measurable data mentioned in this article and to be taken into consideration includes:

- "*the number of individuals, their density or the area covered,*
- *the role of the particular individuals or of the damaged area in relation to the species or to the habitat conservation,*
- *the rarity of the species or habitat assessed, where appropriate, at the regional, national or community level,*
- *the species' capacity for propagation, its viability or the habitat's capacity for natural recovery*
- *the species' or habitat's capacity to recover, solely by virtue of the dynamics of the species or habitat, to a condition deemed equivalent or superior to the baseline condition...*".

Phase	❶	❷	❸	❹	❺	❻	❼

Table VI: Criteria for estimating impairments

	For each damaged habitat or species
Number of damaged individuals, their density or area covered by the damage[20]	Describe as accurately as possible the number of damaged individuals, their density or the area covered by the damage. In many cases, it may be essential to define several areas of damage, as this damage is not necessarily homogeneous over the entire impact area.
Role of the individuals or of the damaged area in relation to the overall species or to the habitat conservation	It should be stated here whether the damaged individuals or habitat plays a particularly strategic role with the overall conservation of the species or habitat. E.g.: damage to a population of species located at the boundary of its natural range (therefore regression of its natural range), damage to a population serving as a genetic exchange relay between two populations (therefore may cause situations of genetic isolation of populations), damage to a climax habitat[21] hosting a number of stenoecic species[22], etc.
Rarity of the species or of the damaged habitat	The rarity is assessed on several scales: on the regional, national and community level. The rarer the damaged species or habitat, the more significant the impairment
Species' capacity for propagation, its viability or the habitat's capacity for natural recovery	The lower the species' capacity for propagation or the longer and/or lower the habitat's capacity for natural recovery, the more significant the impairment
Species' or habitat's capacity to recover, solely by virtue of the dynamics of the species or habitat without intervention other than reinforce protective measures	The more difficult it is for the species or habitat to regenerate spontaneously, the more significant the impairment

Source: CGDD

[20] Reminder: the damage discussed here should be clearly distinguished from the cases listed in Article R. 161-5, i.e. impairments due to natural causes or disappearing within a short time and without intervention and negative variations that are smaller than natural fluctuations regarded as normal for the species or habitat in question.

[21] Climax habitat: end point of the evolution of a plant community corresponding to its optimum development.

[22] Species with a narrow tolerance range for all of the ecological factors specific to its habitat.

Phase	❶	❷	❸	❹	❺	❻	❼

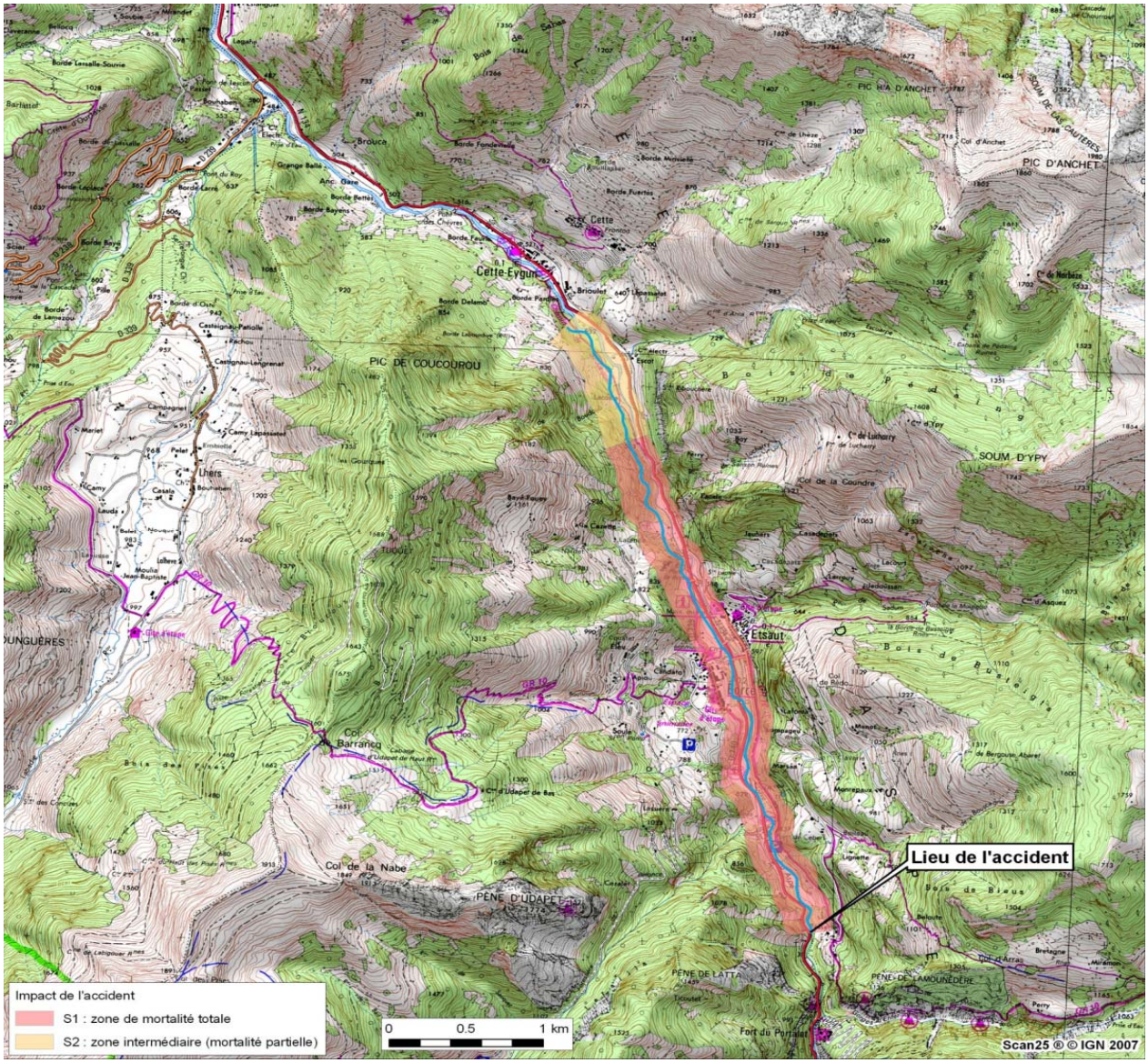
Nature and gravity of the damage applied in the case of the Gave d'Aspe accident

Given the number of damaged individuals and the area covered by the damage, two impact areas S1 and S2 were identified.

- S1 = a first area where the mortality of the individuals was total, covering 4,000 metres long and 17 metres wide, i.e. an overall surface area of 68,000 m² (6.8 ha).

- S2 = a second damaged area where living individuals were observed, an intermediate area between the damaged area and the area not damaged by the accident covering 1,000 metres long and 17 metres wide, i.e. an overall surface area of 17,000m² (1.7 ha).

With the total disappearance of the fauna and damage to the flora along 4 km of waterway (sector S1), the gravity of the accident was undeniable. As for sector S2, although the gravity is lower, the pollution caused irreversible damage to the fish population (fish alive but blind).



Phase	❶	❷	❸	❹	❺	❻	❼

Phase 3: Identification and analysis of potential remediation projects

This phase must determine a relevant remediation project, initially by identifying potential remediation projects then by choosing one of them based on a comparative analysis.

The definition of remedial measures given in the ELL is: "*any action or combination of actions, including mitigating or interim measures to* ***restore, rehabilitate or replace*** *damaged natural resources and/or impaired services, or to provide an equivalent alternative to those resources or services".*

This phase is essential for application of the ELL. It focuses firstly on selecting a remediation project adapted to the damage observed and secondly on the local context. For this, several possible remediation projects should be listed and one of them should be selected based on a comparative analysis (according to the criteria listed in Table VII).

In order to identify potential and appropriate remediation projects, it is strongly recommended to **use the schemes, plans and programmes that may exist on the territory in question**. Based on a non-limitative indicative list, this may, for example, include:

- the SDAGE/SAGE (master plan of the development and management of water/water development and management scheme)
- species remediation plans,
- fish management plans or others,
- French regional guidelines on the management and conservation of wildlife and habitats (ORGFH)
- action sheets of the documents of objectives for Natura 2000 sites.

Obviously, it shall then be necessary to distinguish what comes under the application of a public policy (e.g.: compliance with a regulation in force such as making livestock operations compliant, developing preventive actions against the pollution dispersed) and what may actually constitute a remedial measure pursuant to the ELL.

Two to three potential remediation projects (also called "remedial options" by the Environmental Liability Directive or ELD) may initially be considered. Each option is then evaluated based on the criteria mentioned in Annex II (1.3) of the ELD, the summary of which may be presented in the form of a remediation project comparison table (see table VII, completed as an example using dummy elements). To complete this table, sound knowledge is required on the effectiveness of each project (what impacts does it produce?, for how long?, is its success guaranteed?, etc.).

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Table VII: Example of comparative table of various remediation projects

Criterion	Remediation project 1	Remediation project 2	Remediation project 3
Impacts on public health and safety	Favourable	Neutral	Unfavourable
Implementation cost	Indicate the estimated overall cost related to the same unit[23]	Indicate the estimated overall cost related to the same unit	Indicate the estimated overall cost related to the same unit
Likelihood of success. What is the likelihood of achieving the result?	High	Low	Average
Prevention against future damage and avoidance of potential collateral damage	Yes	Yes	No
Benefits to each component of the natural resource or service	Estimated gain of 10%	Estimated gain of 5%	Estimated gain of 25%
Takes into account the relevant social, economic and cultural aspects and other relevant factors specific to the locality	No (ecological aspects only)	Yes	Yes (tourist area clearly taken into account)
Time necessary for remedying the environmental damage	> 5 years < 20 years	< 5 years	> 10 years
Achieves restoration of the damaged site or a similar site	yes	Yes with no certainty	yes
Geographical link to the damaged site (indicate the distance of the damaged site in km)	15 km on the same basin area	5 km on another same basin area	Immediate vicinity (*in situ*)

When reading the table, the choice would in principle concern projects 1 or 3, as 2 seems less appropriate (low likelihood of success and estimated gain lower than the other two projects).

> *N.B.: The comparison can be more accurate by allocating a score to each of the 9 criteria in Table VII (weighted or not weighted score for each of the 9 criteria, based on its weight: case, for example, of the implementation cost which must be reasonable to society). This score for each criterion could, for example, be defined by the advisory committee, if it exists; the project obtaining the best total would be selected as the remediation project.*

The **time necessary for carrying out the remediation project** must also be estimated at this stage. It must correspond to the time during which the gains from the compensatory remediation shall be calculated (phase 5).

> *N.B.: At this stage of the process, the operator may be supported by local stakeholders constituting the advisory committee, which might be formed (see first part of the guide). Through their knowledge of the territory, these stakeholders may help to identify various remediation projects and assess their appropriateness and their feasibility.*

Finally, if the remediation project retained must not be implemented on one (or more) private properties, it should therefore question the project owner's[24] intervention methods: need to obtain land owner authorisations, start the complementary procedures mentioned in Article L.162-12 (such as the institution of public utility easements or the request for declaration of public utility).

[23] This is the cost of the remediation project in relation to a unit of remediation (1 km, 1 ha, 1 unit of leisure recreated), but at this stage it is inevitably approximate as the details of the cost have not yet been accurately discussed.

[24] The operator liable for the initial damage.

Phase	❶	❷	❸	❹	❺	❻	❼

Phase 4: Choice of scaling approach

This phase must define the scaling approach (the method to be implemented) and determine parameters that are essential for the calculations, and the rates and pace of natural recovery.

Determination of the rate and pace of natural recovery

The remediation project's measures aim to restore these natural resources and their ecological services to their baseline condition.

"Recovery" including "natural recovery" is defined as: "in *the case of water, protected species and natural habitats, the return of damaged natural resources and/or impaired services to baseline condition...*" (source: ELL).

This initially involves determining the rate of natural recovery. This rate is understood to be the **time necessary for restoring to baseline condition** based on data intrinsic to the ecosystem affected. This is the environment's **resilience** (the time necessary for completely "recovering" the damage).

The rate of natural recovery shall be used to **determine the number of years during which interim losses of services and/or resources have to be quantified**.

Subsequently, it should be questioned whether the annual **rate of recovery** is constant throughout the entire recovery period (linear recovery) or whether it occurs in stages (logarithmic or semi-logarithmic recovery). For example, for a return to baseline condition in 3 years and for a linear recovery rate, the rate is 33% a year. In the case of semi-logarithmic recovery, this rate is 50% the first year, 30% the second and finally 20% the last year.

Determination of the rate and pace of natural recovery will probably be subject to discussion throughout the procedure. Therefore, this should also be looked at as objectively as possible, possibly using available feedback and ecological data.

Feedback: at the moment, very little data is available. However, initial **data on resilience** collected at the time of similar accidents may provide practical guidance on which recovery rate to retain.

Available ecological knowledge: information on plant dynamics and the time necessary for achieving a certain level (balance, for example) are relatively well identified based on "point zero" (equivalent to total destruction of the environment). However, damage to the environment does not always relate to the habitat's point zero. It will be of an unknown level which therefore should be defined.

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A few examples of real natural recovery rates in specific damaged environments

- accidental industrial discharge from a paper mill into the Courant de Mimizan in 1997: 3 years were needed for the waterway to return to its baseline condition,
- pollution of a waterway following the discharge of fire extinguishing water in 1996: recovery time varying from 10 years close to the impact to 6 months for the damaged area located the furthest from the discharge,
- California coastline affected by oil spills: 13 years,
- rupture of an oil pipeline into Lake Barre in Louisiana and discharge of 6,561 barrels of oil: from 4 months for the least damaged areas to 20 years for the most seriously affected sectors,
- Gave d'Aspe accident: monitoring actions following the accident showed that 3 years later the waterway had returned to its baseline condition.

Scaling approach

After remediation projects have been identified, they need to be scaled so that the gains related to the project are equal to the interim losses caused by the damage. The scaling may occur over space (in hectares to be restored) or over time (in number of years during which the compensatory remedial measures should be implemented) and require the use of equivalency methods. If equivalency methods are not used, value approaches[25] can be implemented.

In the case of the HEA method, remediation projects must reason in terms of ecological services per hectare and in the REA method, in terms of quantity of resources.

Table VIII: Scaling unit of the project according to the equivalency method used

	SERVICE-SERVICE (HEA)	RESOURCE-RESOURCE (REA)
Scaling unit of the project	Percentage of ecological services provided, per year, for a specific surface area (ha)	Quantity of resources (number of individuals, quantity of biomass, life span, etc.) provided per year

If the value approach is used (monetary valuation technique) the administrative authority is **competent for prescribing,** if it wishes, the method to be used (willingness to pay methods, joint analysis, transport costs, costs avoided, etc.).

[25] Reminder: remedial measures for the damage are determined and evaluated in accordance with 1° of Annex II of the ELD.

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Identification of potential remediation projects and scaling approach applied to the case of the Gave d'Aspe accident

The table below non-exhaustively lists actions that might be used as remediation projects. In the case of the Gave d'Aspe study, the identification of remediation projects was based on the actions proposed in existing local schemes, plans and programmes. If such plans do not exist locally or are unsuitable, remediation projects should be established in light of the damage considered.

List of measures that might be used in remediation projects in the case of the Gave d'Aspe accident (source: CGDD)

Source	Title of the measure	Not usable	HEA	REA	Value-to-	Value-to-cost
PDGP (French departmental plan for the protection of aquatic environments and fish resource management)	Action programme for improving water management (water regulation revision and improvement of the management of solid transport)	X (strict application of the regulations in force)				
PDGP	Equipment for crossing migration obstacles (upstream and downstream migration)			?		X
PDGP Programme of measures for the Adour Garonne basin	Continuation of the river bank remediation and maintenance scheme for the Gave d'Aspe and its tributaries Maintain the river banks and surrounding areas of waterways and riverines		X X			
PDGP	Improvement of the knowledge on local strains: phenotypic analyses and genetic analyses (Brown Trout)			?		X
PDGP	Implementation of the experimental fishing route development programme (e.g.: Gave d'Aspe to Bedous)				X	X
Programme of measures for the Adour Garonne basin	Maintain, protect and restore wetlands (watersheds and valley bottoms, areas surrounding waterways)		X			
PDGP	Installation of grass strips		X			
ORGFH Languedoc-Roussillon	Support or initiate studies and experiments on certain species characteristic of the quality of the environment (Pyrenean Desman, pearl mussel (*Margaritifera margaritifera*), white-clawed crayfish (*Austropotamobius pallipes)*) and monitor control populations					X

Based on these listed remediation projects, some are more relevant (ecologically) than others. In addition, very few remediation projects are likely to improve the "good baseline condition" of the Gave d'Aspe (70% of services restored, see p.76 and 77) and all the more so as there is little hope of reaching a level of services above 80% (which is an increase of +10 % compared with the baseline condition). Effectively, most of the disturbances on this waterway are caused by humans (salination of the water following the salting of snow-covered roads in winter, pondage, dams, repeated road accidents, etc.) and therefore cannot be reduced.
Furthermore, sometimes certain relevant projects cannot be retained due to difficulty in expressing the gains related to the project in the correct unit. For example, in the case of the Gave d'Aspe accident, equipment for crossing migration obstacles (upstream and downstream migration) cannot be conveyed in terms of effectiveness of gains in unit of resource (REA approach).

Phase	❶	❷	❸	❹	❺	❻	❼

List of potential remediation projects retained in the case of the Gave d'Aspe accident

For the HEA approach:

- The **river bank remediation and maintenance** project may be retained as an *in situ* remediation action. It is based on conventional river bank remedial work: cleaning, removing dead wood, selective cutting of trees, removal of logjams, consolidation work, weeding, restoration and maintenance of paths.
- The remediation project of **installing grass strips** on the areas surrounding the waterway is an important project but should be considered in the undamaged section of the Gave. This is an *ex situ*26 project which would improve the habitat's status by taking into account the agricultural pollution dispersed and improve the status of the river banks.

For the value approaches, the experimental fishing route development project (e.g.: Gave d'Aspe to Bedous) is a relevant project. The purpose of this project is to open up sections of the Gave and improve its accessibility for practicing fishing. This involves maintaining and planning the waterway to "relocate" fishing trips lost on an adjacent site.

[26] As a reminder, equivalency methods recommend *in situ* remediation in nature but at reasonable costs. However, the *in situ* remediation project of the banks of the Gave d'Aspe presented a disproportionate cost compared with the *ex situ* project, it would therefore be advisable to arbitrate between these two projects.

Phase	❶	❷	❸	❹	❺	❻	❼

Phase 5: Scaling of the remediation project

This phase explains how to size the project (calculation of interim losses, calculation of gains then calculation of equivalency) for each of the various methods. It concludes with calculation of the remediation costs.

This phase can be broken down into 3 successive stages:

- calculation of interim losses;
- calculation of gains from the remediation project identified;
- the scaling of the remediation project from the ratio between losses and discounted gains calculated.

*Reminder: the assumption of **substitutability of resources and/or services** (the value of the initial resources and services is identical to the value of the restored resources and services hence the **equivalency between losses and gains**) is the key element of the calculations. In the case of the value-to-cost approach, only the interim losses are calculated.*

HEA method

Calculation of interim losses

Interim losses are expressed in units of "surface area-year". For example, if environmental damage affects a surface area of 3 hectares in year t and produces a 50% loss of services, for year t, this equates to 1.5 ha of service area on which the service is no longer available.

To estimate the interim losses, it is necessary to:

- determine the initial level of services on the site before the damage occurred,
- determine the level of services on the site after the damage occurred,
- estimate the loss (in surface area),
- estimate the rate and pace of natural recovery. The rate of natural recovery must be estimated in order to determine the year when the losses shall finish.

The mathematical formula for calculating the losses is the following:

$\sum_{t=0}^{t=n} (A_t * d_t) * 1/(1+r)^{(t-T)}$	t = 0: year when the losses start t = n: year when the losses finish A_t: surface area (in ha for example) damaged in year t dt:% of services lost in year t compared with the environment's baseline condition r: discount rate (4%) $1/(1+r)^{(t-T)}$: discount factor T: reference year for the discounting (often T = t_0) corresponding to the year the damage occurred.

Phase	❶	❷	❸	❹	❺	❻	❼

For example, in year t, the annual loss is calculated by multiplying the damaged surface area (A_t) by the loss of services (d_t), the whole discounted (i.e. multiplied by discount factor $1/(1+r)^{(t-T)}$

Discounted interim losses are calculated **on a year-by-year basis throughout the entire period of impact** (i.e. from the year in which the accident occurred to the year corresponding to when the environment returns to its baseline condition) and subsequently by adding up to correspond to the overall discounted interim losses.

When several sectors are damaged to different degrees, the interim losses must be calculated on each of these sectors, as in the case of the Gave d'Aspe (2 impact sectors: S1 and S2).

Applying the HEA method for the most damaged sector of the Gave d'Aspe (sector S1) gives the following results.

HEA method - Calculation of the interim losses in the case of the Gave d'Aspe accident

The proxy retained for evaluating the damage if the HEA method is implemented is composite and consists of: the Pyrenean Desman, the Pyrenean brook salamander, the fish population (including the Brown Trout) and benthic invertebrates.
Previously, the following assumptions were put forward:
- the proxy is composite.
- the initial level of ecological services on the site before the damage occurred was assessed at 70%,
- the level of services on the site after the damage occurred was assessed at 0%,
- the rate of recovery was set at 3 years according to a semi-logarithmic rate (50% of services recovered in the first year, 30% the 2nd and 20% the 3rd year)
- the estimation of the loss concerns a surface area of 6.8 ha.

Calculation of the discounted interim losses on the most significantly damaged sector S1

Year	Level of services (%)		Average level of services (%) *(1)*	Average losses of services (%) *(2)* *(2) = 70 – (1)*	Discount factor *(3)*	Surface area of the sector (in ha) *(4)*	Surface area (in ha) providing no service *(5) = (2) x (3) x (4)*
	Start of year (Sd)	End of year (Sf)	Sm	Pm	$f = 1/(1+r)^{(t-T)}$	S = 6.80	P
	$Sd_{initial}$	Sf_{final}	Sm = (Sd + Sf)/2	Pm = Sdi-Sm	r = 4%		P = Pm*f*S
2007	70	0	35	35	1	6.80	2.38
2008	0	35	17.50	52.50	0.96	6.80	3.43
2009	35	56	45.50	24.50	0.92	6.80	1.53
2010	56	70	63	7	0.89	6.80	0.42
						Total	**7.76**

(1). The level of ecological services provided by the Gave d'Aspe is 70% at baseline condition at the beginning of 2007. With the environmental damage occurring in June 2007, the provision of ecological services was estimated at 0 for the end of 2007. The average level of services is therefore:

Sd = 70; Sf = 0; Sm = (Sd + Sf)/2 that is (70 + 0)/2 = 35

The average level of ecological services is therefore 35% for year 2007[27].

(2). The average annual losses of ecological services are calculated by deducting the average level of services (for the year considered) from the initial level of ecological services provided by the waterway (i.e. 70% in our case).

Giving for 2007:

Sdi = 70; Pm = Sdi - Sm = 70 – 35 = 35

With a provision of baseline condition ecological services of 70% and an average level of ecological services of 35%, the average loss of ecological services for 2007 is 70-35 = 35%.

(3). The formula for the discount factor is the standard formula using the discount rate defined in the Lebègue report (see p.64).

(5). Finally, the average losses of ecological services "Pm" - *defined in (2)* - is multiplied by the discount factor "f" - *defined in (3)* - and by the damaged surface area "S" - *defined in (4)* - *i.e.:*

P = Pm * f * S = (35/100)*1*6.8 = 2.38.

In 2007, an average of the interim losses of resources of 2.38 "hectares/year" was obtained, i.e. 2.38 hectares on which no ecological service was provided in 2007.

The same calculation is then repeated for each consecutive year constituting the period of impact and the discounted interim losses are added up.

Thus, from 2007 to 2010, the interim losses of services amounted to **7.76 hectares/year** in sector S1. They are **0.46 ha** for sector S2. The total interim losses for the entire damaged area is estimated at **8.22 hectares** on which no service was provided between 2007 and 2010.

Calculation of gains from the remediation project retained

The gains are estimated in percentage of services obtained over a restored unit (one hectare). The reference year must be the same year chosen to estimate the interim losses.

To estimate the gains, it is necessary to:

- determine the level of services on the site after the damage occurred in the case of *in situ* remediation or the initial level of services on a site similar to the damaged site in the case of *ex situ* remediation,
- estimate the gain,
- estimate the lifespan of the remediation project, i.e. when the expected benefits shall be obtained.

[27] In the assumption where the accident would have occurred in March (i.e. 3 months of service provided at 70% and 9 months at 0%), the average level would have been calculated in the following way: (((3/12) x (70/100)) + ((9/12) x (0/100))) x 100) = 17.5%

Phase	❶	❷	❸	❹	❺	❻	❼

The mathematical formula for calculating the gains is the following:

$\sum_{t=0}^{t=n} (1 \times b_t) \times 1/(1+r)^{(t-T)}$	t = 0 is the year when the project starts to provide remediation gains t = n is the year when the project no longer provides remediation gains 1 is the unit of remediation (e.g.: 1 hectare) bt represents the level of services (in%) gained thanks to the project compared with the environment's baseline condition r: discount rate (4%) $1/(1+ r)^{(t-T)}$: discount factor T: reference year for the discounting (often $T = t_0$) corresponding to the year the damage occurred.

An annual gain, for 1 ha, is calculated by multiplying the gain in service for the year (b_t) by the discount factor $1/(1+r)^{(t-T)}$.

The gains obtained per unit restored are calculated **on a year-by-year basis throughout the entire period of impact** (positive) of the project (i.e. from the year the remediation project was implemented to the end of the project's lifespan) and are then added up to correspond to the overall gains discounted for the remediation project.

Phase	❶	❷	❸	❹	❺	❻	❼

HEA method - Calculation of the gains from the remediation project in the case of the Gave d'Aspe accident

Previously, the following assumptions were put forward:
- initial level of ecological services on the site before the damage occurred: 70%
- level of services on the site after the damage occurred: 0%
- the two remediation projects retained correspond to an in situ (P01) river bank remediation project and to an ex situ (P02) project for installing grass strips. But only the calculation for the in situ project's gains is described below.
- project lifespan: 10 years.
- the level of services of the Gave d'Aspe will increase by 10% compared with the baseline condition (i.e. an 80% level of services restored) from the first year and will remain constant for the next 9 years.
- damaged surface area: 6.8 ha

Discounted ecological service gains per hectare restored (P01)

Year	Level of services (%)		Average level of services (%) *(1)*	Average service gains (%) *(2)*	Discount factor *(3)*	Surface area (in ha) *(4)*	Unit gains (%) *(5)*
	Start of year (Sd)	End of year (Sf)	Sm	Gm	$f = 1/(1+r)^{(t-T)}$	S = 1	G
	$Sd_{initial}$	Sf_{final}	Sm = (Sd + Sf)/2	Gm = Sm - 0	r = 4%		G = Gm*f*S
2008	0	10	5	5	0.96	1.00	4.81
2009	10	10	10	10	0.92	1.00	9.25
2010	10	10	10	10	0.89	1.00	8.89
2011	10	10	10	10	0.85	1.00	8.55
2012	10	10	10	10	0.82	1.00	8.22
2013	10	10	10	10	0.79	1.00	7.90
2014	10	10	10	10	0.76	1.00	7.60
2015	10	10	10	10	0.73	1.00	7.31
2016	10	10	10	10	0.70	1.00	7.03
2017	10	10	10	10	0.68	1.00	6.76
						Total	**76.30%**

Calculation of discounted ecological service gains per hectare restored for each year of gains:
(1). As the level of ecological services is 0% at the beginning of 2008 and 10% at the end of the year, the average level of services provided is therefore 5% for 2008:
Sd = 0; Sf = 10; Sm = (Sd + Sf)/2 = (0 + 10)/2 = 5
(2). The ecological service gains are calculated by deducting the average level of services provided from the initial level of services, which for 2008 are 5 – 0 = 5%
(4). The surface area of the sector is set at one hectare because the calculation concerns the ecological service gains provided by the project over on hectare restored.
(5). Finally, the average gains of ecological services "Gm" - *defined in (2)* - is multiplied by the discount factor "f" - *defined in (3)* - and by the damaged surface area "S" - *defined in (4)* - *i.e.:* G = Gm * f * S = (5/100)*0.96*1 = 4.81
Thus, an average gain of ecological services of 4.81% in 2008 per "hectare restored".
The gains are then calculated in the same way up to 2017. The *in situ* compensatory remediation project in the Gave d'Aspe shall provide **76.30% of additional services per hectare restored within the next 10 years**. For the *ex situ* project for installing grass strips, the gains from the remediation project were estimated at **71.59% per hectare** within the next 10 years.

Phase	❶	❷	❸	❹	❺	❻	❼

Calculation of the equivalency

> *Reminder: equivalency requires the compensatory project to be scaled such that the losses from the damage are equal to the gains provided by this project. The scaling (the number of units to be restored) is calculated by the ratio between determination of the losses (the number of hectares no longer providing services) and determination of the gains (percentage of services obtained over one hectare restored).*

Number of hectares no longer providing services (losses)/percentage of services obtained over one hectare restored (gains) = number of hectares to be restored.

The result is expressed in number of hectares to be restored (to possibly then be converted into another unit such as for example linear metres of waterway).

HEA method - Calculation of the equivalency in the case of the Gave d'Aspe accident

The total interim losses obtained for the two damaged sectors amounts to 8.22 hectares. The in situ remediation project considered provides a gain in ecological services of 76.30% per hectare restored.

By applying the previous ratio, this gives: 8.22/0/0.7630 = 10.77.

The *in situ* compensatory remediation project on the Gave d'Aspe must be implemented over a surface area **of 10.77 hectares,** rounded up to 11 hectares, i.e. approximately 6.3 kilometres of the Gave or 12.6 kilometres of river banks.

For the *ex situ* remediation project, the ratio is: 8.22/0.7159, i.e. implementation of the remediation project over a surface area of **11.48 hectares,** rounded up to 11.5 ha. This surface area to be restored is larger than in the case of the in situ remediation project where the gains are lower (71.59% compared with 76.30%).

REA method

Calculation of interim losses

Interim losses are expressed in "resource-year" unit (number of individuals lost per year).

Several parameters must be defined in advance to estimate the losses:

- the initial level of resources on the site before the damage occurred,
- the level of resources on the site after the damage occurred,
- estimation of the loss,
- estimation of the rate and pace of natural recovery. The rate of natural recovery must be estimated in order to determine the year when the losses shall finish.

Phase	❶	❷	❸	❹	❺	❻	❼

The mathematical formula for calculating the losses is the following:

$\sum_{t=0}^{t=n} (R_t * d_t) * 1/(1+r)^{(t-T)}$	t = 0: year when the losses start t = n: year when the losses finish Rt: parameter of the damaged resource in year t dt: loss related to the parameter of the damaged resource in year t compared with the environment's baseline condition r: discount rate (4%) $1/(1+r)^{(t-T)}$: discount factor T: reference year for the discounting (often $T = t_0$) corresponding to the year the damage occurred.

In year t, an annual loss is calculated by multiplying the number of damaged resources (R_t x d_t) by the discount factor $1/(1+r)^{(t-T)}$.

Discounted interim losses are calculated **on a year-by-year basis throughout the entire period of impact** (i.e. from the year in which the accident occurred to the year corresponding to when the environment returns to its baseline condition) and are then added up to correspond to the overall discounted interim losses.

Phase	❶	❷	❸	❹	❺	❻	❼

REA method - Calculation of the interim losses in the case of the Gave d'Aspe accident

As data could only be collected on Brown Trout, implementation of the REA method therefore only concerned this resource. Previously, the following assumptions were put forward:
- the initial level of resources was evaluated at 1,949 individuals. Effectively, the average of the electrical fishing carried out by EDF (in view of controlling the impact of dams on the Gave d'Aspe's operation) over the 5 years before the damage occurred was used to estimate an average number of trout per hectare, i.e. 1,949 individuals.
- the level of resources after the damage occurred was evaluated at 0%,
- the rate of recovery was set at 3 years according to a semi-logarithmic rate (50% of resources recovered in the first year, 30% the 2nd and 20% the 3rd year)
- the estimation of the loss concerns a surface area of 6.8 ha.

Calculation of the discounted interim losses on the most significantly damaged sector (S1)

Year	Level of resources		Average level of resources (%) (1)	Average losses of resources (%) (2)	Discount factor (3)	Surface area of the sector (in ha) (4)	Number of discounted resources lost (5)
	Start of year (Rd)	End of year (Rf)	Rm	Pm	$f = 1/(1+r)^{(t-T)}$	S = 6.8	P
	$Rd_{initial}$	RF_{final}	Rm = (Rd + Rf)/2	Pm = Rdi-Rm	r = 4%		P = Pm*f*S
2007	1,949	0	975	975	1.00	6.80	6,627
2008	0	975	487	1,462	0.96	6.80	9,558
2009	975	1,559	1,267	682	0.92	6.80	4,289
2010	1,559	1,949	1,754	195	0.89	6.80	1,178
						Total	**21,651**

Calculation of the discounted interim loss for 2007:

(1). The number of trout was estimated at 1,949 individuals per hectare before the damaged occurred, which corresponds to the initial level of resources. After the ecological damage occurred in June 2007, the number of trout was estimated at 0 for the end of 2007 (several documents state total mortality over the first linears of the flow of the Gave). With a level of resources of 1,949 individuals/ha at the beginning of the year and 0 at the end of the year, the average level of resources is 975 for 2007.

(2). The average losses of trout throughout the year are calculated by deducting the average initial level number of resources of trout present in the waterway:

Rdi = 1,949; Pm = Rdi - Rm = 1,949 – 975 = 975. For 2007, the average loss of trout is 1,949-975 = 975.

(5). Finally, the losses of resources "Pm" - *defined in (2)* - is multiplied by the discount factor "f" - *defined in (3)* - and by the damaged surface area "S" - *defined in (4) - i.e.:*

P = Pm * f * S = 975*1*6.8 = 6,627. Thus, this gives an average of the interim losses of resources of "trout" of 6,627 individuals in 2007.

Finally, in sector S1 alone, analysis of the interim losses using the REA method estimates **the "discounted" number of trout lost to be 21,651** between 2007 and 2010. The interim losses in S2 are estimated at 1,282.

Phase	❶	❷	❸	❹	❺	❻	❼

Calculation of gains from the remediation project retained

The following needs to be obtained in advance to determine the gains:

- the level of resources on the site after the damage occurred in the case of *in situ* remediation or the initial level of resources on a site similar to the damaged site in the case of *ex situ* remediation,
- estimation of the gain,
- estimation of the lifespan of the remediation project and when the expected benefits shall be obtained.

N.B.: the losses and gains concern the same resource as the equivalency between loss of resources and gain in resources is the basic assumption determining the scaling.

The mathematical formula for calculating the gains is the following:

$$\sum_{t=0}^{t=n} (1 * b_t) * 1/(1+r)^{(t-T)}$$

t = 0 is the year when the project starts to provide remediation gains
t = n is the year when the project no longer provides remediation gains
1 is the unit of remediation (e.g.: 1 resource)
bt represents the number of units of resources gained thanks to the project compared with the environment's baseline condition
r: discount rate (4%)
$1/(1+r)^{(t-T)}$: discount factor
T: reference year for the discounting (often T = t_0) corresponding to the year the damage occurred.

The gains obtained per unit of remediation are calculated **on a year-by-year basis throughout the entire period of impact** (positive) of the project (i.e. the year during which the remediation project was implemented and throughout the entire duration of the project) and are then added up to correspond to the overall gains discounted for the remediation project.

REA method - Calculation of the gains in the case of the Gave d'Aspe accident

The REA approach could not be completed due to lack of data on the efficiency of the remediation projects retained (fishway, improvement of knowledge). Complete explanations on this subject appear in the CGDD's collection "Etudes et documents", no. 47 (see bibliography).

Calculation of the equivalency

The scaling of a remediation project is expressed in **number of years during which remediation shall be necessary.** This scaling is calculated using the ratio between the number of resources lost throughout the period of impact and the number of resources restored per year.

Number of resources lost throughout the period of impact (losses)/number of resources restored per year (gains) = number of years to be restored (number of years during which resources should be provided in compensation).

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Value approaches (value-to-value and value-to-cost)

The value-to-value approach

Calculation of interim losses

Interim losses are expressed either as units of "welfare" lost, for example during a recreational activity (unit of fishing trip lost, etc.), or in monetary units, when, for example, welfare is estimated by the willingness to pay method.

The mathematical formula for calculating the losses, common to both approaches, is the following:

$$\sum_{t=0}^{t=n} [(Qn_t * V_{qn}) + (Ql_t * V_{ql})] * 1 / (1+r)^{(t-T)}$$

t = 0: year when the losses start
t = n: year when the losses finish
Qn_t: number of units of resources and/or services lost. This loss is associated to use and non-use value losses of the population affected by the damage
V_{qn} is the value of the resource or service
Ql_t: number of units of resources and/or services used by the population affected by the damage but where the quality is reduced. Qlt represents partial use and non-use value losses as the individuals continue to use the resources or services with diminished quality.
Vql corresponds to the value associated to the resources and/or services with diminished quality
r: discount rate (4%)
$1/(1+r)^{(t-T)}$: discount factor
T: reference year for the discounting (often $T = t_0$) corresponding to the year the damage occurred.

What is a welfare loss?

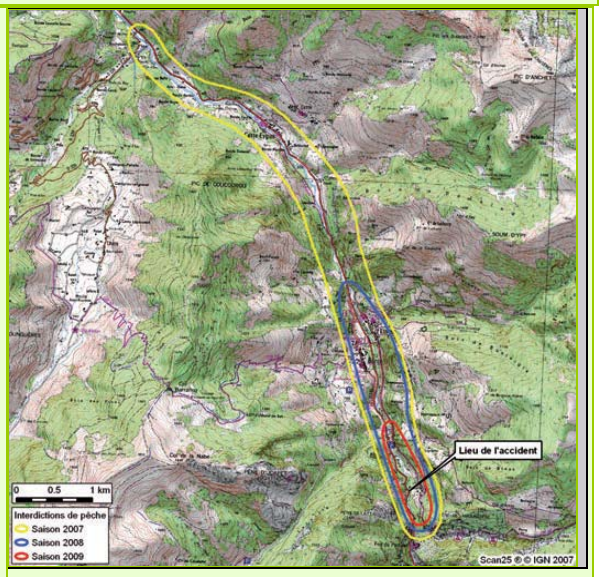
Value approaches mobilise data relating to welfare losses, in particular, related to recreational services. Thus, for example, the temporary inaccessibility to a site due to damage (a beach, a forest, a waterway, etc.) produces a welfare loss. This may concern loss of days at the beach, loss of hiking days, loss of fishing trips or canoe trips, loss of ecotourism related or environmental educational awareness visits, etc.

Phase	❶	❷	❸	❹	❺	❻	❼

Value-to-value approaches: Calculation of the interim losses in the case of the Gave d'Aspe accident

The Gave d'Aspe damaged by the accident is a preferred site for fishing for several reasons: the abundance of fish populations (mainly Brown Trout and sculpin), the beautiful landscape, the quality of the waters and its accessibility (proximity of the RN 134). Following the accidental spillage of potassium hydroxide into the Gave d'Aspe in June 2007, several fishing bans were put in place between 2007 and 2010. In 2010, this ban was completely lifted.

The damaged area could therefore be divided into 3 sectors corresponding to the 3 successive fishing bans. In 2007, the fishing ban covered 8.5 km (outlined in yellow), then 4 km in 2008 (in blue) and only 1.5 km in 2009 (in red). The interim losses were identified for each sector then discounted. The value approach that was tested is based on estimation of the fishing trips lost.



Interim losses in sector 1

Calculation of the interim losses in sector 1 involves calculating the interim losses for 2007. For this sector, available data produces the average figure of 450 fishing trips made annually. Following the accident occurring in June 2007, the fishing ban only came into force over half of the year but involved the busiest months. 340 fishing trips lost can be evaluated for 2007, corresponding to ¾ of the fishing trips made annually. This estimation is based on various surveys on recreational fishing visits.

Interim losses in sector 2

Calculation of the interim losses in sector 2 involves calculating the interim losses for 2008. The number of fishing trips lost can be estimated at approximately 200.

Interim losses in sector 3

This calculation in sector 3 involves calculating the interim losses for 2009. The number of fishing trips lost can be estimated at approximately 80.

Calculation of total interim losses

The simple sum of the discounted interim losses for sectors 1, 2 and 3 gives the total interim losses according to the value approach.

Total discounted interim losses in number of fishing trips

Years	Number of fishing trips lost	Discount factor	Number of discounted fishing trips lost
	N	$f = 1/(1+r)^{(t-T)}$	Na = N*f
	(1)	*(2)*	*(3) = (1)*(2)*
2007	340	1.00	340
2008	200	0.96	192
2009	80	0.92	74
			606

Between 2007 and 2010, 606 fishing trips were lost due to the Gave d'Aspe accident and the subsequent fishing bans.

Phase	❶	❷	❸	❹	❺	❻	❼

Calculation of gains from the remediation project retained

The gains obtained correspond to a number of units of leisure provided by the remediation project (e.g. fishing trips) or the related monetary value.

The mathematical formula used is the following:

$$\sum_{t=0}^{t=n} (1 * q_t * V_t) * 1/(1+r)^{(t-T)}$$

t = 0 is the year when the project starts to provide remediation gains

t_n is the year when the project no longer provides remediation gains

1 is the unit of remediation (e.g.: a recreational activity)

q_t represents the degree of improved welfare resulting from a unit of remediation compared with the baseline condition

V_t is the increase in value (in terms of welfare) related to the degree of improved welfare from a unit of remediation

r: discount rate (4%)

$1/(1+r)^{(t-T)}$: discount factor

T: reference year for the discounting (often $T = t_0$) corresponding to the year the damage occurred.

Phase	❶	❷	❸	❹	❺	❻	❼

Value-to-value approach - Calculation of the gains from the remediation project in the case of the Gave d'Aspe accident

The remediation project retained for the Value-to-Value approach is the establishment of a fishing corner in the municipality of Accous on the Berthe river, a tributary of the Gave d'Aspe (the latter having a fishing ban).

The project involves developing the river and its surrounding area. The project's life span is 15 years and involves one kilometre along the banks. The remediation gains are estimated at 30 fishing trips per year. In addition, this project aims to increase the fish stock and therefore increase the number of fish caught per trip. This increase in the number of fish caught per trip is 10% after 2 years with linear progression (5% the first year then 10% the second year). After 15 years, the gains from the remediation project are estimated at **365 fishing units** (details above) for one kilometre of banks restored.

Estimation of gains from the remediation project

Years	Number of fishing trips	Increase in number of fish caught	Discount factor	Gain in fishing unit restored
	-1	(2)	(3)	(4) = (1)*(2)*(3)
	N	A	$f = 1/(1+r)^{(t-T)}$	G
2008	30	5	0.96	30.29
2009	30	10	0.92	30.51
2010	30	10	0.89	29.34
2011	30	10	0.85	28.21
2012	30	10	0.82	27.12
2013	30	10	0.79	26.08
2014	30	10	0.76	25.08
2015	30	10	0.73	24.11
2016	30	10	0.7	23.19
2017	30	10	0.68	22.29
2018	30	10	0.65	21.44
2019	30	10	0.62	20.61
2020	30	10	0.6	19.82
2021	30	10	0.58	19.06
2022	30	10	0.56	18.32
				365.46

Calculation of the equivalency

In the case of the value-to-value approach, the result is **either the number of welfare units to be restored** (for example, units of leisure to be restored**), or the monetary value of the welfare gain attributed to the remediation operation.** The equivalency is calculated by the ratio between the welfare loss related to the units of leisure lost and the welfare gain obtained on a unit of leisure restored.

Phase	❶	❷	❸	❹	❺	❻	❼

Value-to-value approach - Calculation of the equivalency in the case of the Gave d'Aspe accident

Calculating the losses helps to determine that 606 fishing trips were lost. If 1 km of banks restores 365 units of fishing, in total 606/365 or 1.6 km of banks should be restored.

The value-to-cost approach

In the case of the value-to-cost approach, rather than ensuring that the losses equal the gains, the complementary and/or compensatory remediation project should be sized so that the **monetary value of the welfare losses equals the cost of the remediation project.**

The risk in such an approach is that remediation **does not compensate for all of the losses or, on the other hand, it compensates for them too much**. Therefore, there is no guarantee that the remediation project will accurately compensate for the welfare losses. This is one of the reasons why the ELL only recommends the value-to-cost approach as a last resort.

Value-to-cost approach: calculation of the interim losses in the case of the Gave d'Aspe accident

By taking the case of the accidental spillage of potash lye into the Gave d'Aspe, this method can be applied based on a welfare loss approached by the loss of fishing trips. It is simply the case of taking the elements for calculating the value-to-value approach then converting them into monetary units. The project shall be scaled based on the available amounts.

Years	Number of fishing trips lost	Value of a fishing trip (in €)	Discount factor	Discounted value of fishing trips lost
	N	V	$f = 1/(1+r)^{(t-T)}$	Va = N*V*f
	(1)	*(2)*	*(3)*	*(4) = (1)*(2)*(3)*
2007	340	10	1.00	3,400
2008	200	10	0.96	1,923
2009	80	10	0.92	740
				6,063

The value of a fishing trip was determined based on administered prices, i.e. the price of the general public daily fishing permit in force in the sub region of Pyrénées-Atlantiques, i.e. 10 euros.

Calculating the interim losses therefore shows a welfare loss evaluated at 6,063 euros. This amount corresponds to the cost of the remediation project.

Estimation of the remediation costs

Estimation of the remediation costs must include:

- the cost of primary remediation (e.g.: clean-up of the site, treatment of animal carcasses, etc.),
- the cost for identifying and implementing the remediation project retained,
- the cost of scientific monitoring for evaluating the remediation project.

Phase	❶	❷	❸	❹	❺	❻	❼

In the case of the Gave d'Aspe accident, the remediation costs calculated according to the various approaches are shown below.

Analysis of the costs of damage to the Gave d'Aspe according to the various approaches

	In situ HEA approach	*Ex situ* HEA approach	Value-to-value approach	Value-to-cost approach
Cost of the compensatory remediation	€29,463	€29,463	€29,463	€29,463
Cost of the remediation project	€37,800	€74,620	€12,800	€6,063
Remediation project evaluation and monitoring costs	€30,000	€17,220	€8,760	
Total cost	**€97,263**	**€121,303**	**€51,023**	**€35,526**

Details for estimating the cost of primary remediation in the case of the Gave d'Aspe accident

This estimation is based on the actions taken immediately after the accident. It includes the labour costs for removing fish carcasses, their treatment costs (rendering), the operational losses suffered by EDF when increasing the waterway's flow rate and finally the costs of monitoring this primary remediation.

Removal of carcasses

6 people needed to work for 2 days to remove the dead fish.

Thus, the salary cost of removing the carcasses was estimated at €3,967.

Treatment of carcasses

The cost for treating carcases was evaluated based on the fish census and estimation of the corresponding biomass.

Total theoretical number of individuals per hectare: 1,949.

Average weight of each individual: 44.9 g.

Theoretical biomass per hectare: 87 kg.

As a reminder, sector S1 represents 6.8 hectares. In this sector where the mortality was total, 13,253 trout

(1,949 x 6.8 = 13,253) were therefore affected by the accident. Sector S2 measures 1.7 hectares, and the mortality there was declining. By applying the same environmental conditions to the survival rate (in terms of ecological services), after the accident (level of services changing from 70% to 35%), a survival rate of ½ can be presumed. In sector S2, 1,657 trout

(1,949 x 1.7 x ½ = 1,657) were therefore theoretically affected by the accident.

The number of dead fish in the two sectors can be estimated at 14,910 (13,253 + 1,657 = 14,910). This estimation based on available data corroborates the field results obtained the day the accident occurred as the press release published on 6 June 2007 by the Prefecture of Pyrénées-Atlantiques stated the number of dead fish as being between 12,000 and 15,000.

Bearing in mind that the initial theoretical population was 1,949 individuals per hectare for a biomass of 87 kg, the dead individuals represent 666 kg (14,910 x 87/1,949 = 666). The circular published by the French Ministry for Agriculture and Fishing, DGPEI/SDEPA/C2006-4061, set the cost per tonne of carcasses[28] at €348.46. In the case of this accident, this therefore amounts to a cost of €232.07 (348.46 x 666/1,000 = 232.07).

[28] The circular published by the French Ministry for Agriculture and Fishing, DGPEI/SDEPA/C2006-4061, of 2 August 2006, "restructuring of the public rendering service (SPE)", Annex 3 "national market financial offers accepted", sub region 64.

Phase	❶	❷	❸	❹	❺	❻	❼

Leaching of the Gave d'Aspe

The environmental damage caused was attenuated and controlled mainly due to leaching of the Gave d'Aspe. EDF effectively carried out several releases of water from the dams located upstream of the section of polluted river, which thanks to the flushing effect, brought the flow rate of the Gave d'Aspe to 7.5 m^3/s. An EDF document published in June 2010 assessed the amount for the losses caused at 120 MWh. The amount for this leaching can be evaluated at the price of the MWh not sold because not produced (€110 in June 2007). The leaching cost for the Gave d'Aspe is therefore €13,200.

Primary remediation monitoring costs

Primary remediation monitoring must check that the Gave d'Aspe returns to its baseline condition and monitor its recovery. For this, visual observations, electrical fishing and analyses on benthic invertebrates were carried out.

Monitoring was carried out for 3 years following the damage.

The Pyrénées-Atlantiques federation for fishing and protection of aquatic environments produced a financing plan evaluating the cost of this monitoring over 3 years. Based on this study, the primary remediation monitoring cost can be estimated at €12,063.44.

By adding up all of these costs, the primary remediation can be evaluated at approximately **€29,463**.

Details for estimating the cost of the compensatory remediation project (HEA approach) in the case of the Gave d'Aspe accident

Estimation of the implementation costs for the remediation project P01

The cost for remedying the banks can be estimated based on several documents that give an approximation of the cost of such projects in contexts similar to the Gave d'Aspe. Thus, "the river contract assessment" of the Gave de Pau evaluates such a project at 25 'working days'per kilometre of bank for rivers that are similar to the Gave d'Aspe.

In the case of project P01, 12.6 km of banks require such remediation. This project therefore represents a value of 315 'working days'. The same document sets the 'working day' at €120, therefore the cost of the compensatory remediation project is evaluated at **€37,800**.

Estimation of the implementation costs for the remediation project P02

As a reminder, the *ex situ* remediation project on the Gave d'Aspe must be implemented over a surface area of 11.48 hectares.

The cost of this project may be divided into two components:

-the cost of installing grass strips: €500/ha, i.e. 500*11.48 = €5,740

-the operating losses: €600/ha/year, i.e. 600*11.48*10 = €68,880

Based on this, the cost of the *ex situ* remediation project P02 is estimated at **€74,620**.

Monitoring and evaluating the remediation of projects P01 and P02

As recommended in the REMEDE report, the remediation project must be monitored in order to evaluate its efficiency.

For the *in situ* remediation project P01, the cost of such monitoring is estimated at €3,000/year. As project P01 covers 10 years, the total cost of such monitoring is **€30,000**.

For the *ex situ* remediation project P02, the cost of such monitoring is estimated at €150/ha/year. As project P02 covers 10 years, the total cost of such monitoring is 150*11.48*10 = **€17,220.**

Phase	❶	❷	❸	❹	❺	❻	❼

Details for estimating the cost of the compensatory remediation project (value-to-value approaches) in the case of the Gave d'Aspe accident

For all of the actions mentioned in this remediation project, the various documents collected evaluate the cost of developing the river and its banks at €8,000 for one kilometre of bank restored. In the case of damage to the Gave d'Aspe, the remediation project covers 1.6 kilometres. This remediation project can therefore be estimated at **€12,800.**

The cost of monitoring the remediation project is estimated at €360 for the first year then at €600 for subsequent years. As the duration of this project is estimated to be 15 years, the total monitoring cost is therefore €8,760, i.e. (360*1) + (600*14) = **€8,760.**

The costs of evaluating the damage and identifying remedial measures must be added to these remediation costs, which within the framework of this example, amounts to €160,000.

Phase	❶	❷	❸	❹	❺	❻	❼

Phase 6: Sensitivity analysis

This phase describes how to vary a parameter that was the subject of an assumption in order to assess its influence on the scaling result obtained.

Sensitivity analysis **assesses the influence of the various assumptions put forward** on the scaling result obtained by using equivalency methods or value approaches.

This involves varying each parameter in turn (and one at a time).

The parameters that may be the subject of a sensitivity analysis are, for example, the following (variables based on the approach used):

- the levels of ecological services, resources at baseline condition and after the damage occurred,
- the rate and pace of recovery (shape of recovery curves),
- the number of welfare units lost,
- the longevity of the chosen remediation project and its impact, etc.

The discount rate may also be the subject of a sensitivity analysis. However, as the latter is set irrespective of the damage, this analysis will only be of limited importance: it may however be carried out, in particular, for educational purposes. Such an analysis was carried out within the scope of implementation of the various approaches to the Gave d'Aspe accident (see E&D 47). It concludes that the discount rate plays a relatively minor role in the results obtained: effectively, the scaling of the *in situ* project obtained with the HEA approach and a discount rate of 4%, was 10.8 ha. With a rate set at 2%, this scaling would have been 9.9 ha and 11.7 ha for a rate of 6%.

In most cases, sensitivity analysis **puts the consequences** of the choice of a parameter's value **into perspective** (by showing the magnitude of the results) and usefully guides the members of an advisory committee, if one exists, before a decision is made on a specific assumption.

Phase	❶	❷	❸	❹	❺	❻	❼

Sensitivity analysis of the HEA method applied in the case of the Gave d'Aspe accident

The sensitivity analysis carried out concerned the level of ecological services at baseline condition and after the accident and the shape of the recovery curves.

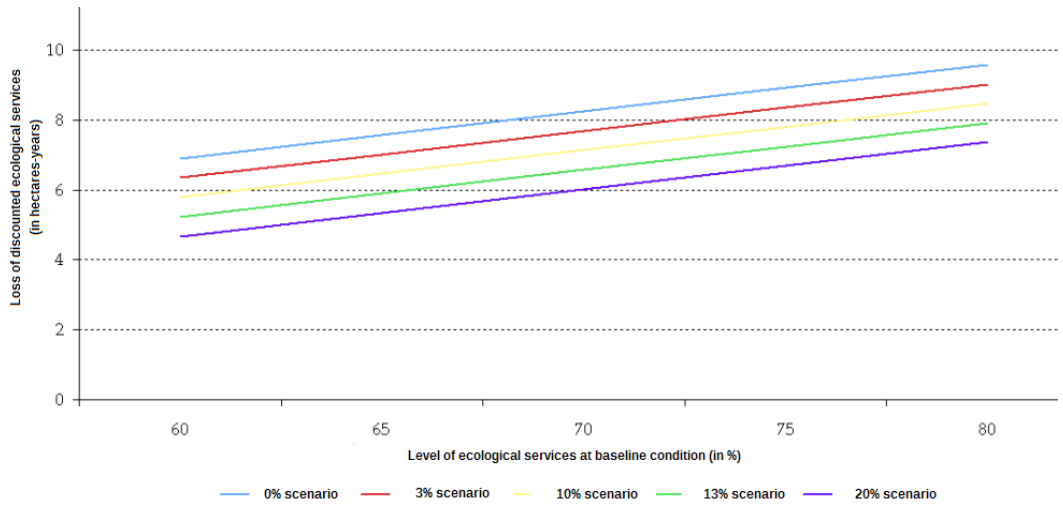
1. Assumptions on the levels of ecological services

In sector S1, the levels of ecological services at baseline condition and after the accident are respectively set at 70% and 0% and produce a discounted loss of surface area of 8.2 hectares. The sensitivity analysis varies these two parameters and calculates the direction and magnitude of the differences observed (the variation chosen for the parameters is deliberately exaggerated to show the impacts better).

Variation of the discounted loss of surface area according to the level of ecological services (at baseline condition and after the accident)

		Level of ecological services at baseline condition (in%)				
	% of ecological services	60	65	70	75	80
Level of ecological services after the accident (in%)	0	6.90	7.57	**8.24**	8.91	9.58
	5	6.34	7.01	7.68	8.35	9.02
	10	5.78	6.46	7.13	7.80	8.47
	15	5.23	5.90	6.57	7.24	7.91
	20	4.67	5.34	6.01	6.69	7.36

Graphical representation of the results obtained



The straight lines illustrate the relationship between the variation of the discounted loss of surface area according to the level of ecological services at baseline condition and after the accident. They show compacted straight lines with a slight gradient. If the variation of the results based on modification of each parameter was significant, then the gradients of the straight lines would be much steeper.

Phase	❶	❷	❸	❹	❺	❻	❼

2. Assumptions on the shape of the recovery curves

The initial evaluation presumed natural recovery curves with a semi-logarithmic shape (in blue in the figure below).

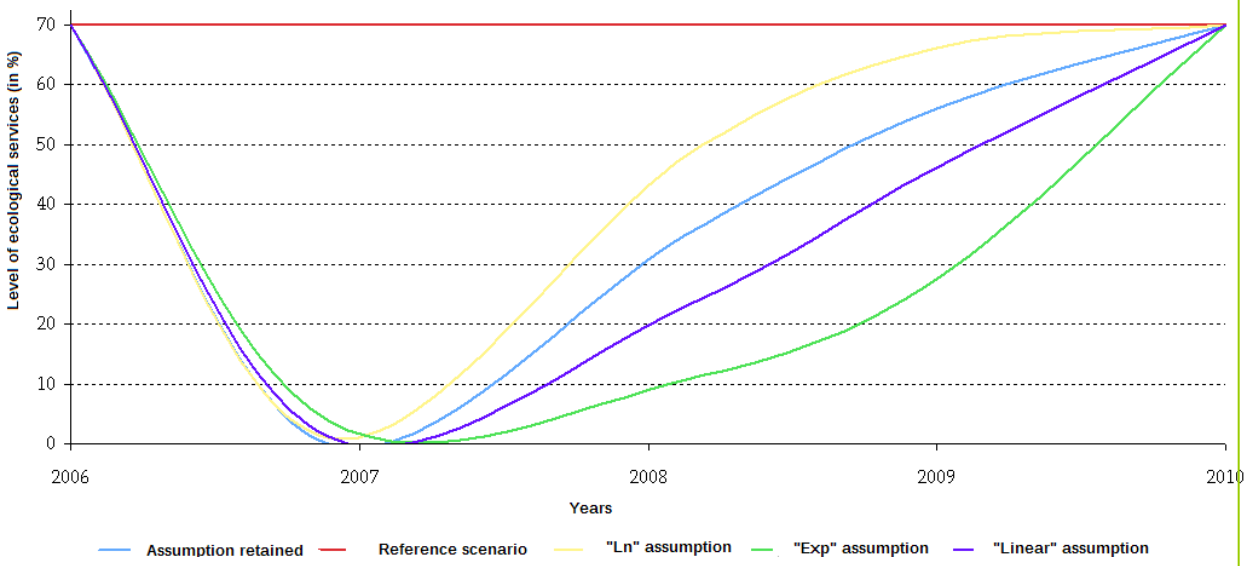
The sensitivity analysis shows the results obtained for a linear, logarithmic or exponential recovery curve shape.

The table below gives the various estimations of the interim losses related to each type of scenario for sector S1.

Variations in discounted surface area losses in sector S1 according to four natural recovery rate scenarios (logarithmic, semi-logarithmic, linear and exponential)

Scenario chosen	Discounted surface area losses for S1
"Ln" assumption	6.25 ha
Assumption retained	7.76 ha
"Linear" assumption	9.06 ha
"Exponential" assumption	10.8 ha

Graphical representation of the results obtained



The previous graph and table also show low variability of the results obtained despite the shapes of the different recovery curves.

Phase	❶	❷	❸	❹	❺	❻	❼

The sensitivity analyses already carried out demonstrate that some of the assumptions made **are more significant than others**.

The damaged surface area, the date the damage occurred, the date when compensatory remediation started and the resource service level restored after implementing primary and/or complementary remedial measures should be retained from the **significant assumptions**.

The resource service level at baseline condition and after the accident, the rate of recovery and the shape of the recovery curve can be identified from the **less significant assumptions**.

These results are confirmed by the 2004 Dunford et al. study.

Phase	❶	❷	❸	❹	❺	❻	❼

Phase 7: Remediation, monitoring and evaluation plan

This phase describes how to finalise the file proposing the remedial measures (preparation of a remediation plan) and discusses the monitoring actions to be implemented after the work has been carried out.

Preparation of a remediation plan and execution of the work

Preparation of a remediation plan

After the remediation project has been defined, **a remediation project implementation plan (or forward programme)** should be prepared, similar to a conventional management information form or plan.

The latter may include, but is not limited to, the following sections:

- **origin of the project and brief description**: reminder of the events causing the damage, chronology of the process for determining the remediation project, brief description of the project retained, objectives and expected results,
- **basic information about the site** on which the project shall be implemented: characteristics of the site and its surrounding environment (location, surface area, geology, hydrology, vegetation, etc.), ecological data (habitats and species present, ecological functioning, etc.), description of past and present uses of the sites, etc.,
- **detailed description of the project**: description of the characteristics to be obtained, schedule and implementation time frames, technical description of the interventions/work considered and possible management measures,
- **description of the monitoring actions**: monitoring of the project's implementation and scientific monitoring (indicating details of the methodologies retained),
- **estimated cost of the project**: indicate the annual cost of the project and its total cost, integrating all of the related monitoring costs.

N.B.: The preparation of this remediation plan is the last part of the file that the operator must compile when the ELL is applied.

Phase	❶	❷	❸	❹	❺	❻	❼

Execution of the work

After the required work has been carried out, the operator liable for the damage informs the competent administrative authority. The latter shall confirm that the work has been carried out via a report (R.162-18). This report is then sent to the operator, the land owner and the mayor or president of the EPCI responsible for town planning.

If an advisory committee was set up, it may be notified of the work carried out through the most appropriate means, such as a meeting or group travel to the site (depending on the magnitude of the damage or local sensitivities).

Monitoring and evaluation - Monitoring report

Regular monitoring (planned on a case-by-case basis by the remediation plan) is carried out by the operator liable for the damage. This operator drafts an evaluation and monitoring report on the remediation project implemented, for the attention of the competent administrative authority (and possibly members of the advisory committee).

An article in the order of requirement of remedial measures may be dedicated to the modalities for submitting such a report.

Remediation project monitoring actions should evaluate and check the effectiveness of the actions implemented. If necessary, they may highlight an "abnormal" situation and possibly determine whether corrective measures should be considered (possibility offered in Article R.162-19). For this, the administrative authority may rely on the opinion of the advisory committee, if it exists.

However, it should be noted that although corrective measures for remedying damage may be imposed on the operator "at any time", the requirement cannot intervene when more than thirty years have passed since the event giving rise to the damage.

Acronyms

AMD	Order of formal notice
BD	"Birds" Directive
BRGM	French Geological Survey
CDNPS	French Departmental Commission on Nature, Landscape and Sites
CGCT	General Local Authorities Code
CODERST	French Departmental Council for the Environment and Health and Technological Risks
COPIL	Project Steering Committee
CSRPN	Regional Scientific Committee for Natural Heritage
DDT (M)	French Departmental Directorate of Territories (and of the Sea))
DOCOB	Document of Objectives
DPU	Declaration of Public Utility
DREAL	Regional Directorate of the Environment, Planning and Housing
EC	Environmental Code
ELD	Environmental Liability Directive
ELL	Environmental Liability Law
EPCI	French public institution of intercommunity cooperation
EQS	Environmental Quality Standard
GIP	General Interest Project
HD	"Habitats, Fauna and Flora" Directive
HEA	Habitat Equivalency Analysis
IBGN	Standardised Global Biological Index
ICPE	Installation Classified for the Protection of the Environment
IPPC	Integrated Pollution Prevention and Control
LPO	French League for the Protection of Birds
MNHN	National Museum of Natural History
ONCFS	French National Hunting and Wildlife Agency
ONEMA	French National Agency for Water and Aquatic Environments
ORGFH	French regional guidelines on the management and conservation of wildlife and habitats
PDPG	French departmental plan for the protection of aquatic environments and fish resource management
pSCI	proposed Site of Community Importance
PUE	Public Utility Easements
RCO	Operational control network
RCS	Surveillance control network
REA	Resource Equivalency Analysis
REMEDE	Resource Equivalency Methods for Assessing Environmental Damage in the European Union.

SAC	Special Area of Conservation
SAGE	Water Development and Management Scheme
SCI	Site of Community Importance
SDAGE	Master Plan of the Development and Management of Water
SDF	Standard Data Form
SIDPC	French Interservice Defense and Civil Protection
SIE	French water information system (data reference base: SANDRE)
SPA	Special Protection Area
WFD	Water Framework Directive
ZNIEFF	Natural areas of ecological, faunistic and floristic interest

Glossary

Baseline condition	The condition at the time of the damage of the natural resources and services that would have existed had the environmental damage not occurred, estimated on the basis of the best information available. (*source: Environmental Liability Directive of 21 April 2004, L.162-9 EC)* Synonym: initial level
Biocenosis	A group of individuals that live in the same environmental conditions, in a given space. (*source: Vocabulary of the environment published in the OJFR on 4 February 2010*)
Biotope	Geographical area characterised by uniform climatic and physico-chemical conditions providing a living place for specific fauna or flora. (*source: Vocabulary of the environment published in the OJFR on 4 February 2010*)
Compensatory remediation	Any action taken to compensate for interim losses of natural resources and/or services that occur from the date of damage occurring until primary remediation has achieved its full effect. Compensatory remediation shall be undertaken to compensate for the interim loss of natural resources and services pending recovery. This compensation consists of additional improvements to protected natural habitats and species or water at either the damaged site or at an alternative site. (*source: Environmental Liability Directive of 21 April 2004)* *N.B. No confusion should be made between the notions of compensatory remediation and compensatory remedial measure covered within the framework of this guide and the notion of compensatory measure in the sequence "prevent - reduce - compensate" which means "ex ante" and which may highlight residual impacts during the studies carried out upstream of the authorisation of a project or adoption of the planning document.*
Complementary remediation	Any remedial measure taken in relation to natural resources and/or services to compensate for the fact that primary remediation does not result in fully restoring the damaged natural resources and/or services. The purpose of complementary remediation is to provide a similar level of natural resources and/or services, including, as appropriate, at an alternative site. (*source: Environmental Liability Directive of 21 April 2004)*
Conservation status (habitat - species)	For a habitat: means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. For a species: means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. *(source: Directive of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.*
Damage	A measurable adverse change in a natural resource or measurable impairment of a natural resource service which may occur directly or indirectly. (*source: Environmental Liability Directive of 21 April 2004)*

Discounting	A method used to adjust cash flows that cannot be directly compared as occurring on different dates to the same basis, according to three principles: inflation and preference for immediate enjoyment (the "cost of the time") and aversion to risk (the "cost of the risk"). Discounting is not only reserved for financial flows but also applies to natural asset flows. The key variable of discounting is the discount rate (see publication *Études & Documents* no. 42 of the CGDD)
Ecological service	Within the meaning of the ELL, ecological services correspond to "functions ensured by the land, waters and species and habitats for the benefit of one of these natural resources or for the benefit of the public, with the exception of the services provided to the public by developments carried out by the operator or the owner". According to the *Millennium Ecosystem Assessment (MEA, 2005),* these include collection or provisioning services (food, drinking water, wood, fibre, etc.), regulating services (air, climate, floods, disease, etc.), cultural services (recreational, aesthetic, spiritual, etc.) and supporting services (gaseous exchanges, soil formation, etc.)
Ecological status (surface waters)	The ecological status is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters. *(source: Order of 25 January 2010 relating to the methods and criteria for assessing the ecological or chemical status and/or the ecological potential of the surface waters)* For example, good surface water status means the status achieved by a surface water body when both its ecological status and its chemical status are at least "good". (*source: Directive of 23 October 2000 establishing a framework for Community action in the field of water policy)*
Ecosystem	A functional ecological unit formed by the biotope and biocenosis, in constant interaction (*source: Vocabulary of the environment published in the OJFR on 4 February 2010*)
Environmental damage	Direct or indirect measurable impairments to the environment described in Article L.161-1 (see § scope). *(source: Law of 1 August 2008 on environmental liability)* Impairments are assessed for example in relation to the conservation status of habitats or species when the risk of damage or damage occurred (R.161-3 III).
Governance (good governance)	The collective decision-making process characterised by participation, transparency and liability. *(source: L'évaluation des impacts sur l'environnement 3ème édition - André P. & al. - 2010)*
Imminent threat of damage	Sufficient likelihood that environmental damage falling within the scope of the ELL will occur in the near future. *(source: Law of 1 August 2008 on environmental liability)*
Indicator	A summary measure that provides information on the state of, or change in, a system at a given time. (dictionnaire de l'académie française, 9ème édition). The values observed are representative of a phenomenon to be studied. In general, indicators quantify the information by the aggregation of miscellaneous data. Indicators summarise information and may help to highlight complex phenomena. *(source: OECD Core Set of "Environmental Indicators". OECD, 1994)* Synonym: proxy

Indicator species	A species whose spontaneous presence defines certain ecological characteristics quantitatively and qualitatively. *(source: Évaluation de l'état de conservation des habitats et espèces d'intérêt communautaire - Guide méthodologique - MNHN - 2006)*
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. Synonym: provisional losses (*source: Environmental Liability Directive of 21 April 2004)* **Interim losses are compensated for by compensatory remediation.**
Monitoring	Data collected over time in order to check the level of compliance with the objectives set.
Natural range	Geographical range of a habitat or species within which the habitat or species is naturally present (not introduced). *(source: Évaluation de l'état de conservation des habitats et espèces d'intérêt communautaire - Guide méthodologique - MNHN - 2006)*
Operator	Any natural or legal, private or public person who operates or controls the occupational activity or, where this is provided for in national legislation, to whom decisive economic power over the technical functioning of such an activity has been delegated, including the holder of a permit or authorisation for such an activity or the person registering or notifying such an activity. (*source: Environmental Liability Directive of 21 April 2004)* Any natural or legal, private or public person who operates or controls a lucrative or non-lucrative occupational activity. *(source: Law of 1 August 2008 on environmental liability)*
Polluter-pays principle	Economic principle according to which the polluter pays the expenses relating to implementation of the preventive measures for the pollution or the damage that it caused. (*source: Charte de l'environnement, 2004)*
Population	All individuals that belong to the same species and live in the same geographical area at a given time. *(source: Biologie – Campbell, Reece - 2004)*
Preventive measures	Any measures taken in response to an event, act or omission that has created an imminent threat of environmental damage, with a view to preventing or minimising that damage. Synonym: prevention measure (*source: Environmental Liability Directive of 21 April 2004)*
Primary remediation	Any remedial measure which returns the damaged natural resources and/or impaired services to, or towards, baseline condition. The purpose of primary remediation is to restore the damaged natural resources and/or services to, or towards, baseline condition. (*source: Environmental Liability Directive of 21 April 2004)*
Project owner	Natural or legal person who initiated the project subject to authorisation. Synonyms: petitioner, promoter, developer, project initiator. Within the framework of this guide, the project owner is the person who filed the remedial file, i.e. the operator (s) liable for damage.
Recovery	In the case of water, protected species and natural habitats the return of damaged natural resources and/or impaired services to baseline condition. **Natural recovery** means an option in which no direct human intervention in the recovery process would be taken. (*source: Environmental Liability Directive of 21 April 2004)*

Remedial measure	Any action or combination of actions, including mitigating or interim measures to restore, rehabilitate or replace damaged natural resources and/or impaired services, or to provide an equivalent alternative to those resources or services. (*source: Environmental Liability Directive of 21 April 2004)*
Remediation project	Any action or combination of actions to restore, replace or acquire equivalent destroyed natural resources and the services procured. Any remediation project constitutes a remedial measure (but the opposite is not true). In practice, the same remediation project may permit complementary or compensatory remediation. The remediation project may be implemented on the damaged site (*in situ* remediation project) or may not be (*ex situ* remediation project). In this guide, the term "remediation project" should be understood as meaning "ecological remediation project". Effectively, the dictionnaire encyclopédique de l'écologie et des sciences de l'environnement (2ème édition - Ramade F. - 2002) defines remediation as "*varied human interventions the aim of which is to reconstitute terrestrial or aquatic ecosystems damaged or even completely destroyed by humans*". *N.B. No confusion should be made between the notion of compensatory remediation covered within the framework of this guide and the notion of compensatory measure in the sequence "prevent - reduce - compensate" which means "ex ante" and which may highlight residual impacts during the studies carried out upstream of the authorisation of a project or adoption of the planning document.*
Residual losses	Losses that could not be recovered by primary remediation. Residual losses are compensated by complementary remediation.
Resilience	Designates the ability of any community and of any ecosystem taken in its entirety to survive alterations and disturbances in their structure and/or their functioning and, following disappearance of the latter, to recover a condition comparable with the initial situation. *(source: Dictionnaire encyclopédique de l'écologie et des sciences de l'environnement 2ème édition - Ramade F. - 2002)*
Total Economic Value (TEV)	A value providing an all-encompassing measure of the economic value of any environmental asset. It decomposes into use and non-use (or passive use) values, and further sub-classifications. Use value means a value relating to the satisfaction of using or being able to use an environmental asset in the future. Non-use value means a value relating to the satisfaction of knowing that a desirable asset or fact exists. These values are often related to the notions of justice or respect for nature and justify the protection of known species or natural sites. *(source: Cost-benefit Analysis and the Environment: recent developments. OECD, 2007)*
Welfare	Term describing the satisfaction of an individual or local authority. The notion of welfare goes beyond the utilitarian vision to include other dimensions such as the freedom of choice, good social relations and personal safety. *(source: Pareto efficient and optimal taxation and the new welfare economics. Stiglitz J., 1987, Handbook of Public Economics, in: A. J. Auerbach & M.)*

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