EUROPEAN SPATIAL PLANNING
OBSERVATION NETWORK

Project 1.3.1
The spatial effects and management of natural and technological hazards in general and in relation to climate change

2nd Interim Report, August 2003

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PART I

I GENERAL FINDINGS AND RESULTS, SWOT

I.1 Overview on results

The second interim report of the Espon 2006 1.3.1 project focuses on the further development of a typologisation of hazards and regions in EU 27+2. In most chapters this report makes reference to the first interim report than can be downloaded from:
http://www.espon.lu/online/documentation/projects/thematic/thematic_60.html

The main concern of the EU Commission and Espon 2006 was to obtain risk and vulnerability maps concerning several hazards for the entire territory of EU 27+2 (15 EU countries; 10 accession countries; Bulgaria and Rumania; + Norway and Switzerland) on NUTS III level. The final result shall lead to a typologisation of regions concerning their risk and vulnerability profile, both towards single hazards as also towards a combination of hazards. Additionally, these hazards should be analyzed in the light of climate change.

The main result of this report is a first approach towards the typologisation of both hazards and regions in Europe. The methodological approach to achieve these goals consisted of several steps. All hazards are characterised by certain indicators (see chapter 1.1). The hazards were plotted into maps to delineate where certain hazards occur in European regions. As these maps do not contain any information about the regional vulnerability, they are merely hazard maps, not risk maps (see definition of risk in the First Interim Report, pp. 13ff.). Due to the differing character of the selected hazards it is difficult to determine a classification that is valid for all types of hazards. Therefore each hazard is classified on an ordinal scale. The limits of the classes for each hazard depend on the range of the values for each indicator and represent in the end a *relative value*.

Risk maps are generated by a combination of the potential of one hazard or combined hazards and regional vulnerability. The regional vulnerability consists of the components "GDP per capita" and "population density". Risk maps can either show the regional risk towards a certain hazard (see chapters 1.2.1 and 1.2.2) or the aggregated risk towards all hazards (see chapter 1.3). Risk maps also present a *relative value* of risk.

The NUTS 3 level information in Europe is not coherent throughout all the countries. Where possible, NUTS 3 levels were used, in other cases NUTS 2 had to be applied.

The hazards were selected on the criteria explained in the First interim report (chapter 6). Unfortunately, not all hazards could be presented in maps due to lack of data (see chapter 1.1). The hazards, their impact and their magnitude are explained in chapter 1.2, the methodologies of the development of the vulnerability and risk maps are explained in the chapter 1.3. Chapter 1.4 contains European maps of hazards, intensity of hazards, vulnerability of regions and risks. The analyzed hazards are earthquakes, floods (and change in run-off and precipitation to show future trends), volcanic eruptions, winter storms and forest fires (natural hazards), as well as nuclear power plants, oil spills and large dams (technological hazards). Chapter 1.5 reflects upon the state of the art in hazard and risk reduction management, taking conclusions from the case study areas and reviewing existing response indicators. Annex 1 contains detailed results of the case study areas where hazard and risk management is analyzed on a large scale, including analyses of legal frameworks and distribution of responsibilities. Consequently, chapter 2 draws draft guidelines for spatial planning in the issue of hazards and chapter 3 analyses and proposes possible structures of monitoring systems. Chapter 4 finally describes the necessary steps for the development of new indicators. This report contains an updated version of a glossary on the issue of hazards (Chapter II.1).

I.2 Data requests

The project team has submitted several data requests and wants to express special thanks to two of the addressed institutions.

The Geo Risks Research Department of the Munich Reinsurance Company has provided the project with several natural hazard data sets. Additionally, Munich Re was so kind to invite the project and discuss the issue of natural hazards and the possibilities of presenting these in maps in great detail.

The development of the hazard on large dams was only possible by the kind cooperation of the German Committee of International Commission of Large Dams (ICOLD). Currently there is no World Dam Register available on the market because a new register is being prepared. The German Committee of the ICOLD provided the project with the World Dam Register of 1998.

The project identified necessary data sets relevant for showing hazards in maps and sent out data requests on all other indicators. Unfortunately, often without any explanation why, the project did not receive other positive answers than from Munich Re and ICOLD. Especially the cooperation within European Institutions appears to be problematic. The project did not receive any data neither from the major European centre on environmental research nor from the main European agency on environmental issues. Partly, the requested data sets were not available but mainly the project did not receive any answers at all. Also, some EU institutions are preparing a similar reports on hazards but requests for cooperation with the involved teams was rejected.

Consequently, the data had to be searched from other sources than data requests. Most data was found on the WWW and other publications. Mostly, the data had to be digitised manually and various data formats had to be adjusted to each other.

I.3 Indicators

In general, the indicator concept of ESPON 2006 appears to differ from the European Environmental Agency's (EEA). EEA indicators are supposed to follow a story line that is to fit into the Driving Force-Pressure-State-Impact-Response (DPSIR) chain. On the other hand, the ESPON 3.1 project has defined that a time series with comparable meta data is already an indicator itself. This report tries to join these two definitions with the risk concept. A table that sheds light on the DPSIR system and the relevant spatial planning hazard indicators can be found in chapter 1.1. As already described in the first interim report, there are few comparable data sets in Europe that allowed the development of Response indicators.

I.4 Networking towards other Transnational Project Groups (TPG's)

Networking towards other TPG's was undertaken as far as needed for the writing of this report. However, the project 1.3.1 is different from the other ESPON projects and the investigation of data sets emerged as very time consuming in the short time available until the deadline of this report. Therefore only little but very fruitful networking was undertaken, especially with project 1.1.2, Urban- Rural Relationships. In order to meet the demands of the third interim report the networking will be intensified for further indicator development (see chapter 4).

I.5 Common platform

The main contributions of this report to the common platform identified during the seminar in Crete in May 2003 are:

- Contributions to the ESPON database with hazard indicators
- Typologies of regions concerning their risk profile
- A collection of hazard and risk maps
- Policy recommendations

I.6 Envisaged contents for the 3rd interim report

The third interim report will:

1. Be a working report on the main results elaborating the approach introduced in the previous report. It will describe the assistance to the database and the map-making developed under project 3.1. It will also focus on the analysis/diagnosis of hazards in Europe, as well as the existing territorial imbalances and regional disparities based on the research questions of the tender. It will concentrate on developing further indicators and show extended number of available territorial indicators and European maps, as far as possible. Via networking with other TPG's it will try to show interrelationships between the aspects concerning the territorial integration of candidate countries in an enlarged EU.

2. Assist in the development of appropriate tools for the processing of the 3.1 project's data base, indicators and map-making

3. Apply systems for the monitoring and benchmarking of new trends of territorial developments in the context of the European territory, including candidate countries and neighbouring countries

4. Continue the detection typologies of regions revealing risks and potentials for the identified types of regions and create comprehensive risk and vulnerability maps for the EU 27+2 territory

5. Focus on policy recommendations, which could provide the basis for future emphasis of Community interventions post 2006; improve an integrated territorial approach in the management of natural and technological hazards, including institutional settings and instruments. Via networking with other TPG's, particular attention will be paid to peripheral and ultra-peripheral regions.

I.7 SWOT

Table 1. SWOT 1.3.1

ESPON SWOT – Remarks and Notes		
	Remarks formal	**Remarks content (as given by project 1.3)**
Overall remarks	- This SWOT analyzes the technological hazards in EU 27+2 and only occasionally refers to natural hazards.	-
1 Strengths	- Most of the hazards are well known and well studied, regarding both their location and the possible extent of damage in case of an accident. There are international and EU guidelines that regulate the handling of hazardous substances (e.g., the Seveso Directive) and the management of hazardous technologies (e.g. nuclear power plants). For many technological hazards exist national and EU-wide institutions that insure the correct implementation of the guidelines. - Some areas in Europe have fewer technological hazards than others and generally the more dangerous hazards are located in certain safety distances from larger settlements by regulation. - The regulated and safety driven rural location of some hazards (e.g. nuclear power plants) lead to increased employment rates in areas of low working place availability.	- Please show the context of the identified strengths in your thematic field. - Please refer to the spatial dimension. - Please make clear the connection to the ESDP? - Please stick to a status- quo perspective.
2 Weaknesses	- Some hazards are well known but not located, such as waste deposits with hazardous goods (leaching of hazardous substances could contaminate groundwater). - Some regions pose a certain threat because of a high density of technological hazards and a high population density. In worst cases these are combined with potential threats from natural hazards (e.g. industrial plants that produce hazardous substances or nuclear power plants in earthquake prone areas). - Sometimes security legislations are not properly followed (e.g. Prestige oil spill, Aznalcollar tailings dam failure, illegal or mis-used waste deposits). Often also concrete emergency plans are missing. In case of an accident, this can lead to severe pollution and thus a long-term economical and environmental draw back for the development of an entire region. A general problem is the data availability and comparability.	- Please show the context of the identified weaknesses in your thematic field. - Please refer to the spatial dimension. - Please make clear the connection to the ESDP? - Please stick to a status- quo perspective
3 Opportunities	- The existing national (and partly EU wide) legislations and monitoring on safety on hazardous technologies, production of hazardous goods and storage of hazardous substances, including waste. If the EU 27+2 is able to streamline all the necessary safety procedures and their strict monitoring then the threats of technological hazards can be reduced to a so far unknown statistical minimum. - A removal of the production, processing and storing of hazardous goods from areas with natural hazards can increase safety. - If the production, processing and storing of hazardous goods are consequently moved from densely populated areas into low populated areas then the remaining risk of technological hazards affect less people (that are also easier to evacuate in case of an accident). This would also ensure the development of rural areas with high unemployment and low availability of working places.	- Please show the context of the identified opportunities in your thematic field. - Please refer to the spatial dimension. - Please make clear the connection to the ESDP? - Please stick to a future perspective.
4 Threats	- The location of the production, processing and storing of hazardous goods in densely populated areas - The location of the production, processing and	- Please show the context of the identified threats in your thematic field. - Please refer to the spatial dimension. - Please make clear the connection to the ESDP?

	storing of hazardous goods in areas with natural hazards - Contamination and probable long-term pollution of areas in case of mismanagement of production, processing and storing of hazardous goods. Additional threats in case of location in areas with natural hazards.	- Please stick to a future perspective.
5 Driving forces	- Economical and political decision-making of locating the production, processing and storing of hazardous goods in densely populated or less populated areas; as well as naturally relatively safe or hazardous areas. - Diversification of industrial landscape, optimizing of transport - Policy, EU structural funding and/or taxation oriented	- Please try to stick to the requirements of the questionnaire when naming and explaining 3-4 driving forces that build upon the answers of question 1-4. - The driving forces should refer to the thematic and to the spatial dimension. - What about operationalising the driving forces?
6 Typology	- Remark: The following points of this document are filled as far as it is possible at the current stage of the project. - The typology of Regions and the risk potential is based on the hazard types and the vulnerability. The vulnerability of a region is defined by the GDP and the population density, i.e. the higher the population density and the GDP, the higher the vulnerability. Please see chapter 1.3 and 1.4 for details. - A general pattern shows that all of Europe has at least a slight threat of earthquake and forest fires. In general the natural hazards appear to increase in a curve from north eastern Europe (low hazard potential) towards southeastern Europe (high hazard potential). The technological hazards are more abundant in areas with higher population density, also regarding the vulnerability and risk. - A more detailed typology, including driving forces, will be submitted with the next interim report.	- Please try to stick to the requirements of the questionnaire especially concerning the regional level. - The typology should clearly refer to the identified driving forces and should be able to give a spatial pattern of the European territory. - It would be good to describe the development of the typology step by step mentioning the statistical processes the typology is based on.
7 Mapping	- The basic statistical data sets (Eurostat) allow straightforward map making. Adding additional information is very complicated and the map making is a very slow process because data sets have to be collected from different sources and must be harmonized (see below).	- Please try to stick to the requirements of the questionnaire concerning the map-making format and the regional level.
8 Data set	- A general problem in Europe is the data availability, as well as the homogeneity and comparability of data sets. An additional problem is the slow and difficult cooperation between different EU institutions.	- Please try to stick to the requirements of the questionnaire concerning the provision of the data set and its format.
9 Reference to concepts	- These questions can be answered in the next interim report, depending on the cooperation with the other TPG's.	- Answer should refer to the thematic and to the spatial dimension. - Both the concepts of sustainable development and balanced competitiveness should be considered. - The connection between spatial policy and its aims should be made clear.
10 Indicators	- The selection of the hazards for the purpose of this project is explained comprehensively in the first interim report, chapter 6.1ff. Based on this, the available indicators are summarized in a table in this report, chapter 1.1. In short, for now the indicators of this project focus on the various hazards and the vulnerability of a region towards this hazard (expressed by the GDP and the population density). - A general discrepancy appears to be between the definition of indicators of ESPON 2006 and the EEA (DPSIR chain). Meanwhile ESPON 2006 takes a single time line (e.g. unemployment rate) already as an indicator, the EEA requires a story line with crosscutting issues. This project tried to bridge this gap (see chapter 1.1) and will continue to do so in cooperating with other TPG's (next interim report). - The data availability and supply are described above, point 8.	- Please try to stick to the requirements of the questionnaire when naming and explaining 3-4 indicators for each aim. Also comment on your choice of the identified indicators. - What about the aspect of data availability and supply?

11	**Reference to sustainability**	- This will be done in the next interim report.	- Please use the chart for assessing the dimension of sustainability as required in the questionnaire. - Would it be possible to give a short description and comment on the formation of the chart?

II OVERVIEW ON CONCEPTS AND METHODOLOGY AND POSSIBLE FINAL RESULTS

This chapter summarises the concepts and methodology that are used in the ESPON Hazards project. It shortly summarises the main conceptual and methodological findings of the First Interim Report (chapter 6.4) and then concentrates on changes in the methodology and on how to deal with methodological problems. Finally, an overview on possible final results is given.

II.1 Overview on concepts

The overall goal of the ESPON 1.3.1 Action is to analyse the spatial effects and management of natural and technological hazards. As a first step towards developing an appropriate methodology for assessing these hazards it is necessary to have a common and consistent terminology. This requires a thorough understanding of key concepts in order to reach an agreement on common definitions. There are many, partly overlapping or even conflicting concepts that are relevant when dealing with 'hazards'. The concepts can be grouped as follows: The first group revolves around dangers (hazard, risk), the second deals with impacts (damage) the third and fourth with the perception and analysis and the management of risks, whereas the final group of concepts is concerned with vulnerability. Therefore relevant concepts were discussed and operational definitions for the use within the project were identified in the First Interim Report (pp. 8-12; 17-19).

An important basis for the identification of relevant components within the discussed concepts and for their operationalisation is the clarification of their relation to each other. A first general way of distinction is the temporal perspective. When talking about extreme events, damage or disaster, this describes the end-result of a causal chain of events. This "ex post" perspective is illustrated in the following Figure 1.

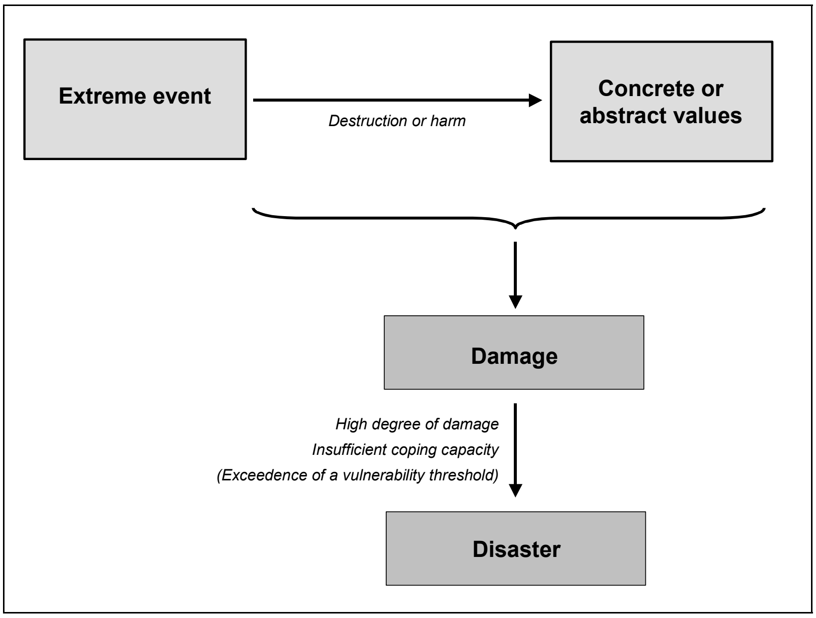

Figure 1: Events and disasters: the ex post perspective
Source: Fleischhauer 2003, p. 50

As the main focus of the ESPON Hazards project is on monitoring risk components with the goal of avoiding the occurrence of disasters or at least the reduction of their impacts, an "ex ante" perspective is appropriate. In this context the terms of hazard potential, damage potential, prevention and response potential, vulnerability and risk are used as shown in Figure 2.

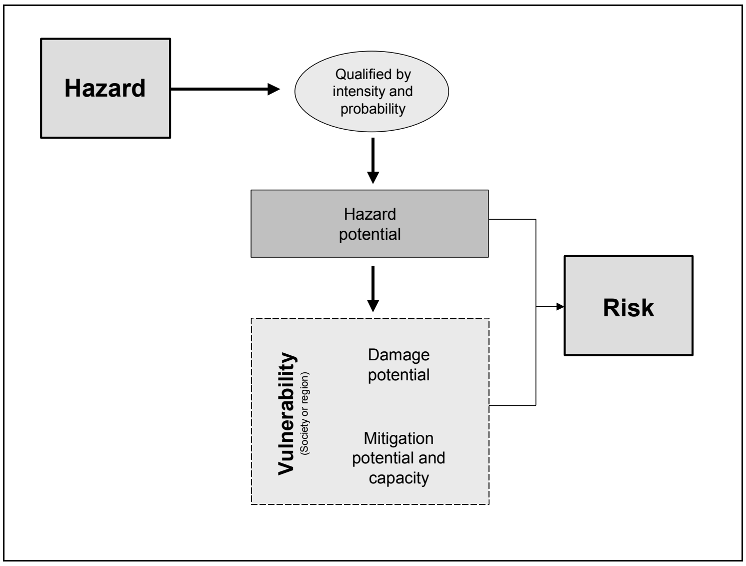

Figure 2: Hazards, vulnerability and risk: the ex ante perspective
Source: Fleischhauer 2003, p. 55

As there are different definitions of vulnerability, some authors define risk as the result of a hazard multiplied by vulnerability divided by the coping capacity. In this case, damage potential is integrated in the hazard potential as a degree of the intensity of a hazard. Other authors suggest to clearly separate the components of damage potential on the one hand and coping capacity on the other hand as shown in the figure above. Following the outlines of the project's tender, only a monetary based index of risk will be feasible in the project, as hazard potential and ordinal scales can express damage potential. This will most likely not be possible for the coping capacity because of methodological reasons. As chapters 2 and 1.5.3 show, coping capacity is described by the interaction of technical, organisational, social and economic factors and response measures are often very specific as regards to a certain hazard. This makes it methodologically not reasonable to portray coping capacity by a simple monetary index. It will be necessary to separate hazard potential, damage potential and coping capacity from each other. Coping capacity will then flow into the project in a qualitative way. Vulnerability will thus be understood as a combination of damage potential and coping capacity will be expressed in a qualitative way. Consequently, this leads to the following formula:

Risk = Hazard potential x Damage potential / Coping capacity,
or:
1 Risk = Hazard potential x Vulnerability
(Blaikie et al. 1994, 23).

This formula is useful in building the logic between the concepts used in this project. In relation to the UNISDR definition, this conceptualisation corresponds to the definition of hazard potential that is characterised by its probability (= frequency) and intensity (= magnitude). Following the previous formula, defining an overall risk in a given location is:

Risk = Hazard potential (Probability x Magnitude) x Damage potential / Coping Capacity

This equation yields, e.g. probabilities (e.g. once every 200 yrs.) for an event (e.g. a flood) the magnitude (height of water level) and the damage potential (possible economic or social damage or loss). Response actions like mitigation and reaction measures lead to alleviation. These are qualitatively determined by the coping capacity (e.g. by poverty, lack of insurance, lack of relief schemes and early warning systems, competent planning efforts, self-help networks and "social capital", etc.).

II.2 Overview on the methodology

On the basis of hazards and indicators outlined in chapters 6.1 and 6.2 of the First Interim Report it is possible to move towards the development of a typology of regions in regard to their vulnerability and existing hazards. The development of risk maps is done in two steps. First, hazard maps are created, and in a second step the combination of hazards with regional vulnerability leads to the emergence of risk maps

To determine the total risk potential of a region the set of single risks identified for the region has to be aggregated. Due to the methodological problems of aggregation and in order to avoid the loss of information (e.g. the differences in threat and vulnerability of a region regarding different hazards) it is preferable to implement the aggregation in four steps:

1. *Hazard maps for selected hazards:* Hazard maps are the basis for all the following maps. They show where and in which intensity the selected hazards occur in Europe. A methodology for measuring technological and natural hazards is developed (see chapters 1.2.1 and 1.2.2). The hazard maps are the basis for the development of the *typology of regions* (see chapter 1.3).

2. *Risk maps for selected hazards:* On the basis of hazard maps, combining hazard intensity and vulnerability can create risk maps for the selected hazards. Risk maps show the regional risk of European regions towards a certain hazard.

3. *Synthetic hazard map:* The synthetic hazard map shows the degree of threat of European regions as regards to the entire 14 selected natural and technological hazards.

4. *Synthetic risk map:* Finally, a synthetic risk map will be created, based on a synthetic index of risk. This synthetic index of risk (see chapter 1.3) consists of two components: (a) summarised intensity of hazards and (b) the degree of vulnerability. Both components will be classified on an ordinal scale as described in the First Interim Report (p. 94 f.). For both parameters only a small number of indicators should be used for two reasons: First, if great care is taken in selecting the most relevant indicators they should be sufficient for estimating hazard potential and vulnerability with the necessary and possible exactness (accuracy). Second, a greater set of indicators would lead to new methodological problems, especially as regards to weighting and aggregating the indicators. Therefore, in the following a small number of indicators for each parameter is identified and justified.

The following figure 3 shows the approach as described above.

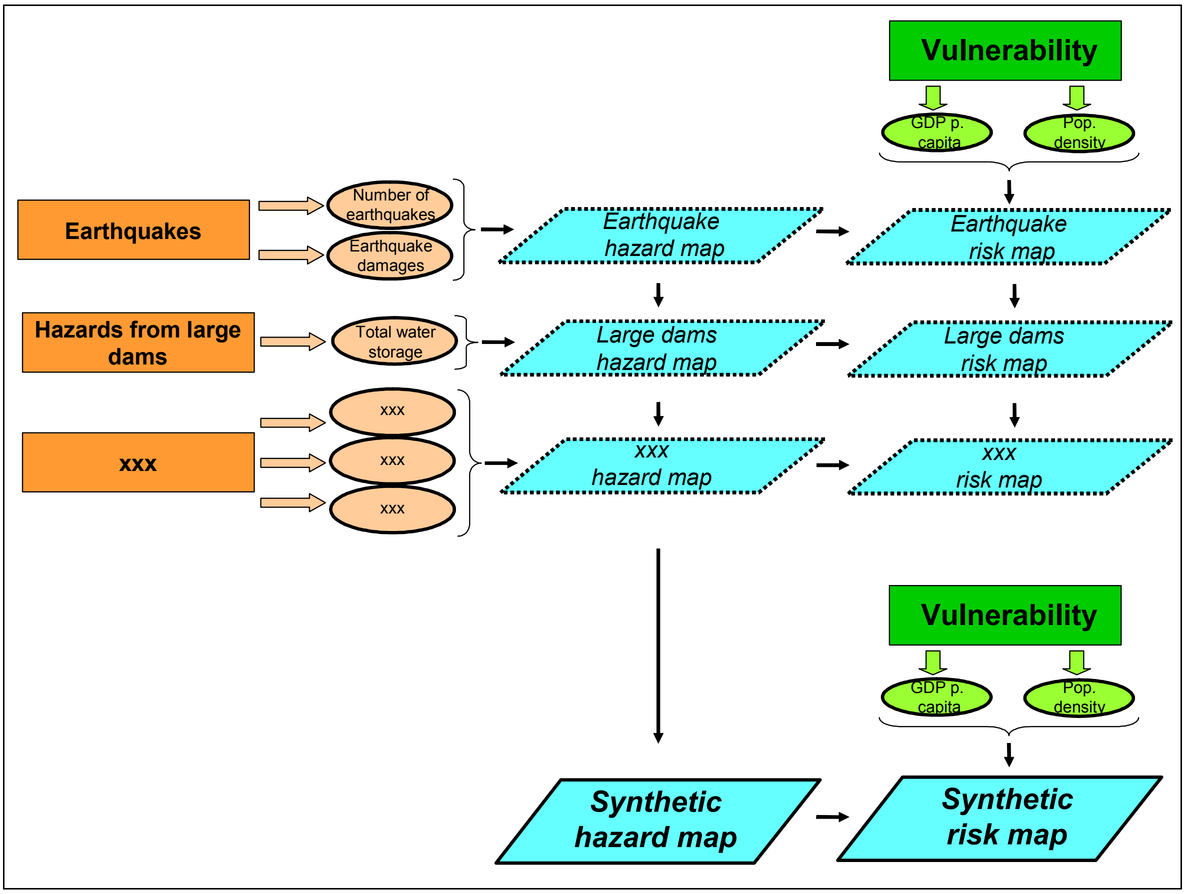

Figure 3: Rationale for the development of hazard maps and risk maps
Source: ESPON Hazards 2003

The index of risk allows a classification of regions that integrates both the hazard potential and the vulnerability. The index allows distinguishing between those regions that are only hazardous areas and those, which are risky areas, referring to their high degree of vulnerability. The following methodology is based on the ecological risk analysis, an estimation method, which is used as a part of environmental impact assessments (Bachfischer 1978, Scholles 1997). The methodology of hazard maps and risk maps is explained in detail in the chapter 1.3

II.3 Change in methodology

The first interim report focused on the description of hazards by frequency and magnitude of their occurrence. This, however, can only be applied for single hazard sources (e.g. a volcano or a river catchment). In this case, the frequency and magnitude for a single event can more or less be determined.

As soon as the regional level is regarded, e.g. the NUTS 3 level, aggregated hazards must be the focus. Therefore it is difficult and sometimes *not possible* to describe the regional hazard potential of a certain hazard by frequency and magnitude. This has the following reasons:

1. Most hazards (even when catastrophic) do not harm the whole area of a region at once. A certain frequency of a hazard therefore does not necessarily mean that the whole

region is at once affected in equal measure. It is more likely that – depending on hazard and magnitude – only a part of the region is affected.
2. Hazards of the same category can differ in their frequency and magnitude within a region. For example, river flooding in a certain region can occur with an annuality (return/reoccurrence period) of 100 years on the main river and 50 years on a tributary river.

It is vital to determine comprehensive indicators that are able to indicate the regional hazard potential. Appropriate methodological and factual foundations are required for probabilistic assumptions that take into account the individual impact radius of each single hazard. A possible basis for these new indicators could be historical data derived from recordings of the past decades that give information on usual frequency and magnitude of certain hazards. However, this leads to two further problems that have to be kept in mind:

1. *Spatial units and scale of data:* Historic data very often is not collected or aggregated in the same spatial areas as modern administrative units of spatial planning. Either disperse or highly aggregated data sets would have to be analysed and applied to those units the ESPON Hazards Project uses as reference (e.g. NUTS 3 level). When applying statistical data to spatial units it is important to make available the data aggregated for the respective spatial unit (the usage of georeferenced data allows an overlaying with administrative data).
2. *Validity of historic data:* Historic data as a matter of fact refer to past eras of an area. Using this data to make assumptions for the future can be misleading in consideration of radical changes in spatial structure that occurred in many areas during the past decades. The vulnerability may have changed dramatically without being displayed in historical records. On the other hand, the occurrence of different types of hazards is either liable to changes due to changing climate, or no historic data can be obtained since occurrence is rather rare or the hazard source is new. The whole territory of the EC is influenced by global change and affected by similar trends in spatial development. Due to this fact, changes in the frequency or the magnitude of specific hazards are less important for the creation of a risk index, which concentrates on the relative relation of NUTS 3 regions to each other. Also, in special cases one or a couple of regions are probably more affected than others. At the same time other regions might be affected by different hazards. The scientific discussion about the consequences of global change goes on and there is no consensus yet about the possible consequences on a regional level.

The first case would mainly apply to natural hazards. The occurrence of floods seems to be changing in certain areas due to changing precipitation dynamics (Caspary and Haeberli 1999; Milly et al. 2002). Landslides may become an increasingly important issue as effect of rising mean temperatures in high mountains that again cause melting of former permafrost soils (Beniston, Haeberli and Schmid 1998). Technological risks may not be sufficiently represented in historic recordings, as the sources often are relatively new. The necessary care thus should be displayed when using historic data as indicator of risk of certain regions. Methodological problems are discussed in detail in chapter 1.3.5.

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III GLOSSARY

Coping capacity: Capacity refers to the manner in which people and organisations use existing resources to achieve various beneficial ends during unusual, abnormal, and adverse conditions of a disaster event or process. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and other hazards.

Damage: The amount of destroyed or damaged property asset, the injury of people and environment as a consequence of an occurred hazard.

Damage potential: The amount of property asset in a threatened area.

Disaster: A hazard might lead to a disaster. A disaster by itself is an impact of a hazard on a community or area – usually defined as an event that overwhelms that capacity to cope with.

Exposure: The economic value or the set of units related to each of the hazards for a given area. The exposed value is a function of the type of hazard.

Hazard: A property or situation that in particular circumstances could lead to harm. More specific, a hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity and probability.

Land-use planning: Land-use Planning creates policies at the local/municipal level that guide how the land (inside the administrative borders of a municipality) and its resources will be used. The main instrument of land-use planning is zoning or zoning ordinances, respectively. Land-use planning is situated below the regional planning level.

Losses: The amount of realized damages as a consequence of an occurred hazard.

Mitigation or disaster mitigation: A proactive strategy to gear immediate actions to long-term goals and objectives.

Preparedness: Readiness for short term activities, such as evacuation and temporary property protection, undertaken when a disaster warning is received.

Reaction: While mitigation is characterised by long-term actions, reaction aims at short-term actions in case of an occurring disaster. Reaction comprises preparedness, response and recovery.

Recovery: This constitutes the last step of post disaster actions, such as rebuilding or retrofitting of damaged structures.

Regional plan: (as defined for the purpose of ESPON 1.3.1 Hazards): The spatial plan of an administrative area (superior to the municipal level); is part of the official (national of federal) planning system; makes statements and/or determinations referring to the spatial and/or physical structure and development of a region (spatial distribution of land use: infrastructure, settlement, nature conservation areas etc.); has impacts on the subordinate levels of planning hierarchy (local level, e.g. municipal land use plans etc.); textual and cartographic determinations and information normally refer to the scale 1:50 000 to 1:100 000.

Regional Planning: Regional planning is the task of settling the spatial or physical structure and development by drawing up regional plans as an integrated part of the formalised planning system of a state. Thereby regional planning is required to specify aims of spatial planning which are drawn up for an upper, state, or federal state wide level. The regional level represents the vital link between the state-wide perspective for development and the concrete decisions on the land use taken at local level within the land-use planning of the municipalities.

Response: The term of ”response” contains three different meanings: 1) as an element within the DPSIR chain, 2) in a general meaning as a spatial planning answer as proposed in the tender and 3) as a narrower term which describes specific reactions immediately after a disaster has occurred. Response in the broader sense means the sum of long-term actions (mitigation in terms of planning responses) and short-term actions (reaction) to prevent disasters or mitigate their impacts. In this case it is linked to the Response chain link of the DPSIR chain. In a narrower sense, response is a part of short-term actions (reaction) when a disaster occurs. Then, response means short-term emergency aid and assistance, such as search-and-rescue operations, during or following the disaster.

Risk: A combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence. More specific, a risk is defined as the probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards.

Risk analysis: Risk analysis is the mathematical calculation including the analysis of a hazard (frequency, magnitude) and its consequences (damage potential).

Risk assessment: Risk assessment consists of risk estimation and risk evaluation.

Risk estimation: Risk estimation is concerned with the outcome or consequences of an intention taking account of the probability of occurrence.

Risk evaluation: Risk evaluation is concerned with determining the significance of the estimated risks for those affected: it therefore includes the element of risk perception.

Risk perception: Risk perception is the overall view of risk held by a person or group and includes feeling, judgement and group culture.

Risk reduction: Risk reduction may be defined as the “consequence of adjustment policies which intensify efforts to lower the potential for loss from future environmentally extreme events.” (Mileti, et al. 1981; Nigg and Mileti. 2002). Such adjustment policies may refer to a broad range of guidelines, legislation and plans that help to minimize damage potential (i.e. exposure to a hazard or maximizing coping capacity of a region or community by, e.g. guaranteeing resources and preparing adequate plans for pre-disaster mitigation and post-disaster response measures). Risk reduction involves both policy/regulatory issues and planning practices. In other words, risk reduction – as defined above – is the result of what has earlier been defined as risk management related response (prevention orientated mitigation, non-structural mitigation, structural mitigation, and reaction).

Sectoral planning: 'Sector' in terms of 'sectoral planning' means the spatial planning under consideration of only one planning criteria (e.g. traffic, environmental heritage, etc.). Sectoral approaches are (in the ideal case) weighted and combined in the context of comprehensive development planning. Sectoral as well as comprehensive planning can take place on different administrative levels.

Sensitivity/highly sensitive areas: In general, sensitivity describes how a system responds to permanent influences. In the context of the ESPON 1.3.1 Hazards project, the highly sensitive areas are defined as those areas that are most sensitive towards the entirety of all hazards. In terms of the chosen methodology the highly sensitive areas are represented by risk intensities of 8, 9 and 10 (red, brown and black colours in the colour scheme of the synthetic risk map).

Typology: At its simplest level, a typology involves the clustering of a large number of items (variety of descriptions) into smaller groups by virtue of their shared characteristics. In the ESPON 1.3.1 Hazards project, the term typology is used in different contexts:

- *Typology of regions:* The typology of regions clusters areas in Europe, which are threatened by similar hazards. This typology does not consider the aspect of vulnerability and it is therefore a hazard based typology instead of a risk based typology. In the typology of regions, interactions between certain hazards are taken into consideration.

- *Hazard typology:* The hazard typology clusters hazards that are somehow interrelated to each other. It is a basis for the development of the typology of regions.

- *Spatial typology:* This is a general term that describes the result of a clustering process that is based on relevant spatial data. Consequently, the typology of regions is a spatial typology.

- *Typology of risk / risk typologisation:* A risk typology clusters risks into groups by the characteristics of probability (and certainty of assessment), extent of damage (and certainty of assessment), ubiquity, persistancy, irreversibility, delay effect and mobilisation potential. The typology of risk distinguishes the risk types of Cyclops, Damocles, Pythia, Pandora, Cassandra and Medusa.

Vulnerability: Vulnerability is the degree of fragility of a person, a group, a community or an area towards defined hazards. In a broader sense, vulnerability is defined as a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards. Vulnerability is determined by the potential of a community to react and withstand a disaster, e.g. its emergency facilities and disaster organisation structure (coping capacity).

Zoning: Zoning is the local governments' tool that regulates land-use, promotes orderly growth, and protects existing property owners by ensuring a convenient, attractive and functional community. Zoning is the way the local governments control the physical development of land and the kinds of uses to which each individual property may be put.

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PART II

1 PRELIMINARY RESULTS BASED ON AVAILABLE TERRITORIAL INDICATORS

The following chapter first gives an overview of available territorial indicators (chapter 1.1). Chapter 1.2 describes the selected natural and technological hazards. In this section, indicators are discussed and suggested: To determine the total risk of a region, the regional vulnerability and total hazard potential will be aggregated into a synthetic index of risk. On this basis, the typology of regions can be developed (chapter 1.3). Preliminary maps of selected hazards, vulnerability and risk will be presented in chapter 1.4. In chapter 1.5 case studies in four European regions will be carried out.

Linkage of indicators and maps, case studies and spatial planning

The development of risk maps is done in a two-step approach. First, hazard maps are created with the use of hazard indicators. In a second step, the combination of hazards with the regional vulnerability (vulnerability indicators) leads to the emergence of risk maps. It is preferable to implement this aggregation in four steps that are in practice characterised by four types of maps (see also part 1, chapter II.2):

5. Hazard maps for selected hazards,
6. Risk maps for selected hazards,
7. Synthetic hazard map,
8. Synthetic risk map.

A further step is the development of a typology of regions that identifies areas in Europe, which are threatened by similar hazards. In this context, typical interactions between certain hazards will be identified. The development of maps and the typology of regions is described in chapters 1.1 to 1.4. Chapter 1.5 presents the case studies of four European regions. The main role of the case studies is to (a) collect data and knowledge about the practice of dealing with hazards and risk reduction management and (b) identify interrelations between hazards. Further aspects of the role of case studies are outlined in the introduction to chapter 1.5. At a later stage of the project, the case studies can serve to test the mapping results and they can be used as pilot regions for the implementation of guidelines on spatial planning for hazard risk reduction (spatial planning response).

Besides the case studies, the formulation of guidelines for a spatial planning response will be supported by the results of the hazard and risk maps. They help to identify the most sensitive regions, the main influence of risk and they are a basis for a regionally appropriate spatial planning response. The following figure shows how indicators, maps, case studies and spatial planning are connected to each other.

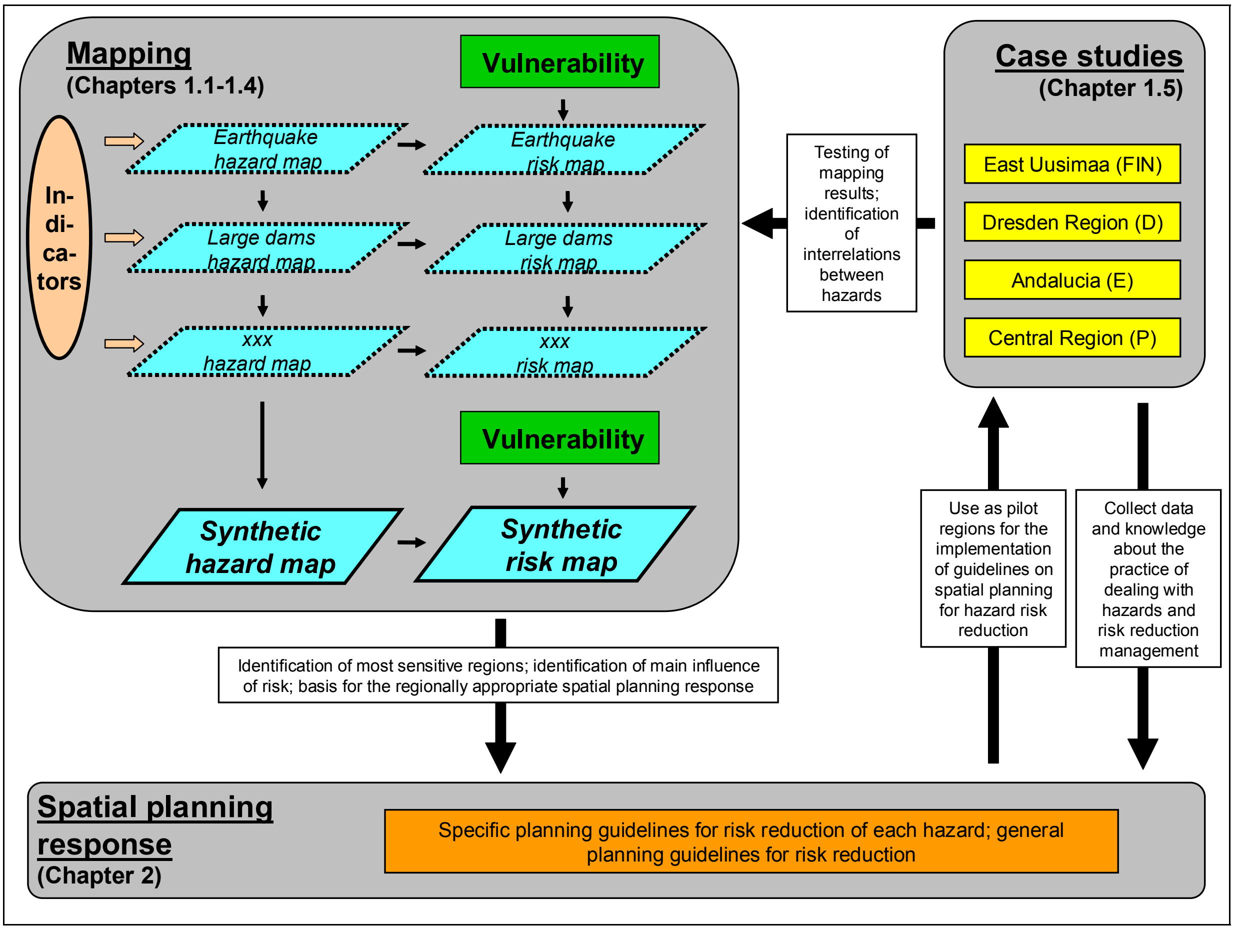

Figure 4: Linkage of indicators and maps, case studies and spatial planning
Source: ESPON Hazards 2003

1.1 Available territorial indicators

The structure of the following table was introduced in the first interim report, page 90. In this report the table gives an overview on what data are available for the project, what data sets are still being collected and which ones were not made available, or are not available for the project (on a comparable EU 27+2 coverage).

Table 2: Indicators on natural and technological hazards

Natural and technological hazards	**Driving forces** ***Indicators of influence factors on hazards and damage potentials***	**Pressure** ***Indicators of hazards and damage potentials***	**State** ***Indicators of spatial risk / spatial security***	**Impact** **Indicators of disaster**	**Response** ***Indicators of disaster response / risk management (indicators of prevention, mitigation, preparedness, response, recovery)***
Natural hazards					
Floods	• Growth of population and GDP in areas that have been flooded • Increase of factors that influence floods (e.g. settlement extension, climate change)	• Areas that have been flooded • Population density/GDP (in areas that potentially can be flooded)	• Combined indicator of Population density/GDP and flooded areas according to flood frequency since 1985	• Clasification of flooded areas according to flood frequency since 1985	• E.g. Building restrictions (retention areas) / safety measures in flooded areas
Droughts	• Growth of population and GDP in areas affected by droughts • Increase of factors that influence droughts	• Areas affected by droughts • Population density/GDP (in areas affected by droughts)	• Combined indicator of Population density/GDP and drought vulnerability	• Classification of drought vulnerability	• E.g. regulations for the storage of water in case of droughts; Regulations on sustainable use of water resources
Forest fires	• Growth of population and GDP in areas affected by forest fires • Increase of factors that influence forest fires	• Areas affected by forest fires (on EU 27+2 level only 2000 data available for the project) • Population density/GDP (in areas affected by forest fires)	• Combined indicator of Population density/GDP and forest fire vulnerability	• Classification of forest fire vulnerability	• Forest fire mitigation practices
Winter storms	• Growth of population and GDP in areas affected by winter storms • Increase of factors that influence winter storms (e.g. climate change)	• Areas affected by winter storms (on NUTS II level) • Population density/GDP (in areas affected by winter storms)	• Combined indicator of Population density/GDP and winter storm vulnerability (on NUTS II level)	• Classification of winter storm vulnerability (on NUTS II level)	• Early warning systems / safety measures against winter storms
Landslides/ avalanches	• Growth of population and GDP in mountainous areas • Increase of factors that influence landslides/ avalanches	• Mountainous areas • Population density/GDP (in mountainous areas)	• Combined indicator of Population density/GDP and landslide (and avalanche) vulnerability	• Classification of landslide (and avalanche) occurrence	• E.g. Building codes / restrictive land use in landslide/avalanche areas
Earthquakes	• Growth of population and GDP in areas with earthquake probability	• Areas with earthquake probability (basically the entire territorial area) • Population density/GDP (in earthquake prone areas)	• Combined indicator of Population density/GDP and earthquake vulnerability according to ground acceleration of ocurred	• Classification of earthquake vulnerability according to ground acceleration of ocurred earthquakes	• E.g. Building codes / safety measures in areas wth high earthquake probability

			earthquakes		
Volcanic eruptions	• Growth of population and GDP in areas with volcanic activities	• Areas with active volcanoes • Population density/GDP (in areas with volcanic activities)	• Combined indicator of Population density/GDP and volcano activity	• Classification of volcanoe activity	• E.g. Building codes / safety measures in case of volcanic activities
Extreme precipitation (heavy rainfall, hail)	• Growth of population and GDP in areas with extreme precipitation • Increase of factors that influence extreme precipitation (e.g. climate change)	• Areas with the possibility of extreme precipitation • Population density/GDP (in areas affected by extreme precipitation)	• Combined indicator of Population density/GDP and areas with the possibility of extreme precipitation	• Classification of areas affected by extreme precipitation	• Early warning systems / safety measures against extreme precipitation
Extreme temperatures (heat waves, cold waves)	• Growth of population and GDP in areas with extreme temperatures • Increase of factors that influence extreme temperatures (e.g. climate change)	• Areas with the possibility of extreme temperatures • Population density/GDP (in areas affected by extreme temperatures)	• Combined indicator of Population density/GDP and areas with the possibility of extreme temperatures	• Classification of areas affected by extreme temperatures	• E.g. regulations on preparedness (see glossary). Also: Guidelines and agreements for cross-border coopeartions between regions.
Technological Hazards					
Hazards from nuclear power plants	• Growth of population and GDP in areas close to nuclear power plants • New installations of nuclear power plants	• Locations of nuclear power plants (amount of reactors and power in MGW) • Population density/GDP (in areas close to nuclear power plants)	• Combined indicator of Population density/GDP and the amount of reactors and power in MGW	• Occurred nuclear power plant disasters (no MCAs yet in Western Europe)	• International saftey standars
Hazards from production plants with hazardous production processes or substances	• Growth of population and GDP in areas close to hazardous plants • New installations of hazardous plants	• Locations of hazardous plants (amount of hazardous plants?) • Population density/GDP (in areas close to hazardous plants)	• Combined indicator of Population density/GDP and the amount of hazardous plants (?)	• Occurred hazardous plants disasters (e.g. from SPIRS/MAH database)	• Seveso Directive
Hazards from hazardous waste deposits / storage of nuclear waste	• Growth of population and GDP in areas close to hazardous waste deposits • New installations of hazardous waste deposits	• Locations of hazardous waste deposits (amount of hazardous waste deposits?) • Population density/GDP (in areas close to hazardous waste deposits)	• Combined indicator of Population density/GDP and the amount of hazardous waste deposits (?)	• Occurred hazardous waste deposits disasters	• Ammended Seveso Directive
Hazards from the marine transport of hazardous goods	• Growth of population and GDP in coastal areas close to major crude oil shipping lines / major oil ports • Increase of the amount of shipped crude oil	• Major crude oil shipping lines / major oil ports • Population density/GDP (in coastal areas close to major crude oil shipping lines / major oil ports)	• Combined indicator of Population density/GDP and the amount of traffic/closeness to coast (?)	• Classification of shipping line vulnerability (amount of traffic/closeness to coast?)	• EU 27+2 safety regulations
Hazards from large dams	• Growth of population and GDP in areas downstream of large dams • New installation of a large dam	• Location of large dams < 5x106 m3 • Population density/GDP (in areas close to large dams)	• Combined indicator of Population density/GDP and the Amount of water (m3) stored in the reservoirs	• Amount of water (m3) stored in the reservoirs	• EU 27+2 safety regulations

Legend:

Font in black colour: Indicator is available
Font in blue colour: Indicator is under development
Font in green colour: Existing data not available for this project
Font in red colour: No data available / not available on comparative European level

1.2 Natural and technological hazards in general

1.2.1 Natural hazards in general and in relation to climate change

Natural hazards are usually defined as extreme natural events that pose threat to people, their property and their possessions. Natural hazards that are geophysical in nature, rather than biological, arise from the normal physical processes operating in the Earth's interior, at its surface, or within its enclosing atmospheric envelope. Most geophysical hazards can be allocated to one or other of three categories: geological, atmospheric and hydrological hazards. Extraterrestrial hazards, such as asteroid and comet impactors are also considered when considering hazards (McGuire et al. 2002).

In accordance with the selection of hazards outlined already in the first interim report and in chapter 6.2 of this second report, the typologies of regions with respect to natural hazards will be developed for the following hazards: flooding, volcanic eruptions, landslides, avalanches, earthquakes, droughts, forest fires, storms, extreme precipitation and extreme temperatures. The typology will be based on both hazard and risk so that hazardous and risky areas can be distinguished.

The following table gives an impression about the interrelationship between hazards and impacts in case of a catastrophe, respectively its influence. Table 3 lists the types of impacts that are generally possible and indicates their relevance for the selected types of natural hazards. The grey shaded fields show the interaction of hazards. A single event of one hazard can trigger others and lead to multiple hazards.

Table 3. Major impact types of natural hazards

Type of impacts / Type of hazard	Toxic gases	Shock wave	Kinetic energy	Sedimentation	Impact on local and regional climates	Landslides/ avalanches	Droughts	Floods	Forest fires
Floods*			+	+		+			
Droughts*					+				+
Forest fires	+				+				
Winter Storms*			+	+		+			
Landslides/ avalanches			+	+					
Earthquakes*		+	+	+		+			
Volcanic eruptions*	+	+	+	+	+				+
Extreme precipitation (heavy rainfall, hail)*						+		+	
Extreme temperatures (heat waves, cold waves)*							+	+	+

* Hazards that can trigger other hazards' occurrence and magnitude

References:

McGuire, B., Mason, I. & Kilburn, C. 2002. Natural hazards and environmental change. London, Arnold, xii.187 p.

1.2.1.1 Floods

In the ESPON Hazards project "flood" was defined as one of the relevant natural hazard. A first important fact that has to be considered is the distinction between high water and flooding:

- *High water:* High water is a normative term that describes the exceedance of a defined water level of lakes, rivers or the sea. In the latter context, high water describes the maximum height reached by a rising tide. High water therefore does not necessarily mean the cause of damage.
- *Flood:* Flood is a high-water stage in which water overflows its natural or artificial banks onto normally dry land, such as a river inundating its floodplain. Floods occur at more or less regular intervals along rivers but also far away from them. Besides storm surges the two main types of flood are river flood and flash flood. Further there are a few special types like ice flood, backwater, groundwater rise, lake-level rise, and glacial lake outburst floods (Munich Re 2000).

Hazard characterisation

River floods and flash floods

Any study of the causes of river flood and flash flood events must include separate analysis and assessment of meteorological, hydrological and hydraulic factors, as well as economic conditions, settlements development and population trends (WBGU 1998, p. 98 ff.):

1. *Meteorological factors:* In most cases, heavy precipitation is necessary for a flood event to occur. Critical factors are the duration, intensity and distribution of rainfall. Rapid melting of snow (often combined with rainfall) increases the quantity of water that appears as runoff. Other flood events that are not caused directly by heavy precipitation are rare and mostly occur after seaquakes, dam breaches, mountain or glacier slides, or as a consequence of ice jam.
2. *Conditions in the catchment basin:* Heavy precipitation causes extreme discharge if a significant portion of the precipitation does not infiltrate and flows instead into stream channels as surface runoff. The infiltration capacity of the soil is most commonly exceeded as a result of natural factors. On the one hand, very intensive rainfall may exceed the maximum infiltration rate of the soil surface at that particular time. On the other hand, the water table may be raised over a wide area by persistent prior rainfall, causing expansion of the saturated areas near water bodies and generally leading to a higher degree of soil saturation, with the result that little or no free pores are available to absorb the precipitation. Moreover, crusting, compaction and sealing processes on the soil surface may reduce the water retention capacity of the catchment area. Other significant factors include the state of vegetation cover as well as the regional topography and micro topography.

3. *State of the hydrological regime:* The hydrological conditions in the stream flow system determine how much and how fast water flowing into a surface water body can be transported in the river bed or in riparian flood basins and what proportion is kept in additional retention areas – whether desired or not. One of the basic problems here is that channel conditions that reduce the likelihood of flooding in the respective area due to high discharge capacities in a section of river make the situation worse for downstream areas because of the unattenuated inflow of water.
4. *Potential damage:* Damage caused by floods is not perceived as such until people or things that they value are adversely affected. The more densely populated the flood areas, the more intensively they are used, the higher the material assets are and the fewer the precautions taken against flood risks, the greater the potential damage. Population growth and an increase in the value of assets in the riparian habitats are sufficient to increase the damage potential. This situation is particularly critical if settlement pressure leads to areas being settled that were previously left aside as buffers against river flooding.

If specific conditions are unfavourable, any one of these factors may contribute to an increased risk of flood damage. If all factors reinforce each other in an adverse constellation, flood events and severe damages occur. The particular conditions and combinations of factors that may occur are extremely wide-ranging and randomised to a certain extent. The absence of only one adverse factor (within a generally unfavourable constellation) may make the difference between a major flood disaster and runoff conditions involving no significant damage. Each of these factors is influenced by human activities to differing degrees.

Storm surges

On account of the astronomic tide the water level on many coasts changes regularly in the course of the day; the difference depends on the local coastal geometry and in the most extreme case is as much as 15 m. The decisive parameter in any storm surge, however, is the height of what is called wind set-up, the rise in water caused by the wind exerting shear force on the water surface and pushing the water in the direction it is blowing. If it encounters a coast, the water rises vertically, the elevation it then reaches depending on the direction, strength, duration, and fetch of the wind. An additional increase in the water level of up to 1 m may result from atmospheric low pressure. The pressure on the water surface is reduced and the water level rises. During a storm, surface waves occur which temporarily raise the water level even further.

The coastal geometry plays an important role. Storm surges chiefly generate a very high water level if the water displaced by the wind cannot escape downwards or to the side. This is particularly the case in gulf-shaped, shallow marginal seas, the estuaries of rivers, and elongated lakes. The area most exposed to storm surge in Europe therefore is the North Sea coast. There is also an elevated storm surge hazard on the Baltic Sea. The main danger associated with storm surge is the sudden occurrence of floods either because a sea wall fails or because, on coasts without any sea wall protection, the sea wave generated by the storm runs up to a height of several metres on land within the space of only a few hours.

The severity of a storm surge cannot be expressed by the extent of the rise in the water level alone but must be seen relative terms, i.e. in relation to the "normal" fluctuations in the water level on the section of coast under observation. In one instance 300 cm may be no problem, in another even 50 cm may be enough to cause major damage (Munich Re 2000).

The table below focuses on the specific criteria of floods:

Table 4. Characterisation of the risk of major flooding (with good data availability)
Source: WBGU 1999, p. 144

Criteria	**Values**
Probability of occurrence *P*	Low
Certainty of assessment of *P*	High
Extent of damage *E*	High
Certainty of assessment of *E*	High
Ubiquity	Low
Persistency	Low-high
Irreversibility	Low
Delay effect	Low
Mobilization potential	Low

Effects of climate change on floods

There has been a great deal of discussion in connection with the extreme flood events that have occurred with increased frequency in recent years, as to the extent to which climate change, river regulation or landscape changes have increased the magnitude or probability of flood events. Only some of the cause effect relationships are understood and scientifically verifiable.

Of the flood-inducing factors, meteorological conditions are of greatest significance as far as possible climate changes are concerned. The state of vegetation and soils in the catchment area may also be impaired by climate changes, with concomitant feedback on flood occurrence. Generalised statements about changes in flood activity can be made to a very limited extent only, since we are dealing with an extremely non-linear system that is dependent on naturally high spatial and temporal variabilities of meteorological and topographical factors, soil, vegetation, climate, groundwater and water bodies. The impacts of climate change on flood peaks, in particular, are extremely difficult to quantify with any degree of uncertainty. However, it is possible to make the following three generalisations regarding the impacts of climate change as they pertain to floods.

1. *Sea-level rise enhances the risk of coastal storm floods and tidal river floods:* The rise in sea level induced by global warming increases the probability of tidal river floods, because an increase in mean sea level produces a rise in extreme water levels by the same amount. This fact now plays a role in establishing the design criteria for flood control structures in the estuary regions of larger rivers, as in the case of the flood protection gate in Rotterdam that was put into operation in 1997 and where the design water level was set 50 cm higher to take into account the expected sea level rise.
2. *Elevated temperatures force the global hydrological cycle:* The energy and hydrological cycles are closely linked systems that mutually influence each other. At the global level and from a thermodynamic analysis, it can be assumed that a

temperature rise will lead to a general intensification of the hydrological cycle. In combination with expected higher climate variability (see below), this results in a significant increase in the amount of precipitation, and probably in heavy precipitation as well, in various regions of the globe.

3. *Climate changes increase the frequency of extreme weather events:* Slight changes in the mean climate or mean climate variability can bring about relatively large changes in the frequency of extreme events. An increased occurrence of weather anomalies would mean a higher frequency of those weather patterns that cause flooding (and droughts) (WBGU 1998, p. 101 f.).

Risk management

As with most natural and technical risks, one characteristic of flood risks is that the potential damage is inversely correlated to the probability of occurrence. The greater the damage, the lower the probability that this damage will actually occur. Frequent minor flooding poses a minimal threat because people can take precautionary steps and be prepared for any damage caused. But if a rare flood event occurs and the water level exceeds the level for which protection has been provided in the form of technical or non-technical measures, the impacts can be catastrophic. Protective measures that help to prevent large-scale damage in the event of small or medium-sized floods may prove counterproductive in the case of rare extreme events. Smaller dams or levees hold back the waters initially, but release them suddenly and all at once when there is a breach or overflow.

It is not possible to protect oneself against every conceivable flood event since the maximum height of a flood remains undefined. People can, of course, avoid areas with a high flood risk, but precisely such regions attract human settlement for a number of reasons. In addition to the physical constraints on complete flood protection, there are also economic limitations. It makes little economic sense to develop flood protection by means of very cost-intensive measures to such an extent that people living on rivers even protect themselves against extreme rare events that are expected only once in several hundred or even a thousand years. Therefore, no matter what technical precautions are taken, there is still a residual risk that can be regarded as barely acceptable.

To safeguard against floods, protective or mitigating measures will be initiated and implemented as long as the local residents deem it acceptable after weighing up the costs and the residual risk. Thus, the objective is not to prevent flooding at all cost, but to reduce the risk to an acceptable level and minimise the damage in the event that a severe flood and the concomitant damage occurs after all. Since individual persons have limited capacities in this respect, flood control is the responsibility of the state or of specialised organisations established for this purpose (WBGU 1999, p. 105 ff.).

The aim is to reduce the risk, by means of technical or non-technical measures, to an acceptable level, i.e. to the residual risk regarded as acceptable by society for the protection of those concerned. The risk can be minimized in two basic ways:

1. By reducing the probability of occurrence or
2. By reducing the range of damage.

The following figure shows areas of risk management along a river.

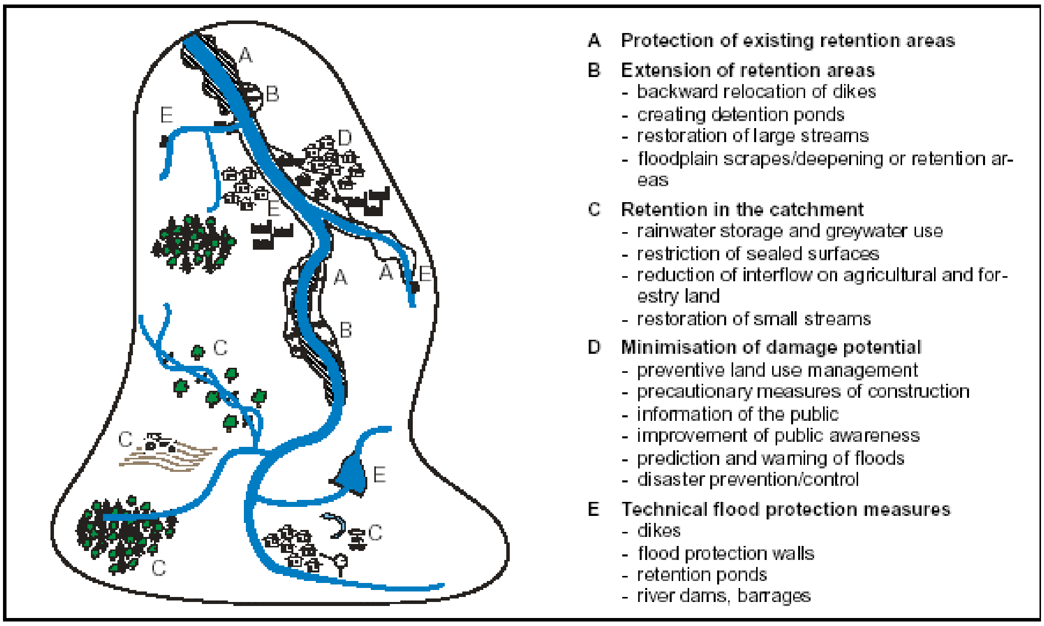

Figure 5: Areas of risk management along rivers
Source: Böhm et al. 2002

Floods and spatial planning

Spatial planning is one of the most relevant factors for dealing with flood hazards, because it is responsible for the land-use inside the catchment areas. Areas that are mostly threatened by floods are mainly the most popular areas for human settlement. At the same time, an adequate land-use is a crucial factor for influencing the damage potential successfully.

For the control of local measures and for minimising of damage potential the local level is important. However, the regional level of spatial planning plays a decisive role in the catchment oriented precautionary control of land use (Böhm et al. 2002, p. III).

The following figure shows areas of spatial planning action for the reduction of flood risks (for the example of the German planning system).

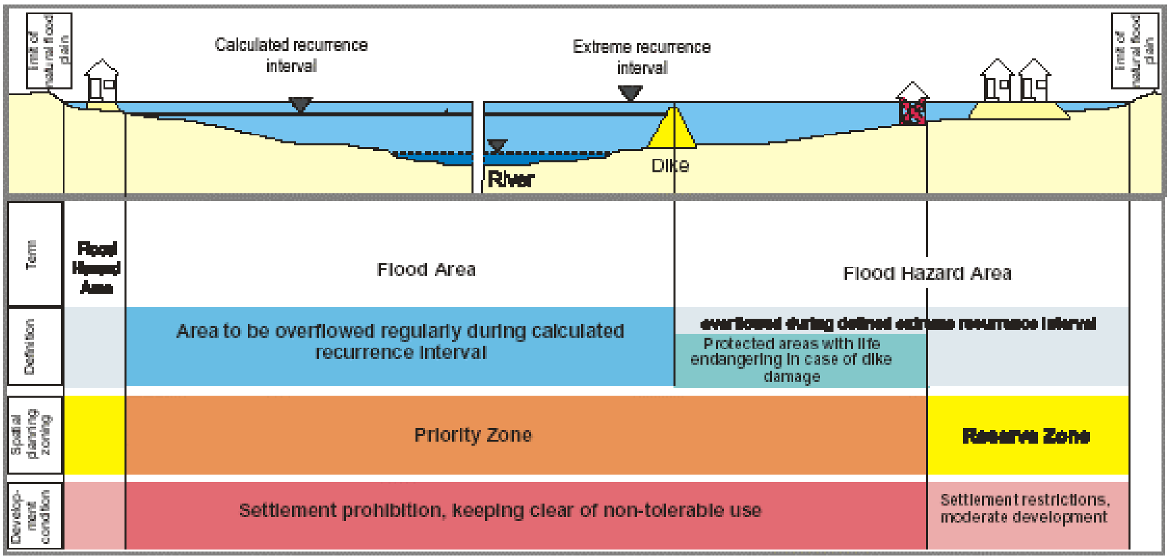

Figure 6: Areas of spatial planning action for the reduction of flood risks
Source: Böhm et al. 2002

Indicators

There are serious differences between the three types of flood (river flood, flash flood, storm surges). Differences regarding the areas that are threatened by flood, differences in cause and last but not least differences in consequences. However, the similarities predominate: for each flood type one can identify flood prone areas. Unfortunately there exists no common database inside the EC about floods, which would enable to integrate all areas that are threatened by a flood. Evidently, there is an urgent need for such databases inside the EC.

Due to this fact, an appropriate indicator for a flood hazard map would be the number of great floods that have occurred during a certain period. Obviously it is possible though, that a certain type of flood threatens a part of the EC where there have been no flood events during the observation period, too. Thus, these indicators are only a first step towards a suitable flood hazard map.

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Böhm et al. 2002. Spatial planning and supporting instruments for preventive flood management. Darmstadt 2002.

Munich Re, 2000. World of Natural Hazards. CD-ROM. Munich 2000.

WBGU, 1998. Ways towards the sustainable management of freshwater resources. Berlin 1998.

WBGU, 1999. Strategies for managing global environmental risks. Berlin 1999.

1.2.1.2 Droughts

Hazard characterisation

Dryness and the more serious drought are conditions encountered in a regional climate system when supply of water that is available for plants and humans cannot satisfy the demand adequately. In addition to precipitation and evaporation, such factors as temperature, wind, type of soil and its capacity to store water, depth and availability of groundwater as well as vegetation growth influence drought. (Munich Re, 2000)

Drought is a natural hazard, which is not restricted to the Mediterranean region; large areas of Europe have been affected by drought during the 20th century. Drought can be defined in terms of meteorological, hydrological, agricultural and socio-economic conditions. There are many drought indices and classification systems for drought problems. For the ESPON project an optimal drought indicator should have harmonized data with large coverage and sufficient resolution for NUTS 2 and 3 level maps.

Table 5. Risk typologisation based on the drought hazard

Criteria	Values
Probability of occurrence *P*	High
Certainty of assessment of *P*	Medium
Extent of damage *E*	High
Certainty of assessment of *E*	High
Ubiquity	Over regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Medium political relevance

Risk management

Drought is extremely difficult to predict and it is usually not recognizable until it is already well advanced. Drought may result in further phenomena such as subsidence (particularly some types of clay can shrink tremendously and collapsing can occur when these types of soil are stressed e.g. by building), desertification (the ability of the ground and the flora is damaged due to prolonged drought so badly that their ability to recover is impaired or destroyed), famine (result of a prolonged drought) and forest fires. (Munich Re, 2000) During the long period of dryness in Europe there has also been serious power failures in southern Europe and in the consequence great economic losses in the industrial sector and the tourism as well as transportation problems for shipping on rivers and lakes all over Europe.

To avoid the problems that dryness can cause the use of water should be sparingly even at those times when it is in abundant supply. This means that reservoirs should always be kept as full as possible, aquifers should not be lowered unnecessarily, and evaporation should be reduced as far as possible, e.g. planting crops that are suitable for the local climate. (Munich Re, 2000)

Indicator

A recent British publication introduces a promising indicator for drought: Lloyd-Hughes, B. & Saunders, M.A. 2002: A drought climatology for Europe. International Journal of Climatology 22, 1571-1592.

Lloyd-Hughes and Saunders present a high spatial resolution, multi-temporal climatology for the incidence of the 20th century drought. The monthly standardized precipitation indices (SPIs) are calculated on a 0.5^{o} grid. The models provide the time series of drought strength, the number, the mean duration, and the maximum duration of droughts of a given intensity, and the trend in drought incidence.

Two SPI maps could be used as drought indicators in the ESPON project:
1. Number of extreme drought events in Europe during 1901-1999
2. Mean duration of extreme drought events in Europe during 1901-1999.

The longest mean extreme drought durations were found in Italy, northwest France, Finland and northwest Russia. These data sets should be included in the next data request.

In general, the drought risk follows the hazard pattern, with certain modifications based on the importance

References:

Munich Reinsurance Company, 2000. World of Natural Hazards (CD-Rom).

1.2.1.3 Forest fires

Hazard characterisation

Every year, some 50 000 forest fires break out in southern Europe and about 0.6 million hectares of forest is burnt in southern Europe. Fires can cause considerable damage in environmental terms through the destruction of fauna and flora and also human casualties. They also have serious economic implications like forest damage and costs of fire-fighting as well as fire prevention. In the past, fires were of natural origin (lightning) but nowadays most fires are caused by human activities, especially in the Mediterranean basin. For example, the extensive use of natural and forest regions as recreational areas have increased the number of human caused fires. However, there are many natural factors such as drought, wind speed, topography and vegetation that influence the spread of fires.

Table 6. Risk typologisation based on forest fires

Criteria	Values
Probability of occurrence *P*	High
Certainty of assessment of *P*	Low
Extent of damage *E*	High
Certainty of assessment of *E*	Low
Ubiquity	Regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Medium political relevance

Risk management

Fire is a complex phenomenon that is difficult to model. There are many factors that co-exist for the ignition of forest fire. These include human factors (population density, road density), topographic variables (slope steepness and direction), meteorological variables (temperature, precipitation) and vegetation variables (land cover type, moisture content).

Estimating forest fire risk involves identifying the potentially contributing variables and integrating them into a mathematical expression, such as an index. This index quantifies and indicates the level of risk. However, there are several perspectives from which forest fire risk indices can be classified. Regarding the time-scale for which they are meant to be operative, fire risk indices are often grouped into short-term or dynamic and long-term or structural indices. Different variables are used in these two approaches. Dynamic indices are derived from factors that vary in short periods of time, such as the vegetation status or the meteorological conditions. Conversely, long-term fire risk indices are based on variables that do not change in a short period of time. These include variables that are fairly static such as the topography or soil quality. They are indicators of stable conditions that favour fire occurrence. They can be used to determine areas with high risk of fire due to their natural conditions (San-Miguel-Ayanz, J., 2002).

European level evaluation of fire risk

The European Commission (EC) set up in 1997 a research group to work specifically on developing and implementing methods for the evaluation of forest fire risk at the European scale. This group is since 1999 working as a part of the Natural Hazards project of the EC DG Joint Research Centre. In addition to investigate the development of new forest fire risk indices, the work of this research group has mainly focused on adapting those approaches used by national/local forest fire risk indices to the European scale.

The Natural Hazards project has produced three types of European long-term forest fire indexes: 1) Fire probability index, 2) statistical index, and 3) likely damage (vulnerability) index. The fire probability index estimates the probability of forest fire occurrence to a series of long-term variables using a grid-size of 1 km². Three types of variables were considered: fuel sources available burning, topographic and socio-economic variables. At this moment the index is only calculated for southern Europe. Statistical index tries to be as objective as possible. It has calculated at NUTS 3 level for southern Europe. The index classifies the areas according to the estimated annual mean of fires per km² over the period 1985-1995. There are 37 variables (independent) that are used, such as agrarian, cattle and unemployment statistics, statistics on productions by sectors, population density, topographic variables and fuel type of land. Likely damage index estimates the damage that fire could cause if it would take place in a given area. The critical areas can be valuable natural areas, areas susceptible to soil erosion and areas that are close to human settlements. This index is also developed for the south Europe.

The Natural Hazards project has also produced short-term fire risk indices. These dynamic indexes are focused on determining the probability of forest fire ignition and on the capacity of fire spread. They are mainly based on determining vegetation status and especially on meteorological variables. Two types of dynamic indexes are computed at the European level within the project: meteorological fire risk index and vegetation stress index. Also the forecasting of these indexes will be available.

Advanced forest fire risk index (Fire Potential Index) agglomerates several factors that are taken into account by the long-term and short-term indexes. The model requires the knowledge of three vegetation variables: the live-ratio, the moisture content of small dead vegetation and the fuel type. Also the relative greenness, maximum air temperature, relative humidity, cloudiness and rainfall are taken into account in the model to estimate the ten hours time lag fuel moisture content. The working resolution is 4.4 km cell and it covers the whole Europe (San-Miguel-Ayanz, J., 2002).

FAO (Food and Agriculture Organization of the United Nations)

For more than 50 years, FAO has provided information and technical assistance in the area of forest fire management, including data collection and dissemination, preparation of guidelines on forest fire management, status reports on forest fires and provision of direct advice to member countries. Special attention has recently been given to information and public awareness on related policy, legal and institutional issues.

FAO has produced many reports. The report "Global Forest Fire Assessment 1990-2000" (http://www.fao.org/forestry/fo/fra/docs/Wp55_eng.pdf) has information on forest fires in every continent. The report includes information on total amount and areas of forest fires in the European ECE member states in 1990-1997 and also detailed information on some countries in Europe, e.g. Spain, Italy, German, Finland.

Forest Fire Information System (EC)

The European Commission has given Commission Regulation (EC) No 804/94 laying down certain detailed rules for the application of Council Regulation (EEC) No 2158/92 as regards forest-fire information systems. The first article states that Member States shall collect a set of information on forest fires. The set of information shall contain at least a number of standard items, comparable at Community level, called the 'minimum common core of information on forest fires'. The collection of such a set of information may be confined to high and medium-risk areas in the Member States. The following data should be collected in the case of forest fire:
1) Date and time of first alert.
2) Date and time of first intervention on which the first fire-fighting units arrived on the scene of the forest fire.
3) Date and time on which the fire was completely extinguished, i.e. when the last fire-fighting units left the scene of the forest fire.
4) Location of outbreak. The name of the commune and the successive territorial units to which it belongs (province or department, region, state) in which the outbreak of the fire was reported.
5) Total area burnt. The total area covered by the fire and the unit of area used.
6) Breakdown of burnt area into wooded and unwooded land. The wooded area and the unwooded area covered by the fire and the unit of area used or the respective percentages of the total area covered by the fire on wooded and unwooded land should be indicated.
7) Presumed cause of the forest fire. The presumed cause of the fire should be indicated according to the following four categories: 1. Cause of fires unknown; 2. Natural cause, e.g. lightening; 3. Accidental cause or negligence, i.e. the origin is connected directly or indirectly with a human activity but the person concerned did not act with the intention of destroying an area of forest; 4. Fires started deliberately, i.e. by someone intending to destroy an area of forest for whatever motive.

8) Commune code. The European code for the commune in which the fire broke out should be indicated. This code consists of nine digits, representing the code of the Member State, the region, the province and the commune.

Indicator

Since data from the above mentioned Natural Hazard Project was not accessible for the 1.3.1 project, other sources had to be found to get an idea of forest fires in Europe. Unfortunately, no long-term data was available but data for a particular year (2000).

Global Burnt Area 2000 Project

The Global Burnt Area 2000 Project (GBA2000) has been launched by the Global Vegetation Monitoring Unit of the JRC (Joint Research Centre), in partnership with 8 other institutions. The objective of the project was to produce a map of the areas burnt globally for the year 2000, using the medium resolution (1 km) satellite imagery provided by the SPOT-Vegetation system and to derive statistics of area burnt per type of vegetation cover.

The GBA 2000 products can be downloaded at no cost from the website. Regional and global products can be downloaded for the year 2000 and as well as monthly products. For the Forest Fire Map the annual data of the Region C (Europe**,** European Russia, Maghreb and the Middle East) was used as it was available as binary files (BSQ Format). It has to be mentioned that the estimation of the true burnt area in Europe and northern Africa provides difficulties because of the often small size of the fire events. Therefore the recent map shows only the observed forest fires by satellites in the year 2000 in Europe.

The raw data was processed into grid data showing the area of forest fires in km2 per NUTS 3 level.

References:

http://europa.eu.int/comm/research/leaflets/disasters/en/forest.html

http://natural-hazards.jrc.it/fires

http://www.fire.uni-freiburg.de/GlobalNetworks/Mediterrania/mediterranean-fire-disasters-programmes-2.pdf

http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=31994R0804&model=guichett

http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=4021&langId=1

http://www.gvm.jrc.it

http://www.gvm.jrc.it/fire/gba2000/gba2000_data.htm.

San-Miguel-Ayanz, J., 2002. Methodologies for the evaluation of forest fire risk: from long-term (static) to dynamic indices, in *Forest Fires: Ecology and Control*, Anfodillo T. and Carraro, V. (Eds), Forest Fires: Ecology and Control, University degli Studi di Padova, pp. 117-132.

1.2.1.4 Storms

The ESPON Hazards project defined "storms" as natural hazard; this chapter explains the possible development of indicators on this topic. According to the Munich Reinsurance Company (Munich Re) storms may essentially be divided into four categories on the basis of their evolution and expanse:

- Tropical cyclone (hurricane, typhoon, cyclone)
- Extra tropical storm (winter storm)
- Tornado
- Other storms (monsoon storm, thunderstorm, hailstorm, sandstorm, snow storm etc.). The other storms can also be defined as regional storms. The regional storms can have such effects as floods, snow pressure, ice pressure and soil degradation.

Because tropical cyclones as well as tornados do not occur in Europe and there is no adequate information on regional storms on European regional levels, the ESPON Hazards project will concentrate only on winter storms.

Winter storms

Hazard characterisation

Winter storms are the result of intense polar outbreaks (cold air conveyed from the polar regions into the moderate latitudes). The differences in temperature between the polar air masses and the air in the middle latitudes are particularly great in autumn and winter. At this time a "mountain" of cold air builds up over the ice- and snow-covered surfaces of the Arctic on account of the decreasing and later complete lack of radiation from the sun. The boundary between air masses is called a polar front. Affected by the earth rotation and the Force of Coriolis, the heavier cold air collides with the lighter warm air and transforms the air mass boundary into a wave, which then leads to a swirling of the two air masses around an area of several hundred kilometres. The intensity of the storm fields within these turbulent zones is proportional to the difference in temperature between the two air masses and is therefore at its greatest in late autumn and winter when oceans are still warm but the polar air masses are already very cold. (Munich Re, 2000)

Extratropical cyclones generally have less destructive power than tropical cyclones or tornadoes, but they are able to provide damaging winds over a wide area, and also can cause wave damage in coastal areas. The wind speed tends to be higher in open country, on hills and over the sea, though topographic features can increase speeds locally. The wave hazard depends on the wind's fetch (the distance of water over which the wind blows) and duration as well as its speed. (McGuire et al. 2002)

Winter storms can have such associated effects as storm surge (result of prolonged onshore winds), floods, avalanches, landslides, high seas / waves (depends on the duration and intensity of a storm), snow pressure (heavy snowfalls) and coastal erosion (wave action and suction on the shoreline). However, compared with other types of storms winter storms have lower wind speeds. The damage concentrates on non-structural components of buildings (roofs, windows) rather than on entire structures. The factors that influence the magnitude of damage are turbulence, frequency spectrum of the wind, duration of wind impact and wind direction. (Munich Re, 2000)

Table 7. Risk typologisation based on the winter storms.

Criteria	**Values**
Probability of occurrence *P*	High or medium (in northern Europe), low (in central Europe)
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-high
Certainty of assessment of *E*	Low
Ubiquity	Over regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Low political relevance

Risk management

Winter storms are climate related hazards that are quite difficult to predict long time in advance. Their probability of occurrence is the highest in northern Europe near the coastline (e.g. Great Britain, Norway, Denmark, the Netherlands and Germany) and the occurrence as well as the magnitude of winter storms gets lower in inlands (e.g. Sweden, Finland, Baltic countries). Reducing the occurrence of winter storms is not possible but it is possible to reduce the extension of damages caused by storms by a certain degree.

The damages caused on buildings by winter storms are usually dominated by damage to roofs, windows and facades. Making sure that these parts of buildings undergo proper maintenance and are kept in good state of repair can make an effective contribution towards loss prevention. Also, care should be taken when making extensions on the outside of buildings to ensure that these additional elements are sufficiently designed to withstand high wind loads. (Munich Re 2000)

The damages on nature, like felling of trees due to strong wind or heavy snowfalls, can also be massive. These damages are practically impossible to prevent. A possibility to lower the amount of damage caused by falling trees is to monitor their age and the stability before the main storm season. Weak trees should be cut-in time. Still, the damages for forest economy itself cannot be prevent.

Indicator

Winter storm indicator is available from the World Map of Natural Hazards compiled by Munich Reinsurance Company. Winter storm probability is presented in three levels: no risk, medium to high risk and high to very high risk.

References:

McGuire, B., Mason, I. & Kilburn, C. 2002. Natural hazards and environmental change. London, Arnold, xii.187 p.

Munich Reinsurance Company, 2000. World of Natural Hazards (CD-Rom).

1.2.1.5 Landslides and avalanches

Hazards characterisation

Landslides are the most widespread and undervalued natural hazard on Earth. Unlike many other geophysical events, even small landslides can incur considerable economic loss. Giant catastrophic landslides can even release within seconds the energy of an earthquake with Richter magnitude between 6 and 8. Mass movements have consequences on the environment. Movement enhances surface erosion and can strip fertile soils from agricultural land which in turn increases the amount of sediment being dumped into rivers, lakes and sea. This in turn can increase aquatic mortality rates and increased sediment loads in rivers can damage purification filters for drinking water as well as pumps for irrigation systems. At larger scale, slope collapses can alter the paths of rivers or dam them completely. (McGuire et al. 2002)

Landslides are unstable mixtures of soil and rock. They occur when the pull of gravity overcomes natural slope resistance. This situation typically arises when slope resistance is reduced below a critical value by combination of chemical weathering, increased fluid pressure in rock and soil, and the undercutting of the base of a slope. (McGuire et al. 2002)

The possibility of landslides can be estimated by refining the slope steepness, depths of sliding surfaces, volume of instable soil layers, and also meteorological conditions, like heavy rainfalls can cause landslides as well as earthquakes. Still, it is almost impossible to forecast the occurrence of landslides. Landslides can be prevented or stabilized in areas sensitive for slides by making the slopes more gentle and rounding them, making drainage for supporting structures and trying to tie up the upper soil with vegetation. The most important factors for landslides are hydrological, geological, geotechnical parameters as well as vegetation.

Sluggish deformation
Sluggish movements are associated with soils and clays, the earthflows, mudflows and mudslides. Sluggish earth deformation is the most common form of mass movements in nature. Movements may involve volumes from a few cubic metres to hundreds of millions of cubic metres. They occur on slopes from 2° to 45° but are most obvious on slopes around 20°-25°. Morphologically they can be subclassified into two groups according to the shape of their basal failure surface. Slides are called *Rotational* slides when movement occurs over curved surfaces. *Transnational* slides are those for which movement away from the headscarp occurs over planar or weakly undulating surfaces. (McGuire et al. 2002)

Catastrophic deformation
Catastrophic landslides occur when huge volumes of rock collapse and shatter with accelerations of the order of 1 m/s^2. They can travel kilometres within minutes and erase everything in their paths. Rock failures occur in regions of high relief, from young mountain chains to volcanic edifices. The largest sub-aerial catastrophic landslides on record have occurred in the metamorphic rocks of the Alps, Flims landslide in Switzerland. Some catastrophic landslides are triggered by earthquakes but they are normally preceded by accelerating creep. Giant catastrophic collapse normally occurs on slopes greater than 20°. The approach to catastrophic collapse can be hastened by water accumulating within an unstable mass. (McGuire et al. 2002)

Intermediate deformation

Intermediate movement typically occurs in poorly consolidated material, ranging from masses of mud, silt and clay to collections of debris within a fine-grained matrix. The resulting landslides are produced by rotational or trans-lational failure on slopes normally greater than 20°-25°. Flows may be triggered directly or they may evolve from rapid slides. They can occur during regional rainstorms. The most dramatic regional events are associated with hurricanes, cyclones and typhoons. Investigations of regional landsliding have sought to identify critical combinations of mean rainfall intensity and duration above which slopes become unstable. (McGuire et al. 2002)

Clayey material has the tendency to change from a relatively stiff condition to a liquid mass when it is disturbed. Clay can behave like a solid when still (because of surface tension holding the water-coated clay flakes together), but it can flow like a liquid when shaken. These are special problems in Norway around fjords.

Avalanches

An avalanche is a mass of snow sliding down a mountainside. The parameters describing the possibility of having avalanches are quite similar to those for land slides: slope steepness, depth of snow cover, volume of weak layers in the snow cover, and existence of external triggers starting an avalanche. European Avalanche Services that include maps and reports on avalanches can be found at http://www.slf.ch/laworg/tab.html.

Slope becomes less stable when it contains more water. Four key mechanisms by which water can induce instability are by reducing the effective normal stress, liquefying mixtures of soil and fine-grained rock, chemically weathering a rock, and enhancing rock cracking. As well as destabilising a slope, accumulated groundwater reduces the resistance of a moving mass and, hence, increases its potential velocity. (McGuire et al. 2002)

Table 8. Risk typologisation based on landslides and avalanches

Criteria	**Values**
Probability of occurrence *P*	Low-High
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-high
Certainty of assessment of *E*	Low
Ubiquity	Local
Persistency	Relatively short removal period
Irreversibility	Medium
Delay effect	Low
Mobilization potential	High local political relevance

Risk management

The MITCH project (Mitigation of Climate induced natural Hazards http://www.mitch-ec.net/default.htm) is a Concerted Action funded through the European Commission's 5th Framework Programme, with additional support from the UK Environment Agency. The project has concentrated their work in floods, droughts and landslides. However, European wide information on landslides is not available. The studies have been concentrated in specific case study areas. Also the DAMOCLES project (Debris fall Assessment in Mountain Catchments for Local End-Users http://damocles.irpi.cnr.it/welcome.htm) financed by EU has concentrated in landslide studies in specific case study areas. There is also project on landslide hazards in cultural heritage sites (http://steno.geo.unifi.it/ricerca/igcp-425.pdf). The project concentrates in UNESCO World Heritage Sites and has classified the types of landslide hazards encountered in European and Mediterranean sites, whereby the principal instability causes are taken into consideration.

There are also commercial companies in Europe that are specialized in slope stabilization and landslide management. For example, the Halcrow Landslide Management Unit (http://www.halcrow.com/landslides/) has over 25 years experience in landslide studies all over the world. However, the studies cover only single case study areas.

The first step for estimating the possibility for landslides is to calculate the slope steepness in EU27+2 area. This can be done by using the GTOPO 30 USGS 1x1 km grid layer. The vegetation might be possible to estimate from CORINE Land cover or from GISCO database. GISCO database has data layer on natural potential vegetation with 232 vegetation types from Pan Europe. The scale is 1:3 000 000. Information on soil properties is not available in European level. GISCO database do have soil map in scale 1:1 000 000 but it covers only EU12 and it is not available for the project 1.3.1.

Estimations for landslide probability due to meteorological conditions (rainfalls, etc.) could also be done for the areas sensitive for landslides. Also the probable occurrence of earthquakes can be estimated.

Landslides are a local phenomena that should be managed by large-scale studies. NUTS 3 levels might be too coarse for pinpointing areas sensitive for landslides.

References:

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McGuire, B., Mason, I. & Kilburn, C. 2002. Natural hazards and environmental change. London, Arnold, xii.187 p.

Natural Hazards and Earth System Sciences. Volume 3, Number 1/2, 2003. *Special Issue*: Landslides and related phenomena: Rainfall triggered landslides and debris flows.

http://www.copernicus.org/EGU/nhess/3/contents1_2.htm

1.2.1.6 Earthquakes

Hazards characterisation

Of all the natural phenomena capable of inflicting disasters upon human communities, earthquakes are perhaps the most frightening, the most unpredictable, and one of the most expensive natural hazards, even though the studies show that they are responsible for fewer deaths and smaller economic losses than for example storms and floods. Most of the world's earthquakes (over 90 %) occur in areas where large tectonic plates meet but they may also occur within plates themselves. Earthquakes can trigger other hazards, such as tsunamis (seismic sea waves), landslides (destabilization of layers) and fires following earthquake.

Table 9. Risk typologisation based on the earthquake hazard

Criteria	Values
Probability of occurrence *P*	Low
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-high
Certainty of assessment of *E*	Low
Ubiquity	Overregional
Persistency	Long removal period
Irreversibility	High
Delay effect	Low
Mobilization potential	High political relevance

Risk management

It was long belived that earthquake prediction was possible and help to mitigate this hazard. Currently this appears to be increasingly unlikely because the chaotic nature of earthquakes. Since the degree of damage may be high over relatively large areas, earthquakes have an enormous loss potential. There are numerous areas with high concentrations of population and ecenomic values situated in zones of high seismic activity in the world. The damage caused during an earthquake depends not only on the earthquake parameters themselves but also on the characteristics of the structures affected. These include for instance the type of construction, occupancy, age and height.

Minimization of the loss of life, property damage, and social and economic disruption due to earthquakes depends on reliable estimates of the seismic hazard. National, state, and local governments, decision makers, engineers, planners, emergency response organizations, architects, universities, and the general public require seismic hazard estimates for land use planning, improved building design and construction (including adoption of building construction codes), emergency response preparedness plans, economic forecasts, housing and employment decisions, and many more types of risk mitigation. Increasingly, it is being seen that the key to protecting against earthquakes is threefold: engineering to strengthen buildings, planning to minimise casualties and insurance to cover the cost. All these approaches require advice from the seismological community in order to strike the right balance.

In 1996, the Commission drew up a veritable European "battle plan" designed to ensure greater protection for citizens of the European Union from the risk of earthquakes. Member States are called upon to strengthen their information and communication systems, develop international cooperation (particularly with Japan), and systematically implement Eurocodes, the anti-earthquake standards system for the construction industry.

Indicator

The peak ground acceleration data from the Global Seismic Hazard Assessment Project (GSHAP) were used to produce a earthquake hazard map covering the whole of Europe. The GSHAP project was designed to provide a useful global seismic hazard framework and serve as a resource for any national or regional agency for further detailed studies applicable to their needs. One of the main goals of GSHAP was to produce a homogeneous seismic hazard map for horizontal peak ground acceleration representative for stiff site conditions, for the probability level of an occurrence or exceedance of 10% within 50 years. The peak acceleration is the maximum acceleration experienced by the particle during the course of the earthquake motion. Acceleration is chosen, because the building codes prescribe how much horizontal force building should be able to withstand during an earthquake. This force is related to the ground acceleration.

The Global Seismic Hazard Assessment Program (GSHAP) http://seismo.ethz.ch/gshap/

References:

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1.2.1.7 Volcanic eruptions

An eruption is considered here as arrival of solid products at the Earth's surface in the form of either the explosive ejection of fragmental material or the effusion of initially liquid lava. This definition excludes energetic, but non-ash-bearing steam eruptions.

Hazard characterization

Major volcanic eruptions are destructive but their occurrence is quite low. There is connection between volcanic activity and plate movements. Volcanic activity on convergent plate boundaries is explosive and on divergent plate boundaries effusive. However, volcanoes may also be found in the middle of plates. These volcanoes are called hot spots, e.g. Hawaiian island chain, and they can even cause the plates breaking apart, e.g. East African Rift. Hot spot volcanic activity is always effusive. (Munich Re, 2000)

Table 10. Risk typologisation based on volcanic events

Criteria	**Values**
Probability of occurrence *P*	Low
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-High
Certainty of assessment of *E*	Low
Ubiquity	Over regional
Persistency	Relatively long removal period
Irreversibility	High
Delay effect	High
Mobilization potential	Medium political relevance

Risk management

The damages that volcanic eruption causes are ash fall, lava flows, gases (sulphur oxides and nitrous oxide), glowing clouds (can have high temperature) and volcanic earthquakes. Volcanic eruptions can also have effects, such as tsunamis (seismic sea waves), lahars (thick mud flows that are composed of pyroclastic material and water, and can float even tens of kilometres) and/or climate change (the ash that is thrown out in large eruptions may reach into the Earth's upper atmosphere and that way affect the global climate by blocking out the sun's rays). Ash fall and tsunamis are capable causing damage over a relatively large area, the others (except climate change) usually only threaten areas that are close the volcano. These phenomena are easier to consider. Still, the geographical extent of ash fall depends on direction and strength of the wind and is difficult to estimate. (Munich Re, 2000)

There is no scale of magnitude for volcanic eruptions like there is for earthquakes. Besides the size of the eruption the explosivity of the eruption also plays a decisive role. (Munich Re, 2000) The Volcanic Explosivity Index (VEI) uses a number of parameters, including height of the eruption column, volume of material ejected and eruption rate, to determine the scale of an eruption.The index starts at 0 and is opened, although nothing larger than a VEI 8 has yet been either observed or identified in the geological record. While eruptions in the 0-4 range are commonplace, the larger events have progressively lower frequencies. VEI 5 eruptions, of which the 1980 Mount St Helens blast is an example, occur on average every decade, while VEI 6 events, like the 1991 eruption of Pinatubo, the Philippines, have return periods of around a century. (Simkin & Sievert, 1994; McGuire et al. 2002)

Indicator

The used data have been compiled by volcanologists of Global Volcanism Program, Smithsonian institute, National Museum of Natural History (http://www.volcano.si.edu/gvp/world/index.cfm). Data elements in the digital version of Volcanoes of the World are:

Table 11. Data elements of volcanoes

NUMBER	Unique identification number based on the scheme established for the "Catalogue of Active Volcanoes of the World" (CAVW)
VOLCANO NAME	Primary name by which this volcano is known
LOCATION	Geographical and/or political area
LATITUDE & LONGITUDE	Given in decimal degrees
ELEVATION	Summit elevation in meters
TYPE	Volcano morphology
STATUS	Type of evidence for Holocene activity
TIME FRAME	Code indicating whether dated eruptions have been recorded, and the time period of the volcano's last known eruption

It is also possible to have a brief background on each volcano's geological history with photograph of present situation.

All volcanoes with known eruption dates within last 10 000 years are marked on the Volcanic Eruption map of Munich Re.

The risk classification is based on Munich Reinsurance Company's classes:

Class 0: the status of Holocene eruption is uncertain or Holocene activity is only hydrothermal
Class 1: last eruption before 1800 AD
Class 2: last eruption after 1800 AD
Class 3: volcanoes that are identified as being particularly dangerous by the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).

Project 1.3.1 has used the same classification in its volcanic eruption maps (see chapter 1.4.1.4.)

References:

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1.2.1.8 Extreme precipitation events

Hazard Characterisation

Extreme precipitation events can have severe impacts from local to over regional scale. They can even lead to major flooding events, as occurred along the river Elbe in 2002. On a local scale heavy rain falls can lead to destruction of agricultural crops and cause sudden strong erosion processes that might lead to the failure of structures (roads, bridges, etc.). If the precipitation occurs in the form of hail, persons can be severely harmed and valuable structures can experience severe damages. Local extreme precipitation events are very difficult to forecast as they occur according to very special local weather conditions. There are certain patterns that characterise the weather conditions that cause large extreme precipitation events that hit regional scales but possibilities of long-term prediction are rather low. It is also difficult to identify the exact location of the area that will be hit by extreme precipitation events. For example, the flood in the Oder River in 1998 was caused by a similar weather constellation as the Elbe flood in 2002. It was only a matter of a few hundred kilometres that determined the catchment area that would then discharge the water of the rainstorms.

Table 12. Risk typologisation based on Extreme precipitation events

Criteria	Values
Probability of occurrence *P*	Medium
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-high
Certainty of assessment of *E*	Low
Ubiquity	Over regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Low political relevance

Risk management

The management of extreme precipitation events is very difficult because of the uncertainty of occurrence, the location of occurrence and the magnitude of damage. The most severe effect of larger extreme precipitation events are the subsequent floods, therefore please see the chapter 1.2.1.1 Floods for risk management. The damages of heavy precipitation on a local scale are difficult to avoid, so the best management is to improve the forecast methodologies so that damage preventive measures can be taken in time.

Indicator

This indicator is available from the GISCO data layers: climate data base EU and European interpolated climate data. These data sets are already in the list of data to be requested but they were not available for the ESPON evaluation in June 2003.

1.2.1.9 Extreme heat waves

Hazard Characterisation

Heat waves are extremely difficult to predict because they form quickly and are dependent on exceptional weather conditions. Once occurring, it is also difficult to predict their duration. Extreme heat waves can cause all kind of problems. First of all they often lead to droughts (please see chapter 1.2.1.2). Also, heat waves cause a strong impact on the energy sector, because many energy-producing plants are depending on cooling water. Often, cooling waters are taken from rivers that also heat up during extreme heat waves. Subsequently, power plants have to lower their output or even shut down completely. Besides the economical impacts, also safety issues in the case of nuclear power plants have to be taken into account.

The resulting energy cuts lead to problems in all sectors. For example, have to lower their production and offices cannot cool the computer systems properly. Other subsequent effects are the stronger use of cooling systems that lead to a higher demand of energy and cause a local increase in temperatures.

Table 13. Risk typologisation based on Extreme heat waves

1.1 Criteria	**Values**
Probability of occurrence *P*	Medium
Certainty of assessment of *P*	Low
Extent of damage *E*	Low-high
Certainty of assessment of *E*	Low
Ubiquity	Over regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Low political relevance

Risk management

Since extreme heat waves are very difficult to predict, also in their magnitude, it is very difficult to manage this hazard. The most needed management tools are probably emergency plans in case of extreme heat waves so that the most vital institutions, such as hospitals and other rescue facilities can still operate.

Indicator

This indicator is available from the GISCO data layers: climate data base EU and European interpolated climate data. These data sets are already in the list of data to be requested but they were not available for the ESPON evaluation in June 2003.

1.2.1.10 The effect of climate change

The expected future climate change, as related to anthropogenic release of greenhouse gases, is proposed to affect both the frequency and intensity of natural hazards. Understandably, hazards caused directly by climatic factors will be affected but changes in temperatures, winds, precipitation etc. may affect other hazards as well. The link between changes in the frequency or intensity of weather-related hazards and climate change is difficult to establish because of several factors: natural variability in climate and weather is large, humans have markedly changed the landscape, societal and economical vulnerability has increased, and statistical data on extreme climatic events is scarce. Furthermore, the spatial resolution of current global climate models is too low to catch many weather-related hazards. This can be aided by the use of different techniques such as dynamical and/or statistical downscaling. Changes in the frequencies of hazardous weather phenomena can also be assessed by observing changes in the frequency-intensity distributions or in occurrence of less extreme events. An important task is to find good indicators based on climatic factors such as temperature and precipitation related to hazards. Those indicators are crucial if climate model data are to be used when establishing the possible effect of climate change on weather-related hazards.

The effects of climate change were addressed already in the first interim report (pages 65-68 and table 4). Because hazardous weather phenomena are always deviations from the mean, a shift in the mean may cause marked changes in the frequency of extreme events. With the rising average temperature, higher maximum temperatures are expected and hot day and heat waves become more frequent. On the other hand, minimum temperatures appear to be rising more rapidly than the maximum and so the temperature range is getting narrower. This development leads to more frost-free days and a decrease in cold waves.

Global warming is expected to lead to a more vigorous hydrological cycle. Water vapour in the atmosphere increases leading to increase overall precipitation. In some areas, intensity of precipitation events increases. The daily precipitation extremes are expected to increase more than averages. On the other hand, summer drying will increase in many areas and may well be a hazardous problem regarding agriculture, tourism and health among other areas. Hazardous hailstorms and ice storms are difficult to predict, but as the former are related to severe thunderstorms, their frequency may increase.

Changes in the frequency of wind-related hazards are less easy to predict. Several competing factors affect the mid-latitude storminess and local factors are of importance as well. The changes appear to be small but an increase in the intensity of extra tropical cyclones, combined with an overall decrease in low pressure, is expected. Thus, windstorms may increase in intensity but become less frequent.

Since the first interim report, the literature on indicators with respect to climate extremes has been reviewed more thoroughly. The indicators published by Frich et al. (2002) on temperature and precipitation extremes seem to be widely accepted in the scientific community (see Table 14 for some examples). The fact that changes in wind extremes are more difficult to predict and detect is reflected in much fewer available indicators, and the ones presented in the literature build on observations of Sea Level Pressure (Jones et al., 1999, Alexandersson et al., 2000).

For Europe, values and trends in a number of indices for precipitation and temperature have been computed and mapped within the European Climate Assessment & Dataset project: ECA&D (Klein et al., 2002, Klein et al., 2003, http://www.knmi.nl/samenw/eca/index.html). The ECA&D computations are based on station data sets from different parts of Europe. ECA&D is initiated by the European Climate Support Network and supported by the Network of European Meteorological Services.

Two on-going EU projects are making extensive use of standard sets of indices of climatic extremes. The work within the MICE project (Modelling the Impacts of Climate Extremes) includes the evaluation of indices computed from observations, global climate models, and regional climate models. From the STARDEX project (STatistical And Regional Dynamical Downscaling of EXtremes for Europe) a software package is available to calculate nearly 60 indices from daily temp/precip data. Data on daily temperature and precipitation may not be available in the GISCO data layers. The STARDEX project uses a dataset from the NCEP reanalysis for the present day climate. An extract for Europe of this dataset is available on STARDEX' web site www.cru.uea.ac.uk/projects/stardex/. Both MICE and STARDEX include an uncertainty assessment of climate change scenarios. There is no room for such an assessment within the ESPON project, and the results from MICE and STARDEX will not be available until year 2005. Consequently, any climate change scenarios applied within ESPON (e.g. from SWECLIM) can only be seen as examples of possible future development. It thus seems reasonable that ESPON should focus on the task of how to apply the indicators estimated from climate variables to produce indicators of vulnerability.

The effect on floods of changes in precipitation and temperature is not always straightforward. Particularly in areas with snow, the seasonal distribution is important. An increase in the number of extreme precipitation events does not necessarily lead to an increase in flood events (Groisman et al., 2001). An increased mean precipitation may, on the other hand, also lead to increased flooding.

In addition to having an influence on direct weather hazards, climate change can affect other natural hazards. Landslides, for instance, are influenced by precipitation. Water accumulation can promote all types of landslides by increasing the weight of the earth mass. Water also detaches gliding surfaces that otherwise would adhere because of small-scale roughness and irregularities. Increased pore pressure promotes landslides by diminishing effective normal stress and causing liquefaction. In stressed rock water enhances weathering and cracking. In addition, the decrease in resistance increases the velocity of the mass and run-out length, further increasing damage potential. In addition to precipitation, global warming may increase landslide risk in some areas because of melting glaciers and permafrost.

Sea level rise may also increase coastal landslides as well as coastal erosion, but it also affects other hazards. It aggravates estuarine floods and storm surges that may be increasing also because of changes in precipitation (estuarine floods) and wind patterns (storm surges). Clearly, the increases in extreme precipitation events described above also increase river flood frequencies, together with prolonged rains or exceptional melting of snow.

Sea level change can also have an effect on hazards such as seismicity and volcanism. Isostatic readjustments and eustatic sea level changes can cause seismic activity and changing sea level may also increase volcanism. However, the expected sea level rise is probably too small to have an effect on volcanic activity. Also the suggested link between volcanism and climate change presented by Rampino et al. (1979) pertains to non-anthropogenic climatic changes and is not applicable here. Especially a lowering in the sea level may increase submarine landslides in the continental margins and ocean islands whereas rising sea level is apparently less harmful in this respect. The elevated erosion level can, however, cause collapses also in volcanic areas, which may increase volcanic risk.

Table 14. Example of indicators for the detection of changes in climate extremes. From Frich et al. (2002).

Indicator	Rationale	Limitations
HWDI: Heat Wave Duration Index. (days) Maximum period > 5 consecutive days with T_{max} > 5°C above the 1961-1990 daily T_{max} normal.	Linked with mortality statistics.	Not really valid outside mid-latitude climates
R10 (days) No. of days with precipitation ≥ 10 mm/day.	A direct measure of the number of very wet days. This indicator is highly correlated with total annual and seasonal precipitation in most climates.	Very regionally dependent.
CDD (days) Maximum no. of consecutive dry days (R_{day} < 1 mm).	Effects on vegetation and ecosystems. Potential drought indicator. A decrease would reflect a wetter climate if change were due to more frequent wet days.	
R5d (mm) Maximum 5 days precipitation total.	A measure of short-term precipitation intensity. Potential flood indicator.	
R95T (%) Fraction of total annual precipitation due to events exceeding the 1961-1990 95th percentile.	A measure of very extreme precipitation events	May be highly correlated with number of extreme events.

References:

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1.2.2 Technological Hazards

1.2.2.1 The process of risk

The process of risk in the field of technological hazards is very complicated. The emission from a technological hazard may leak out of a production facility/deposit/stockpile/transport corridor etc. through specific transmission media (water, air, soil) - often over a period of time – and change into an immission, which harms people, the environment or facilities. To create a risk, a specific damage potential has to exist, which is determined by the type and magnitude of an immission. In the first instance, typical technological hazards focus on very small areas of emission (e. g. a waste deposit, dam etc.). However, some hazards have a great perimeter of influence and thus can affect a relatively great part of the whole European Union. Furthermore, it is very difficult and in many cases not possible to define specific threatened areas (weather influence, unknown processes below ground). Approximately the whole EU is threatened by accidents with a regional, local or sub-local level of influence (e. g. major accident hazards). Thereby not the more or less omnipresent hazard component but the vulnerability component is the more important part of the risk for technological hazards.

The following table gives an impression about the interrelationship between hazards and immissions, respectively influence. The table lists the types of immission which are generally possible and indicates their relevance for the selected types of technological hazards:

Table 15: Technological hazards and types of emission

Type of immission / Type of hazard	Toxic gases	Toxic substances in a liquid form	Shock wave	Ionized radiation	Non-ionized radiation	Kinetic energy
Hazards from nuclear power plants	+	+	+	+	+	+
Major accident hazards. Hazards from production plants with hazardous production processes or substances (large-scale chemical works, weapons, fireworks ore processing plants, etc.) No available data	+	+	+	+	+	+
Hazards from hazardous waste deposits or the storage of nuclear waste or mining stockpiles inclusive tailings dams. No available data	+	+	-	+	-	-
Hazards from the marine transport of hazardous goods (oil etc.)	-	+	-	-	-	-
Dam failures. Hazards from water reservoirs respectively their dams	-	-	+	-	-	+

1.2.2.2. Nuclear power plants

Hazard characterization

The technological hazard related to nuclear power plants (NPPs) is special in certain respects and needs to be treated accordingly. First, as described above, the consequences of a large-scale nuclear accident have a large spatial extent, making all of Europe exposed to possible nuclear fallout. Second, the theoretical frequency of occurrence (probability) of such an accident is extremely small, less than once in two million years (Fortum, 1999). Because of this, a simple calculation of averaged annualized losses caused by even a major nuclear power plant accident would result in negligible hazard intensity estimates throughout Europe. However, NPPs have to be taken into account in spatial planning considering that the time frame of planning is completely different from such million-year projections and keeping in mind the Chernobyl accident in Ukraine in 1986. In practice we cannot afford the luxury of viewing the damages in a million-year perspective but have to consider a spatial planning response to the NPP hazard.

NPP accidents cause damage because of several factors: the direct health effects of high doses of radiation (non-stochastic health effects); later, stochastic health effects of low-level exposure to radiation (cancer and teratogenic or genetic mutations); other health effects related to the accident (both physical and mental); economic losses due to restrictions on the use of water, foodstuffs, timber and milk; damage to property and the inaccessibility of the contaminated land areas; damages to the (international) public image of the area affecting tourism and food industry; long-term reduction of energy generating capacity; and costs of relocation, decontamination etc.

Nuclear power plant incidents and accidents are described on the International Nuclear Event Scale (INES). Deviations of no safety significance are level 0, whereas the INES incidents range from level 1 (anomaly) to level 7 (major accident). Incidents between INES 1 and 3 involve what is called "defence in depth degradation", meaning that there have been failures in the safety layers but off-site impacts are very limited. INES 4 to 7 levels describe accidents instead of incidents and involve off-site impacts (releases).

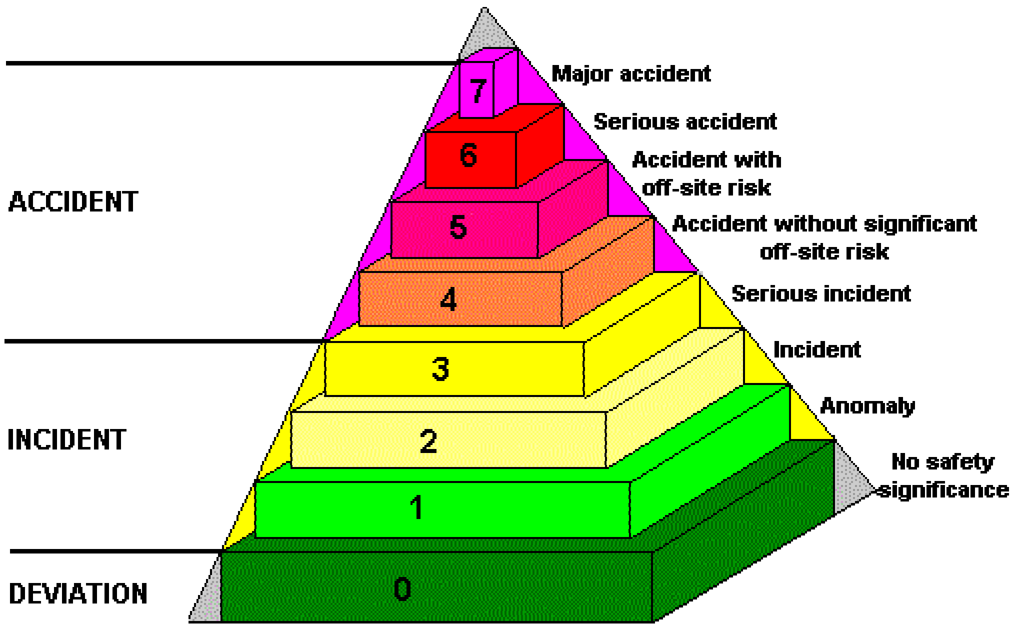

Figure 7: The INES scale (http://www.iaea.or.at/ns/nusafe/ines.htm).

As shown in figure 7, the accidents to be taken into consideration in the spatial planning context mainly fall into INES classes 5 through 7 that involve off-site impacts. As described above, the expected frequency of occurrence of such an accident is very small. However, there are cases in which INES level 5 to 7 accidents have occurred in NPPs in the past:

Chernobyl 1986 (INES 7), Sellafield 1957 (INES 5) and Three Mile Island 1979 (INES 5). In addition, the precautionary principle, adopted by the Commission, should be applied in cases where "scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU". Therefore, severe (INES 5-7) nuclear power plant accidents are included in the list of hazards to be considered here.

INES 5 to 7 accidents in nuclear power plants involve serious reactor damages that allow radioactive substances to escape. In most NPPs, the reactor is located in a gas tight building capable of withstanding high pressures. This building is designed to control radioactive gases and particles emitted from the reactor in a case of an accident, but in INES 5-7 accidents this precaution fails at least partly and radioactive substances are transported outside the power plant area. The releases can be in the form of gases, aerosols and fuel fragments and the releases are estimated and described as fractions of the core inventory at the time of the accident. In the case of Chernobyl, the estimate for fuel material released is 3.5 +/- 0.5%, corresponding to 6 t of fragmented fuel (OECD NEA, 2002). However, the radionuclides responsible for most of the radiation exposure for the general public, ^{131}I and ^{137}Cs, were released to a much higher degree (50-60 and 40-20 %, respectively, table 16). Altogether, large amounts of radioactive substances were released in the accident (table 16). The Chernobyl case was consulted here in order to determine the possible spatial effects of an INES 7 accident because it is the most severe nuclear power plant accident to date and the only one falling into that category. The accident, which is described and evaluated in an OECD NEA report of 2002, cannot be used as a reference case for detailed emergency planning, but is more suitable for the present purpose.

Table 16: Estimate of radionuclide releases during the Chernobyl accident (OECD NEA, 2002).

Core inventory on 26 April 1986			Total release during the accident	
Nuclide	Half-life	Activity (PBq)	% of inventory	activity (PBq)
^{33} Xe	5.3 d	6 500	100	6500
^{131} I	8.0 d	3 200	50-60	~1760
^{134}Cs	2.0 y	180	20-40	~54
^{137}Cs	30.0 y	280	20-40	~85
^{132}Te	78.0 h	2 700	25-60	~1150
^{89}Sr	52.0 d	2 300	4-6	~115
^{90}Sr	28.0 y	200	4-6	~10
^{140}Ba	12.8 d	4 800	4-6	~240
^{95}Zr	65.0 d	5 600	3.5	196
^{99}Mo	67.0 h	4 800	>3.5	>168
^{103}Ru	39.6 d	4 800	>3.5	>168
^{106}Ru	1.0 y	2 100	>3.5	>73
^{141}Ce	33.0 d	5 600	3.5	196
^{144}Ce	285.0 d	3 300	3.5	~116
^{239}Np	2.4 d	27 000	3.5	~95
^{238}Pu	86.0 y	1	3.5	0.035
^{239}Pu	24 400.0 y	0.85	3.5	0.03
^{240}Pu	6 580.0 y	1.2	3.5	0.042
^{241}Pu	13.2 y	170	3.5	~6
^{242}Cm	163.0 d	26	3.5	~0.9

The Chernobyl INES 7 accident was detectable in practically every country of the northern hemisphere (OECD NEA 2002). The largest particles, primary fuel particles, deposited within 100 km of the reactor. Small particles were carried by wind to large distances and their deposition depended on local rainfall. Meteorological conditions varied frequently during the 10 days of the accident, causing significant variation in the dispersion of the contamination. The most highly contaminated area was the 30 km zone around the reactor where ground depositions exceeded 1500 kBq/m^2. The far zone of contamination ranges from 100 to 2000 km around the reactor. There, local rainfall produced three spots of especially high contamination. One of them was the Kaluga-Tula-Orel contamination spot located as far as 500 km from the site of the accident. In that region, the ^{137}Cs deposition was in the order of < 600 kBq/m^2. Areas outside the former Soviet Union were affected as well as the radioactive plume moved across Europe. Initially the wind was blowing to northwest over Fennoscandia, the Netherlands, Belgium, and Great Britain. After that the plume moved south and much of Central Europe, Northern Mediterranean and the Balkans received some deposition. Altogether, most countries in Europe received some deposition of radionuclides

The extent of dispersion of radionuclides can thus be expected to be large in a case of a severe NPP accident. The harmful effects seem also to be fairly irreversible and long lasting in the severely contaminated areas. For short-lived radionuclides, such as ^{131}I (half life 8 days), the main exposure of humans is through vegetables and milk consumed within a few days of the accident as well as direct inhalation of radioactive iodine, which is accumulated to the thyroid gland. The longer-lived ^{137}Cs appear to reside in soil for a long time, however. After the initial decrease of transfer coefficients of ^{137}Cs from soil to plants, the sorption-desorption processes then seem to be approaching steady state and the ecological half-lives tend towards the physical decay rate. In practice this means that foodstuffs will remain contaminated much longer than previously thought and radioactive caesium will be present for approximately 300 years (ten half lives).

Based on the above characterizations, the hazard related to nuclear power plant accidents is described in table 17. Although the certainty of assessment of the probability of occurrence (P) can be debated, the NPP accident risk seems to be of the Damocles risk type. Also the extent of damage need not be as high as that caused by the Chernobyl accident and in lower INES categories this is by definition the case. For instance, in the Three Mile Island (Harrisburg) INES 5 accident the reactor was badly damaged but the shielding building contained most of the radionuclides. However, the spatial planning response in European scale is dictated by the most severe accident estimates.

Table 17: Risk typologisation based on nuclear power plants

Criteria	**Values**
Probability of occurrence *P*	Low
Certainty of assessment of *P*	High (medium)
Extent of damage *E*	High
Certainty of assessment of *E*	High
Ubiquity	Global
Persistency	Very long removal period
Irreversibility	High
Delay effect	Low (medium depending on weather conditions)
Mobilization potential	High political relevance

Risk management

The most important risk management aspect for nuclear power plants is the reduction of the probability of occurrence of hazardous events in the nuclear facilities themselves. Indeed, the nature of nuclear power and the great damage potential has lead to the adoption of extensive, independent, multi-layered safety practices at the installations. The tendency is also towards simple safety features that are directly based on laws of physics and are not dependent on electricity, pumps etc. All these precautionary measures, continuous training and safety practices help to reduce the probability of an NPP accident.

In addition to the safety procedures at nuclear facilities, risk management is achieved by mitigating the effects of possible radioactivity releases from NPPs. Besides spatial planning responses, nuclear emergency plans have been developed at different administrative levels ranging from individual power plants and municipalities to national plans. These plans include precautionary and protective measures such as distribution of information, closure of public buildings, suspension of business, sheltering, evacuation, medical treatment and distribution of potassium iodide tablets. After the first emergency phase, further exposure of the public is limited by entry control and monitoring of the environment, water and foodstuffs. In the recovery phase, controlled re-entry, radiation surveys, decontamination, relocation and compensation are implemented.

After the Chernobyl accident, international nuclear emergency exercises (INEX) have also been arranged with INEX 1 series in 1993, INEX 2 between 1996 and 1999, and INEX 2000 in 2001 (http://www.nea.fr/html/rp/inex/index.html). After INEX 1, three areas of further work were identified: The implementation of short-term countermeasures after a nuclear accident, agricultural aspects of nuclear and/or radiological emergency situations and nuclear emergency data management. The INEX 2 series of exercises further highlighted three areas in need of improvement: Better identify key emergency data, improve emergency communication and information management and improve emergency monitoring strategies. INEX 2000 then focused on civil liability, progress made after INEX 2 and testing of the data matrices and communication strategies developed. The INEX exercises help to improve transboundary communication and co-ordination, promoting the application of protective measures in neighbouring countries.

NPP risk indicators

Nuclear power plant accidents can cause extensive damage in the immediate surroundings of the facility as well as in distances of hundreds of kilometres, depending on weather conditions during the accident. In the hazard characterization above, several points related to the selection of the risk indicators were discussed: the types of damage the accident may cause, the relevance of the most severe accidents, the importance of the fraction of core inventory as the measure of the releases, the large spatial extent of the radionuclide releases, and the long removal time.

The types of damage nuclear power plant accidents can cause are related to the indicators of vulnerability. First, human populations are affected by radiation and mostly so in the near zone of the reactor. Therefore, information on population density can be regarded as a relevant indicator. Second, indicators of agriculture may be used because soil contamination will definitely restrict the use and export of foodstuffs and dairy products. In addition, forestry, aquaculture and fisheries may experience losses although these were not very substantial in the case of Chernobyl (OECD NEA, 2002). Another major branch of industry that would suffer from an NPP accident is tourism and indicators on its importance in different parts of Europe may be studied.

The most severe, INES 5 to 7, accidents were chosen as the basis of the assessment because off-site releases of radioactive substances are involved. While the releases can be quite limited in INES 5 accidents, the radius of the effects of INES 6 and 7 accidents can be tens or even hundreds of kilometres. The most important transport mechanism for radionuclides is by wind. Major wind directions have been determined for individual power plants but winds can vary in strength and direction during a release. This affects the risk assessments because, in practice, the same approach has to be adopted as used in nuclear emergency planning: concentric zones of different degree of effect have to be defined. These zones have to take into account the large spatial extend of the radionuclide deposition, the long removal time, and the effects of the contamination on especially agriculture.

The magnitude of hazard posed by individual power plants is less easy to assess. NPPs are of several different types, but even these large-scale variations are difficult to use for estimations of risk. However, as the core inventory is an important determinant of the potential release, the power of the plants can be used as an indicator. The most easily obtainable indicator may be the electrical power capacity (expressed as MWe), which is more often reported that the thermal capacity of the reactor (MWt) or the core inventory of radioactive material. This approach does not take into account the amount of nuclear waste stored on site, or the storage and transport of nuclear fuel, but is sufficient for the present purpose.

The GISCO database contains the NPEC data set, titled Nuclear power plants European Union. It contains the locations and characteristics of 151 nuclear power plants in the European Union. Information such as the location (decimal degrees and commune code); name; reactor type; criticality, grid and begin dates; and thermal, installed, and output capacities are given. Unfortunately, however, the data are from 1985 and are thus necessarily outdated.

The International Atom Energy Agency (IAEA) maintains what is called the Power Reactor Information System (PRIS). It is the most complete data bank on nuclear power reactors and is updated regularly. Importantly, reactors under construction or planned for shutdown are also included. Selected data are available at:
http://www.iaea.org/programmes/a2/index.htmland the lacking data on location can be supplied from other sources because of the unique reactor identifiers.

Due to the available data sets, a first useful indicator would be the number of nuclear plants. As a result of the potentially extreme (probable European wide) perimeter of influence in a case of a MCA a more detailed indicator (e. g. energy output) is less important. The risk depends here in the first instance on the damage potential. However, the size of the nuclear reactors would be useful as an additional indicator. The amount of installed capacity is a measure of "how much of nuclear power plant is at the site" and the amount of radioactive materials leaked is a function of how much was initially present in a major accident because gaseous fractions then escape.

Regarding to the well known differences in safety standards between western and eastern European nuclear plants it would be suitable to examine the influence of this factor more in detail at a later stage of the project.

1.2.2.3 Major accident hazards

Hazard characterisation

The hazard type "major accident hazard" represents a wide range of different hazards. The most important similarity of these hazards consists in their origin as an emission from an industrial facility, e.g. specific substances leaking out of a production area. Over specific mediums of transmission (water, air, soil) - and often over a period of time - the emission then changes to an immission.

First of all, the most threatened areas are the industrial facility and its employees itself. In addition, the area around the facility is threatened by an immission from the facility. Influences on the hazard comprise the type and magnitude of the emission, weather conditions, the warning period after an emission occurs, etc. Generally speaking, major accident hazards can be characterised by the following criteria:

Table 18: Risk typologisation based on major accident hazards

Criteria	Values
Probability of occurrence *P*	Low
Certainty of assessment of *P*	High
Extent of damage *E*	Medium – high
Certainty of assessment of *E*	High
Ubiquity	Local – transnational
Persistency	Depends on released substances (low – high)
Irreversibility	Depends on released substances (low – high)
Delay effect	Depends on released substances (low – high)
Mobilization potential	High political relevance

Risk Management - SEVESO II Directive

Major accident hazards belong to the best-known hazards with a long history of experience in dealing with them. Within the European Union a specific directive, the SEVESO II Directive is responsible for these types of hazards.

Council Directive 96/82/EC (SEVESO II) aims at the prevention of major accidents involving dangerous substances and the limitation of their consequences. The provisions contained within the Directive were developed following a fundamental review of the implementation of Council Directive 82/501/EEC (SEVESO I).

In particular, certain areas were identified where new provisions seemed necessary on the basis of an analysis of major accidents that have been reported to the Commission since the implementation of SEVESO I. One such area is management policies and systems. Failures of the management system were shown to have contributed to the cause of over 85 per cent of the accidents reported.

Against this background, requirements for management policies and systems are contained in the SEVESO II Directive. The Directive sets out basic principles and requirements for policies and management systems, suitable for the prevention, control and mitigation of major accident hazards.

There is a requirement for lower tier establishments to draw up a Major Accident Prevention Policy (MAPP) that is designed to guarantee a high level of protection for man and the environment by appropriate means. These include appropriate management systems that take into account the principles contained in Annex III of the Directive. The operator of an upper tier establishment (covered by Article 9 of the Directive and corresponding to a larger inventory of hazardous substances) is required to demonstrate in the 'safety report' that a MAPP and a Safety Management System (SMS) for implementing it have been put into effect in accordance with the information set out in Annex III of the Directive.

The elements of the Safety Management Systems (SMS) are:

- Organisation and personnel: The role, responsibility, accountability, authority and interrelation of all personnel who manage, perform or verify work affecting safety should be defined.
- Hazard identification and evaluation: Hazard identification and evaluation procedures should be applied to all relevant stages from project conception through to decommissioning, including:

    - Potential hazards arising from or identified in the course of planning, design, engineering, construction, commissioning, and development activities;
    - The normal range of process operating conditions, hazards of routine operations and of non-routine situations, in particular start-up, maintenance, and shut-down;
    - Incidents and possible emergencies, including those arising from component or material failures, external events, and human factors, including failures in the SMS itself;
    - Hazards of decommissioning, abandonment, and disposal;
    - Potential hazards from former activities;
    - External hazards including those arising from natural hazards, from transport operations including loading and unloading, from neighbouring activities, and from malevolent or unauthorised action like terrorism.

- Operational control: The operator should prepare and keep up to date and readily available the information on process hazards, design and operational limits as well as controls coming from the hazard identification and risk evaluation procedures. Based on these, documented procedures should be prepared and implemented to ensure safe design and operation of the plant, processes, equipment and storage facilities,
- Management of change: The operator should adopt and implement management procedures for planning and controlling all changes in personnel, plant constructions, processes and process variables, materials, equipment, procedures, software, design or external circumstances which are capable of affecting the control of major accident hazards,
- Planning for emergencies: The operator should develop and maintain procedures to identify, by systematic analysis starting from the hazard identification process, foreseeable emergencies arising from or in connection with its activities, and to record and keep up to date the results of this analysis. Plans to respond to such potential emergencies should be prepared, and arrangements for testing and review on a regular basis should be included within the Safety Management System. The procedures should

also cover the necessary arrangements for communication of the plans to all those likely to be affected by an emergency.

- Monitoring performance: The operator should maintain procedures to ensure that safety performance can be monitored and compared with the safety objectives defined. This should include determining whether plans and objectives are being achieved, and whether arrangements to control risks are being implemented before an incident or accident occurs (active monitoring), as well as the reporting and investigation of failures which have resulted in incidents or accidents (reactive monitoring).
- Audit and review: In addition to the routine monitoring of performance, the operator should carry out periodic audits of its SMS as a normal part of its business activities. Senior management should, at appropriate intervals, review the operator's overall safety policy and strategy for the control of major-accident hazards, and all aspects of the Safety Management System to ensure its consistency with these.

Major-accident hazards and spatial planning

The requirements for land-use planning (Art. 12 Seveso II Directive) are newly introduced into Community legislation on major-accident hazards; the Seveso I Directive did not contain such requirements. The context is elaborated by Recital (22) of the Seveso II Directive which states: “Whereas, in order to provide greater protection for residential areas, areas of substantial public use and areas of particular natural interest or sensitivity, it is necessary for land-use and/or other relevant policies applied in the Member States to take account of the need, in the long term, to keep a suitable distance between such areas and establishments presenting such hazards and, where existing establishments are concerned, to take account of additional technical measures so that the risk to persons is not increased”

Although land-use planning requirements are newly introduced into Community legislation, several Member States have existing established practices for achieving a degree of separation between Seveso establishments and residential population. In general, the methods used are disparate, ranging from explicit consideration of major-accident risks in some cases to a generic ‘zoning’ approach based on distances derived historically, normally by taking account of various environmental factors such as noise, pollution, etc. The methods include separation distances that are sometimes especially designed to also take account of accident hazards. Some Member States have not yet established neither a land-use planning policy nor an emergency system that address major-accident hazards.

In general, the requirements of Article 12 of Seveso II can be met using whichever method best fits with the historical development and legislative style of land-use planning in each of the EU 27+2 states. However it can be expected that practices within individual Member States would yield broadly similar results in similar situations.

Available data basis: Seveso Plants Information Retrieval System (SPIRS)

Rational decision-making in the risk assessment and management of major hazards in industrial plants is of great importance. The geographical component of risk is indispensable, especially when the spatial distribution of cost and benefit factors related to the operation of industrial plants with major hazard potential are quite diverse across the EU 27+2 states. The common presentation of spatially distributed data are maps as a central part of the spatial planning systems. In the context of industrial risk management, maps create a visual and thus "immediate" understanding of the cause/effect relations with regard to hypothetical major accidents on a "Seveso Plant" site and their effect on the immediate surroundings.

The EC's accident database MARS is now complemented by SPIRS, a distributed database system which was set up in order to provide access to risk related information from major hazardous industrial establishments. By using SPIRS, which is based on the requirements of the Seveso II Directive, it is possible to analyse and make available information about the geographical component of risk in Europe. This will mainly be done by providing a map of all major hazardous industrial establishments in Europe together with information on their basic risk related characteristics. Unfortunately, the usage of these databases for the ESPON project purpose is prohibited.

Due to this fact, a substitute data basis is necessary. For the project objectives a geographical component below the NUTS 3 level is as well dispensable as exact information about the hazard characteristics of a specific chemical plant. Therefore it would be possible to estimate the hazard potential of a NUTS 3 region over the annual turn over of the regional chemical industry. Under the control of SEVESO II, similar safety standards are to be maintained inside the EU. As a result of this, a higher annual product output correspondingly a higher turn over would be a suitable basic indicator. However, differences regarding the specific hazard potential of the several different substances would be neglected. Anyway, the turn over indicator seems to be an appropriate way to deal with major accident hazards for the ESPON purpose.

1.2.2.4 Hazardous waste deposits

Hazard characterization

The EU policy on hazardous waste consists of several pieces legislation. There are Directives on both waste (75/442/EEC) and hazardous waste (91/689/EEC). The first of these includes the definition of waste and requires Member States to take all necessary steps to prevent waste generation, to encourage reuse and to ensure safe disposal while the Hazardous Waste Directive (HWD) aims to provide precise and uniform definition of hazardous waste and to ensure the correct management of such waste. In the HWD, hazardous waste is defined by a list of hazardous wastes drawn up by the EC. These wastes possess one or more of the hazardous properties set out in the HWD Annex III. In short, such properties include: explosive, oxidizing, highly flammable, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, teratogenic, mutagenic, and ecotoxic.

The list of hazardous wastes has been updated several times. In 1994, a list of all wastes was produced to create what is known as the European Waste Catalogue (EWC 1994, Commission Decision 94/3/EC). The catalogue was revised in 2002 (EWC 2002, Commission Decision 2000/532/EC) and the revised catalogue with its subsequent amendments also identifies hazardous wastes. These form the Hazardous Waste List that was originally created in 1994 when the Council Decision 94/904/EC identified which wastes of the EWC 1994 are deemed to be hazardous.

The HWL and its amendments are employed in the 2001 report of the EEA entitled Hazardous waste generation in EEA member countries (Brodersen *et al*. 2001). It includes data from 15 EEA countries and two regions. The report highlights the difficulties in obtaining comparable data and differences in the nature of hazardous wastes generated between countries. For instance, while the 20 most common waste types in each country generally account for approximately 75 % of total quantity of hazardous waste generated, the top five hazardous waste types in the eight countries using the full HWL list included as many as 35 waste types (out of max 40 if all had been different). Industrial structure is an important determinant for this because manufacturing industries, energy generation types and waste incineration practices differ between regions.

Landfilling is the most common hazardous waste treatment technology in OECD countries with more than half of the waste consigned to landfill (Schmid *et al.* 2000). In general, landfills receive many different kinds of materials from which emissions may arise: specific organic components, general organic matter, inert components, metals, and inorganic non-metals. Of these, specific organic components and metals can be toxic, organic matter produces methane that is often associated with various trace substances, and inorganic non-metals such as chlorine, nitrogen and sulphur can cause contamination of ground and surface waters. Depending on the age, condition and management practices of the landfill, emissions arising from them include: dust, litter, landfill gases (methane, carbon dioxide, odours), emissions of leachate to waters and soil, emissions from fire and explosions, contamination transported by animals that frequent landfills. Technical instability of the landfills also poses a threat to the environment.

Besides special hazardous waste landfills, mining, quarrying and ore-processing operations produce waste characteristic to those activities that may pose a hazard to the surroundings of the waste deposits. More than 70% of all the material excavated in mining operations worldwide is waste especially in surface mines. In the EU, more than 400 million tonnes of mining waste is produced each year, which represents about 29% of total waste. At mining sites, topsoil, overburden, waste rock are stored and temporary ore stockpiles are also common. Ore processing in its turn is associated with tailings deposits. The effect these wastes have on the environment depends on their chemical and mineralogical composition, physical properties, amount and disposal method as well as climatic, geological and land use conditions.

In the wake of the spectacular mining waste-related accidents of Aznalcóllar and Baia Mare, much interest has focused on the geotechnical stability of the tailings embankments. For instance, on 23 October 2000, the European Commission adopted a Communication on the "Safe operation of mining activities: a follow-up to recent mining accidents" and on 2nd June, 2003, adopted a proposal for a directive on the management of waste from the extractive industries. Throughout the world tailings dams have failed at an average rate of 1.7 per year over the past 30 years (Penman, 2001). The stability of the embankments is influenced by factors such as embankment height and slope; strength of the embankment; permeability and groundwater levels (gradient); and strength of the embankment foundations. However, hazardous phenomena related to tailings embankments are not confined solely to dam failures. Contaminated drainage can seep through or under poorly designed embankments, water may percolate to the subsoil and groundwater, and dam walls or spillways may overflow due to operating errors. The leachates of many tailings-derived waters are acid due to the acid generation in conjunction with sulphide oxidation. This is the well-known acid mine drainage (AMD) or, in case of waste rock piles, acid rock drainage (ARD). Metals and residues of process chemicals (cyanide, acids, bases, organic compounds) may also be leached from the tailings. Furthermore, if the tailings are not treated properly during basin infilling, windborne tailings dust may also be carried to the surroundings and the tailings may be eroded.

Pollutants related to the extractive industries are presented in Table 19. In addition, uranium mining and milling-produced waste may be a source of radiation.

Table 19: Extractive industrial activities and the related pollutants (modified from BRGM, 2001).

Industrial activity	Antimony	Silver	Arsenic	Barium	Beryllium	Boron	Bromine	Cadmium	Chromium	Cobalt	Copper	Manganese	Mercury	Nickel	Lead	Selenium	Thallium	Vanadium	Zinc
Coal extraction			■						■						■				■
Other hydrocarbons extraction				■			■												■
Ferrous metallic ore extraction																			
Non-ferrous metallic ore extraction			■				■	■	■		■		■		■				■
Non-ferrous metals production	■	■	■		■	■			■	■	■		■	■	■	■	■	■	■
Industrial minerals extraction																			
Industrial minerals production												■							

Industrial activity	Calcium	Magnesium	Sodium	Potassium	Iron	Silica	Aluminium	Nitrogen	Chlorine	Fluorine	Sulphur	Cyanide	Aromatic hydrocarbons	Polyaromatic HCs	Halogenous aromatic HCs	Organometallics	Phenols	Sulphides	Several chemical fractions
Coal extraction	■	■	■			■		■	■		■	■	■	■	■		■	■	■
Other hydrocarbons extraction	■	■	■					■			■		■	■	■	■			
Ferrous metallic ore extraction			■		■				■		■	■					■		
Non-ferrous metallic ore extraction	■		■	■	■				■	■	■	■					■	■	
Non-ferrous metals production								■	■	■		■	■	■	■				
Industrial minerals extraction									■										
Industrial minerals production							■												

Based on the characteristics of the hazardous waste landfill-related hazard, the following table was compiled. Due to the high variability of hazardous wastes and the associated deposits an unambiguous definition of the hazard is difficult. With sufficient site-specific investigations, the probability of occurrence of, for instance, leachate seepage or embankment instability can be accurately determined whereas the probability of a hazardous event is poorly known for unstudied landfills. The extend of damage is landfill specific and depends on the substance(s) involved as well as on the properties of the landfill and its environmental setting. While large-scale landfill accidents certainly fall into the Damocles category, in certain respects the hazardous waste landfill hazard is of the Cassandra type, with slow seepage or destabilizing processes operating unnoticed.

Table 20: Risk typologisation based on hazardous waste deposits

Criteria	Values
Probability of occurrence *P*	Low-medium
Certainty of assessment of *P*	High-medium
Extent of damage *E*	Low-high
Certainty of assessment of *E*	High
Ubiquity	Local (regional in special cases)
Persistency	Low – high
Irreversibility	Low – high
Delay effect	Low – high
Mobilization potential	High political relevance

Risk management

The hazardous waste deposit-related hazard is, first of all, managed at the source of the waste by aiming to minimize its production and to lower its hazardousness. For instance, the Basel convention of the United Nations Environment Program (UNEP), originally set up to control transboundary movement of hazardous waste, is shifting its focus to minimization of waste. The convention also promotes other ways of reducing the HWL hazard by giving technical assistance and publishing guidelines about physico-chemical and biological treatment of hazardous waste.

When hazardous waste has ended up in a landfill, however, it is the technical properties and management of the site that determine the risk involved. Guidelines for specially engineered landfills are available (e.g., Secretariat of the Basel Convention, 1997) and for the EU, Council Directive 1999/31/EU on the landfill of waste sets out the criteria that landfills of hazardous (and non hazardous) waste must meet (Annex I). The directive also concerns acceptance of wastes to landfills (Annex II), landfill permits, control and monitoring procedures during operation (Annex III), closure and after-care (Annex III), and reporting obligations.

The UNEP-ICOLD (2001) bulletin concerns the failures of tailings dams, but the conclusions and recommendations apply to other embankments as well. According to the report, based on 221 tailings dam incidents, main reasons for failure are often related to lack of attention to detail with staff and ownership changes, exceedance of original design heights, changes in tailings properties, and lack of water balance. Other causes include insufficient geotechnical investigations, slope instability, erosion, inadequate or failed decants, structural inadequacies and additional loading of closed impoundments. Thus, the nature of the causes of failure is such that most situations can be solved with engineering technology, indicating that available specialized knowledge should be applied more systematically.

UNEP and ICOLD recommend that the design, construction, operation and closure of dams and impoundments with risk potential to downstream shall include the following requirements:

1) Detailed site investigation by experienced geologists and geotechnical engineers to determine possible potential for failure, with in situ and laboratory testing to determine the properties of the foundation materials.

2) Application of state of the art procedures for design.
3) Expert construction supervision and inspection.
4) Laboratory testing for "as built" conditions.
5) Routine monitoring.
6) Safety evaluation for observed conditions including "as built" geometry, materials and shearing resistance. Observations and effects of piezometric conditions.
7) Dam break studies.
8) Contingency plans.
9) Periodic safety audits.

Hazardous waste deposit indicators

European-wide data on landfills of hazardous waste has been collected by the EEA's European Topic Centre on Waste and Material Flows (ETC/WMF). The data is stored in what is called Electronic catalogue of waste management facilities that can be browsed in the Internet (WasteBase at: http://wastebase.eionet.eu.int/). The data are summarised and evaluated by Weissenbach (2001). The database is based on a questionnaire concerning hazardous waste treatment facilities, sent to EEA member countries after the compilation of already existing databases (EEA Technical report No 43). Data has been collected from all EEA member countries, validated and imported into the Electronic catalogue. Altogether, 17 countries reported 2163 companies that manage 1836 facilities and 278 landfills. Information on location and recovery or disposal type (D code: D1 or D5) is nearly complete in the catalogue so that landfills can be identified and their location is known. It is important to note, however, that the catalogue does not include abandoned landfills. Furthermore, disposal volume information is available for only 18 % of the sites and information on waste types for 28 %.

The WasteBase thus contains information on current hazardous waste treatment facilities. In addition to these, data on abandoned landfills is needed to fully describe the hazard in Europe. However, such information is not available even for individual countries, let alone the whole Europe. This is because many of those landfills are unauthorized or predate any legislation concerning landfill disposal of hazardous waste. For instance old industrial sites may contain hazardous wastes deposited on land or under ground that are discovered only years later. Thus, a possible source of information to complete the data on hazardous waste deposits are national surveys of contaminated land. Identification of hazardous waste deposits may be possible if detailed information on the cause of contamination is included in such inventories. An EEA European Topic Center on Soils (ETC/S) study (EEA, 2001) conducted to investigate soil-polluting activities from localized sources in eight test countries discusses the limitations of these types of data and proposes, among other things, a more detailed breakdown of industrial branches and the inclusion of information on size and type of facilities in the future.

A European inventory of mining-related waste also exists. It is described and evaluated in BRGM (2001). The inventory is based on a questionnaire sent to most of the EU member countries, regarding the mined substances, waste deposits, mining systems and ore processing methods. The questionnaire is rather detailed, including information on location, ownership, activity, waste types, known accidents, environmental setting, and environmental impact. However, as with all wide surveys of this type, the data are incomplete in many respects. The survey nevertheless represents the best available European wide source of information on mining waste and should be consulted for the current ESPON project purposes. Creation of a database suitable for spatial treatment using the data involves a considerable amount of work, however.

For mining risk analysis two main criteria type have to be considered: intrinsic mining criteria and external environmental criteria.

a) Intrinsic mining criteria
- Global Security – shafts, galleries, open pit, buildings
- Mining exploitation dimension – tailings extension (tonnage, volume, etc)
- Tailing characteristics – type, grain size, deposition method, physical stability, chemical stability
- Spoils Geochemistry – waste rocks, sediments, alluvial materials, soils
- Water chemistry – superficial and underground waters
- Visual impact and landscape

b) External environmental criteria
- Distance to urban locals
- Land use

Water supply

The major sources of information on hazardous waste deposits identified so far are both EU wide, but do not concern the accession countries (WasteBase includes most EEA member countries). Obtaining harmonized data from these countries presents a challenge but the situation will certainly improve in the future with reporting obligations related to EU membership.

All in all we should start with the Electronic catalogue of waste management facilities. However, information about the number and location of waste facilities are a sufficient basis for our project purposes. Nevertheless it would be very useful to extend the information by data about the disposal volume. This indicator would be comparable with the indicator water storage volume (dam failures).

1.2.2.5 Hazards from the marine transport of hazardous goods

Hazard characterisation

These types of hazards are clearly linked with two separate causes such as failed technical structures of the ship (e. g. fault engines, hulls) and natural events like heavy storms. These causes are evident for oil spills as for other goods as well. Nevertheless, in the following the argumentation focuses on oil spills as the best-known and most important type of hazard in relation to marine transport. Due to their high ubiquity, other hazards along transport networks are not of relevance for the ESPON project (see p. 88, first interim report).

Table 21: Risk typologisation based on marine transport of hazardous goods

Criteria	Values
Probability of occurrence *P*	Rather low
Certainty of assessment of *P*	High
Extent of damage *E*	Medium (High in coastal areas)
Certainty of assessment of *E*	High
Ubiquity	Regional - transnational
Persistency	Medium
Irreversibility	Rather low
Delay effect	Rather low
Mobilization potential	High political relevance

A more detailed overview of different causes for oil spills is shown in the table below:

Table 22: Incidents of oil spills by cause, 1974 – 2001(where, global or in Europe?)

Type/dimension	< 7 tonnes	7 – 700 tonnes	> 700 tonnes	Total
Operations				
Loading/discharging	2767	299	17	3083
Bunkering	541	25	0	566
Other operations	1167	47	0	1214
Accidents				
Collisions	163	254	87	504
Groundings	222	200	106	528
Hull failures	562	77	43	682
Fires & explosions	150	16	19	185
Other/Unknown	2221	165	37	2423
Total	**7793**	**1083**	**309**	**9185**

Source: ITOPF 2002

Due to the available data resources, the "number of oil spills over 7 tons" would be an appropriate indicator to assess the hazard potential at NUTS3 level.

Inside the territory of the European Union (and outside the twelve-mile zone) there is very dense marine traffic, which concentrates on a few main routes. Due to this fact, there is a specific increased risk, which concentrates

- First on the narrow and flat streets like the "Kadetrinne" in the Baltic Sea, the "English Channel", the "Danish Straits", the "German Bay" and others.
- Second, on areas with extraordinarily severe weather conditions like the Gulf of Biscay, the Hebrides, etc in combination with rocky coasts and underwater riffs.

Risk Management

It is apparent that

- Most of the oil spills result from routine operations such as loading, discharging and bunkering which normally occur in ports or at oil terminals. Thus there is a specific increased risk for those locations.

- The majority of these operational spills are small, with some 92% involving quantities of less than seven tonnes. It is a matter of fact, that there is normally a good coping capacity inside harbours and oil terminals, which would minimize the extent and impact of oil spills.
- Accidents involving collisions and groundings generally give rise to much larger spills, with almost a fifth involving quantities in excess of 700 tonnes. The necessity and importance for preventing strategies rises far away from harbours and available coping capacity and additionally during bad weather conditions. Suitable strategies are double hull tankers, pilots on board, emergency anchor places etc.

Due to these facts, objectives of risk management on the transportation of dangerous goods are:

- Monitor in real time,
- Control the risk posed by their transportation,
- Provide early warnings in case of emergency.

Essential elements of a risk management system are:

- Automatic alarm recognition,
- Identification of the place and time of emergency,
- Inform all relevant entities,
- Consequence assessment and definition of impact zones,
- Identification of most vulnerable areas,
- Coordination of available resources,
- Identification and tracking of procedures,
- Communication, coordination and reporting.

Most of the accidents happened in international water bodies outside the twelve-mile zone. As a substitute, supranational agreements are suitable instruments to implement counter measures. In this field of action, the International Maritime Organisation (a United Nations agency) was established as the most important platform for international cooperation. During the last years, Particularly Sensitive Sea Areas (PSSAs), which have a high hazard potential and vulnerability at the same time, have been identified and determined (watt sea, great barrier reef and others). Further areas (Gulf of Biscay, Baltic Sea) will be determined in the next years. Furthermore, the EU Commission has developed an ‘EU-Marine-Strategy’. One common goal is the obligation for pilots on board in PSSAs.

According to the United Nations Convention on the Law of the Sea (done at Montego Bay, Jamaica, 10 December 1982; entered into force, 16 November 1994), “States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, and they shall endeavour to harmonize their policies in this connection” (article 194 of the Convention).

As an additional organisation, the International Tanker Owners Pollution Federation coordinates responses to oil spills and governs international funds.

1.2.2.6 Dam

Hazard characterisation

Large dams represent a major hazard because dam failures – besides the loss of lives – can lead to severe damage of infrastructure and settlement areas. The large damage potential, the relation of dam failures to extreme natural events and of course the clear spatial relevance of large dams makes them important to be considered in the ESPON Hazards project.
A dam for itself is defined as a barrier constructed across a watercourse for the purpose of storage, control or diversion of water. Dams typically are constructed of earth, rock, concrete or mining tailings. A dam failure is the collapse, breach, or other failure resulting in downstream flooding.

A dam failure is a specific type of hazard, because it could at the same time be a natural and technological hazard. As we have seen during the great floods in August 2002, many water reservoir dams were threatened by an extreme water level, but they did not fail. Such events are natural hazards, which are influenced by technological structures. In another case, the physical structure of such a dam could fail, because of a weak or damaged construction. Those events are clearly technological hazards, in spite of the fact that the damage causing medium is the same, namely water. Following, only the technological side will be described in more detail. The table below focuses on the specific criteria of dam failures:

Table 22: Risk typologisation based on dam failures

Criteria	Values
Probability of occurrence *P*	Low
Certainty of assessment of *P*	High
Extent of damage *E*	Medium
Certainty of assessment of *E*	High
Ubiquity	Regional
Persistency	Relatively short removal period
Irreversibility	Low
Delay effect	Low
Mobilization potential	Medium political relevance

The catastrophic nature of dam failures places a responsibility on those who own and operate the dams to search for all means to minimize risk to the public. In the worst case, an abrupt dam failure as consequence of an earthquake, a terrorist attack or something else, leads to harm in consequence of the enormous kinetic energy of a gigantic flood wave. Without or with a very short period of time for warning, the life of a lot of people are threatened.

Public and private physical structures and installations that are situated downstream of a dam may be exposed to the risk of dam failure after the dam was built. Therefore, also the public authorities, namely the planning and permission divisions as well as private stakeholders have to keep in mind the risk of dam failures.

The failure rate of large dams before 1950 is approximately 2,2 % over the whole period of their existence. For dams built after 1950, the rate is approximately 0,5 %. Most of the failed dams were less than 30 meters in height. Most failures have involved newly built dams (70% of all failures occurred within the first 10 years following the construction, many even within the very first year).

According to Widmann (1984) one has to distinguish between several causes for dam failures (most common cause first):

- Overtopping (landslide into reservoir, wave action, precipitation exceeds storage capacity, etc.)
- Internal erosion of the dam body or its foundation.
- Inaccurate construction (static's, structural failures).
- External causes, including those arising from natural hazards, or from malevolent or unauthorised action like terrorism.

Further, dam failures may happen as a result of natural events like wind pressure, ice pressure, earthquakes or extreme temperatures (Wieland 2002, p. 278; Rißler 1998, p. 264). In the case of tailing dams (Tailings dam: A dam constructed to retain tailings or other waste materials from mining or industrial operations) the damage is in the first instance a consequence of the hazardous substances. Large dams can also be a source for flood waves even if the construction of the dam is not damaged, for example if land- or rockslides come down into the reservoir. In 1963 this caused about 1900 deaths in the Piave valley (Italy) after a landslide came down from Monte Toc into the reservoir of Vaiont and caused a large flood wave (Abele 1994, p. 417).

Risk management

In the field of risk management four types of preventive measures could be identified (Mineiro 1984):

- Information to downstream residents of the hazards posed by the dam and of the procedures of warning and evacuation.
- The prohibition of further development in risk areas to reduce the damage potential.
- The implementation of a monitoring and inspection system at the dam to detect any dangerous trends and trigger maintenance work
- Hazard identification and evaluation procedures should also be applied to external hazards (e.g. the identification and surveillance of potential landslides which interfere with dam safety or to persons and property in the landslide area).

For the project's purpose, the most important indicator for hazards from great dams is the reservoir capacity in cubic metres (see also FEMA, p. 256). This indicates more or less directly the hazard potential of a dam, respectively the possible dimension of a flood wave after a dam failure occurs. The necessary data resources are available by the ICOLD´s (International Commission on Large Dams) World Dam Register.

Contrary to this, the frequency of the occurrence of such a single event or a specific dam is less important at NUTS 3 level. Furthermore, information about occurred damages in the past is unsuitable for usage as an indicator, because of the lack of relevant events (see chapter C “Change in methodology” of the Technical Note). For example: In the period from 1950 – 1986, only 49 of about 40.000 large dams failed.

Due to this fact, there is a need for a factor, which takes account of the approximate failure rate of dams. It is a matter of fact, that as a result of the few occurred disasters the overall risk from dam failures is low compared to risks from other natural and technological hazards. This problem will be described more in detail as a part of chapter 1.3.

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1.3 Synthetic index of risk and typologies regions

The index of risk allows a classification of regions that integrates both the hazard potential and the vulnerability. The index allows distinguishing between regions, which are simply hazardous (i.e. potentially affected by hazard events) and those that are risky areas, referring to their damage potentials and high degree of vulnerability. The following methodology is based on the ecological risk analysis, an estimation method, which is used as a part of environmental impact assessments (Bachfischer 1978, Scholles 1997).

1.3.1 Hazard maps for selected hazards

A typology of regions taking into account all hazards seems to be possible only on an ordinal scale (see First Interim Report, p. 94). Therefore, the selected technological hazards (see chapter 1.2.1) and natural hazards (see chapter 1.2.2) will be described by indicators and then classified into a fivefold ordinal scale. In table 23, the first column shows how the intensity of a certain hazard can be classified into such a fivefold ordinal scale. Finally, hazard maps show the intensity of hazards in European NUTS 3 regions in degrees from I to V.

1.3.2 Risk maps for selected hazards

The difference between hazard and risk is the consideration of the regional vulnerability. For the development of risk maps, there is thus a need to relate hazards and vulnerability to each other.

To reflect the vulnerability of a region, it should be sufficient to analyse the **GDP per capita** and the **population density** that will both be equally weighted (50:50). These indicators already catch a range of factors influencing vulnerability: The population density represents the potential vulnerability of humans within a region. The GDP per person in combination with the population density thereby represents the economic damage potential (infrastructure, buildings, movable facilities), the technical response potential (financial coping capacity) and the potential exposure of people. Regarding the aggregation of both indicators, a simple addition and division by two can be justified and would generate a quantitative variable on an ordinal scale that can be used for statistical operations (see table 23). This table indicates how the two vulnerability indicators could be classified. Due to the fact, that the differences in population density in Europe are greater than differences in GDP per person, it seems necessary to use different ranges.

Table 23: Categories for the determination of a typology of regional vulnerability
Source: ESPON Hazards 2003

Degree of vulnerability	GDP per capita (EU-average = 100)	Population density (EU-average = 100)
I	< 50	< 25
II	50 – 75	25 – 100
III	75 – 125	100 – 200
IV	125 – 175	200 – 500
V	> 175	> 500

The right part of table 24 shows how vulnerability can be classified into a fivefold ordinal scale and how (NUTS 3) regions can be placed into this matrix. The different colours indicate the degree of risk. The green areas in table 24 indicate a risk degree of 0. The reason is that –

according to the definition of risk – no risk exists if there either is no hazard potential or no damage potential.

Table 24: Matrix for the identification of the regional risk of hazard x
Source: ESPON Hazards 2003

Intensity of hazard x	Degree of vulnerability				
	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

Coping capacity should then flow into the project in a qualitative way. As the result of the integration of coping capacity into our quantitative risk index probably some corrections regarding the ranking of specific regions will be necessary, if they have an extraordinarily high or low coping capacity.

1.3.3 Synthetic hazard map

The synthetic hazard map shows which regions are most threatened by natural and technological hazards. The suggested procedure sums up the respective hazard intensities for every region. Because the total number of hazards that are examined in the ESPON Hazards project is 14, the values for the sum of hazard intensities for every NUTS 3 region ranges between a minimum of 14 and a maximum of 70 (see column 1 of table 25). In other words, a region reaches a total intensity of only 14 if the intensity of every single natural and technological hazard is just 1 (14 x 1). The other extreme would be a region where the hazard intensity reaches 5 for every hazard that summarises to the maximum value of 70 (14 x 5) (see column 2 of table 25). In reality, it is not likely that this maximum range will be reached. Therefore, the actual range of values (e.g. 22-53) has to be divided into five classes that represent the hazard intensity in degrees from I to V. This, of course, can be done only after the analysis of data was done. For the time being, these classes should span the whole range from 14 to 70.

1.3.4 Synthetic risk map

One of the final results of the ESPON Hazards project will be the development of a risk map that shows the overall risk for European regions on the NUTS 3 level (synthetic risk map). This can be achieved on the basis of the classification for each individual hazard as explained in the previous chapter II.2.3. Similarly, this has to be done for the hazard vulnerabilities for every region. Of course, the degree of vulnerability for one region does not change from one hazard to the other which explains why there is no need to summarise the regional vulnerabilities (see columns 3-7 of table 25).

The relation between the degree of hazard intensity and the degree of vulnerability can be presented in a summary matrix as shown below. The different colours indicate the degree of risk.

Table 25: Matrix for the identification of the overall regional risk
Source: ESPON Hazards 2003

Sum of hazard intensi-ties	Intensity of hazard x	Degree of vulnerability				
		1	2	3	4	5
14-24	1	2	3	4	5	6
25-35	2	3	4	5	6	7
36-46	3	4	5	6	7	8
47-57	4	5	6	7	8	9
58-70	5	6	7	8	9	10

This procedure seems to be practicable and at the same time illustrative. However, it neglects the interrelations between hazards because scores for each hazard are simply added up. A more sophisticated approach which would take account of the interrelations between hazards (exacerbating and ameliorating effects) would be desirable, but only little scientific work has been done so far on aggregating different risks, let alone aggregating a great number of risks. More complex aggregation procedures, which take into account interrelations between hazards, would also remain beset with serious methodological problems that could actually distort the results. Further, the results of this method lead to a *relative* estimation of regional risk that has always to be seen within the European context.

Given these problems and the limited time and personnel capacity of the ESPON Hazards project, the proposed simple aggregation seems to be the most feasible and justifiable procedure.

1.3.5 Dealing with methodological problems

Some methodological problems have emerged during the development of a synthetic risk index. This part discusses these problems and suggests how to deal with them. The main problems – which are in close relationship to each other – are:

1. *Aggregation:* How can risks of single hazards be aggregated to an overall risk index? Is it allowed to aggregate risks of different types? For example: Risks with a high probability (floods, storms) on the one hand and risks with a low probability (large earthquakes) on the other hand. The problem of aggregation is a consequence of weighting and measuring problems.

2. *Weighting:* How should different risks be weighted in the process of aggregation? Are all hazards of the same importance or are there differences?
3. *Measuring:* How can hazards be measured if there has not been any catastrophic event in the past that can serve as a reference? For example: There has not been a nuclear MCA[1] in Central and Western Europe so far, consequently there is only deterministic data available about the probability of such an event as well as the extent of damages. Furthermore, the consequences of such a disastrous event that exceeds a certain threshold has to be avoided in any circumstances.

Generally there are two possibilities for aggregation: either weighting each indicator with the same value or weighting all indicators according to their importance. The first possibility neglects the different importance the indicators might have but on the other hand guarantees transparency of the methodology. With the second possibility the indicators may be weighted according to their importance but the main question here will be which value should be chosen for weighting the indicators. Is an earthquake twice as dangerous as a drought? Or maybe only 1.5-times? Additionally, it is problematic that only realized damages are a proper way to weight the different hazard potentials (see above). The determination of such values in general is highly subjective. Also, it increases non-transparency because it is difficult to follow the steps within the methodology.

For the synthetic index of risk it is suggested to first develop risk maps for each hazard and in a first step weigh them equally. In a second step the single risks can be weighted according to plausible assumptions (categories which stand for the different hazards potentials of the several natural and technological hazards). This is still subjective to a certain degree but the step of weighting the different risks is open and understandable.

References:

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Scholles, Frank (1997): Abschätzen, Einschätzen und Bewerten in der UVP. Weiterentwicklung der ökologischen Risikoanalyse vor dem Hintergrund der neueren Rechtslage und des Einsatzes rechnergestützter Werkzeuge. Dortmund. (= UVP-Spezial, 13).

[1] MCA: maximum credible accident.

1.3.6 Typology of regions

An important result of ESPON Hazards is the development of a typology of regions to identify areas in Europe that are threatened by similar hazards. This typology does not consider the aspect of vulnerability and therefore represents a hazard typology instead of a risk typology. This is due to the fact, that – according to the chosen methodology – there are no differences in vulnerability regarding the different hazards (for the explanation see chapter II.2.2).

The typology of regions takes aggregations of certain hazards into consideration. For this purpose, only hazard intensities above average (IV and V) should be considered. Otherwise it would be impossible to identify specific correlations due to the fact that almost every region is – on a moderate level – more or less threatened by natural hazards e.g., earthquakes or major accident hazards.

The following matrix gives an example of the specific occurrence of hazards in regions. The typical and frequent occurrence of certain hazard constellations points at an existing hazard typology. Table 26 shows that Regions A and C are characterised by the hazard typology "flood-storms-oil spills".

Table 26: Matrix for the identification of regional hazard typologies
Source: ESPON Hazards 2003

Type of hazard/NUTS 3 region	Region A	Region B	Region C	Region D	…
Flood	**IV**	**II**	**IV**	**I**	
Storms	**IV**	**III**	**V**	**III**	
Oil spills	**V**	**I**	**IV**	**II**	
…					
…					

Finally, the results of the typology can be tested by correlation with other data (settlement structure etc.).

1.4 Preliminary maps of selected hazards, vulnerability and risk

The first preliminary maps of selected hazards are presented in this chapter 1.4. These maps can be classified in four groups, which are the following: 1) general hazard maps presenting the chosen indicator, 2) hazard intensity maps divided in (mainly) five classes, 3) vulnerability maps and 4) risk maps of selected hazards. The combination of risk maps of selected hazards into a synthetic risk map for Europe will be presented in the third interim report.

1.4.1 Preliminary maps of selected hazards

The hazards were selected on the criteria explained in chapter 6 in the first interim report. Unfortunately not all hazards could be presented in maps due to lack of data (see part I and chapter 1.1 of this report). The hazards, their impact and their magnitude are explained in chapter 1.2, the methodology of the development of the vulnerability and risk maps is explained in chapter 1.3.

1.4.1.1 Floods hazard map

The large flooding events background data comes from the Global Active Archive of large Flood Events maintained by the Dartmouth Flood Observatory. This archive is presented in order to facilitate research into the causes of extreme flood events, provide international warning of such floods, and improve widespread access to satellite-based measurements and mapping. Many floods have been imaged by satellite or airborne sensors and translated by Dartmouth Flood Observatory staff into maps of inundation extents.

Two maps present the large flood events recurrence. The first (map 1) has a time frame from the year 1996 to 2002. The second map (map 2) is produced using more expansive time interval from the year 1985 to 2002. Unfortunately, the map with the wider time interval contains some gaps, i.e. the flood events from the years 1989, 1990, 1991, 1992 and 1994 are missing due to the lack of source data. The cell size of the grid based flood event layer is 25 km x 25 km.

In map 3 “Flood hazard intensity” the average value of the large flood events has been calculated for each NUTS 3 area. The flood hazard intensity has been classified on the basis of the average values using the time interval 1997-2002 in the following manner:

Flood intensity	Average value of flooding event on NUTS 3 level
1 Very low hazard	0 - 0,1
2 Low hazard	0,1 - 1
3 Moderate hazard	1 - 2
4 High hazard	2 - 3
5 Very high hazard	> 3

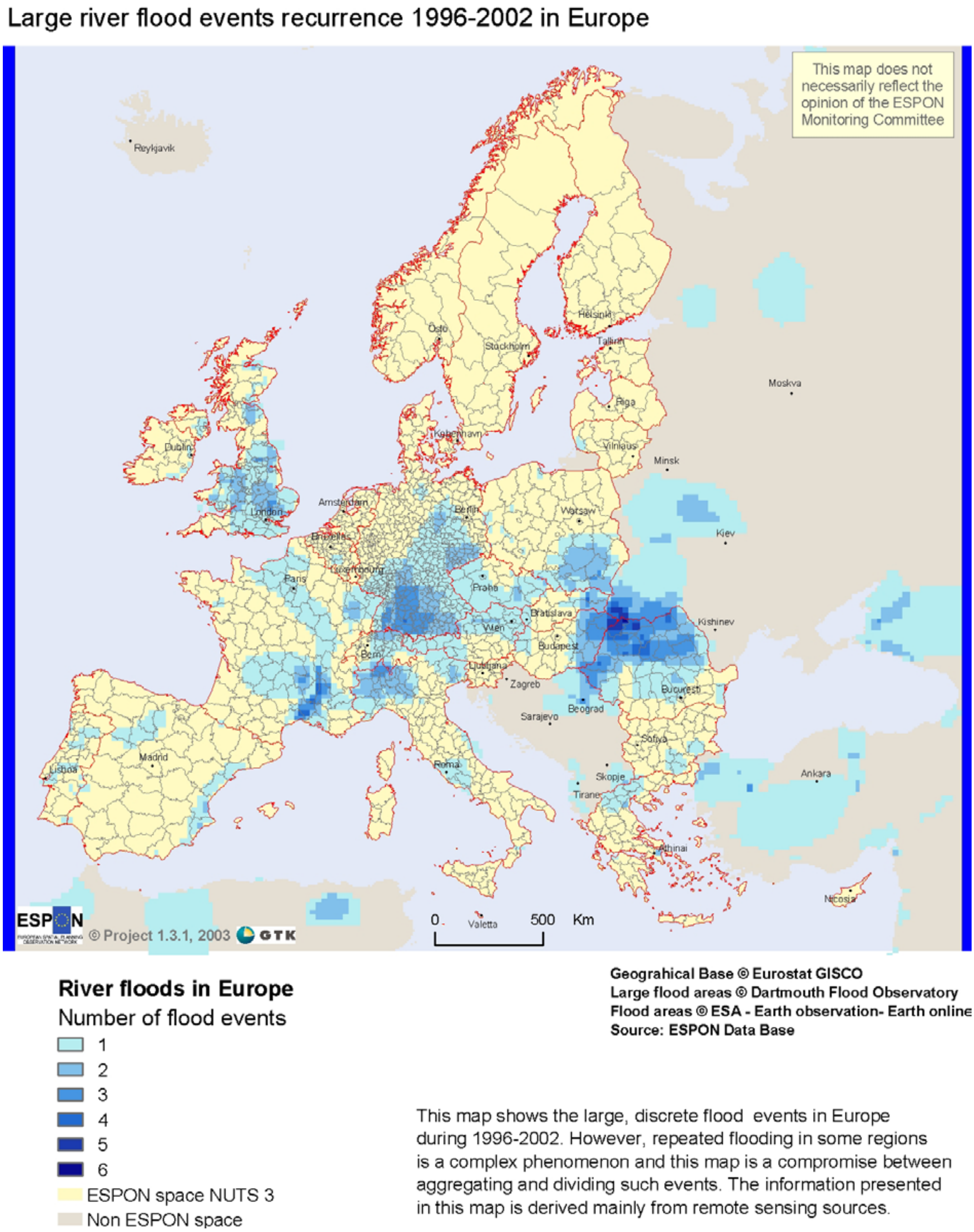
Based on maps 1, 2 and 3 the highest amount of large flood events during these periods are concentrated in North-West of Romania, South-Eastern France, Central and Southern Germany and the East of England. Nevertheless, the source data was obtained through satellite images and areas mapped may not coincide to 100% with areas that have actually experienced this phenomenon. Nevertheless, the presented maps are the most comprehensive flood maps of Europe based on publicly available data.

The maps 4 and 5 show the change of precipitation and change of mean runoff in the future compared to the present situation in Europe. Both of these data layers are provided by Rossby Center's regional climate model (RCAO). Unfortunately, the change of mean precipitation or mean runoff does not give much information of the occurrence of the maximum events.

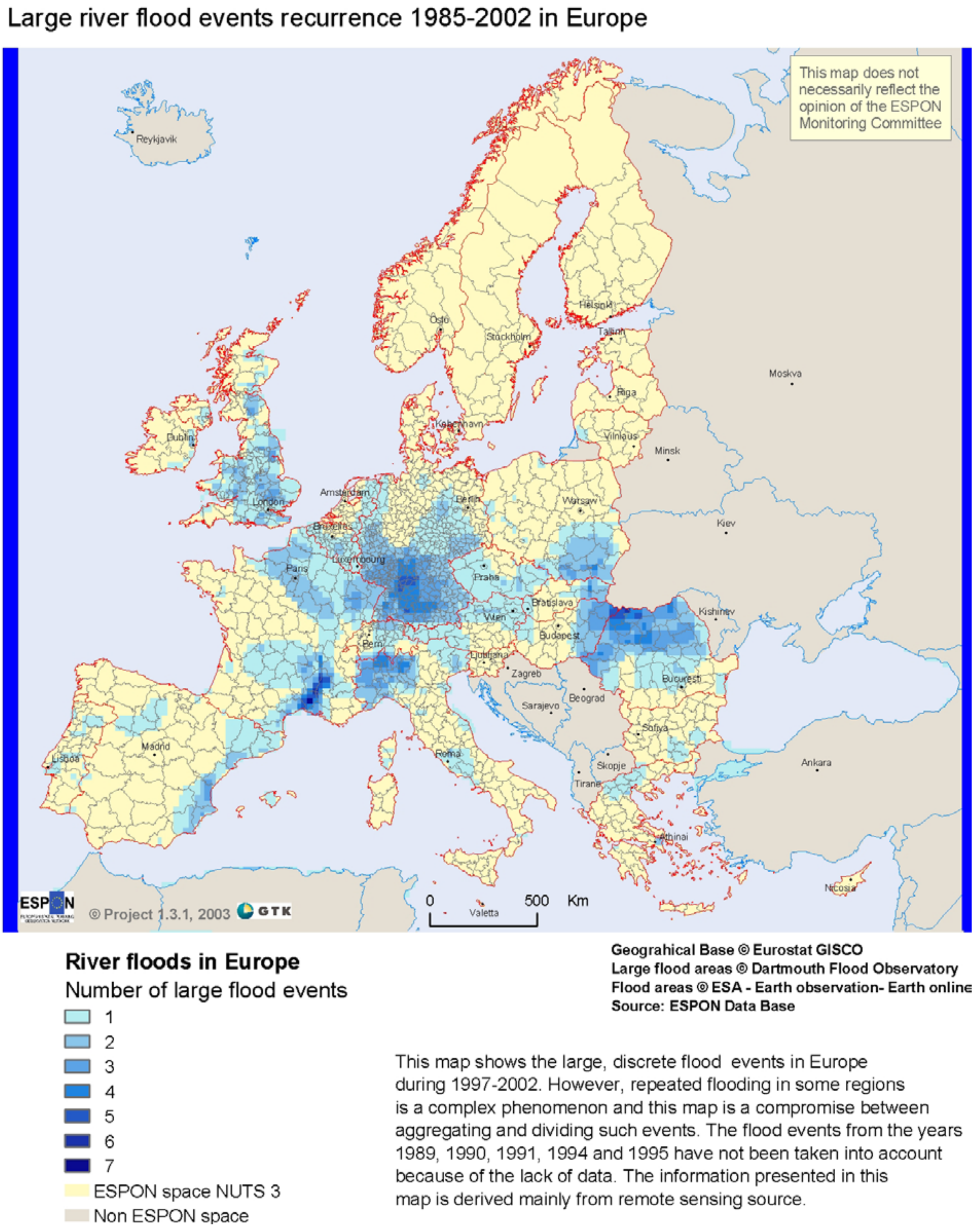
References:

Dartmouth flood observatory: http://www.dartmouth.edu/artsci/geog/floods/index.html

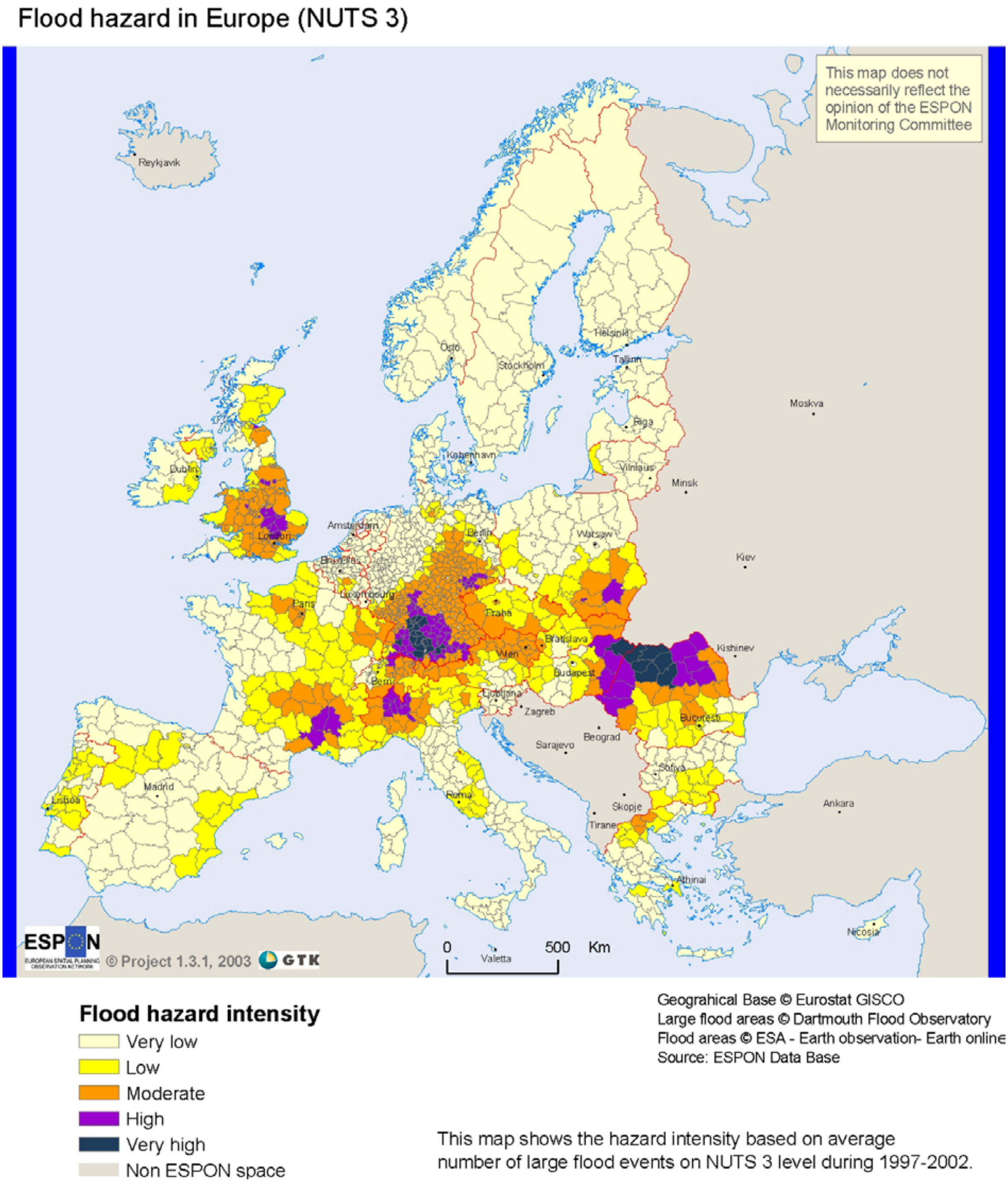
EEA, 2001. Sustainable water use in Europe, Part 3: Extreme hydrological events: floods and droughts



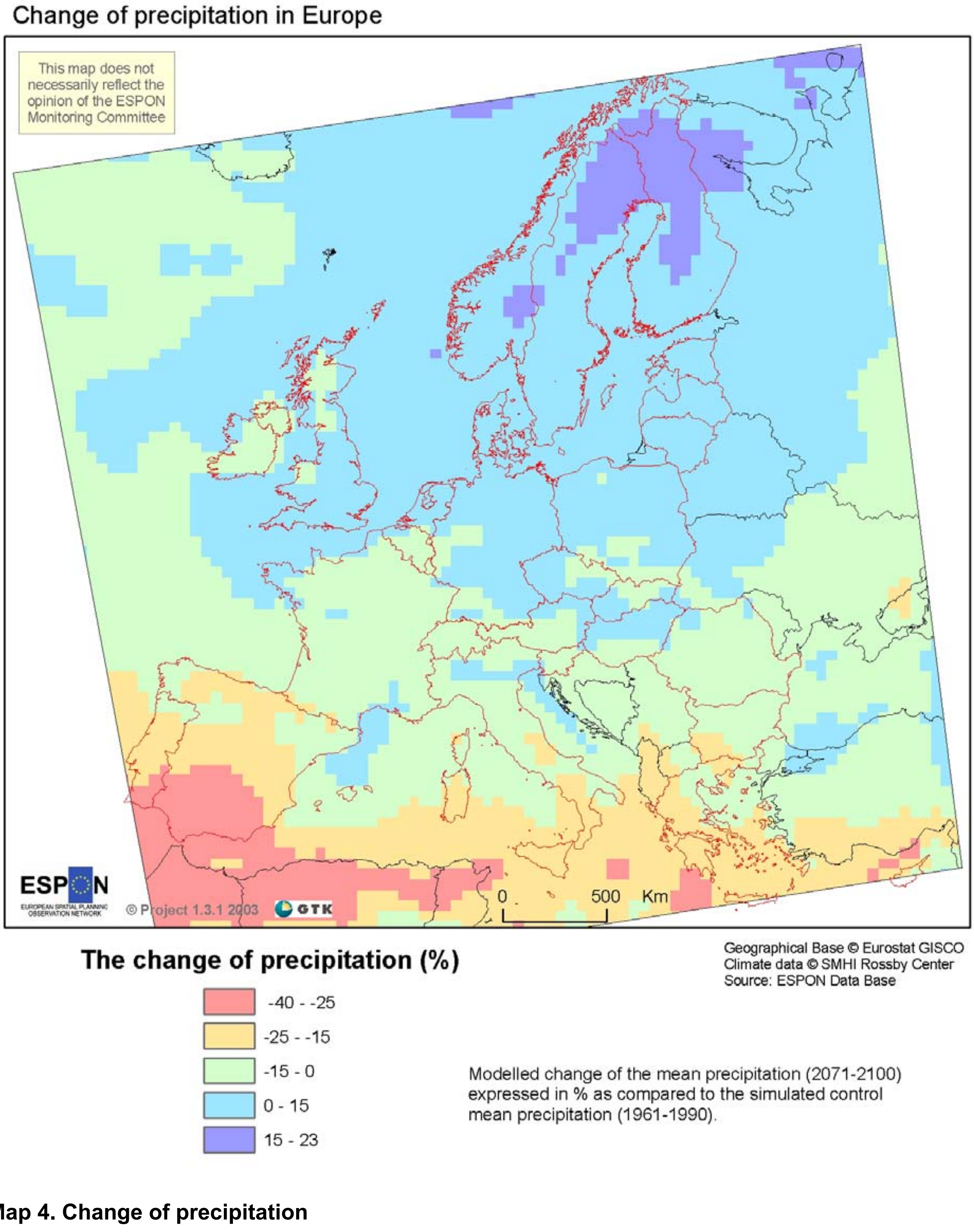
Map 1. Large river flood events recurrence 1996-2002



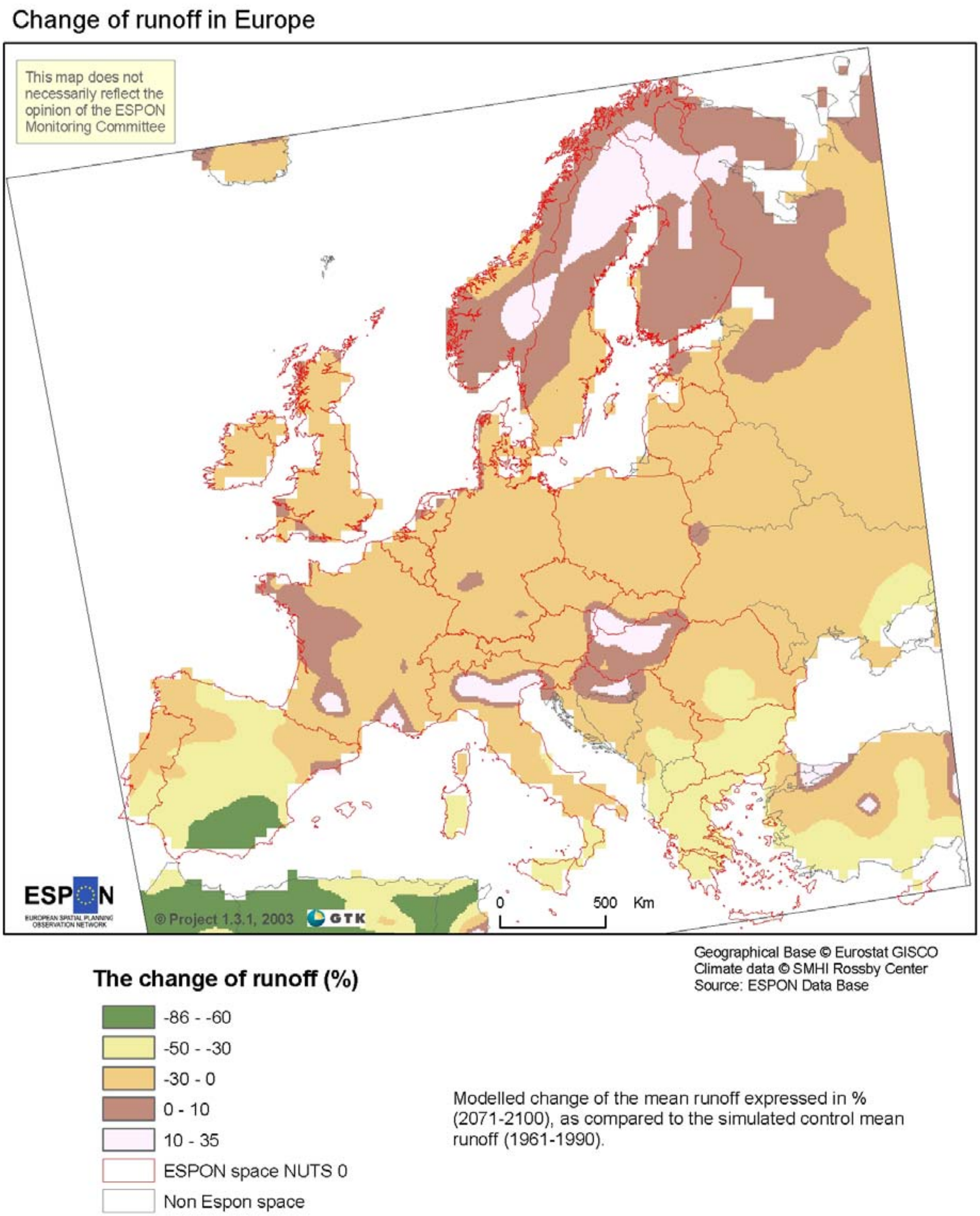
Map 2. Large flood events recurrence 1985-2002



Map 3. Flood hazard intensity on NUTS 3



Map 4. Change of precipitation



Map 5. Change of runoff

1.4.1.2 Droughts hazard

Rainfall deficiency is the primary driving factor for drought and directly influences soil moisture, groundwater recharge and river flow, although the hydrological system will delay and smooth the effects. Rainfall is the mostly widely used indicator of drought conditions, as long-term rainfall records exist at many stations across Europe. Rainfall deficit is expressed as rainfall over a selected period, usually a month, a season, or a natural or hydrological year, compared with the long-term mean over a standard period. The severity of a drought is not simply a function of the size of the rainfall deficit but depends on the timing of the deficit. Droughts, for example in the growing season, can have serious financial implications on large regions.

Unfortunately, there were no long-term rainfall records available and the only drought related indicators used in this phase of the project are the climate model based change of precipitation (map 4) and evaporation in the future provided by Rossby Center. This information can give an idea about suspected areas, which are maybe in future " drought prone".

The climate models provide data about changing precipitation, evaporation and temperature which are three parameters highly influencing the probability of a drought. Nevertheless, there are other hydrological parameters that have an impact on the phenomenon. Since the data for temperature change is lacking, there is no "drought hazard map" produced yet, but two maps showing the differences for changing precipitation and changing evaporation.

In addition, droughts are, unlike aridity, a temporary phenomenon and can be characterised as a deviation from normal conditions (ARIDE, 2001). These maps would rather show changes in aridity due to climate change than indicating a drought hazard.

References:

Demuth, S. and Stahl, K. (editors) 2001: Assessment of the Regional Impact of Droughts in Europe, Final Report to the European

Union ENV-CT97-0553, Institute of Hydrology, University of Freiburg, Germany

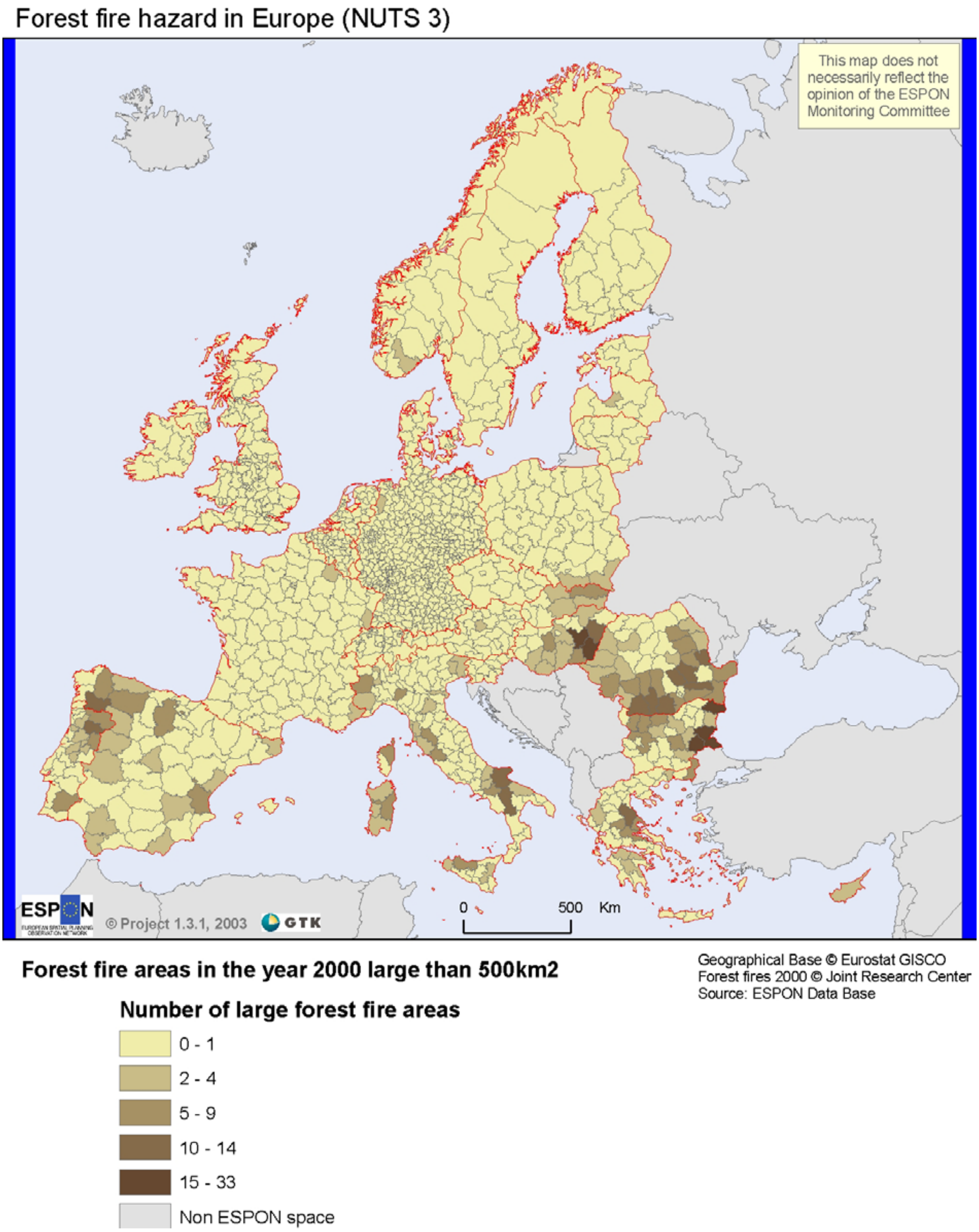
EEA, 2001. Sustainable water use in Europe, Part 3: Extreme hydrological events: floods and droughts

Munich Re, 2000. World of Natural Hazards. CD-ROM. Munich 2000.

1.4.1.3 Forest fire hazard map

Based on map 6, the large scale forest fires are concentrated in the Southern parts of Europe like Romania, Bulgaria, Hungary, Greece, Italy, Portugal and Spain. Unfortunately, the map covers only a one year situation, due to the lack of data (see part I, data requests). In general, forest fires are highly dependent on special factors, such as regional climate conditions and others.

Because the lack of available long-term data, the forest fire hazard map is plotted using the Global Burnt Areas (GBA) project's global burnt area grid (Joint Research Centre). The objective of the GBA project produced a map of the areas burnt globally for the year 2000, using the medium resolution (1 km) satellite imagery provided by the SPOT-Vegetation system and deriving statistics of area burnt per type of vegetation cover. The raw data is publicly available and was processed by project 1.3.1 into polygon data showing the number of forest fire areas larger than 500 km^2 per NUTS 3 area.



Map 6. Forest fires in NUTS 3 level

1.4.1.4 Winter storm hazard map

The original data on winter storms is available from the World Map of Natural Hazards compiled by the Munich Reinsurance Company. The probability of having winter storms is presented in this data source in three levels: low hazard, medium to high hazard and high to very high hazard. The classification is based on the factors that influence the magnitude of damage of winter storms. Those factors are turbulence, frequency spectrum of the wind, duration of wind impact and wind direction. (Munich Re, 2000)

The winter storm in Europe (map 7) shows the probability of having winter storms in Europe in three levels. Grey indicates the medium to high winter storm hazard and dark grey high to very high winter storm hazard. Yellow indicates the areas with a very low winter storm hazard.

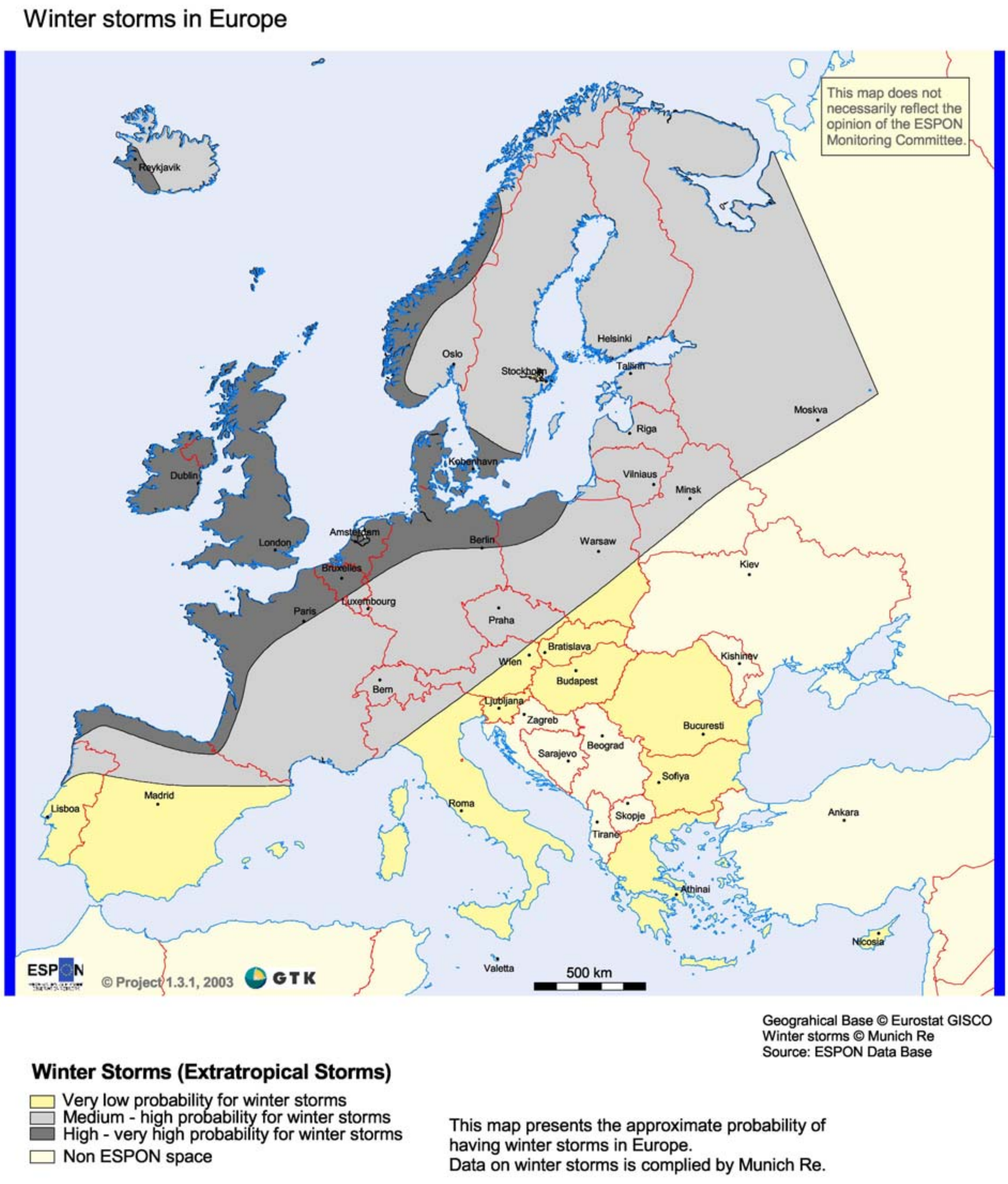
Winter storm hazards in Europe have been calculated on NUTS 3 level (map 8) by giving the each NUTS 3 area the highest hazard value that exists within the studied area, i.e. if the NUTS 3 area has both medium and very high probability for winter storms, the whole NUTS 3 area is evaluated to have the very high hazard probability.

Table 27. Hazard classification value for winter storms

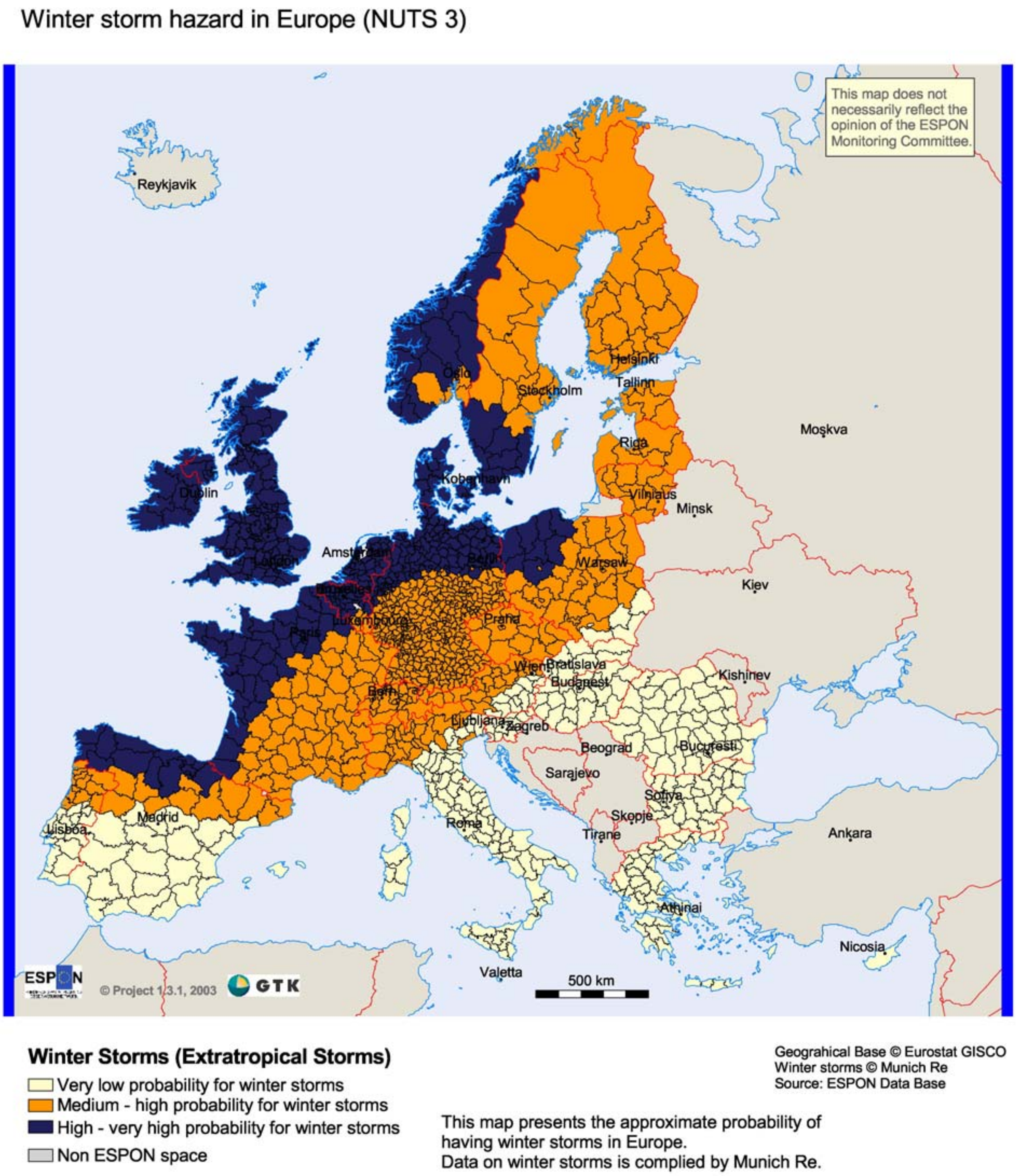
1.1.1.1 Legend of winter storm hazard map	*1.1.1.2 Intensity of hazard*
1.1.1.3 Very low hazard	1
Medium to high hazard	3
High to very high hazard	5

References:

Munich Reinsurance Company, 2000. World of Natural Hazards (CD-Rom).



Map 7. Winter storms in Europe.



Map 8. Winter storm hazard in Europe on NUTS 3 level.

1.4.1.5 Earthquake hazard map

Peak ground acceleration data from the Global Seismic Hazard Assessment Project (GSHAP) -project were used to produce a earthquake hazard map covering the whole Europe. The GSHAP project was designed to provide a useful global seismic hazard framework and serve as a resource for any national or regional agency for further detailed studies applicable to their needs. One of the main goals of GSHAP was to produce a homogeneous seismic hazard map for horizontal peak ground acceleration, representative for stiff site conditions for the probability level of an occurrence or exceedance of 10% within 50 years. The peak acceleration is the maximum acceleration experienced by the particle during the course of the earthquake motion. Acceleration is chosen, because the building codes prescribe how much horizontal force a building should be able to withstand during an earthquake. This force is related to the ground acceleration. Several steps of the preparation of the seismicity data for the calculations and the derivation of further input parameters are described more accurate on the project's WWW-pages. The cell size of the pga and relief base grids is 0.0833 degrees (corresponding 9,3 x 9,3 km).

To create the hazard potential classification in five classes, the mean value of the grid points inside the NUTS 3 boundaries were calculated. This method will lower the effect of the peak values in the area. Another possibility is to use the maximum values of the NUTS 3 area.

The final classification of the earthquake hazard potential roughly correspond to the actual level of the hazard. In the primary classification by GSHAP the following four classes were used:

0-8% g	Low hazard
8-24% g	Moderate hazard
24-40% g	High hazard
> 40% g	Very high hazard

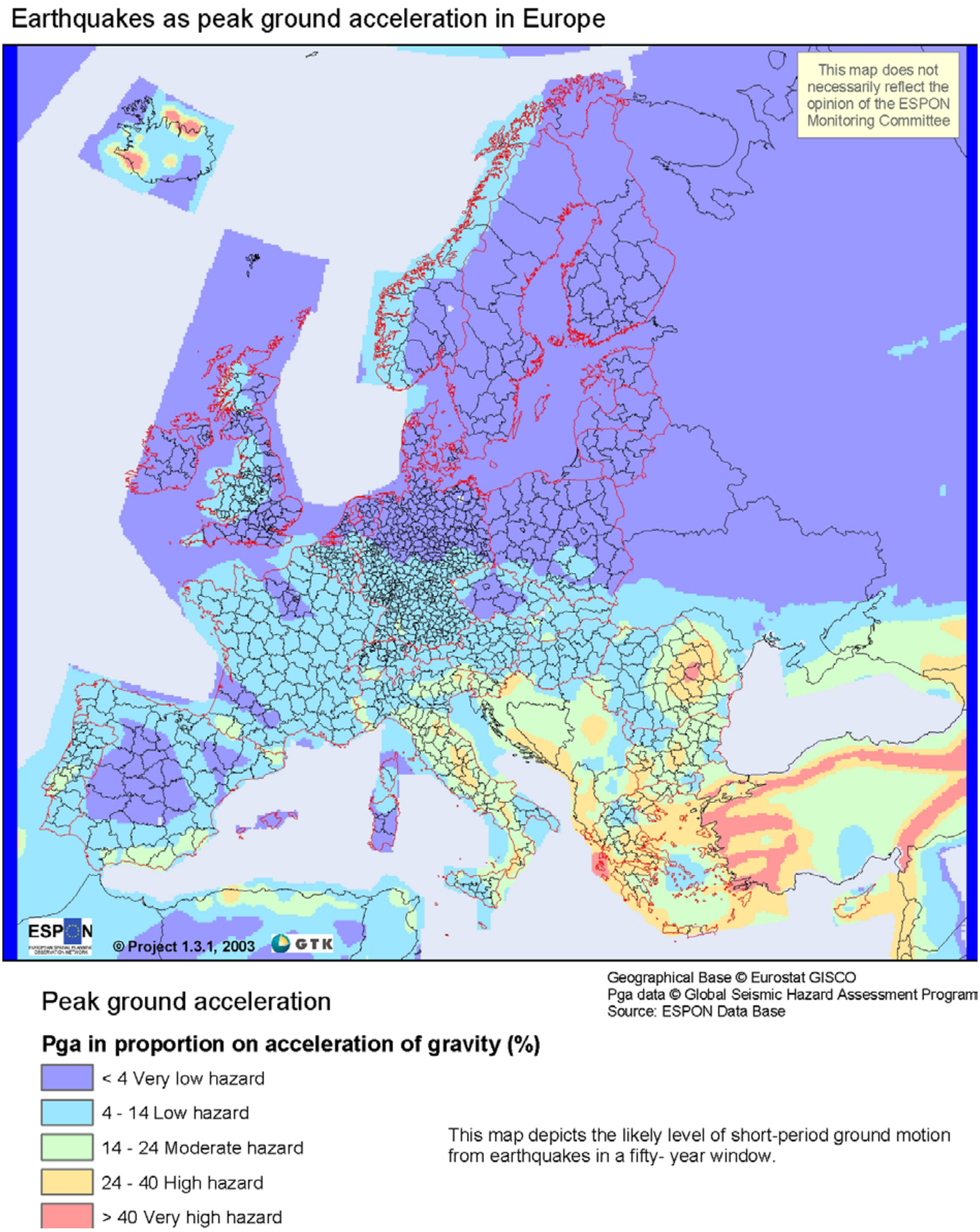
This classification was turned to five classes by the project 1.3.1:

0-4% g	Very low hazard
4-14% g	Low hazard
14-24% g	Moderate hazard
24-40% g	High hazard
> 40% g	Very high hazard

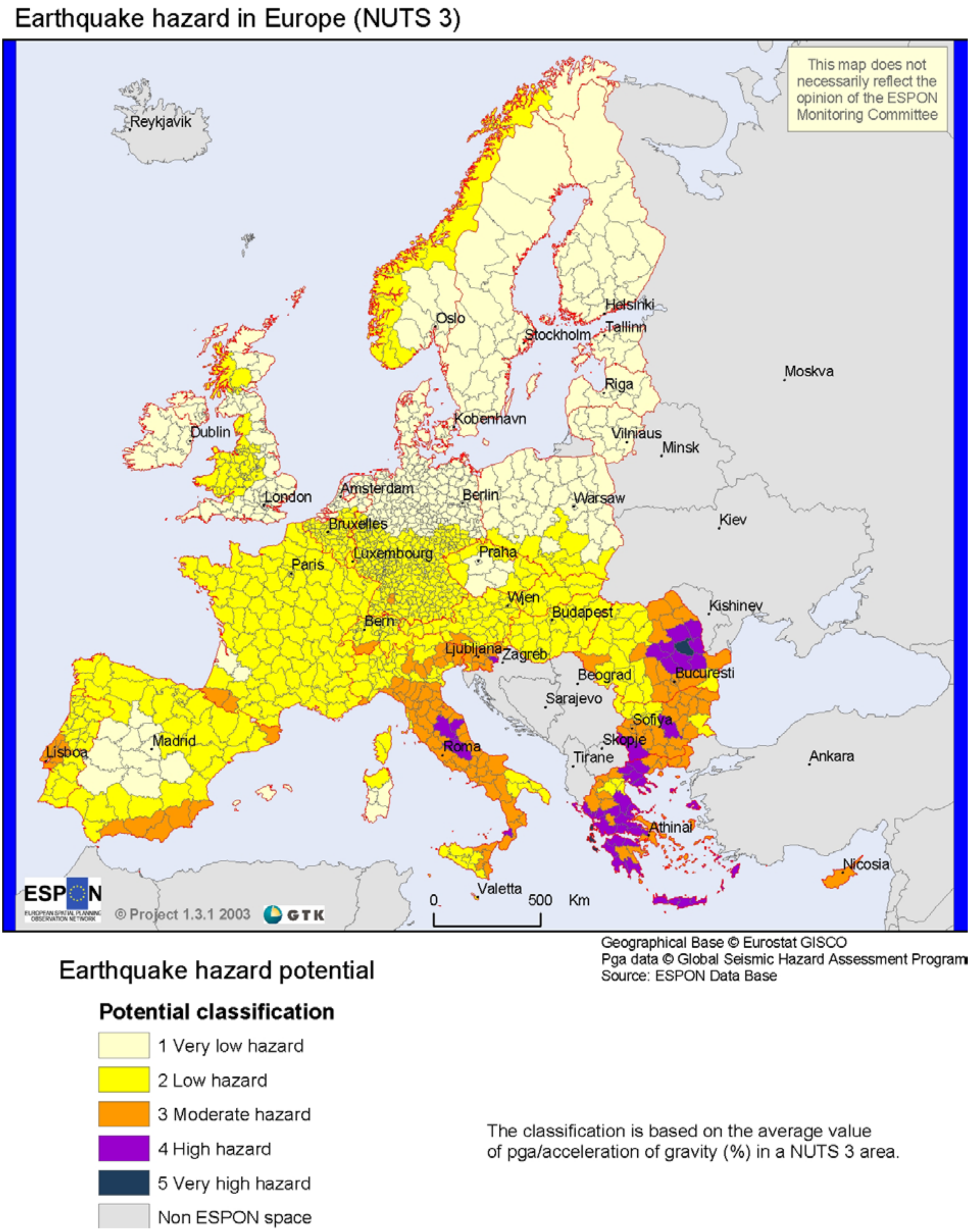
Based on maps 9 and 10, the earthquake hazard is concentrated in South-Eastern areas of Europe, e.g. Greek, Italy and Romania. With the theory of plate tectonics, it has become evident that most earthquakes occur along the margins of plates, where one plate comes into contact with another, developing shear stresses. There are, however, examples of significant earthquakes apparently not associated with the plate boundaries. The earthquake activity zone affecting in continental Europe is sometimes called the "Mediterranean and trans-Asiatic" zone. Earthquakes in this zone have foci aligned along mountain chains. These active zones have not changed significantly through human history.

References:

The Global Seismic Hazard Assessment Program (GSHAP):
http://seismo.ethz.ch/gshap/



Map 9. Earthquake hazard map



Map 10. Earthquakes on NUTS 3 level

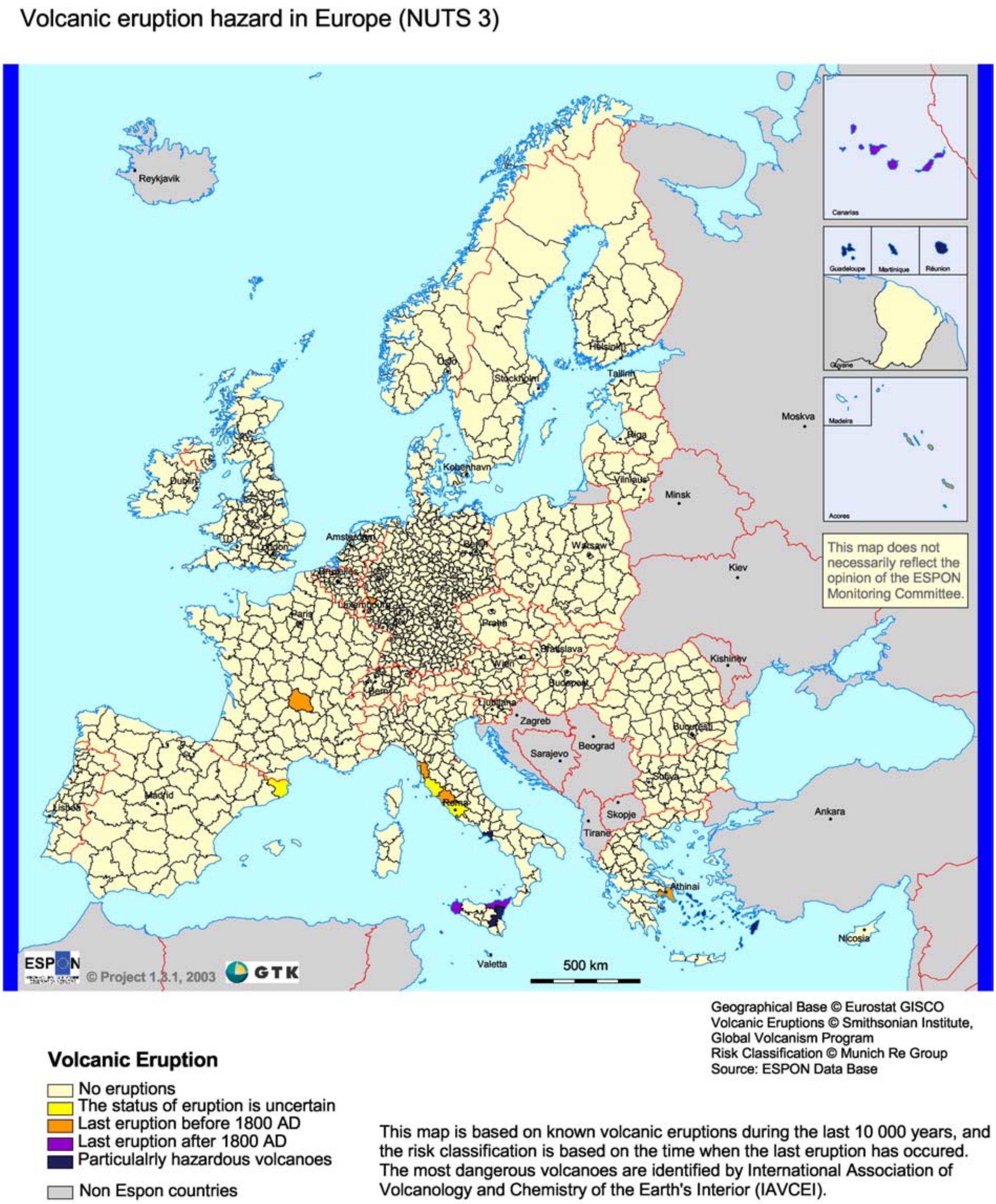
1.4.1.6 Volcanic eruption hazard map

The volcanic eruption hazard map is based on information of known volcanic eruptions in Europe during the last 10.000 years. The data on volcanic eruptions is collected by the Global Volcanism Program of the Smithsonian Institute. The risk classification used in the map is based on the classification of Munich Re. The classification relies on the time when the last eruption has occurred. The most dangerous volcanoes (risk value 5) are identified by International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI). The volcanoes can also be classified according to Volcanic Explosivity Index (VEI) that uses, e.g. the volume of material ejected to determine the scale of an eruption. Unfortunately, this kind of data was not available for the project 1.3.1 at this phase.

Table 28. Hazard classification value for volcanic eruptions

Legend of volcanic eruptions hazard map	Intensity of hazard
Very low hazard No eruptions	1
Low hazard The status of eruption is uncertain	2
Moderate hazard Last eruption occurred before 1800 AD	3
High hazard Last eruption occurred after 1800 AD	4
Very high hazard Particularly hazardous volcanoes	5

The original data on volcanic eruptions is in point format. The number of eruptions in each NUTS 3 area has been investigated and the hazard intensity value has been calculated for the whole NUTS 3 area. The largest intensity value of an area determines the hazard intensity value of the studied NUTS 3 area. For example in Napoli, Italy, there are volcanic eruptions that have hazard values of 3 and 5 in the same NUTS 3 area. According to hazard intensity classification the whole area is at the hazard value 5. It must also be considered that several Greek islands are clustered into NUTS 3 levels, i.e. every island is not its own NUTS 3 area, and this gives the higher hazard value also for the islands that are not volcanic.



Map11. Volcanic eruption hazard in Europe (NUTS 3)

1.4.1.7 Nuclear power plants hazard map

The locations of Nuclear Power Plants are identified using the NUKE DATABASE SYSTEM created by the Nuclear Training Centre in Ljubljana (Slovenia) in Nuts 3 level. Additionally, nuclear power plants of the non-Espon space are included due to the nature of the hazard. The data provided give information about the location, the type and number of operational reactors, net capacity in Mega Watts [MW] and the operational status of the plant. Therefore, it was attempted to create a multivariable classification reflecting all the above mentioned information. The power plants are classified into five classes showing the number of operational reactors (from shut down status to max. 6 reactors) giving an idea about the hazard intensity, indicated by the hazard intensity colours according to the colour scheme for the Espon Hazards. Furthermore, the size of the symbol depicts the net capacity of the plant or the generated power, respectively. This is reasonable due to the different effectiveness of reactor types, e.g. two modern reactors can produce more power than 3 old reactors, but are not so dangerous in terms of hazard intensity.

The nuclear power plants are classified in the following way:

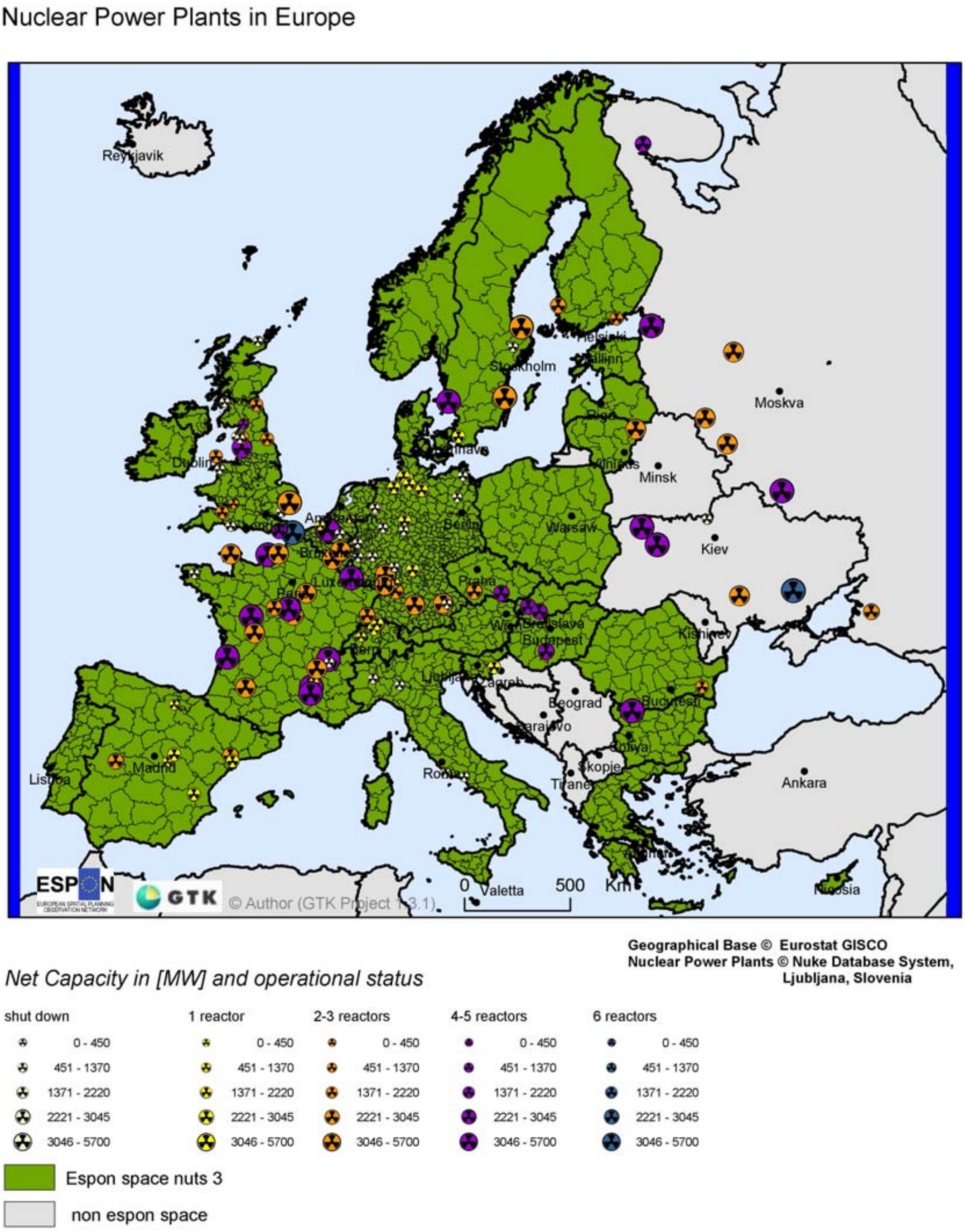
Operational reactors (colour of the symbol) are classified in 5 classes:
1. Shut down
2. 1 reactor
3. 2-3 reactors
4. 4-5 reactors
5. 6 reactors

Sum of the net capacity of the plant in [MW] (size of the symbol):
1. 0 - 450
2. 451 - 1370
3. 1371 - 2220
4. 2221 - 3045
5. 3046 – 5700

The Chernobyl MCA is the only example of an exploding nuclear power plant in human history. The then contaminated territories were divided into four different zones, depending on the CS-137 contamination in kBq/m²:

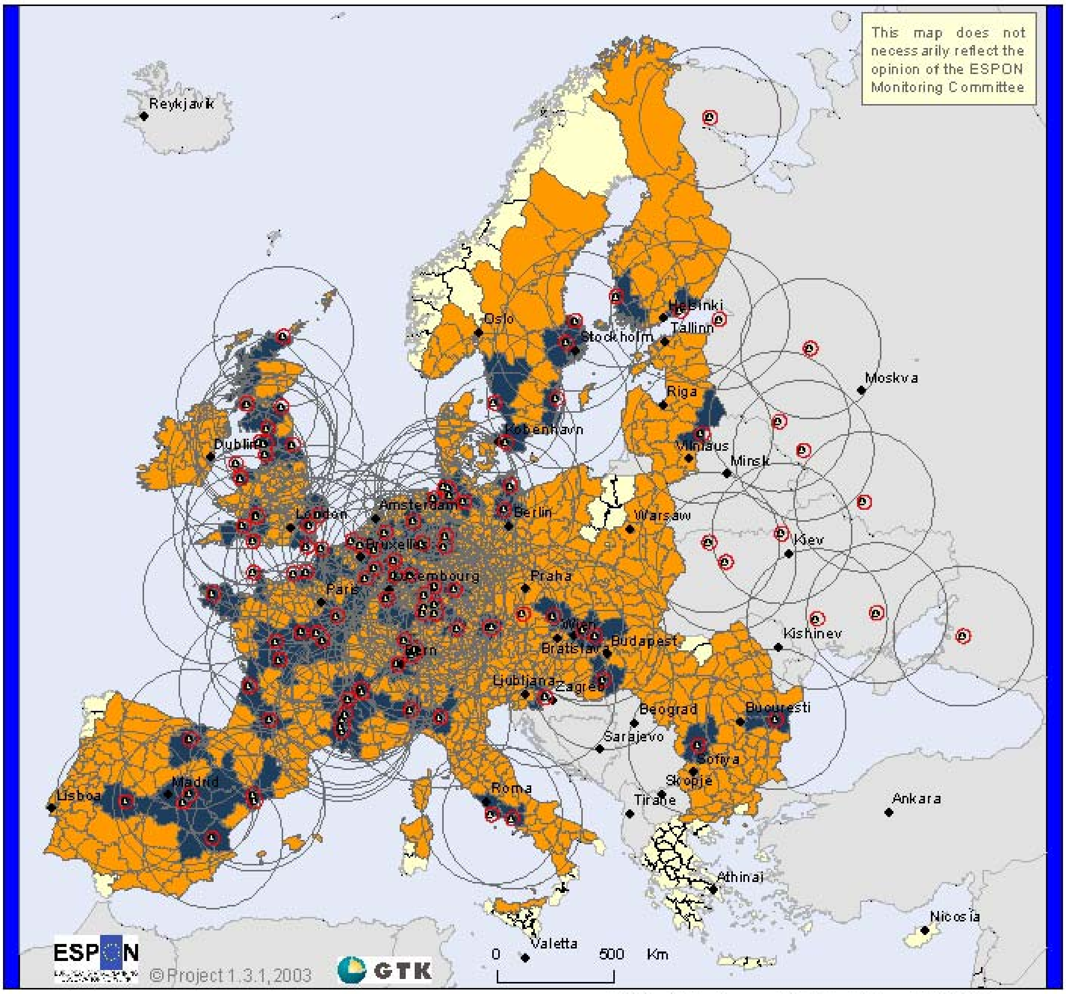
Zone I: 30 km Radius evacuation zone: > 1480 kBq/m²
Zone II: 555 – 1480 kBq/m²
Zone III: 185 – 555 kBq/m²
Zone IV: 37 – 185 kBq/m²

In Belarus, Ukraine and Russia, the zones are non-contiguous. This is the result of local differences in the wind directions and rainfall distribution after the first ten days following the accident. Nevertheless, according to a map that is available in the internet, all territories belonging to Zone II are approx. within a distance of 300 km from a nuclear power plant. The here presented risk assessment for Europe's power plants is developed according to the experiences made after the accident in 1986.



Map 12. Nuclear power plants in Europe

The potential risk of radioactive contamination in case of a nuclear fallout (Based on experiences made after the Chernobyl accident in 1986)



Origin of data: Geographical Base © Eurostat GISCO
Nuclear Power Plant © Nuke Data Base System, Ljubljana, Slovenia
Source: ESPON Data Base

The potential risk of radioactive contamination on NUTS 3 level

- Nuclear Power Plant
- Area to be evacuated (Radius 30 km)
- Area with a posible severe caesium 137 contamination (Radius 300 km)
- Directly affected areas
- Indirectly affected areas
- Areas outside 300 km Radius in ESPON space
- Non ESPON space

Map 13. The potential risk of radioactive contamination in case of a nuclear fallout. Based on experiences made after the Chernobyl accident in 1986.

The following risk zones classification was established:

- Areas that have to be evacuated in a distance of 30 km from the plant
- Areas with a possible severe caesium 137 contamination in a distance of 300 km from the nuclear power plant
- Areas outside 300 km radius from the plant

To get an idea about which NUTS 3 levels are affected the following classification for a possible severe contamination is used:

- Directly affected areas (NUTS 3 levels in direct vicinity of a nuclear power plant or containing the plants
- Indirectly affected areas (NUTS 3 levels situated within a distance of 300 km of one or more nuclear power plants
- Areas outside a 300 km radius in ESPON space

References:

NUKE DATABASE SYSTEM: http://www2.ijs.si/~icjt/plants/
Information about the contamination zones after the Chernobyl accident: http://www.chernobyl.info/en/Facts/MainOverview/Overview2

1.4.1.8 Dam hazard map

Information about dams in Europe was provided by the World Register of Dams, which is a product of the International Commission on Large Dams (ICOLD), available on CD-ROM. The register provides data upon the technological characteristics of all reservoirs in the world (1998). For Europe, there is an overall number of 6194 reservoirs (including non ESPON space). Due to this high number, the major dams of Europe having a reservoir capacity greater than 100 Mio m^3 were extracted. As a result 486 major dams were identified for the hazard map.

Unfortunately, the precise location of each dam was not given. Therefore the approximately location had to be found out manually. Since it was not possible to use Nuts 3 level due to the often too small size of areas, the locations of dams are identified in the TGN Full Record Display system in Nuts 2 level. The collected data give information about the location and the capacity of dams. The dams are classified into five classes according to their reservoir capacity and:

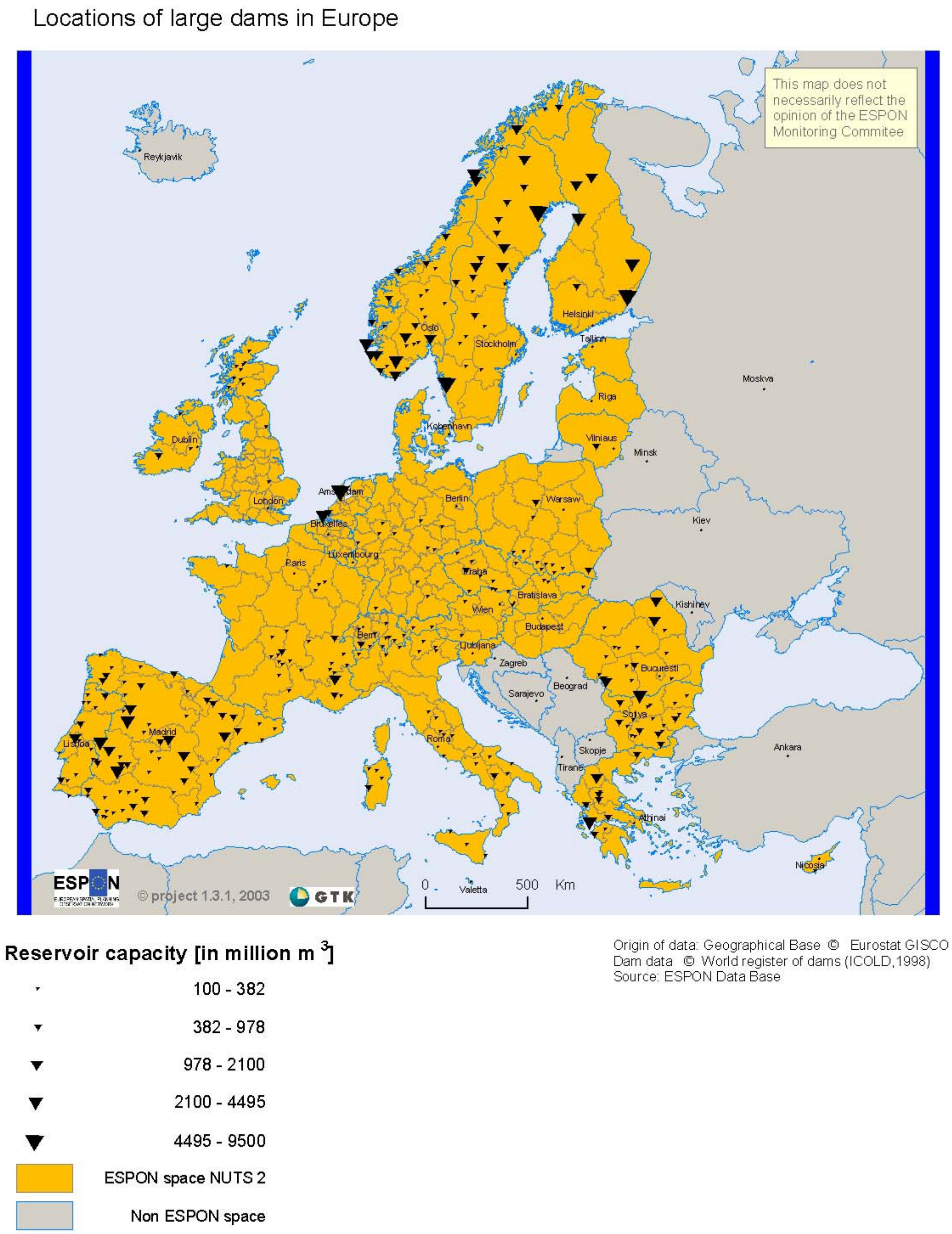
Capacity of dam in [Mio m^3]

1	100-382
2	382-978
3	978-2100
4	2100-4495
5	4495-9500

Since the location of the major dams are not precise enough it is rather difficult to derive a hazard intensity classification and a vulnerability assessment.

References:

The World Register of Dams, International Commission on Large Dams (ICOLD), CD-ROM, 1998



Map 14. Locations of large dams in Europe

1.4.1.9 Oil spill hazard map

Spilt oil is hazardous, both physically and chemically. For example, , oil can physically coat and clog biological structures (feathers and gills) that are adapted to cope with water. Chemically, oil contains a range of toxins that can either poison living organisms directly in high concentrations or build up slowly in low concentrations, gradually disrupting their biochemistry and increasing their vulnerability to other natural or man-made hazards. Exposure can be both rapid through the massive release of oil associated with the bigger oil tanker accidents or chronic through the build-up of toxins in the marine community after years of oil dumping. Chemical toxins that are not rapidly broken down become concentrated in ecosystems, rendering those organisms at the top of food chain (including humans) most vulnerable to chronic pollution. (CEOS DISASTER MANAGEMENT SUPPORT GROUP)

The map gives summarizes major oil spills since 1967 until 2002 in Europe. It gives information on the amount of oil that was spilt and shows where and when oil spills have occurred. All this information comes from ITOPF (Oil tanker spill statistics) and GREENPEACE.

The oil spills are classified in three classes:

Amount of spilled oil (tonnes)	
1	72000-100000
2	100000-144000
3	144000-227000

In the third interim report the oil ports and oil transportation routes will be presented in this same map. The location and information on oil ports will be identified using the NIMA "World port index" (Publication 150). The map will give information on the locations of the oil terminal ports and their size. The ports will be classified in four classes. The classification of port size is based on several applicable factors, including area, facilities, and wharf space.
The oil terminal ports will be categorized by size as follows:

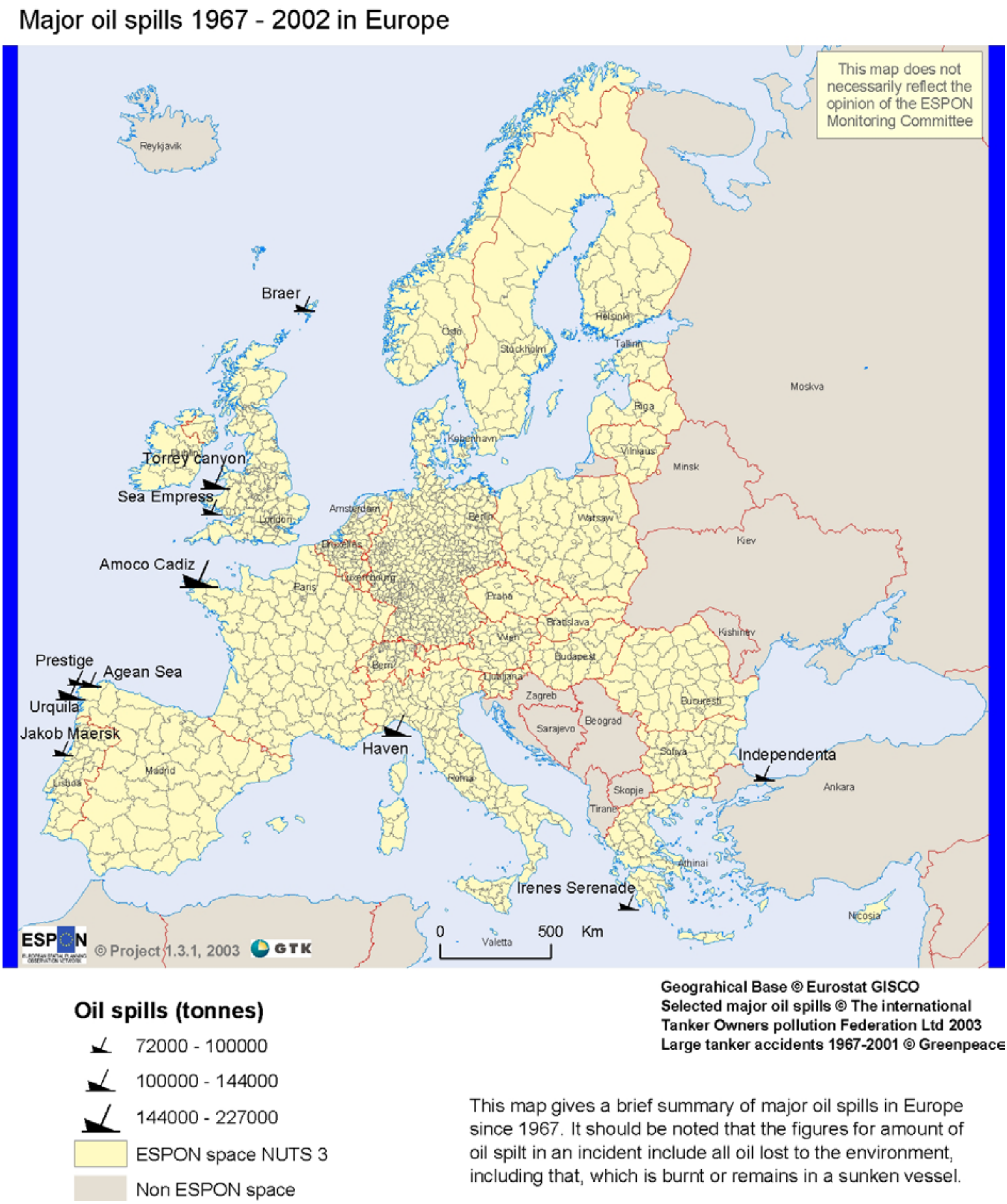
1	Very small
2	Small
3	Medium
4	Large

References:

http://disaster.ceos.org/

http://www.greenpeace.de/

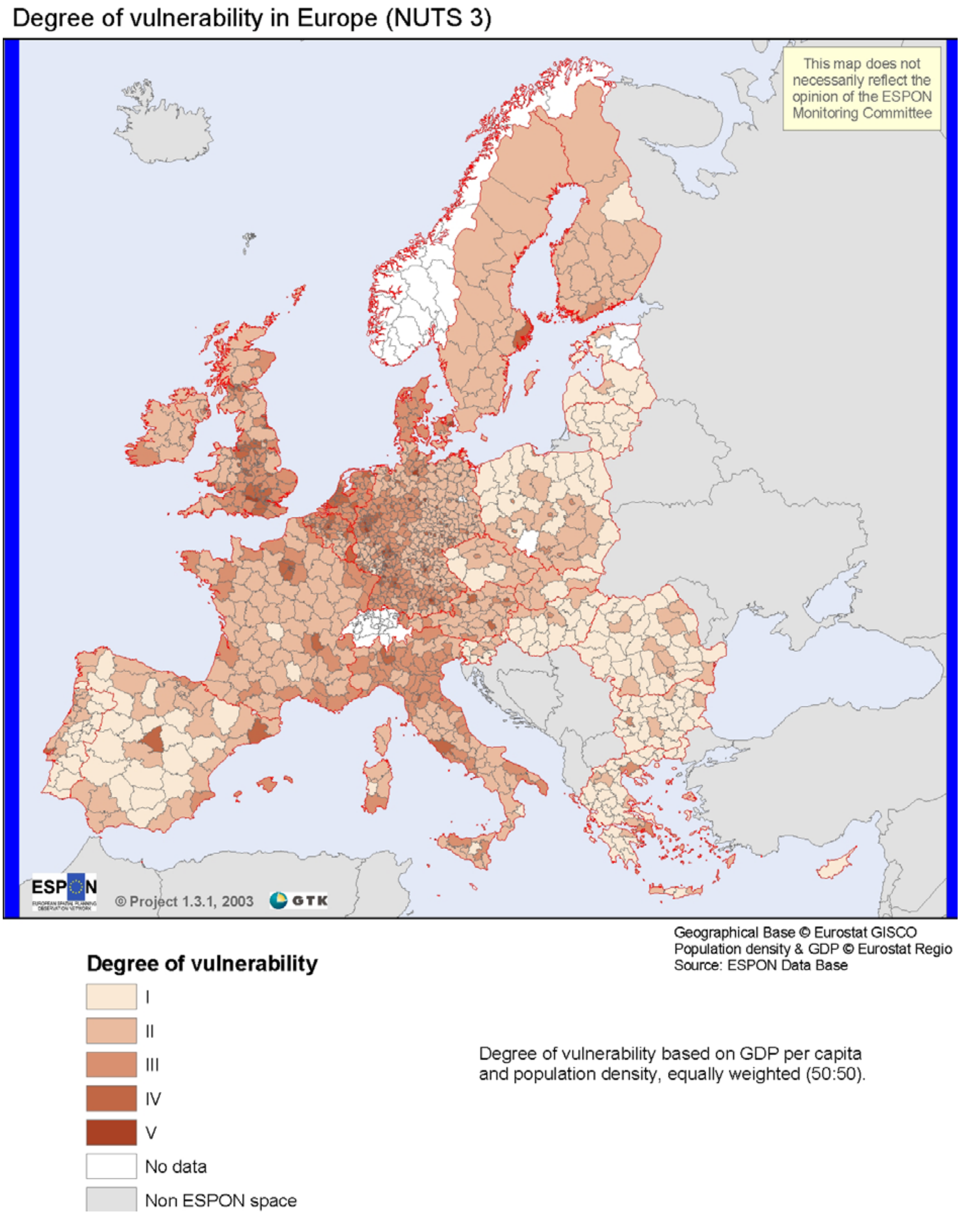
http://www.itopf.com/http://pollux.nss.nima.mil/pubs/



Map 15. Major oil spills in Europe in 1967-2002

1.4.2 Maps of vulnerability

The vulnerability maps have been prepared using the method developed in the chapter 1.3, where the GDP per capita and the population density is suggested to be equally weighted. The result can be seen in the following map “Degree of vulnerability in NUTS 3 level” (map 16). Because of lacking information of population density on NUTS 3 level in Norway, Switzerland, Malta and some parts of Estonia, and lacking GDP information on NUTS 3 level of Norway, Switzerland, Malta, Berlin and some parts of Poland and Estonia, the vulnerability map contains some “no data” areas inside the ESPON space. If this data will not be available until the third interim report, these missing areas will be presented with NUTS 2 data.



Map 16. Degree of vulnerability on NUTS 3 level

1.4.3 Preliminary maps of risks

The degree of vulnerability is presented in a 50:50 relationship of the GDP and the population density of a given area, which is then plotted in a 50:50 relationship with the intensity of a hazard x (see chapter 1.3). Thus, all fields with the same sum (e.g. 3,1 2,2 and 1,3) have the same vulnerability and/or risks towards a certain hazard. The numbers in the coloured fields show the values of the intensity of hazard plus the degree of vulnerability. Numbers with the same value are in the same colour to associate the different colours representing the same risk type on a map of Europe. The different shades of the same colour allow distinguishing between a higher intensity of a hazard or a higher degree of vulnerability, respectively.

Table 29. Colour scheme of hazard and risk maps

Legend of risk maps	Degree of vulnerability				
Intensity of hazard x	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

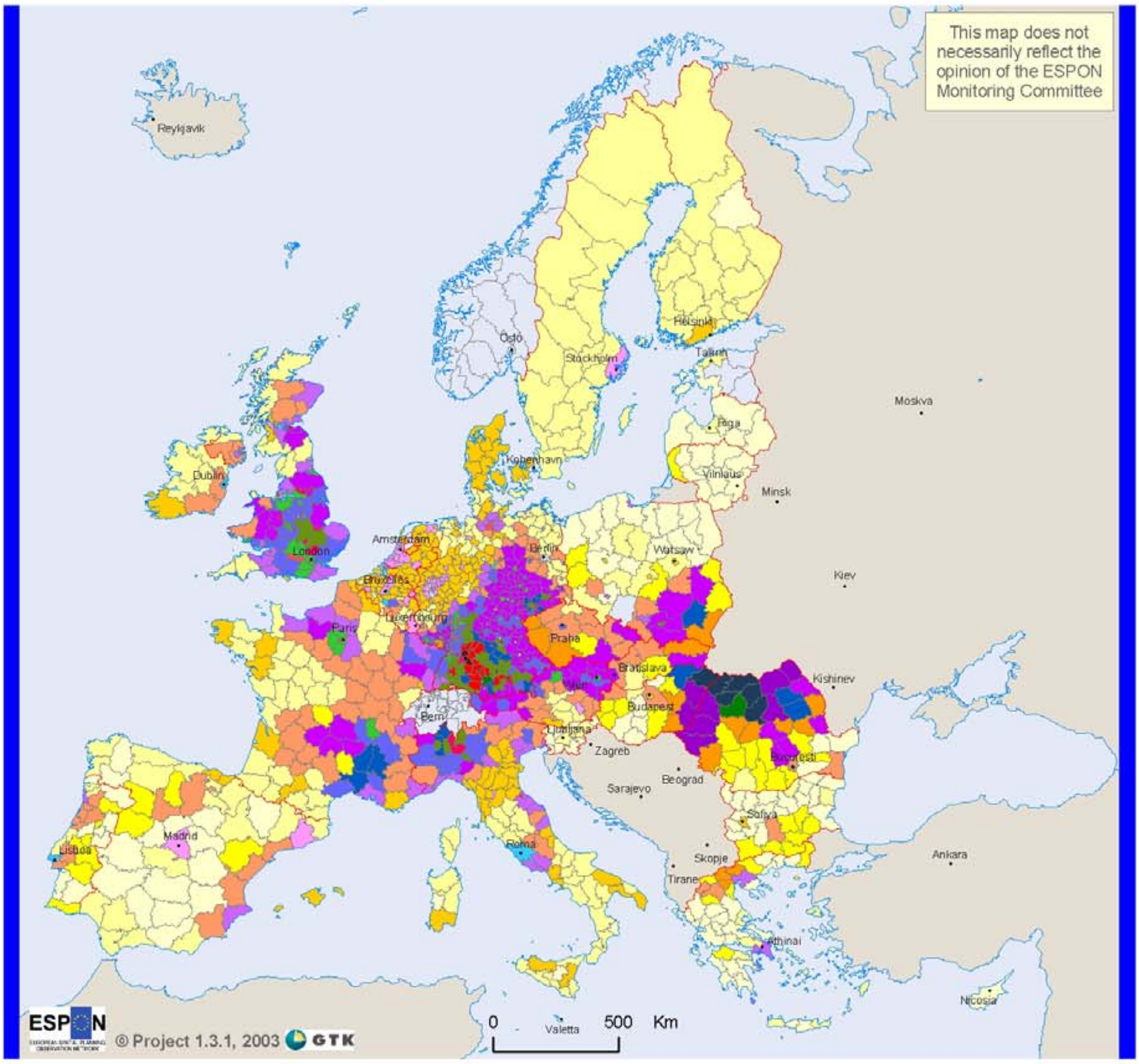
The table below shows the colour codes for the map production. This shall help the reader of the report to identify the colour schemes in case of different printer qualities.

Table 30. Colour codes for map production (RGB codes):

Legend of risk maps	Degree of vulnerability				
Intensity of hazard x	1	2	3	4	5
1	(255,255,204)	(255,255,153)	(255,204,0)	(255,153,255)	(204,236,255)
2	(255,255,0)	(255,153,102)	(204,102,255)	(51,204,255)	(153,255,51)
3	(255,153,0)	(204,0,255)	(102,102,255)	(51,204,51)	(255,80,80)
4	(153,0,204)	(0,90,193)	(102,153,0)	(255,0,102)	(153,51,0)
5	(30,60,92)	(0,128,0)	(255,0,0)	(128,0,0)	(0,0,0)

The available risk maps are the following: floods, winter storms, earthquakes and volcanic eruptions. Please note, because of the lacking vulnerability data, Norway, Switzerland, Malta, Berlin, some parts of Estonia and Poland are out of the typology of risk maps.

Flood risk in Europe (NUTS 3)



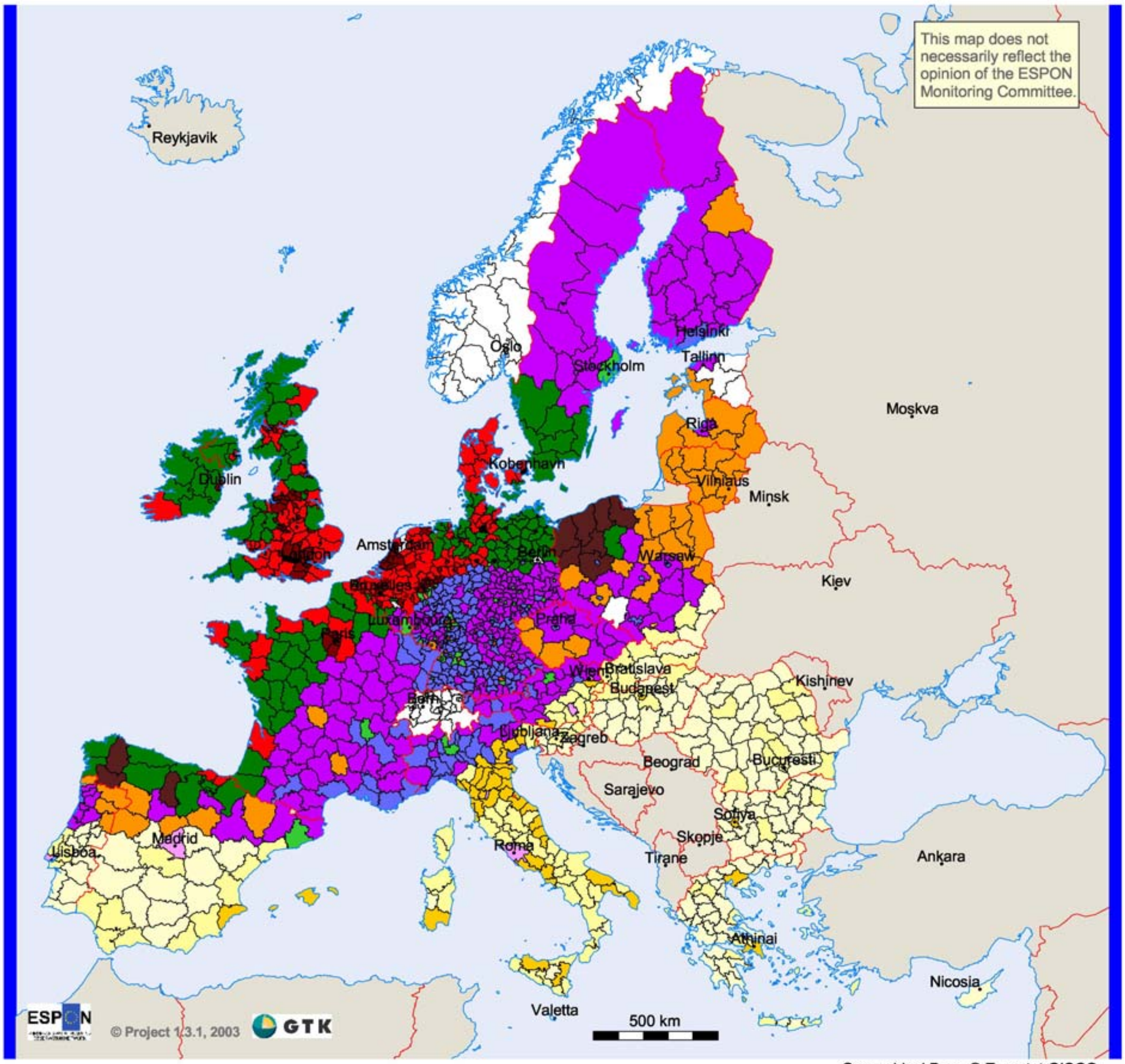
Geograhical Base © Eurostat GISCO
Large flood areas © Dartmouth Flood Observatory
Flood areas © ESA - Earth observation- Earth online
Source: ESPON Data Base

Typology of the regions

Legend of risk maps	Degree of vulnerability				
Intensity of hazard	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

Map 17. Flood risk map on NUTS 3

Winter storms risk in Europe (NUTS 3)



Geograhical Base © Eurostat GISCO
Source: ESPON Data Base

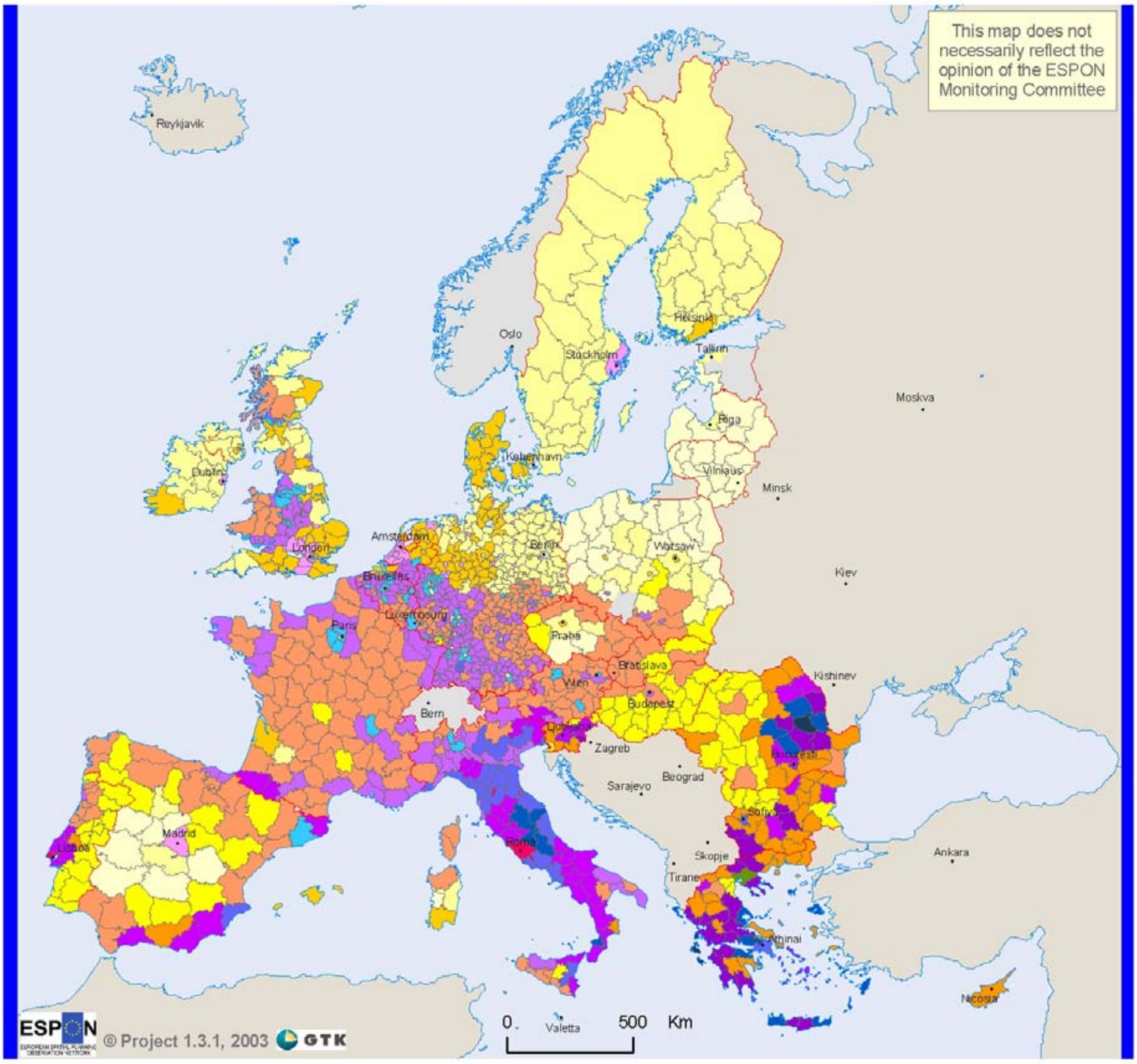
Typology of regions

Legend of risk maps	Degree of vulnerability				
Intensity of hazard x	1	2	3	4	5
1	2	3	4	5	6
3	4	5	6	7	8
5	6	7	8	9	10

Map 18. Winter storm risk in Europe (NUTS 3).

The classification of winter storm risk map differs from the other risk maps because the original data on winter storms has only three hazard categories. The intensity of hazard is 1 when the hazard probability is very low, the intensity is 3 when the hazard probability is medium to high, and the intensity value is 5 when the hazard probability is high to very high.

Earthquake risk in Europe (NUTS 3)



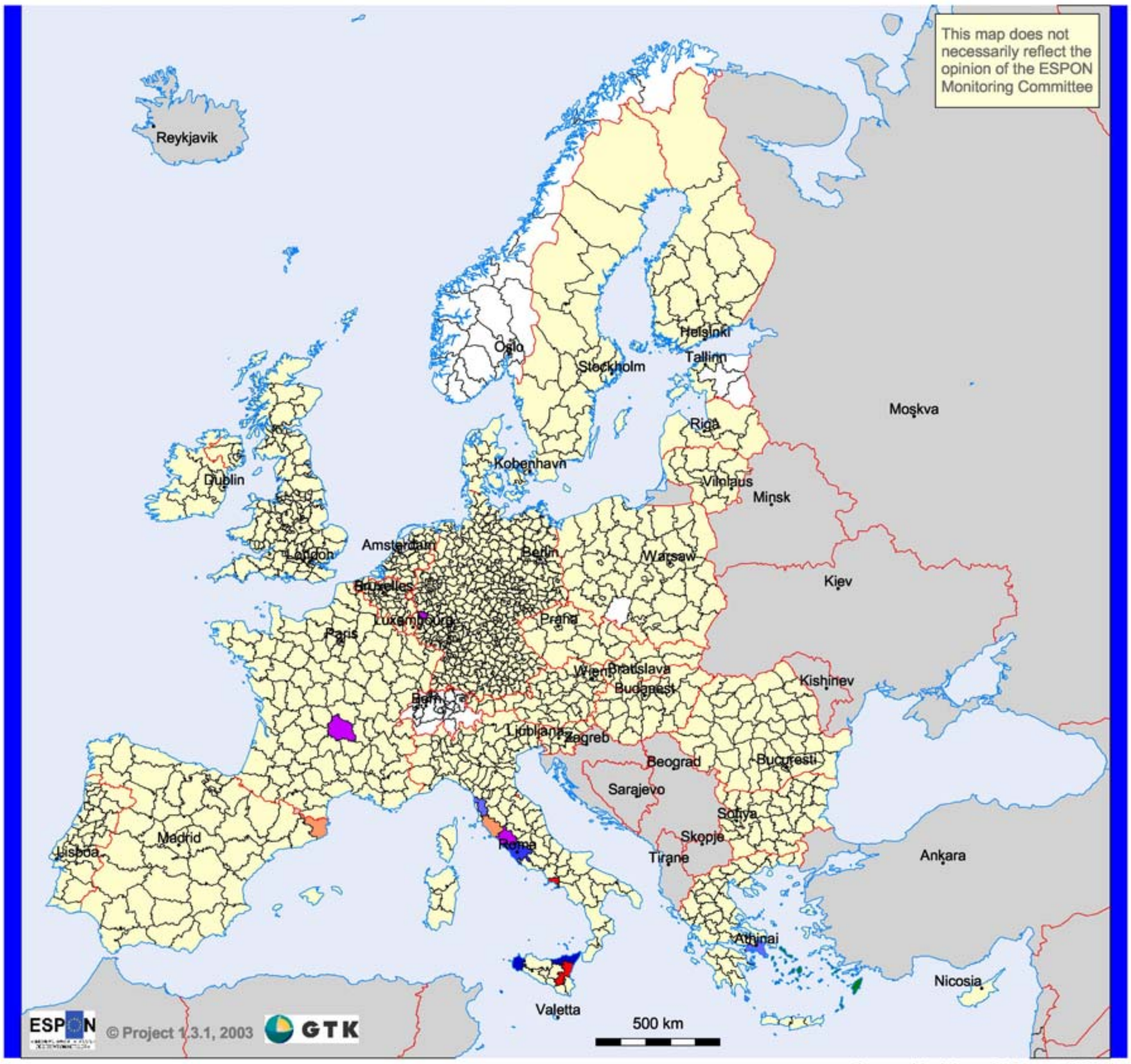
Geograhical Base © Eurostat GISCO
Source: ESPON Data Base

Typology of the regions

Legend of risk maps	Degree of vulnerability				
Intensity of hazard x	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

Map 19. Earthquake risk map on NUTS 3 level

Volcanic eruption risk in Europe (NUTS 3)



Geographical Base © Eurostat GISCO
Source: ESPON Data Base

Typology of regions

Legend of risk maps	Degree of vulnerability				
Intensity of hazard x	1	2	3	4	5
1*	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

* The first hazard class indicates areas that do not have volcanic eruptions, i.e. the intensity of hazard is null.

Map 20. Volcanic eruption risk in Europe (NUTS 3).

The first class of intensity of volcanic eruption hazard stands for "no hazard", i.e. they are the areas that do not have volcanic eruption hazard at all. Because of this "null" –value the degree of vulnerability has not been considered within these areas. The first column is illuminated with same colour throughout the different degree of vulnerability.

1.4.4 Towards the synthetic risk map and the identification of most sensitive regions

The selected hazards set the basis for the development of a typology of regions regarding hazard and risk profiles. Because of the different nature of hazards, the typology is developed separately for each hazard. So far, there this report presents synthetic vulnerability maps for all European Regions and risk maps on most of the identified hazards (according to data availability, see chapter 1.1). Subsequently, the separate assessments for the individual hazards will be superimposed to reveal the most threatened areas regarding multiple hazards to create a synthetic risk map. This will be done in the third interim report.

1.5 State of the art in hazard and risk reduction management

This chapter analyses good practice for the management of natural and technological hazards and risk reduction in selected pilot case study areas. The subsection closes the gap between the indicators that will be developed in the ESPON Hazards project on the NUTS3 level and the way risks and hazards are dealt with on the regional level in reality. Chapter 1.5 can therefore be seen as a qualitative supplement to the quantitative conclusions that will be possible on the basis of the risk indicators. This added qualitative value will be achieved in two steps:

- Analysis of existing regional plans and risk plans in the pilot case study areas (Chapter 1.5.1) and
- Interview of spatial planning administrations - to be presented in the 3rd interim report.

Additionally, existing response indicators will be reviewed (Chapter 1.5.3).

Risk reduction as minimizing vulnerability

In the first interim report, risk was defined as a function of hazard potential, damage potential and coping capacity as follows:

Risk = Hazard potential (probability x magnitude) x vulnerability (=Damage potential / Coping capacity)

Here, vulnerability refers to the combination of damage potential and coping capacity. Consequently, minimizing vulnerability can proceed through minimizing damage potential and maximizing coping capacity. Minimizing damage potential means minimizing exposure, i.e. not placing lives and valued assets at risk. Maximizing coping capacity means guaranteeing resources and preparing adequate plans for pre-disaster mitigation and post-disaster response measures. An important aspect of coping capacity is the availability and accuracy of hazard-related knowledge. Just like a hazard, vulnerability is place-specific and varies from region to region. Vulnerability is a complex of different elements of social and spatial organization. The combination of damage potential and coping capacity in a specific region can be defined as *regional vulnerability*.

Key elements of the regional coping capacity relevant for land use planning (see table 13 in 1st interim report) to be analysed in pilot case study areas include the following:

1. Knowledge: What knowledge exists at the regional level of the hazard potentials? What kinds of indicators are used to monitor development?

2. Resources: How much resources are available for mitigation measures? How are resources distributed?
3. Open space: Is space available for planning in a risk-sensitive manner?
4. Awareness (risk perceptions): Is the public informed and aware of hazard potentials?
5. Planning capacity: How effective is planning? What kinds of plans exist? How are they implemented?

Different combinations of these elements will be reflected in the pilot case studies, with a special stress on regional planning efforts. Regional planning capacity is a central concern for the project, as for the whole ESPON programme. Therefore, the analysis of regional plans has a key importance in the pilot case studies (see chapter 1.5.1). Other aspects of coping capacity listed above will be dealt with in the interviews of planning administrators (see chapter 1.5.2). The interviews also serve the purpose of comparing EU-level indicators with local ones.

Although a hierarchical structure of spatial planning instruments can be found in all EU member states, there are significant differences concerning the contents, structure and binding character of regional plans. Therefore a common understanding of 'regional planning' and 'regional plan' is required for the work in the ESPON Hazards project. The following definitions are suggested:

Regional planning is the task of settling the spatial or physical structure and development by drawing up regional plans as an integrated part of the formalised planning system of a state. Thereby regional planning is required to specify aims of spatial planning which are drawn up for an upper, state, or federal state wide level.
The regional level represents the vital link between the statewide perspective for development and the concrete decisions on the land use taken at local level within the land-use planning of the municipalities.

Regional plan as defined for the purpose of ESPON 1.3.1 Hazards:
- Is a Spatial plan (of an administrative area) superior to the municipal level,
- Is part of the official (national of federal) planning system,
- Makes statements and/or determinations referring to the spatial and/or physical structure and development of a region (spatial distribution of land use: infrastructure, settlement, nature conservation areas etc.),
- Have impacts on the subordinate levels of planning hierarchy (local level, e.g. municipal land use plans etc.),
- Refers to the textual and cartographic determinations and information in the scales of (approx.) 1:50 000 to 1:100 000.

For further analysis in terms of the spatial planning response the EU member states can be grouped into three categories referring to the degree of coordination and integration of regional planning policies (Greiving and Kemper 1999):
- Category A contains countries with institutionalised regional planning that includes binding regional plans or other forms of binding effects.
- Category B includes countries with institutionalised regional planning but without binding effects.
- Category C contains countries without regional planning and/or regional plans, with coordination taking place just at the regional level.

The consideration of different categories of regional planning is necessary for assessing the transferability of instruments and indicators. In the end the selected indicators of risk and risk reduction, respectively, must be adequate for and applicable to existing regional planning systems, regional plans and risk plans.

Plans are effective to the extent that there is legitimacy and compliance by different actors (e.g. developers). Another important factor in determining effectiveness in planning is the relation between national legislation and local plans (i.e. do legal norms and guidelines exist and are they included in local plans?) For planning to have an effect both horizontal (local cooperation and compliance) and vertical (functioning of the planning hierarchy) integration needs to take place. These two dimensions, as presented in figure 8, will be studied in the pilot case areas.

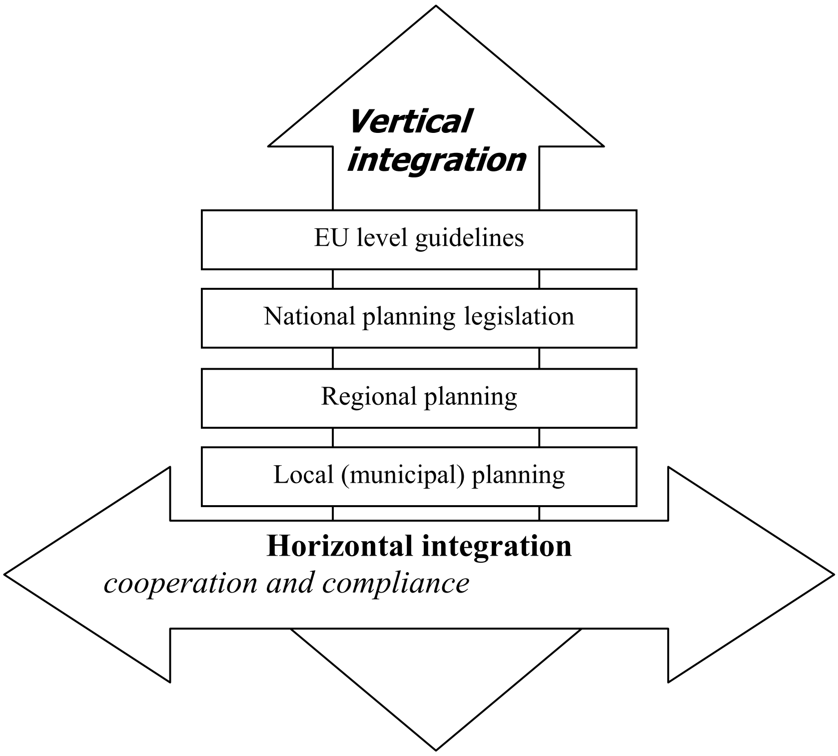


Figure 8. Vertical and horizontal integration in planning

The role of case studies

Overall, the ESPON programme does not favour a case-based approach in its research projects. In the context of the ESPON Hazards project case studies can, however, add important knowledge on different issues – which are beyond the methodological possibilities of aggregated EU-wide data. This refers especially to the aspect of regional vulnerability and possible spatial planning responses:

1. Case studies shed light on the real-life interconnections between various factors relevant for risk management and vulnerability. This provides relevant information for the

development of indicators and for testing their limitations, i.e. what indicators actually indicate.
2. The simple aggregate approach on different hazards neglects the interrelations between them. Hazards, at the local/regional level don't just "add up", but are interconnected in various more dynamic ways – and, consequently, require dynamic response measures. There are serious methodological problems involved here. Hence, case studies can show what issues and mechanisms are relevant in multi-hazard settings. This requires attention beyond the pilot case study areas.
3. The idea of response networks, as used in the ESPON tender, can be mobilised as a heuristic device in local case studies. This helps to point out the network-like constellation of local actors involved in risk management efforts. The idea of local networks refers directly to the notion of social capital, a candidate concept for operationalisation and complementing the monetary approach. Another related issue is participation and community involvement. Participatory planning processes, for instance, help build networks and reduce vulnerability with both vertical and horizontal integration of actors in a community (see Tobin and Montz, 1997). These aspects are relevant for the description of authorities (1.5.1.1.6) and the interviews of spatial planning administrators (1.5.2).
4. Further, case studies can provide information on historical developments in different regions. For instance, the recent experience of a hazard may explain heightened awareness thereupon and willingness to integrate it into planning. Often, the experience of a hazard provides a strong motivation for mitigation – but this is also contingent upon the local level of education, quality of media and public awareness (incl. campaigns etc.)
5. Unlike aggregated indicators, case studies allow analyzing how planning processes unfold in reality and under differing administrative backgrounds.
6. Through the choice of cases, both best practice and failure can be highlighted and better understood.

The pilot case studies (Chapter 1.5.1) and the interviews with spatial planning administrations (Chapter 1.5.2) help to unveil specific aspects of regional vulnerability as well as the components of coping capacity / resilience such as knowledge, monetary resources, open space, awareness and planning capacity (see also 1st Interim Report, Table 13). On the basis of this qualitative analysis, response indicators should be identified and finally reviewed (Chapter 1.5.3). The exercise of mapping vulnerability in the pilot case areas provides the basis for developing a vulnerability index.

References:

Greiving, S.; Kemper, R. (1999): Integration of Transport and Land Use Policies: State of the Art. Dortmund (IRPUD) 1999. (= Berichte aus dem Institut für Raumplanung; 47)

Tobin, G. A. and B. E. Montz (1997): Natural hazards: Explanation and integration. The Guilford Press, New York.

1.5.1 Conclusions from case study reports

The chosen case studies from different European countries provide an overview on different regional approaches towards risk management in regional planning. The reports on the case study areas are included in *Annex I*. In the context of ESPON 1.3.1 case study areas are crucial for the understanding of regional responses towards hazards and risks and a major step towards the work with practitioners in the further phases of the project. Especially the development of indicators (processes of validation and testing) will require intensive work with practitioners on regional levels.

Case study reports are an important basis summarising the respective conditions including the planning background, relevant legislation and involved boards (administrations). In the next step this knowledge will allow to properly address the right stakeholders in the cases study areas. This will help to make the validation process and the testing of acceptance of indicators practicable and ensure scientifically sound, comparable results.

In the following table major findings are summarised (for complete reports see *Annex I*).

Table 31: summary information from case study area reports

Relevant hazards	
Region of Dresden	• Floods • Landslides • Extreme precipitation • Hazards from production plants with hazardous production processes or substances • Hazards from hazardous waste deposits / storage of nuclear waste • Hazards from the marine transport of hazardous goods • Dam failure
Central Region of Portugal	• Floods • Droughts • Forest Fire • Storms • Hazards from hazardous waste deposits / storage of nuclear waste • Dam failure
Region of Itä Uusimaa	• Floods • Hazards from hazardous waste deposits / storage of nuclear waste • Hazards from Nuclear power plants • Hazards from production plants with hazardous production processes or substances • Hazards from the marine transport of hazardous goods
Region of Andalusia	• Earthquakes • Droughts • Floods • Storms • Forest Fires • Hazards from production plants with hazardous production processes or substances • Hazards from hazardous waste deposits / storage of nuclear waste • Hazards from the marine transport of hazardous goods

Level of Regional Planning	
Region of Dresden	• NUTS 1 providing the spatial planning framework • NUTS 2 providing the regional planning framework • 'Planning regions' below NUTS 3 as practical level of regional planning
Centro Region of Portugal	• NUTS 1 providing the spatial planning framework • NUTS 2 as practical level of regional planning • NUTS 3 doing preliminary work to regional planning process
Region of Itä Uusimaa	• NUTS 1 providing the spatial planning framework • NUTS 3 as practical level of regional planning
Region of Andalusia	• NUTS 2 as practical level of regional planning • NUTS 3 Regional Offices as sub regional level doing preliminary work to regional planning process
Authorities involved (relevant for further investigation, e.g. interview)	
Region of Dresden	• Saxon Ministry of Internal Affairs (NUTS 2) • Regional Council (NUTS 3) • Regional Planning Authority (below NUTS 3)
Central Region of Portugal	• Ministério das Cidades, Ordenamento do Território e Ambiente (NUTS 1) • Head office of spatial planning and urban development (NUTS 1) • Comissão de Coordenação da Região Centro / (NUTS 2) • Regional Head Office of Environment and Spatial Planning (Direcção Regional do Ambiente e Ordenamento do Território, NUTS 2)
Region of Itä Uusimaa	• Ministry of the Environment (NUTS 1) • Regional environmental centres (NUTS 3) • Regional Councils (NUTS 3)
Region of Andalusia	• Council for the Government of Andalusia (NUTS 2) • Regional Office for Public Works, Transport and Urbanisation (NUTS 2) • Regional Offices (NUTS 3)
Main Background Legislation	
Region of Dresden	• Regional planning law (NUTS 2) • Spatial planning Law (Framework law, NUTS 1)
Central Region of Portugal	• Law nº 48/98 on spatial planning and urban policy (NUTS 1) • Decree-law nº 555/99 on legal regime for urban operations at municipality level (NUTS 1)
Region of Itä Uusimaa	• Land Use and Building Act (NUTS 1) • Municipal Building Codes (NUTS 4)
Region of Andalusia	• Andalusian Land Planning Act 1/94 (NUTS 2) • Andalusian Urban Planning Act (NUTS 2 for NUTS 4)

SWOT analysis

The SWOT-analysis refers to the respective regional planning system as far as it is applicable to risk management in the respective case study area (see respective case study area reports presented in Annex I).

Table 32: SWOT analysis for cases study areas

	Region of Dresden	Central Region of Portugal	Region of Itä Uusimaa	Region of Andalusia
Overall remarks	-	-	-	-
Strengths	- well developed hierarchical planning system and planning culture - sound legislative planning background - clearly distributed competences - many spatial planning tools available at different levels - hazard oriented regulations implicit to various acts - good implementation of European directives - well developed control mechanisms - regional plans cover the whole area - area wide land use plans	- planning system developed at different levels - regional planning backed by national legislation - good legislative basis for flood risk management - existing data base for Flood risk management - emergency plans developed at different levels and for different hazards	- well developed hierarchical planning system and planning culture - sound legislative planning background - clearly distributed competences - good implementation of European directives - regional plans cover for the whole area	- sound legislative planning background - clearly distributed competences - well developed scientific backing - well developed data base for risk assessment - existing systematic risk evaluation - good implementation of European directives - well developed control mechanisms - Synthesised cartography showing the spatial distribution of the various hazards

	Region of Dresden	Central Region of Portugal	Region of Itä Uusimaa	Region of Andalusia
Weaknesses	- no data basis for risk evaluation - no risk documentation for planning issues - almost no explicit legislative requirements - hazard related regulations are very disperse - no systematic risk evaluation - no systematic risk management - underused steering power of regional planning due to insufficient political backing	- no strategic plans covering the whole region - limited binding character of regional plans - no risk documentation for planning issues - no systematic risk evaluation - no systematic risk management	- no data basis for risk evaluation - no risk documentation for planning issues - hazard related regulations are very disperse - no systematic risk evaluation - no systematic risk management - limited binding character of regional plans	- Region of Andalusia is not representative for whole Spain - no area wide land use plans - no strategic plans covering the whole region - risks on a regional and sub regional scale are addressed unevenly - Natural hazards addressed in greater extent than those of technological nature - lack of large-scale maps, necessary for the appropriate treatment required for municipal planning
Opportunities	- appearing risk management approaches - developing data basis for Flood Risk Management	- central planning level (NUTS 2) allows balance of local interests in the scope of risk management - developing risk management approaches (e.g. floods, forest fires, uranium mining)	- spatial planning cooperation between municipalities - public participation in planning	- central planning level (NUTS 2) allows balance of local interests in the scope of risk management
Threats	- systematic risk management approach covering all risks still missing - comprehensive risk management may stay limited to floods	- systematic risk management approach covering all risks still missing - comprehensive risk management may stays limited selected hazards	- systematic risk management approach covering all risks still missing	- comprehensive risk management may stay limited selected hazards - Nuclear power and forest fire strongly addressed by legislations but hardly respected in planning - lack of a proper catalogue and identification of risk areas for technological hazards

1.5.2 Review of existing response indicators

This chapter gives a comprehensive overview over risk oriented response indicator approaches. This is meant as basis for further indicator development within ESPON Hazards (see chapter 4) that will put emphasis on response indicators.

1.5.2.1 Theory of response indicators

The term 'response indicators' has already been introduced in the first Interim Report of ESPON Hazards. This chapter specifies the term "response indicators" more precisely for further development.

Several definitions on the international level have been presented in the last ten years to set the frame for response indicators in the PSR (Pressure-State-Response) respectively DPSIR models. The origin of these is in the field of environmental indicator development as well as more recently in the field of sustainability indicator development (see e.g. OECD 1993, Jesinghaus 1998, EEA 1999a, DIREN 2001, INECE 2002). Thus the frameworks set for response indicators so far usually refer to environmental conditions or, in a wider sense, sustainability indicators. These are in the following applied to issues of risk management for the ESPON Hazards project.

Response indicators in the sense of the project mean the "spatial planning answer" (ESPON Hazards 2003) towards risks in certain areas. Immediate reactions during or after a disaster are not considered as key responses in the understanding of the project. In terms of a systematic risk management, more importance is given to middle and long term management approaches in a wider sense. These take hazards into account before disasters occur and take measures through the implementation of preventive mitigation strategies and the inauguration of disaster management plans.

Societal response in the European society has to be seen as something different from passive adaptation strategies and short-term reactions to occurring symptoms (Ribot 1996) such as disasters and accidents. *Response* means the proactive risk management strategies to lower risk for vulnerable areas by a wide array of measures aimed at the other components of the DPSIR-chain (see also chapter 2 on draft guidelines in this report for more details on the role of response in the DPSIR framework). In this context adaptation and short-term reactions may play a role within the response, but rather as mitigation strategies in the scope of comprehensive long-term management concepts.

Based on existing definitions, the following basic understanding can be given for response indicators:

> ***Response Indicators*** *are process-oriented indicators describing how, in which ways, respectively by which means the concerned public authorities at the regional ... level respond to natural and technological hazards and risks in their area. They quantify, simplify and communicate the status and trends in planning activities. Response indicators identify the administrative (and political) measures that a certain region has undertaken to improve the situation and to move towards a better state* (OECD 1993, p. 7-8).
>
> *They thus measure "how policies are implemented by tracking treaty agreements, budget commitments, research, regulatory compliance, the introduction of financial incentives, or voluntary behavioural changes"* (Hammond et al. 1995 p. 12). *"These*

indicators measure progress toward regulatory compliance or other governmental efforts, but do not directly tell what is happening to the environment" (INECE 2002).

In this context response indicators can be important in measuring society's action. However, like the other indicators of the DPSIR chain *response indicators* only "reflect the current situation as it is, without reference to how the situation should be" (EEA 1999b, p. 11). In contrast to this there is also a need for *performance indicators* and *efficiency indicators* going beyond the 'simple' description. Performance indicators compare "(f)actual conditions with a specific set of reference conditions" to measure the distance between the current and the desired situation (EEA 1999b, p. 11). Efficiency indicators measure the efficiency of actions expressing the "relation between separate elements of the causal chain" (EEA 1999b, p. 12).

Even though response indicators form an equitable part of the indicator concepts (PSR respectively DPSIR) their development in general appears to be noticeably behind pressure and state indicators. In recent publications on indicator issues (mostly environmental and sustainability indicators), the presented indicator sets lack especially response indicators (see World Bank 1995, Hammond et al. 1995, UN 2001, OECD/UNDP 2002, DIREN 2002 and other). Also the review of EEA and JRC indicators presented in the 1st Interim Report ESPON (Hazards 2003 p. 5) has shown that among the DPSIR chain most indicators represent State and Impact, a few Pressures and very few Driving Forces and Responses.

The reason for this may be seen in the nature of things – the first step of the approach is to recognise a problem (state), the second to find its reason (pressure, driving force) before finally measures (response) can be taken. Thus the last element of the DPSIR model naturally is the latest to be developed. Another reason may be a practical one: data to construct indicators is usually best available for state and pressure indicators and sparse for response indicators (see Hammond et al. p. 12).

"Compared to indicators of environmental pressures and many indicators of environmental conditions most indicators of societal responses have a shorter history and are still in a phase of development, both conceptually and in terms of data availability" (OECD 1993, p. 8). Up to now there still persist gaps in indicator frameworks which are "particularly apparent with respect to response indicators" (UN 2001, p. 20) and even most recent publications claim to place "further emphasis on developing indicators … describing societal responses including economic and fiscal instruments" (OECD 2000, p. 148).

1.5.2.2 Existing response indicators

This chapter presents the current state of the development of response indicators within the DPSIR chain for the purpose of the management of natural and technological risks. Beside indicators presented in chapters 1.1 and 1.2 the evaluation of existing response indicators is an important basis for the development of further indicators that will be initiated in chapter 5.1 of this interim report.

As referred to above, the development of indicator chains relevant for ESPON Hazards issues originates from the environmental and sustainability science. Thus it is here where the most complete indicator sets are available and in use (see e.g. publications of EEA, OECD and other). In fact indicators related to natural hazards are first named in the scope of environmental indicators (see e.g. Hammond 1995, World Bank 1995 and others). On the basis of what has been published in the field of risk management indicators so far, it can be stated that the theoretical basis is still sparse. Nevertheless, the development of response indicators is slowly advancing too, as far the theoretical framework from environmental and sustainability indicators can be used as background concepts for risk related indicators.

In the following, four approaches showing more or less comprehensively the current state of the development of response indicators shall be presented. They show the development in the most recent work of indicator development related to issues of hazards and risks:

- EEA core set of indicators (under development)
- INDNR draft indicators
- UNDP draft indicators
- IADB indicators

1.5.2.3 EEA indicators

As presented in the ESPON Hazards first interim report 2003 the up to date published indicator sets of the European Environmental Agency are rather weak in terms of response indicators. It is also obvious that none of the presented response indicators (see table 33) relates to any hazards.

Table 33: Response indicators EEA as presented in ESPON Hazards 2003 (pp. 24-36)

Indicator Nr	Indicator
YIR01AG09	Structure of common Agricultural Policy Support
YIR01AG11	Area under agri-environmental management contracts
YIR01SO03	Progress in the management of contaminated sites
No ID No	Implementation of strategic environmental assessment (SEA) in the transport sector
No ID No	Generation and treatment of sewage sludge

Currently under development, the European core set of indicators (EEA 2003) comprises almost 100 indicators designated as response indicators. The report states that the development of response indicators does not have a high priority due to the necessity for state and pressure indicators (EEA 2003, p. 28). However, the multitude of listed indicators highlights the emphasis laid on indicators measuring societal response to problems addressed by other indicator types. Some of the presented environmental response indicators could form a basis for the development of hazard related response indicators (see table 34).

The EEA describes response indicators as presented in the report with the question: “how effective is the response?” (EEA 2003, p. 17) For this reason not all of the EEA indicators can be regarded as response indicators as defined above since neither performance nor effectiveness indicators are comprised under the ESPON Hazard definition of response indicators (see definition above). Table 2 shows the core set draft response indicators that fit the ESPON Hazards definition.

Table 34: selected response indicators from the proposed EEA core set of indicators (EEA 2003)

Indicator	Availability at: **ST** short term **MT** middle term **LT** long term	**Element of interest** (what is the indicator about?)
BDIV8 Protection of threatened species		regulations
BDIV8a Proportion of globally threatened fauna species protected by European instruments (EC Directives and Bern Convention)		compliance
BDIV8d Progress in implementation of action plans for globally threatened species		compliance
BDIV8e Funds spent through LIFE Nature projects for species and habitats		financing
BDIV10 Designated areas	ST	planning
BDIV10a Cumulated area of sites over time under international conventions and initiatives	ST	compliance / planning
BDIV10b Cumulated area of sites proposed over time under EU Directives	ST	planning / compliance
BDIV10c Proportion of sites under EU Directives already protected under national instruments	ST	planning / compliance
BDIV10d Cumulated area of national designated areas over time in Pan-Europe		planning / compliance
BDIV15c Financial investment for fauna passages	MT	financing
WQ5 Water prices	MT	taxation
WEU16 Urban waste water treatment	ST	compliance
AGRI17 Implementation of Nitrate Directive	ST	compliance
WEC8 Implementation of EU Water Policies	MT	compliance
TECO3 Progress in coastal zone management (Integrated Coastal Zone Management)	MT	activity programme
WMF4 Indicator of "shifting environmental burden" 71	MT	?
AGRI13 Area enrolled in agri-environment schemes	ST	activity programme
AGRI15 Environmental elements of CAP spending	ST	financing
AGRI17 Nitrate Directive Implementation	ST	compliance
AGRI11 Use of cross-compliance instrument	MT	?
AGRI18 Environmental training of farmers	LT	education
FISH13 Fleet decommissioning subsidies (compared to Investment/Modernisation subsidies)	MT/LT	financing
FISH14 Quota/Zone management	MT	planning
FISH14a Multi-annual management plans in place (or not)	LT	planning
FISH14b International fisheries agreements	ST	regulations
FISH16 National legislation with specific provision for environmental management of aquaculture	LT	regulations
EE29 Energy Taxes	ST	financing
EE31 Energy subsidies by fuel type	ST	financing
EE32 Energy-related research and development expenditure	ST	financing
TERM 19 Investments in transport infrastructure per capita and by mode	ST	financing
TERM 21Fuel prices and taxes	ST	financing
TERM 22Transport taxes and charges	ST	financing
TERM 36 Institutional cooperation in transport and environment	ST	cooperation
TERM 38 Uptake of Strategic Environmental Assessment in the transport sector	ST	compliance

Indicator	Availability at: **ST** short term **MT** middle term **LT** long term	**Element of interest** (what is the indicator about?)
TERM 26 Internalisation of external costs	ST	financing
TERM 19 Investments in transport infrastructure per capita and by mode	ST	financing
TOUR 11 Tourist tax revenue and environmental expenditure	LT	financing
TE Progress in initiatives implemented by local stakeholders (Integrated Quality Management, Agenda 21, SEA, ICZM; in tourism destinations)	MT	activity programme
TOUR 16 Progress in integration of tourism and environment into national strategies and monitoring systems	MT	compliance
TOUR 17 EU support to sustainable tourism projects	MT	financing
Non-compliance with European standards (page 88)		compliance

The indicators presented in table 34 are so far neither aggregated nor operationalised for the practical use. They do not differentiate between different scales addressed (some of them are laid out for national level, others seam to be applicable on the regional level) nor are they thematically classified. However, for some of the presented short-term indicators fact sheets are available (EEA 2003) that could be used for methodical follow up.

Within the project it is foreseen to produce a proposal for a methodology on how to produce policy response information until the end of 2003 (see EEA 2003, p. 61).

1.5.2.4 IDNDR indicators

In the scope of the International Decade of Natural Disaster Research (IDNDR), a German researcher group developed a set of hazard related indicators for the first time in 1998. Among those a small number of response indicators was proposed (Lass et al. 1998). Table 35 shows the extracted draft response indicators as presented in the publication.

Table 35: Response Indicators for risk reduction as presented by Lass et al.(1998, pp. 35-40)

Indicator	**Hazard**	**DPSIR**	**Desired final state**	**Remarks** (quoted from original table)
Size of areas that can be safely flooded	Flood	R	increasing	A lack of safely floodable areas along the upper reaches of the Rhine river was identified as a cause of the consequences of the 1993/94 and 1995 Rhine floods; on the other hand, the presence of polders was seen as one of the reasons for the relatively mild consequences of the 1997 Oder flood.
Quality of early warning systems		R	increasing	In all disasters the time factor plays a decisive role in reduction of damage
Amount of insured damage as a percentage of total damage	all disasters	R	increasing	Background: growing discrepancy between total damage and insured damage. Uninsured damage reduces capability to act and develop (sustainability objective).

Indicator	Hazard	DPSIR	Desired final state	**Remarks** (quoted from original table)
Quality of structures (as an aid, age of the structures	earthquakes, storms	S/R	increasing	… "Most effective is the disaster preparedness, i.e. the improvement of construction quality and hazard resistance"
High state expenditures for disaster protection	all disasters	R	increasing	Oriented to: GDP
Quality of technical equipment of aid personnel	all disasters	R	increasing	
Number of helpers in disaster protection	all disasters	R	increasing	Professional and volunteer helpers (not including self-help among the population); It is widely maintained that the helper-index figure of 1%, which dates from wartime, is no longer adequate; flexible and expandable structures are required
Degree of co-ordination and co-operation among state and private assistance services	all disasters	R	increasing	… a) co-operation among assistance organisations co-operation between assistance organisations and state emergency response personnel c) co-operation with company / plant fire departments …
Degree to which population is prepared for disasters (preparedness)	all disasters	R	increasing	Approximation: training in first aid

This can be taken as the first comprehensive hazard, risk and risk management oriented indicator list (Fleischauer 2003). The presented system (table 35 shows an extract only), based on qualitative naming of possible indicators, remains in this first draft state. A further description and operationalisation has not been realised since the publication of the list.

1.5.2.5 UNDP (ZENEB) indicators

The so far most comprehensive approach was presented in the scope of the United Nations World Vulnerability Report (WVR) (ZENEB 2002b see Annex UNDP). The indicator list was developed with the aim of introducing indicators that allow the vulnerability of a country to be measured.

The indicators address different levels and are classified into the following six categories (cp. ZENEB 2002b, pp. 40-41). Each category contains a number of themes that are then broken down into a list of draft indicators.

A. **Governmental commitment to risk reduction and institutional structure**
Indicators evaluating the respective governmental commitment and the institutional structure.

B. **Risk identification:**
Indicators evaluating the assessment or identification of risks.

C. **Risk prevention and mitigation**
Indicators evaluating different short- and long-term activities necessary to reduce the hazard and the vulnerability of the exposed people, animals and objects.

D. **Risk transfer** (widely used instrument only in industrialised states)
Indicators evaluating measures taken or proposed in order to spread the risk of losses and damages. These measures are to facilitate affected people's recovery after the occurrence of an extreme natural event and thus avoid or reduce a disastrous impact on them.

E. **Disaster preparedness**
Indicators evaluating a wide range of activities that can increase people's (population, institutions, non-governmental organizations etc.) capacity to anticipate and react to extreme natural events in a way to reduce losses and damages. An important aspect of preparedness is warning.

F. **Political and economic-social context**
Indicators evaluating the economic and social context (societal structures for poverty reduction, better educational system) capable to essentially contribute to the reduction of disaster risk.

Even if the major emphasis of the WVR is drought risk the indicator list presents a wide array of systematically developed (draft-) indicators (see tables at the end of this chapter) that can be used as a well-structured basis for further indicator development. Annex UNDP presents the proposed indicator list. The original list is extended by hazards addressed by ESPON Hazards and contains a first evaluation of the applicability of each indicator to the respective hazard type (see table below for the complete list).

Not all of the indicators presented are really response indicators, though the biggest part of the list can be accepted as such. As the indicators are currently in the state of development and testing within the World Vulnerability Reports the outcomes should be screened for appropriate methodical results that could be applied to further indicator development within ESPON.

Already now the proposed indicators should be used as a possible starting point for the development of response indicators in the context of ESPON, which will be continued in the 3rd interim report. However, to which extent the indicators can be operationalised for the use at different spatial levels in Europe will depend from the data availability which will have to be scrutinised within the development process (cp. Chapter 5, this interim report)

Table 36: Draft Indicators for Measuring Risk Reduction Efforts (ZENEB 2002, p. 32ff) extract from UNDP table below (extended by ESPON 1.3.1)

Indicators*	Sources of information*	Relevance of Indicators for Each Hazard Theme Draft Indicators, Core Aspects												
		Volcanic eruptions*	Floods*	Land slides /Avalanches**	Earthquakes*	Droughts*	Forest fires**	Storms*	Extreme precipitation**	Extreme temperatures**	Nuclear power**	Hazardous production**	Hazardous/ nuclear waste**	Marine transport**
A. Government commitment to risk reduction and institutional structure														
1. Shift in government's approach from disaster response to disaster risk management focusing on risk reduction														
1.1 A total risk management national policy and regulatory framework is in force, covering mitigation and prevention, preparedness and recovery		x	x	x	x	x	x	x	x	x	x	x	x	x
1.2 National structure for disaster risk reduction		x	x	x	x	x	x	x	x	x	x	x	x	x
1.3 % of national budget for disaster risk reduction		x	x	x	x	x	x	x	x	x	x	x	x	x
1.4 Participation in regional co-operation (institutions, strategies) on the subject		x	x	x	x	x	x	x	?	?	x	x	x	x
1.5 Economic incentives, tax regulations etc., promoting pro-mitigation behaviour		x	x	x	x	x	x	x	?	?	x	x	x	x
1.6 Inclusion of risk reduction measures in recovery process		x	x	?	x	x	?	x	?	?	?	?	?	?
2. Decentralization of disaster risk reduction and response structures														
2.1 Local authorities charged with local disaster risk management		x	x	x	x	x	x	x	(x)	(x)	o	o	(x)	o
2.2 Existence of trained risk reduction committees at community level		x	x	x	x	x	x	x	(x)	(x)	o	x	x	o
2.3 Allocation of financial resources at municipal, provincial or state level		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
3. Empowerment of national disaster risk reduction and response structures														
3.1 Adequate budget for national structure		x	x	x	x	x	x	x	x	x	x	x	x	x
3.2 Existence of staff experienced in disaster risk reduction		x	x	x	x	x	x	x	x	x	x	x	x	x
B. Risk identification														
4. Availability of risk identification information														
4.1 Magnitude, frequency, duration, location, timing and probability of occurrence of all major hazards affecting the country being established on a sound scientific basis		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.2 Elements at risk (population, infrastructure, socio-economically important activities) inventoried		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.3 Vulnerability of the major categories of elements exposed to each hazard assessed to obtain a systematic, transparent, comprehensive and geographically specific assessment of risk		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.4 Disaster costs and losses systematically reported and logged in a national disaster event database conforming to international standards		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.5 Availability of local risk information as basis for mitigation measures		x	x	x	x		x	x	(x)	(x)	(x)	x	x	(x)
C. Risk prevention and mitigation														
5. Adequate land-use planning														
5.1 Land-use planning incorporating disaster risk	ICC	x	x	x	x	x	o	x	o	o	o	x	x	0
6. Risk adapted codes, norms and standards														
6.1 Existence and control of codes, norms, standards responding to specific risk	NCSBCS, UIA, ICC													
· Building codes			x	x	x		x	x	(x)	(x)	(x)	x	x	o
· Other infrastructure (roads, bridges, lifelines); etc.			x	x	x		x	x	(x)	(x)	(x)	x	x	o

* information presented in the column derived from the original paper

** extension of the original table by ESPON Hazards – draft evaluation

1.5.2.6 IADB (GTZ) indicators

Whereas preceding indicator lists (except for partially the EEA indicators) represent merely names of indicators the Inter-American Development Bank is currently preparing the first operationalised Indicator list related to risk management (IADB 2003). The approach is based on the above presented draft indicators of the UNDP (email message Christina Bollin, see references). It can be stated that this is the most advanced indicator set containing response indicators in the field of risk management.

The underlying understanding of the IADB indicator set is "that in order to manage risk, decision makers and local communities need to understand the threat posed by a *hazard*, the magnitude of lives and values *exposed* to the threat, the specific susceptibility towards hazards through present *vulnerabilities***,** and the range of *capacities & measures* to protect against risk." (IADB 2003, p. 10). Thus 'hazard', 'exposure', 'vulnerability' and 'capacity and measures' were chosen as key factors defining the term risk and which thus serve as main headlines for the indicator development. The proposed indicators are meant to cover these four topics by addressing different issues that help to measure each of them.

Table 37: Capacity and measure indicators by Inter-American Development Bank (INDB 2003, p. 12)

Component measured	Indicator
Physical planning and engineering	(C1) Land use planning (C2) Building codes (C3) Retrofitting/ Maintenance (C4) Preventive structures (C5) Environmental management
Societal capacity	(C6) Public awareness programs (C7) School curricula (C8) Emergency response drills (C9) Public participation (C10) Local risk management/ emergency groups
Economic capacity	(C11) Local emergency funds (C12) Access to national emergency funds (C13) Access to intl. emergency funds (C14) Insurance market (C15) Mitigation loans (C16) Reconstruction loans (C17) Public works
Management and institutional capacity	(C18) Risk management/emergency committee (C19) Risk map (C20) Emergency plan (C21) Early warning system (C22) Institutional capacity building (C23) Communication

In its preliminary draft paper the presented list is reinforced by descriptions to each indicator. Here a three-step scale is proposed to measure the value of each indicator. Table 38 Shows the names of the indicators. For each of them a fact sheet exists detailing its background and use application. In table 38 the basic information from the indicator descriptions is summarised to give a quick overview how the measurement is approached (see also IADB table below).

Table 38: IADB indicator descriptions – a summary (extract from IADB table below)

Element	Indicator name	Question	**Ranges**	Measurement	
Physical planning and engineering	(C1) Land use planning	Does a land use plan or zoning regulations exist that keeps local production and housing out of hazardous areas?	Their enforcement is:	Low --- High	Low Medium High
	(C2) Building codes	Do building codes, design standards, and performance specifications for facilities exist that guarantee the use of hazard resistant methods, techniques and material. Building codes?	Percent of buildings in threatened area complying to code/standards:	< 30% 30-70% > 70%	Low Medium High
	(C3) Retrofitting/ Maintenance	Are existing infrastructure (e.g. bridges, roads) and buildings (schools, hospitals etc.) retrofitted to withstand natural hazards (flood proofing, hurricane shutters, roof straps etc.) and/or are regular maintenance works carried out (River dredging, flood canals, etc.)?	Implemented measures:	Many Some Few	Low Medium High
	(C4) Preventive structures	Do hazard exposure- limiting mechanisms/ structures exist (dykes retaining walls, dams, barrages, rock fall barriers, terraces, drainage, windbreaks, water wells, etc.)?	Expected effect on damage:	Low Medium High	Low Medium High
	(C5) Environmental management	Are there activities to promote and enforce conservation of national resources in risk areas (e.g. protection of water reserves and other of natural resources, desertification control techniques, reforestation etc.)?	Number of activities and projects	Many Some Few	Low Medium High

These indicators were developed for Latin American countries, whose administrative structures are less established and data sources less elaborate than in the European union. The application of the indicators thus addresses the enquiry of data by simple means such as qualitative statements by involved parties ranging the statements on a three-step scale.

On the other hand, the IADB approach is designed to cope with problems that the development and application of response indicators faces in areas with differing societal backgrounds. In principle this is a circumstance that has to be considered in the case of highly fragmented administrative structures of the European union too.

1.5.2.7 Conclusions

The development of response indicators is still in its initial state. Most of the indicators presented are rather criteria that still need to be reinforced by indicators. Nevertheless, by response describing the criteria, an important step towards the development of indicators with which to measure these criteria is set.

As the example of IADB indicators shows, these criteria can be extended to real indicators. However, especially response indicators face a serious problem in terms of their operationalisation. On the one hand response indicators are rather qualitative in nature und thus in many difficult to quantify objectively. On the other hand, since the response indicators are qualitative, it is difficult to apply them in different political and administrative backgrounds.

The presented indicator lists unveil numerous attempts to produce indicators to measure societal response. But they also display the need to place much more effort in the development of response indicators. Accepting that the development of indicators, to some extent, reflects policy concerns about certain topics (e.g. monitoring of EU programmes and policies such as the Common Agricultural Policy represented by see EEA Indicators, see EEA 2002) the formulation of a more coherent European policy on risk management could boost the development of hazard related indicators, including those of response, too.

Generally response indicators apply to different spatial (administrative) levels measuring the response at national, regional and local levels. They also differentiate between different stakeholders involved in the response process, which can be:

- Public entities
- Private (e.g. commercial organisations)
- Civic activities

Based on the definition that response indicators measure the societal activity they can be classified according to the elements of activities they measure. These elements act as different "steering instruments" that can be regarded as responses to situations displayed by the other types of indicators of the DPSIR chain. The found indicators usually refer to the following elements:

1. **Financing instruments**
   Financial tools capable of affecting the steering of the development (e.g. fuel taxes to increase energy efficiency of fuel reliant devises and facilities; financing of research activities to foster scientific development in a certain field). Financing tools comprise negative (taxes) as well as positive (incentives) instruments. (Remark: it is agreed that especially taxes do not necessarily constitute directed steering instruments, but are often introduced to cope with financial needs of the society. Nevertheless, taxes (can) steer the behaviour irrespective of their background.)
   Financial tools aim at financing different risk mitigating activities by different stakeholders.

2. **Policy - legal regulations**
   Policy tools enacted to set the basis / framework for activities aimed at the amelioration of problematic situations (e.g. building codes etc.).

3. **Planning basics and instruments**
   Tools providing the basic information about relevant hazards (maps, data bases etc.) and such for steering development according to necessities or dangers realised in the evaluation process (spatial and management planning).

4. **Compliance measures to cope with requirements**
   a) Measures and/or degree of compliance or the enforcement of legal acts
   b) Measures complying with a certain state of the art (e.g. not legally required standards in planning)

5. **Structural support measures (built and non built structures)**
   a) Existence and endowment of supporting structures with special dedication to risk mitigation (administrative and scientific cooperations, workgroups etc.)
   b) Existence and maintenance of built protection and mitigation structures

6. **Education of staff and public /dissemination of information**
   Tool for increasing awareness of staff and public engaged in processes related to the issue of interest.

7. **Activities and activity programs**
   Existence and forthcoming in drawn up activities and activity programmes (not legally required) aimed at the amelioration of the identified situation. Activities comprise those by different administrative levels as well as by commercial and private organisations.

The overview of exiting approaches to the creation of response indicators in the following working periods of ESPON Hazards will serve as basis for the development of risk oriented response indicators. This includes first of all the advancement of proposed indicators towards a Europe-wide applicable list of response indicators partly complementing the unfinished DPSIR chains. For this reason the presented indicators will be deeper analysed and most appropriate may be sized to form a part of the final indicator list.

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Not published information

Bullin, Christina: originally in charge of the UNDP indicator list: email conversation August 2003

Table 39 Draft indicators for measuring risk reduction efforts (for better quality of this table please see separate pdf file: ESPON 1.3.1_1.5.2_UNDP_indicators)

Draft Indicators for Measuring Risk Reduction Efforts (ZENEB 2002, p. 32ff)															
Indicators*		Sources of information*	Relevance of Indicators for Each Hazard Theme Draft Indicators, Core Aspects												
			Volcanic eruptions*	Floods*	Land slides /Avalanches	Earthquakes *	Droughts*	Forest fires	Storms*	Extreme precipitation	Extreme temperatures	nuclear power	hazardous production	hazardous/nuclear waste	marine transport
A. Government commitment to risk reduction and institutional structure															
1. Shift in government's approach from disaster response to disaster risk management focusing on risk reduction															
1.1 A total risk management national policy and regulatory framework is in force, covering mitigation and prevention, preparedness and recovery	policy		x	x	x	x	x	x	x	x	x	x	x	x	x
1.2 National structure for disaster risk reduction	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
1.3 % of national budget for disaster risk reduction	financing		x	x	x	x	x	x	x	x	x	x	x	x	x
1.4 Participation in regional co-operation (institutions, strategies) on the subject	activities		x	x	x	x	x	x	x	?	?	x	x	x	x
1.5 Economic incentives, tax regulations etc., promoting pro-mitigation behaviour	financing/education		x	x	x	x	x	x	x	?	?	x	x	x	x
1.6 Inclusion of risk reduction measures in recovery process	compliance		x	x	?	x	x	?	x	?	?	?	?	?	?
2. Decentralization of disaster risk reduction and response structures															
2.1 Local authorities charged with local disaster risk management	policy		x	x	x	x	x	x	x	(x)	(x)	o	o	(x)	o
2.2 Existence of trained risk reduction committees at community level	structural		x	x	x	x	x	x	x	(x)	(x)	o	x	x	o
2.3 Allocation of financial resources at municipal, provincial or state level	financing		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
3. Empowerment of national disaster risk reduction and response structures															
3.1 Adequate budget for national structure	financing/structural		x	x	x	x	x	x	x	x	x	x	x	x	x
3.2 Existence of staff experienced in disaster risk reduction	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
B. Risk identification															
4. Availability of risk identification information															
4.1 Magnitude, frequency, duration, location, timing and probability of occurrence of all major hazards affecting the country being established on a sound scientific basis	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.2 Elements at risk (population, infrastructure, socio-economically important activities) inventoried	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.3 Vulnerability of the major categories of elements exposed to each hazard assessed to obtain a systematic, transparent, comprehensive and geographically specific assessment of risk	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.4 Disaster costs and losses systematically reported and logged in a national disaster event database conforming to international standards	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.5 Availability of local risk information as basis for mitigation measures	planning		x	x	x	x		x	x	(x)	(x)	(x)	x	x	(x)
C. Risk prevention and mitigation															
5. Adequate land-use planning															
5.1 Land-use planning incorporating disaster risk		ICC	x	x	x	x	x	o	x	o	o	o	x	x	0
6. Risk adapted codes, norms and standards															
6.1 Existence and control of codes, norms, standards responding to specific risk															
· Building codes		NCSBCS, UIA,		x	x	x		x	x	(x)	(x)	(x)	x	x	o
· Other infrastructure (roads, bridges, lifelines); etc.	policy / compliance	ICC		x	x	x		x	x	(x)	(x)	(x)	x	x	o
6.2 Retrofitting of infrastructure adapted to risk specific standards (roads, bridges, hospitals etc.)	compliance		x	x	x	x		(x)	x	x	x	(x)	o	o	o
6.3 Compliance with international codes, norms, standards concerning specific risk	compliance			x	x	x		x	x	(x)	(x)	x	x	x	x
7. Hazard prevention measures															
7.1 Construction of hazard control structures (e.g. dikes, retaining walls, lahar deviation structures, well and aqueduct construction, irrigation channels)	activity		x	x	x	x	x	x	x	(x)	(x)	x	(x)	(x)	x
8. Protection and management of natural resources															
8.1 Implementation of water management measures															
· Conservation and increase of water reserves, water demand reduction, recycling and distribution	compliance				o		x	(x)		o	x	o	o	o	o
· Dams, renaturalization of riverbanks and -beds, flooding areas	measures	ICID		x	o			(x)		o	x	o	o	o	o
8.2 % major protected areas of national territory	S	HDR, EVI		x	o		x	o		(x)	(x)	o	o	o	o
8.3 Laws to promote and enforce conservation of national resources in risk areas	policy			x	x		x	x		o	o	(x)	o	x	x
8.4 Trends in deforestation rate	S	HDR, EVI		x	x		x	x		?	?	o	o	o	o
8.5 Trends in land degradation	S	EVI		x	x		x	x		?	(x)	o	o	o	o
8.6 Desertification control techniques	activity	EVI			(x)		x	o		x	x	o	o	o	o
8.7 Incorporate environment impact assessment in projects aimed at building hazard control structures and water-management	compliance		x	x	x	x	x	x	x	o	o	(x)	x	x	(x)
9. Dissemination and availability of disaster risk and risk reduction information															
9.1 Dissemination of national information and experience on risk and risk reduction to raise public awareness	education		x	x	x	x	x	x	x	x	x	x	x	x	x
9.2 Availability of academic education related to risk management	education		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
9.3 Availability of vocational training related to risk management	education		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
9.4 At-risk communities are aware of, and actively managing, risk	S policy/planning		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x
10. Prevention and mitigation projects															
10.1 % of communities at risk covered by prevention and mitigation projects (GO and NGO)	S planning		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x
D. Risk transfer															
11. Insurance mechanisms for public infrastructure and private assets															
11.1 Availability and utilization of disaster risk insurance	transfer		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
11.2 Degree to which individuals and private enterprise exposed to hazards have transferred risks	transfer		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x
12. Other risk-spreading instruments															
12.1 Existence of national safety funds such as catastrophe bonds, weather-indexed hedge funds, compensatory funds, calamity funds	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
12.2 Existence of micro-credit facilities that could be involved in recovery lending	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
12.3 Private banks (including micro-credit institutes) offering loans for disaster risk reduction measures	policy response?		x	x	x	x	x	x	x	x	x	x	x	x	x
12.4 International banks include risk reduction measures in their projects	policy		x	x	x	x	x	x	x	x	x	x	x	x	x
12.5 Existence of seed banks	structural			x	o		x	o		x	x	o	o	o	o
E. Disaster preparedness															
13. Contingency planning															
13.1 Existence and implementation of contingency planning at national level	planning		x	x	(x)	x	x	x	x	x	x	x	x	x	x
13.2 Existence and implementation of contingency planning at local level	planning		x	x	x	x		x	x	(x)	o	x	x	x	(x)
13.3 Coverage of training in first aid or community-based preparedness including	education/financing		x	x	x	x		x	x	o	o	x	x	x	(x)
14. Forecasting and early warning systems															
14.1 Existence of forecasting systems	planning	WMO/WWW UK IDNDR-Commitee		x	x		x	o	x	x	x	o	o	o	o
14.2 Existence of early warning systems	planning		x	x	x		x	x	x	x	x	x	x	x	x
14.3 Local participation in early warning systems	education		x	x	x		x	x	x	o	o	x	x	x	x
14.4 Seismological network established and working, to monitor seismic activities to elaborate and adjust seismic models and codes	planning					x									
15. Effective emergency response networks (local/national)															
15.1 Effective communication system between response entities	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.2 Public confidence in emergency response structure			x	x	x	x	x	x	x	x	x	x	x	x	x
15.3 Reconstruction plans and arrangements prepared	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.4 Adequate relief capacity can be mobilized in case of likely disaster scenarios	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.5 Existence of safe refuge sites in high risk areas	planning		x	x	x	x		?	x	(x)	(x)	x	x	x	x
F. Political and economic-social context															
16. Good governance to insure effective disaster and risk management															
16.1 Trends in Corruption Perception Index		TI	x	x	x	x	x	x	x	x	x	x	x	x	x
16.2 % of population satisfied with work of government			x	x	x	x	x	x	x	x	x	x	x	x	x
17. Democratization															
17.1 Trends in voter turnout level at elections (%)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
17.2 Trends in press freedom (correct, difficult, very difficult)		RSF	x	x	x	x	x	x	x	x	x	x	x	x	x
17.3 Gender empowerment measure index: GEM-value	education	HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
17.4 Trends in access to information flows (radio, TV, telephones, internet)	educatin	ITU, HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18. Economic-social progress															
18.1 % of total government expenditure invested in education & health	financing	HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.2 Trends in literacy index		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.3 Trends in daily per capita supply of calories/protein		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.4 Poverty reduction measures (combination of trends in share of income or consumption, trends in PI-value and in GDP per capita)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.5 Demographic trends: fertility rate comparison (urbanization)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.6 Trends in % of population with access to safe drinking water			x	x	x	x	x	x	x	x	x	x	x	x	x
18.7 Trends in number of hospital beds in high risk areas			x	x	x	x	x	x	x	x	x	x	x	x	x
19. Income security by diversification															
19.1. Trends in diversification level of income: agriculture, industry and services as % of GDP (see HDR)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
		* information presented in the column derived from the original paper													

Table 40: Proposed response indicators

Lass, W. / Reusswig, F. / Kühn, K.D. - pp. 35-40: Proposed Response Indicators (extract from table, only response indicators)					
Indicator	**Hazard**	**DPSIR**	**Desired final state**	**Remarks** (quoted from original table)	
Size of areas that can be safely flooded	Flood	R	increasing	A lack of safely floodable areas along the upper reaches of the Thine river was identified as a cause of the consequences of the 1993/94 and 1995 Rhine floods; on the other hand, the presence of polders was seen as one of the reasons for the relatively mild consequences of the 1997 Oder flood.	
Quality of early warning systems		R	increasing	In all disasters the time factor plays a decisive role in reduction of damage	structural
Ammount of insured damage as a percentage of total damage	all disasters	R	increasing	Background: growign discripancy between total damage and insured damage. Uninsured damage reduce capability to act and develope (sustanability abjective).	transfer
Quality of structures (as an aid, age of the structures	earth quakes, storms	S/R	increasing	... "Most effective is the disaster preparedness, i.e. the improvement construction quallity and hazard resistance"	
High state expenditures for disaster protection	all disasters	R	increasing	Oriented to: GDP	financing
Quality of technical equipment of aid personel	all disasters	R	increasing		financing
Numbers of helpers in disaster protection	all disasters	R	increasing	Professional and volunteer helpers (not inkluding self-help among the population); It is widely maintained that teh helper-index figure of 1%, which dates from wartime, is no longer adequate; flexible and expandable structures are required	sructural
Degree of co-ordination and co-operation among state and private assistance services	all desasters	R	increasing	... a) co-operation among assistance organisations co-operation between assistance organisations and state emergency response personel c) co-operation with company / plant fire departments ...	structural ?
Sdegree to which population is prepared for disasters (preparedness)	all desasters	R	increasing	Approximation: traningin firs aid	

Table 41: EEA 2002: extract, response indicators only, collated from all tables

		Indicator	DPSIR	ST/MT/LT
	Number of / which (countries that have ratified various protocols LRTAP) How effective is the response (What are the socio-economic implications of measures? Overall policy effectiveness; Efficiency of measures)	(*No specific indicators available*)		
	Policy-effectiveness of measures	APM14 Effect of measures on past trends	R	ST
	What are the projected emissions in 2010?	CC13b Projected emissions of key source sectors (energy, transport, industry, agriculture, waste)	R	ST
	What measures are taken to conserve or restore biodiversity?	BDIV8 Protection of threatened species	R	
		BDIV8a Proportion of globally threatened fauna species protected by European instruments (EC Directives and Bern Convention)		
		BDIV8b Proportion of known species present in Europe protected by European instruments		
		BDIV8c Proportion of species only present in Europe protected by European instruments		
		BDIV8d Progress in implementation of action plans for globally threatened species		
		BDIV8e Funds spent through LIFE Nature projects for species and habitats		
		BDIV9 Restoration	R	MT
		BDIV9a Total area of wetlands (and other ecosystems types) reclaimed by country, biogeographic region, Europe		
		BDIV10 Designated areas	R	ST
		BDIV10a Cumulated area of sites over time under international conventions and initiatives		ST
		BDIV10b Cumulated area of sites proposed over time under EU Directives		ST
		BDIV10c Proportion of sites under EU Directives already protected under national instruments		ST
		BDIV10d Cumulated area of national designated areas over time in Pan-Europe		
	Are these measures effective in reaching the objectives?	BDIV11 Species diversity in designated areas	R	ST
		BDIV11a Bird species distributions and Special Protection Areas (SPAs) coverage		MT
		BDIV11b Range of Species of European Interest or Threatened Species present in designated areas		MT

		BDIV11c Trends of selected species population within and outside designated areas		
		BDIV12 Habitat diversity in designated areas BDIV12a Percentage (in surface area) of Annex I habitat-type included in potential Sites of Community Interest (pSCIs) BDIV12b Change (in surface area) of Annex I habitat-type included in pSCIs BDIV12c Range of Habitats of European Interest present in designated areas	R	ST MT MT
	Transports	BDIV15a Number of individuals per main fauna species group killed on roads per length per year BDIV15b Number of fauna passages per infrastructure length unit BDIV15c Financial investment for fauna passages	 R R	 MT MT
efficient uses of water? Are water prices and water saving technologies used as a tool for water conservation?	Is water pricing used as a tool for more	WQ5 Water prices	R	MT
	Are water conservationtools used?	WQ6 Efficiency of water use	R	MT
		WQ7 Water Leakage	R	MT
How effective are existing policies in reducing loading of nutrients and organic matter?	Is the Urban Waste ater Treatment Directive being implemented in Member States?	WEU16 Urban waste water treatment	R	ST
	Is the Nitrates Directive being implemented in Member States including codes of good agricultural practices and action programmes?	AGRI17 Implementation of Nitrate Directive	R	ST
How effective are existing policies in reducing pollution with hazardous substances?	Are the emissions, discharges and losses of priority hazardous substances ceased or phased out?	*Indicators on Loads of hazardous substances into waters do also include policy evaluation*	R	
How effective are existing policies in improving the ecological quality?		WEC8 Implementation of EU Water Policies	R	MT
		TECO3 Progress in coastal zone management (Integrated Coastal Zone Management)	R	MT
	I.d) How effective are policies aimed at using resources more sustainable?	WMF4 Indicator of "shifting environmental burden" 71		MT
	III.a) Are we improving the recovery of waste?	WMF15 Waste recovery by operation categories and waste stream: Sewage sludge, waste tyres, paper and cardboard, glass, municipal waste and packaging waste		MT/LT
	III.b) Are we disposing waste in a sustainable way?	WMF16 Waste disposal WMF16a Waste disposal (total and by operation categories) WMF16b Waste disposal specific waste streams		MT MT/LT LT

		TEP4 Application of sewage sludge on agricultural land		
	III.c) Are we reducing the environmental pressures from waste recovery and disposal?	CC5j GHG emissions from waste recovery and disposal		LT
		WMF17 Land use associated with waste recovery and disposal WMF17a Land use for landfills		LT LT
		WMF18 Leachate formation from landfills TEP1c Risks of contamination of surface and groundwater from contaminated sites		LT
	III.d) Is the transportation of waste being minimised?	WMF19 Total amount of waste transported for disposal (tonne km)		LT
		WMF20 Transboundary movements of waste WMF20a Transboundary movements of hazardous waste WMF20b Transboundary movements of total waste		MT LT
	III.e) Are the current and future (planned) waste management capacities sufficient?	WMF21 Treatment capacity WMF21a Treatment capacity (amount of waste) WMF21b Treatment capacity number of facilities		LT MT
	III.f) What are the costs and benefits of waste management?	WMF22 Waste management costs per ton by treatment category		LT
	III.g) How effective are policies aimed at managing waste more sustainable?	*Indicator to be defined*		
	How is the size and shape of agriculture developing (including technological advances)?	AGRI12 Area planted with GMO crops		MT
What is the progress in economic integration?	What policy and market incentives are available to encourage environmentally friendly farm management?	AGRI13 Area enrolled in agri-environment schemes		ST
		AGRI14 Organic farming market share		LT
		AGRI15 Environmental elements of CAP spending		ST
What is the progress in management integration?	How widespread is the use of environmental policy measures and farm management knowledge?	AGRI16 Farm management practices		LT
		BDIV13b Agricultural land in designated areas		MT
		AGRI17 Nitrate Directive Implementation		ST

		AGRI11 Use of cross-compliance instrument		MT
		AGRI18 Environmental training of farmers		LT
4. What is the progress in economic integration?	Does Community aid help the sector to restructure?	FISH13 Fleet decommissioning subsidies (compared to Investment/Modernisation subsidies)	R	MT/LT
5. What is the progress in the management of integration environmental policy into fisheries policy	How is restricting catches aiding management of fisheries?	FISH14 Quota/Zone management (R) FISH14a Multi-annual management plans in place (or not) FISH14b International fisheries agreements	R R R	MT LT ST
		FISH15 'Green' fisheries FISH15a Number of fisheries certified under an eco-labelling process FISH15b Products (percentage of) certified under an eco-labelling process	R R R	LT LT LT
	Is the industry complying to the integration of environmental considerations in policy-making?	FISH16 National legislation with specific provision for environmental management of aquaculture	R	LT
What is the progress in economic integration?	Are we moving towards a pricing system that better incorporates environmental costs?	EE28 End-user (Final) energy prices (inclusive of taxes) by economic sector		ST
		EE29 Energy Taxes		ST
		EE30 The external costs of electricity production		ST
		EE31 Energy subsidies by fuel type		ST
		EE32 Energy-related research and development expenditure		ST
	Are we optimising the use of existing transport infrastructure capacity and moving towards a better-balanced intermodal transport system?	TERM19 Investments in transport infrastructure per capita and by mode	D/R	ST
		TERM21Fuel prices and taxes	D/R	ST
		TERM 22Transport taxes and charges	R	ST
		TERM36 Institutional cooperation in transport and environment		ST
		TERM 37 Number of Member States with a national transport and environment monitoring system		ST
		TERM38 Uptake of Strategic Environmental Assessment in the transport sector		ST

		TERM40 Public awareness and behaviour		ST
		TERM26 Internalisation of external costs	R	ST
What is the progress in management integration?	How effectively are environmental management and monitoring tools being used to support policy- and decision-making?	TERM35 Number of Member States that implement an integrated strategy		ST
	Are we optimising the use of existing transport infrastructure capacity and moving towards a better-balanced intermodal transport system?	TERM19 Investments in transport infrastructure per capita and by mode	D/R	ST
		TERM Development of less environmental damaging transport system for tourism travels (services)	R	LT
Are we moving towards a better internalisation of the external costs in the tourism sector?	4.Internalisation of external costs	TOUR11 Tourist tax revenue and environmental expenditure	R	LT
How effective are environmental management and monitoring tools towards a more integrated tourism strategy?	5.1 Tools of industry	TOUR12 Uptake of environmental management systems by tourism companies (EMAS, EIA)	R	LT
		TOUR14 Ecolabels of tourism facilities (% of total)	R	ST
	5.2 Measures of local stakeholders (at destinations)	TE Progress in initiatives implemented by local stakeholders (Integrated Quality Management, Agenda 21, SEA, ICZM; in tourism destinations)	R	MT
	5.3 Sustainable tourism strategies of national authorities	TOUR16 Progress in integration of tourism and environment into national strategies and monitoring systems	R	MT
	5.4 Tools and measures of the EC transversal policies	TOUR17 EU support to sustainable tourism projects	R	MT
		Noncompliance with european standards (page 88)		

Table 42: IADB indicators
Extrachttp://www.iadb.org/int/DRP/ing/Red6/Docs/GTZComponenteIII03-03eng.pdf

Element	Indicator name		Question	**Ranges**	Measurement	
Physical planning and engineering	(C1) Land use planning	planning	Does a land use plan or zoning regulations exist that keeps local production and housing out of hazardous areas?	Their enforcement is:	Low	Low
					---	Medium
					High	High
	(C2) Building codes	policy	Do building codes, design standards, and performance specifications for facilities exist that guarantee the use of hazard resistant methods, techniques and material. building codes?	Percent of buildings in threatened area complying to code/standards	< 30%	Low
					30-70%	Medium
					> 70%	High
	(C3) Retrofitting/ Maintenance	activity/awareness	Are existing infrastructure (e.g. bridges, roads) and buildings (schools, hospitals etc.) retrofitted to withstand natural ha zards (flood proofing, hurricane shutters, roof straps etc.) and/or are regular maintenance works carried out (River dredging, flood canals, etc.)?	Implemented measures:	Many	Low
					Some	Medium
					Few	High
	(C4) Preventive structures	structural	Do hazard exposure- limiting mechanisms/ structures exist (dykes retaining walls, dams, barrages, rock fall barriers, terraces, drainage, windbreaks, water wells, etc.)?	Expected effect on damage:	Low	Low
					Medium	Medium
					High	High
	(C5) Environmental management	activity	Are there activities to promote and enforce conservation of national resources in risk areas (e.g. protection of water reserves and other of natural resources, desertification control techniques, reforestation etc.)?	Number of activities and projects	Many	Low
					Some	Medium
					Few	High

Element	Indicator name		Question	**Ranges**	Measurement	
Societal capacity	(C6) Public awareness programs		Are public awareness programs executed?	Yearly frequency of execution of programs:	Once	Low
		education			Sometimes	Medium
					Regular	High
	(C7) School curricula		Are risk, disaster, environment and development topics part of taught lessons at school?	The topics are taught at:	One grade only	Low
		education			2-3 grades	Medium
					all grades	High
	(C8) Emergency response drills		Is regular (at lest yearly) emergency response training and drills at multiple levels ongoing?	Drills at levels:	One level only	Low
		education			2 levels	Medium
					All levels	High
	(C9) Public participation		Is the public represented as member in the risk management/emergency committee?	Composition of management/emergency committee:	One level only (administration)	Low
		?			2 levels	Medium
					Mix of 3 levels	High
	(C10) Local risk management/ emergency groups		Do local groups exist, that have organized members with specific tasks (e.g. emergency response)?	% of villages at risk with local emergency group	< 30	Low
		structural			30 - 60	Medium
					> 60	High
Economic capacity	(C11) Local emergency funds		Does a local fund for emergency exist?	Fund as % of local budget:	<0.1	Low
		structural			0.1 – 0.5	Medium
					> 0.5	High
	(C12) Access to national emergency funds		Is there access to a national emergency fund?	How fast can it be released/received	> 7 days	Low
		structural /financing			3-Jul	Medium
					< 3 days	High
	(C13) Access to intl. emergency funds		Is there access to international eme rgency funds?	Access to funds is:	Difficult	Low
		structural			------	Medium
					Easy	High

Element	Indicator name		Question	**Ranges**	Measurement	
	(C14) Insurance market	transfer	Is disaster risk insurance coverage for buildings available?	The use is:	Not common	Low
					------	Medium
					Common	High
	(C15) Mitigation loans	financing	Do private banks (including micro-credit institutes) or the government offer loans or subsidies for disaster risk reduction measures (relocation, retrofitting, protective structures etc.)?	The use is:	Not common	Low
					------	Medium
					Common	High
	(C16) Reconstruction loans	financing	Are there reconstruction credits for affected households?		With collateral	Low
					------	Medium
					Without collateral	High
	(C17) Public works	structural	Do local public works programs (e.g. food for work) exist to support risks reducing measures (retrofitting, preventive structures, reconstruction)?	Their magnitude is:	Low	Low
					Medium	Medium
					High	High
Management and institutional capacity	(C18) Risk management/emergency committee	structural	Does a community risk management or emergency committee exist, that deals with prevention, mitigation, preparedness and response	Meeting frequency	Only during emergency	Low
					Once in a year	Medium
					at least quarterly	High
	(C19) Risk map	planning	Is there a worked out and circulated emergency plan?	The map is available at different levels: (see (C9) for levels)	Only at level 1	Low
					Also at level 2	Medium
					Also at level 3	High
	(C20) Emergency plan	planning	Is there a worked out and circulated emergency plan?	Availability of copies at different levels: (see (C9) for levels)	Only at level 1	Low
					Also at level 2	Medium
					Also at level 3	High

Element	Indicator name		Question	**Ranges**	Measurement	
	(C21) Early warning system		Is an early warning system in place?	Does it work?	Low	Low
		planning			Medium	Medium
					High	High
	(C22) Institutional capacity building		Do local institutions (administration, police, fire brigade, hospitals, building sector) receive training on risk management?	Frequency:	Sometimes	Low
		education			Often	Medium
					Constant	High
	(C23) Communication		Is there coordination with national level risk management organizations (national committees, government etc.)?	Within a year there is communication:	Seldom (< 5 calls or meetings)	Low
		structural			Sometimes (5 – 10 calls or meetings)	Medium
					Often and regular (> =once a month)	High

2. DRAFT GUIDELINES ON SPATIAL PLANNING FOR HAZARD RISK REDUCTION

2.1 Introduction

The purpose of this chapter is to provide a draft outline of spatial planning guidelines for risk reduction within the framework of the ESPON 1.3.1. “Hazards” project. The focus is on how spatial planning can contribute to risk reduction in the face of natural and technological hazards. These draft guidelines shall be further developed in conjunction with the case studies (see chapter 1.5.1) in order to test the practicability of the guidelines against the background of well-known circumstances within these areas.

Risk reduction may be defined as the “consequence of adjustment policies which intensify efforts to lower the potential for loss from future environmentally extreme events.” (Mileti, et al. 1981; Nigg and Mileti. 2002).[2] Such adjustment policies may refer to a broad range of guidelines, legislation and plans which help either to minimize damage potential, i.e. exposure to a hazard or to maximize coping capacity of a region or community through, for instance, guaranteeing resources and preparing adequate plans for pre-disaster mitigation and post-disaster response measures. Risk reduction involves both policy/regulatory issues and planning practices. In other words, risk reduction – as defined above – is the result of what has earlier been defined as *risk management related response* (prevention orientated mitigation, non-structural mitigation, structural mitigation, and reaction).

Risk reduction is an integrated effort with various social, economic, political and spatial aspects. Spatial planning practices and land use patterns reflect the broader social context in which they are embedded. Thus, spatial planning can be seen as a manifestation of prevailing attitudes and institutional commitments towards hazards. Understanding spatial planning in context implies a variety of spatial planning responses. The multiplicity of spatial planning agents, planning systems in Europe on horizontal and vertical dimensions at the same time, and different hazards, provides a whole range of different ‘matches’ between specific planning systems and hazards. This multiplicity is a challenge for any attempt at developing guidelines for planning for risk reduction. This points to a need for planning responses that take into account the different European national planning systems, the different planning levels and specific hazards.

The chapter opens with a discussion on the need for an integrated approach in risk reduction efforts across spatial scales and societal sectors. Second, European planning systems are discussed, with respect to their different institutional capacities, especially regarding the regional planning level, which has been identified as the most important level of a spatial planning response towards hazards. Third, the importance of the local land-use planning level for risk reduction will be discussed. Fourth, the contribution of spatial planning to different risk reduction strategies is addressed. This is done through the DPSIR indicator framework, presenting specific risk reduction concerns related to different phases of the disaster cycle (e.g. pre-event mitigation and post-event response & recovery). Further, the linkages between case studies and the guidelines are discussed. The case studies serve to demonstrate how regional planning organizations with their particular institutional settings address specific hazards. Fifth, the limitations of spatial planning in relation to hazards are considered. Finally, a framework is developed where the respective contribution of spatial planning measures

[2] Note: This definition applies to both natural and technological hazards. “Environmentally extreme events” do not depend on the causes of the event but, rather, their consequences.

towards different hazards are presented. This framework will be further used as a matrix for sorting the experiences and information of the case studies within the project. In the end, some ideas for further development towards local land use planning guidelines are presented.

2.2 An integrated approach to risk reduction

2.2.1 Integration across multiple scales of spatial planning

Since the European Union lacks competences in spatial planning, no overarching European legislation exists for spatial planning in general and in relation to natural and technological hazards. Instead, spatial planning in the EU context is seen as a task for increasing coordination and cooperation. This goal is reflected in the European Spatial Development Perspective (ESDP), drafted in 1999, which aims at *balanced and sustainable spatial development* in the European territory. Sustainable development refers to the aspirations of reconciling the goals of economic development and environmental quality. The ESDP remains a framework for Member States, regional and local authorities and the European Commission in their own respective shares of responsibility.

The ESDP calls for an integrated spatial development approach, including horizontal co-operation between administrative sectors and vertical co-operation between different levels (European, national, regional, local) of government (ESDP 1999, 35). From an EU point of view, transnational co-operation is, evidently, a key dimension, which has become central with the process of European unification. In this respect, the ESPON programme, being directly linked to the development of the ESDP, plays a role in instigating European-level criteria and guidelines for good spatial planning practices. Also in its policy options, the ESDP favours a non-hierarchical approach, mentioning urban regional networks and partnerships between public and private actors as important forms of governance.

The discrepancies between areas exposed to hazards (e.g. flood plain areas or transnational areas exposed to possible breakdowns in industrial processes) and legislative and administrative jurisdictions point to the need for going beyond territorially based, hierarchical forms of governance. The integration of spatial planning and policy at different spatial scales – something akin to the notion of *multilevel governance*[3] – can be taken as one starting point for integrating policies and planning for the purposes of risk reduction in complex, multi-agent settings. This should not mean, however, that more traditional forms of regulation (command and control) are totally obsolete. On the contrary, instruments such as legally binding regional plans or land use plans are important in risk reduction. It may well be argued that hazards, due to their nature as constraints to development, require clear regulatory measures. It should also be noted that the ESDP deals with hazards only in a limited and non-systematic manner.

Integration and cooperation across scales helps address the problem of compatibility between the scope of the hazards (e.g. flood plains) and the institutional arrangements (e.g. regional planning authorities) responsible for their management. According to Meadowcroft (2002),

[3] Multi-level governance refers to negotiated, non-hierarchical exchanges between institutions at the transnational, national, regional and local levels. Taken one step further, the definition could […] denote relationships between governance processes at these different levels. Thus, multi-level governance refers not just to negotiated relationships between institutions at different institutional levels but to a vertical 'layering' of governance processes at these different levels. Peters, G.B., and Pierre, J. 2001. Developments in intergovernmental relations: towards multi-level governance. *Policy & Politics*. 29(2): 131-135.

"There are many inconsistencies in this formal hierarchy of scale. [...] And territorially rooted institutions are constantly being stretched to engage with issues which escape their jurisdiction or infiltrate their frontiers." The problem of scale will be further discussed together with the problems of "fit" and "interplay" in subchapter 2.6.

Despite the fact that the European territory is emerging as a space for strategic planning with a spatial planning policy community and diffusing principles of spatial development across Europe (Albrechts, et al. 2003), spatial planning remains a national and sub-national level practice. This means that spatial planning legislation is found predominantly at the state/provincial level, and varies from country to country. Hence, spatial planning for risk reduction relies on national and sub-national actors – and their cooperation with each other. (See the discussion on different European planning systems under subchapter 2.7.1)

The coherence between policies, plans and practices is a crucial determinant for the success of risk reduction. According to the UNISDR (2002) principles regarding land use management and urban planning for risk reduction, national level policies should provide a clear legal and structural framework that would find a spatial expression through planning at lower spatial levels. First, the sectoral national policies should be tied down to territorial (regional) jurisdictions and administrative frameworks. Second, regional (e.g. metropolitan) strategic plans should be formulated for sustainable development. Third, at the municipal level, municipal ordinances and regulatory plans and building codes should define local land use management practices. Finally, at the neighbourhood/community level, management plans should encourage participatory management of community works and urban projects. Finally mechanisms of control should be installed to ensure an adequate contribution of all parties to risk management.

2.2.2 Integration of legal, technical, social and political dimensions in planning

In addition to spatial scales, successful risk reduction operates across different institutions (as it may involve legislation, education, economic incentives, media attention etc.) and between different actors. Spatial planning is situated in a broader social context that includes legal, technical, social and political structures. First, planning is linked with regulatory elements such as laws, decrees, ordinances and other regulations adopted by national, regional and local governments and authorities. Second, the technical and instrumental dimension includes planning tools and instruments that regulate uses of land and strive for the best balance between private interests and the public good. Third, the social and institutional dimension includes those mechanisms that include stakeholder participation in land use management practices, such as consultations, public hearings etc. The better the integration of these elements is, the better the institutional capacity of planning in the face of hazards and disasters.

Recent paradigms in risk management call for stakeholder participation early in the risk analysis process aimed at eliciting the "values" and the perspectives of the community so that the multiple dimensions of risk can be taken into account early on in the assessment (Amendola. 2002). Similarly, participatory planning at municipal and regional levels helps integrate views and concerns of different stakeholder groups and networks into the planning process (Innes and Booher. 2000). Participation promotes inter-organisational learning that is an important element building local resilience against disasters. Furthermore, an open and participatory approach is compatible with the precautionary principle, on which the EU health and environmental policies are based.

Ideally, a clear legal and regulatory framework defines the competencies of the various stakeholders and the "rules of the game", including the role of each actor in the various stages of planning. Further, different agencies and stakeholders should have sufficient resources (e.g. expertise, experience, information, financial resources, and material resources). Access to sufficient information on issues pertaining to land use planning is an important aspect of transparent and participatory planning for risk reduction. Such information includes regulatory plans, land and property markets, and public and private investment projects.

Implementing risk reduction, then, consists of both; 1) policies, regulatory frameworks and administrative tools; and 2) goal-oriented planning and design considerations. The former provides the operating context for planning. Since policies are subject to contention and political struggles, coherence between spatial scales and different societal dimensions is important. According to Prater and Lindell (2000), hazard mitigation policies may be effective if their implementation includes the following:

1. Clear and consistent enabling legislation
2. Sound causal theory behind policy
3. Assignment of implementation to sympathetic agencies with sufficient resources to implement the policy
4. Skilful leadership of the implementing agencies
5. Active support by constituency groups and key governmental actors
6. Stable political and social environment

In the following, we will turn to a crucial and specific part of risk reduction, namely regional planning. Planning, at the regional and municipal levels should be seen as a key element in hazard avoidance and risk reduction.

2.3 The regional level and spatial planning responses to hazards

In terms of institutional vulnerability and coping capacity, the role of spatial planning is a central concern for the ESPON project. Planning can be seen as a crucial factor in reducing losses from disasters. The setting up of guidelines for a spatial planning response to technical and natural hazards focuses on the regional level. This has two reasons:

- First it has to be recognised that spatial planning acts on different spatial levels. Therefore, the appropriate level of space related risk planning has to be addressed by planners and planning instruments. For natural and technological hazards the most important level is the regional level because the local/municipal level is too small in scale for appropriate risk reduction planning, mainly because of the existence of individual local interests.
- Second, although European planning systems differ significantly from country to country, on the local level of land-use planning the differences are moderate as zoning[4] exists in almost every European country (except for Great Britain). Therefore, guidelines for the local planning level will presumably be almost similar all over Europe. But when it comes to the regional level, there exists a wide variety of regional planning in terms of coordination and integration of regional planning policies. Because of the differences of regional planning systems, it will probably not be

[4] Zoning is the local governments' tool that regulates land-use, promotes orderly growth, and protects existing property owners by ensuring a convenient, attractive and functional community. Zoning is the way the local governments control the physical development of land and the kinds of uses to which each individual property may be put (see definition of land use planning in chapter 1.5.1.1).

possible to find a planning response that is suitable for all countries at the same time as can be seen in chapter 1.5.3.

For these reasons there is a need to identify categories of regional planning systems. This is also necessary for assessing the transferability of instruments and indicators. In the end the selected indicators of risk and risk reduction, respectively, must be adequate for and applicable to existing regional planning systems, regional plans and risk plans.

A related aspect refers to the different planning cultures in Europe, and the whole legal framework, as this determines what planning is meant to do and what it can achieve. The following sub-section therefore deals with the differences of the planning systems in the different European countries in view of their relevance for the spatial planning response to hazards and risks.

2.3.1 Classification of regional planning systems in Europe

The EU member states can be grouped into three categories referring to the degree of coordination and integration of regional planning policies (Greiving and Kemper 1999):

- *Category A:* Countries with institutionalised regional planning that includes binding regional plans or other forms of binding effects.
- *Category B:* Countries with institutionalised regional planning but without binding effects.
- *Category C:* Countries without regional planning and/or regional plans, with coordination taking place just at the regional level.

This categorisation can be extended to the EU 27+ countries. The following table classifies the regional planning of European countries.

Table 43: Classification of regional planning in Europe
Source: Greiving and Kemper 1999, pp. 30 f.; VASAB 2000, ESPON Hazards 2003

Category	Countries
Category A *(Countries with institutionalised regional planning that includes binding regional plans or other forms of binding effects)*	Austria, Belgium, Denmark, Finland, Germany, Italy, Luxembourg, Netherlands, Spain, Sweden, ...
Category B *(Countries with institutionalised regional planning but without binding effects)*	Ireland, Portugal, United Kingdom, ...
Category C *(Countries without regional planning and/or regional plans, with coordination taking place just at the regional level)*	France, Greece, ...

This shows that all member states have a tier of regional planning, but many have a second tier of sub-regional planning, such as Austria, Belgium, France, Germany, Italy, Luxembourg, Portugal, Spain, Sweden and the United Kingdom.

2.3.2 Typology of regional authorities in Europe

The following table presents an overview of the organisation of the regional administration and regional planning in EU member states. The term "regional" in this case refers generally to sub national spatial entities at different administrative (e.g. NUTS) levels.

Table 44: Typology of regional authorities. (Source: Greiving and Kemper 1999, p. 14)

Type of region	Description	Responsible for regional planning
Type 1 *(Regions with wide ranging powers)*	– Elected regional parliament – Right to levy taxes – Budgetary power – Legislative power	– Belgian regions (NUTS 1) – German states (Länder) (NUTS 1)
Type 2 *(Regions with advanced powers)*	– Elected regional parliament – Limited right to levy taxes – Limited budgetary power – Legislative power	– Italian regions (NUTS 2) – Spanish autonomous communities (NUTS 2)
Type 3 *(Regions with limited powers)*	– Elected regional parliament – Limited right to levy taxes – Limited budgetary powers – Substantial financial transfers from central government	– Danish regions (NUTS 3) – Dutch provinces (NUTS 2) – French regions (NUTS 2) – Italian provinces (NUTS 3) – Scotland and Wales (NUTS 1) – Specific German regions (NUTS 3) –
Type 4 *(Regions with no powers)*	– No elected regional parliament – No right to levy taxes – No budgetary power – No legislative power – Substantial financial resources transferred by central government	– Austrian districts (NUTS 3) – Belgian provinces (NUTS 2) – English counties and regional offices and Northern Ireland (NUTS 2) – Finnish regions (NUTS 3) – French departments (NUTS 3) – German regions (mostly NUTS 2) – Greek regions (NUTS 2) – Irish counties (NUTS 4) – Luxemburg regions and sub-regional level (NUTS 4) – Portuguese regions and sub-regions (NUTS 2) – Spain second regional level (Provincias) (NUTS 3) – Swedish regions and sub-regional level (NUTS 3)

Some anomalies regarding the size of regions in the different countries of the EU are interesting (and inevitable) here. For instance, some municipalities in Finnish Lapland are many times larger (in square kilometres, although much tinier in population) than Luxemburg. They also have elected councils, powers to levy taxes, and binding land-use instruments – i.e. important in planning for risk management.

2.4. The local level and spatial planning responses to hazards

The notion (or paradigm) of *disaster resilient communities* has become widespread in the research on natural and technological hazards. The disaster resilient or resistant communities approach stresses a shift away from emergency response to preventive mitigation measures. (Britton and Clark. 2000; Geis. 2000). According to Burby et al. (2000), land-use plans can be seen as statements of community goals, principles and actions. Integrating hazards into land-use planning can help a community through:

- Intelligence about long-term (and unpredictable) threats,
- Problem-solving to cope with immediate threats prior to, during & after disaster,
- Advance planning to avoid or mitigate damage from a future disaster event,
- Management strategies to implement plans through policies.

Burby et al. (2000) stress the importance of participatory practice in planning for hazard resilience. This has many simultaneous benefits such as stronger commitment to jointly agreed planning measures, the horizontal and vertical integration of a community (building social capital and concrete response networks), and better public awareness of hazards.

A starting point for a scheme on *planning-relevant coping capacity* could be the observation by Smith (1992, 97), on the main limitations to land-use planning as a means of reducing vulnerability. The following factors limit the capacity of land use planning in risk reduction:

1. *Lack of knowledge about hazards*

Lack of knowledge about the type, location, recurrence interval and hazard potential of events that might affect specific areas.

2. *Costs of mitigation and hazard mapping*

Mitigation measures may be costly, just as costs of hazard mapping, including detailed inventories of existing land use, structures, occupancy levels etc.

3. *Existing saturated & extensive development*

Presence of extensive existing development does not allow "room for manoeuvre" for land-use planning. Damage potentials are difficult to alter in such a situation.

4. *Declining awareness of hazards*

Infrequency of most disaster events and the difficulty of maintaining community awareness and avoidance of hazard-prone land. Measures developing public awareness (e.g. awareness raising campaigns, education) and an "institutional memory" of local and regional risks helps counterbalance the normal tendency to rely on routine activities instead of expecting extreme events.

5. *Social conflict & weak land use controls*

Social, economic and political resistance to land use controls weaken the possibilities for effective planning. The legitimacy of local and regional governance is a key factor here. Key conflict dimensions may be found in the tensions or vested interests, that can occur between government and private interests or national and local interests.

Linked to social conflict, competition between actors may also hinder land use controls. Thus, a sixth point may be added to the above list of Burby et al.:

6. *Competition between municipalities for investments and tax revenues*

Competition between the municipalities often prevents "wise" land use decisions for the benefit of mainly economically founded decisions in hope for the creation of jobs and rising tax revenues.

In other words, for land-use planning to be helpful as a coping strategy, regions and communities require 1) knowledge on hazards, 2) monetary & other resources, 3) open space for flexible planning, 4) public awareness of hazards and 5) legitimacy of the planning system, mutual trust/capacity to co-operate and 6) hyper-municipal control mechanisms to ensure "risk management solidarity". The lack of these elements constitutes vulnerability while their existence in a region constitutes coping capacity and resilience.

Table 45: Coping capacity relevant to land-use planning (tentative)
Source: ESPON Hazards 2003

Coping/ resilience component	Operationalisation	Main issues	Possible indicators
1. Knowledge	Mainly qualitative	What knowledge of hazards exists? Is this sufficient? [Note: this is also a challenge for the ESPON 1.3.1. project]	Integration of hazards into plans, existence of local hazard assessments, existence of hazards related studies/research, existence of hazards related research or monitoring institutes
2. Monetary resources	Quantifiable	How much resources are available for mitigation efforts? How are resources distributed? (social vulnerability)	Resources allocated to mitigation and contingency planning. Background indicators: GDP/capita, inequality of income distribution, unemployment rate
3. Open space	Quantifiable	Is there space available for hazard-sensitive planning? [Note: areas with higher damage potential may have fewer benefits from spatial planning measures.]	Existence and extent of deliberately undeveloped space in the region. Possible background indicators: Population density, infrastructure density (built space/ total area), land cover indicators
4. Awareness	Mainly qualitative	Are the local people aware of hazards?	Existence of awareness programmes, media attention, level of education, GDP spent on education (?), environmental awareness indicators, existence of environmental NGOs & other organisations
5. Planning capacity	Mainly qualitative	How effective is planning? Are people committed to it? Are plans disputed? Are there powerful actors (e.g. developers) who neglect planning?	Level of participation in planning, existence of unplanned/ unauthorized development, degree of local autonomy in planning in relation to national guidelines/ hazard mitigation plans

A crucial aspect here is that the local vulnerabilities and responses to different hazards may come in very different constellations. The table presented above does not reflect the differences between hazards even if the elements listed are not hazard-specific.

It serves to note that areas with high damage potential tend to have limited space available for benefiting from land-use planning as a measure for reducing vulnerability. What kind of planning practices are relevant for such locations? This should be looked at in the case study areas.

Here, risk perceptions can be seen as intertwined in the institutions and safety measures taken. Institutional risk perceptions, if realistic and sensitive, add to institutional preparedness. According to some researchers with a social constructionist approach, risk perceptions or expectations are the most important determinants of risk (Nigg & Mileti 2002). In any case, risk perceptions may affect, for instance, the estimations on the probability of an emergency event (such as determining the frequency of a flood: 1/50yrs to 1/1000yrs...). One way to look at risk perceptions might be through European and/or national level surveys on popular risk perceptions and environmental awareness. Based on uniform data across Europe, this can help indicate risk perceptions in different regions, contributing to and indicating (in a rather marginal sense, of course) regional and institutional vulnerability.

2.5 Contribution of spatial planning to risk management for hazards

2.5.1 Linkage to the DPSIR framework

Regarding the concept of **risk management** the discussion made clear that this concept goes beyond the DPSIR framework (driving forces, pressures, state, impact, response) mentioned in the ESPON 1.3.1 tender. Although the DPSIR framework was originally built for reporting on environmental issues (EEA 1999: 6) it can also be applied to spatial risk issues. Therefore it was proposed in the tender that in this ESPON project response indicators (see chapter 1.5.3) would refer to responses by the response network to prevent, compensate, ameliorate or adapt to changes in the state of "spatial security" (the opposite term to "spatial risk") (see figure 9).

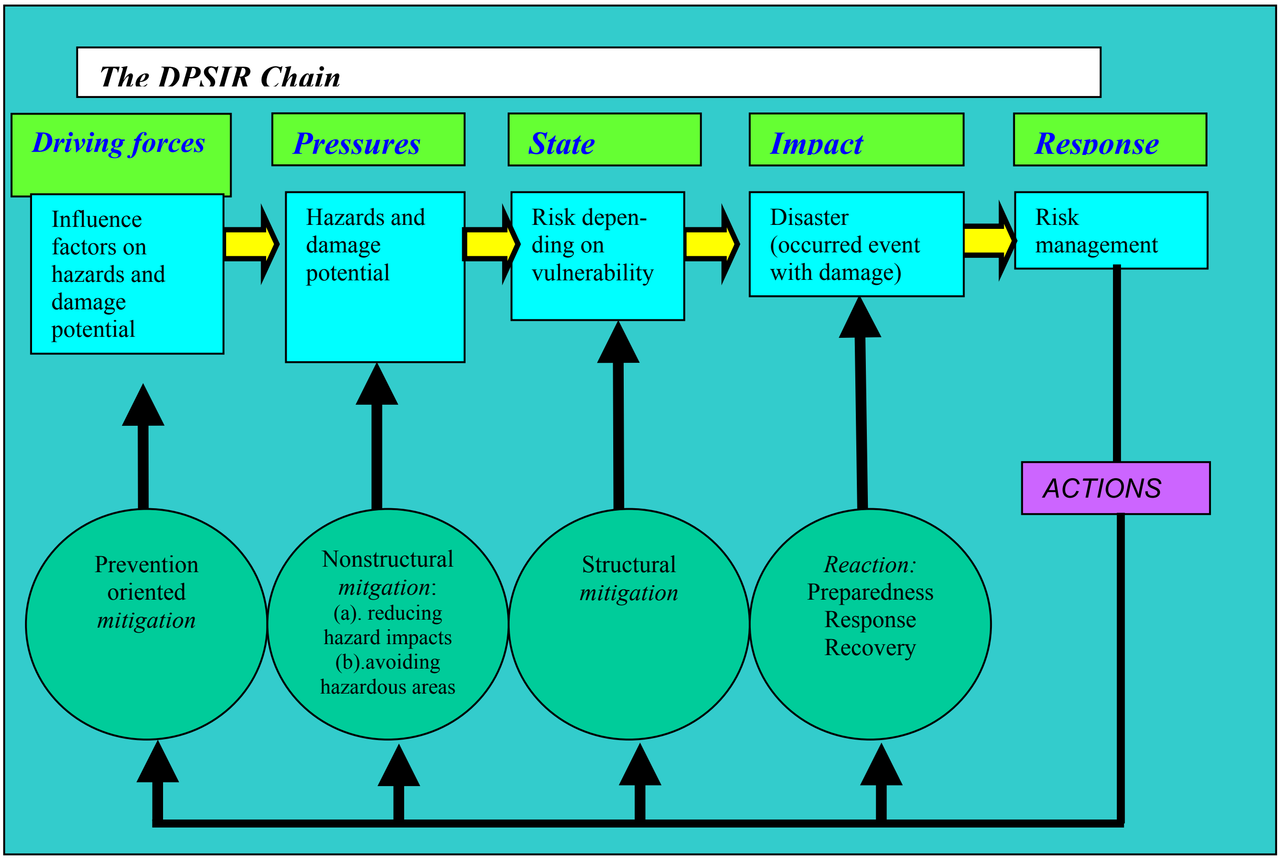

Figure 9: The proposed ESPON Hazards concepts in relation to the DPSIR chain
Source: ESPON Hazards 2003

From the broader viewpoint of risk management this means that the risk management stages of prevention, mitigation, preparedness, response and recovery should be incorporated into the DPSIR chain link of 'response'. At the same time, planning responses can be attributed to the respective risk management strategies. Table 46 (below) differentiates between regional planning, land-use planning and sectoral planning[5]. Further, supporting instruments are mentioned.

[5] 'Sector' in terms of 'sectoral planning' means the spatial planning under consideration of only one planning criteria (e.g. traffic, environmental heritage, etc.). sectoral approaches a (in the ideal case) weighted and combined in the context of comprehensive development planning. Sectoral as well as comprehensive planning can take place a different administrative level.

Table 46: Contribution of spatial oriented planning and supporting instruments to risk management strategies
Source: ESPON Hazards 2003

Risk management strategy *(see glossary for definitions)*	**Regional planning**	**Local Land-use planning**	**Sectoral planning**	**Supporting instruments**
Prevention oriented mitigation *(aims to reduce Driving Forces)*	E.g. planning settlement and transport structures that cause less greenhouse gas emissions,...	...	...	Information management, economic instruments,...
Nonstructural mitigation (a): reducing hazard impacts *(aims to reduce Pressures)*	Maintenance of protective features of the natural environment that absorb or reduce hazard impacts (retention areas, sand dunes)	...	Retention measures,...	Information management,...
Nonstructural mitigation (b): avoiding hazardous areas *(aims to reduce Pressures)*	Designations in regional plans like flood hazard areas	Zoning instruments,...	Hazard maps, natural recreation areas, adequate allocation of threatended infrastrucure,...	Interregional co-operation; economic instruments; information management,...
Structural mitigation *(aims to reduce the state of risk)*	Secure the availability of space for protective infrastructure,...	Prevention measures as a part of building permissions,...	Engineering design, Protective infrastructure (shoreline dams,...)	...
Reaction: preparedness, response, recovery *(aims to reduce Impacts)*	...	Rebuilding planning,...	Emergency plans, e. g. SEVESO II saftey report,...	Public awareness and emergency management,...

This first draft of spatial planning contributions shows that spatial planning instruments have to be applied in close relationship with each other and that they have to be supported by additional instruments.

The final spatial planning guidelines will distinguish between "general responses" that are relevant for all hazards (and planning systems) as presented in chapter 1.5.3, and specific ones which apply only to some or single hazards. The proposal and evaluation of such general and specific planning responses belong to the final results and therefore will be presented at a later stage of the project. Nevertheless, a methodology for structuring and evaluating spatial planning responses on different spatial levels, different planning systems and different natural and technological hazards has already been developed. This procedure is portrayed in part 2.7.1.

2.5.2 Linkage to the case studies: Regional coping capacity and regional planning

This sub-section shows how the results of the case studies flow into the projects' planning guidelines. The input from the case studies mainly refers to the following points:

1. *Examples of regional risk reduction measures:* The case studies can provide the project with examples of how regional authorities deal with hazards, which instruments they use and especially which measures were chosen to reduce the risk towards natural and technological hazards (in general and concerning specific hazards).

2. *Identification of institutional vulnerability:* In the context of the ESPON 1.3.1 project, the notions of *response networks* and *regional coping capacity* have been used to refer to the resilience of a region against hazards. The notion of response networks (see tender & 1st interim report) points to the different, multiscale and intersectoral networks that are in place in a specific region to reduce risks from natural and technological hazards. Regional resilience is greatly affected by the extent to which organisations interact and network with one another to mount a coordinated regional-level reponse to disaster (cf. Nigg & Mileti 2002, 283).[6] *Institutional vulnerability* can be studied through the case studies, which then provide a clearer picture of the above factors and their interlinkages at regional/local levels. On the basis of the framework developed for the local level (see table 45), specific questions can be formulated for the case studies also on the regional level. A common framework for the project has been developed, since different partners will be dealing with different case study areas (see chapter 1.5).

To sum up, the case studies provide important information on the problems of fit, interplay and scale (see part 2.6). First, they point to issues that can be dealt with at the regional or local level – or need to be dealt with at a larger scale, e.g. national or transnational. Second, the cases highlight the interaction between planning its regulatory/policy context (can deficient policy lead to successful planning?) and provide useful knowledge on where there is room for improvement. Third, they also point to the limits of regional planning as a tool for risk reduction. Finally, the case studies provide a compilation of useful concrete instruments and indicators for risk reduction management shall be derived. These should be studied at both policy and planning levels.

2.6 Limits of spatial planning in regard to risk management

The analysis of spatial planning measures is likely to reveal that spatial planning is not the only field of action to reduce spatial risks. This is rooted in the fact that there are (a) general limits to spatial planning and (b) specific limits concerning the spatial planning response in risk management (e.g. many other actors who are responsible for risk reducing measures). So the main questions here are: What is possible? Where are the limits for spatial planning? The main problems might be:

- Planning authorities often do not cover the spatial area that would be necessary from a geophysical point of view (e.g. administrative borders vs. river catchments).
- The main share of risk reduction planning and strategies is covered by sectoral planning not being sufficiently integrated in the process of comprehensive spatial planning. At the European level this meets the problem of incongruence of different planning (or administration) systems.
- It is problematic to transfer a measure designed for a certain spatial level to another spatial level. Also, the horizontal transfer from one region to another region is likely to be difficult due to specific regional characteristics.

[6] According to Nigg & Mileti, interorganisational coordination enhances the effectiveness of community-level responses to any disaster. They identify the following contributing factors have been identified, such as 1) consensus of organisations' roles in disaster situations; 2) lines of authority among the different organisations; 3) the number of cooperating organisations can not be too large; 4) organisations perform better if they interact normally, not only in disaster situations; 5) communication between organisations is crucial; and 6) organisations need to relinquish part of their autonomy in disaster situations for flexibility (Nigg & Mileti 2002, 285).

Research on the institutional dimensions of environmental change (and we could add spatial risk here) has identified three "cutting-edge" themes that are known as the problems of fit, interplay, and scale. Young (2002, pp. 19 ff.) gives a closer description:

- *Problem of fit:* The problem of fit deals with congruence or compatibility between ecosystems and institutional arrangements created to manage human activities affecting these systems. Overall, the presumption is that the closer the fit between ecosystems and institutional systems, the better the relevant institutions will perform.
- *Problem of interplay:* Most institutions interact with other similar arrangements both horizontally and vertically. Horizontal interactions occur at the same level of social organisation. Vertical interplay is a result of cross-scale interactions or links involving institutions located at different levels of social organisation. Interplay between or among institutions may take the form of functional interdependencies or arise as a consequence of politics of institutional design and management.
- *Problem of scale:* Scale has to do with the levels at which phenomena occur in the dimensions of space and time. Much work on regimes dealing with common-pool resources, for example, is based on the study of small-scale, typically local arrangements devised to deal with human uses of natural resources. At the same time, many observers have noted the fact that some global systems like the Earth's climate system, also exhibit the defining features of common-pool resources. Therefore it has to be asked whether propositions derived from the study of small-scale systems apply to global common-pool resources as well and vice versa.

The problems of fit, interplay and scale can serve as research guidelines in the context of (planning) institutions and spatial risk to identify the limits that exist for the planning response.

Concerning the *problem of fit*, the ESPON Hazards project faces at least as many fitting problems as the number of hazards that are taken into account. This is due to the fact that each hazard has its own spatial characteristic that is normally not identical with the administrative extent of measures that are generally limited to administrative borders. A strategy to tackle the problem of fit is to adjust the administrative area of influence to the specific planning problem (here: the spatial characteristic of the risk or hazard). An example for this is the EU Water Framework Directive that aims at an integrated river basin management for Europe. But this strategy cannot be extended to every problem because this would lead to a fragmentation of competences that in consequence increases the problem of co-ordination between authorities (problem of interplay). In other words: The more the problem of fit will be reduced, the more the problem of interplay will be increased.

The *problem of interplay* is a consequence of the existence of a multitude of actors. Normally, national planning systems hold a second, sectoral dimension with own organisational units, instruments and authorities. The differences of the material purpose in connection with the different authorities permit hardly any internal harmonisation through a common superior authority. Thus again and again problems of the co-ordination and the sphere of responsibility occur in planning. The relationship between comprehensive spatial planning and sectoral planning divisions is a crucial factor for successful risk reduction strategies. By the way, in contrast to spatial planning, the EC has strong legal competences and hence a great number of powerful directives (SEVESO II; Flora Fauna Habitat, Water Framework Directive) in the field of sectoral planning, especially environmental planning.

The *problem of scale* is significant for the ESPON Hazards project especially in the context of climate change and its influence on natural and technological hazards. Today it is possible to predict future climate change on a large scale (globally) – at least to a certain extent. But detailed predictions are not possible. This concerns particularly the regional and temporal distribution of climate change impacts.

2.7 Challenges and further development

In view of the final results of the ESPON hazards project, this chapter has to be further developed, especially in terms of concrete planning guidelines in general and for certain hazards, planning levels and planning systems (chapter 2.7.1). Finally, there are issues for further consideration (chapter 2.7.2).

2.7.1 Towards specific and general planning guidelines

First it is necessary to identify specific planning responses that aim at the reduction of risks that are related to certain hazards. As hazards differ significantly in their character, each hazard has to be looked at separately. Therefore the following procedure for the identification and evaluation of planning measures is suggested for each hazard. Second, general planning responses will be derived from the specific planning guidelines.

Towards specific planning guidelines for risk reduction of each hazard

The following measures and strategies for a spatial planning contribution to risk management have been identified (with our case studies in chapter 1.5 and with additional literature and maybe even interviews with key persons) for *Hazard X*:

Prevention oriented mitigation

- Measure 1: xxx
- Measure 2: xxx
- Measure 3: xxx

Non-structural mitigation (a): reducing hazard impacts

- Measure 4: xxx
- Measure 5: xxx

Non-structural mitigation (b): avoiding hazardous areas

- Measure 6: xxx
- Measure 7: xxx
- Measure 8: xxx

Structural mitigation

- Measure 9: xxx

Reaction: preparedness, response, recovery

- Measure 10: xxx
- Measure 11: xxx
- Measure 12: xxx
- Measure 13: xxx

The table below shows the spatial planning contribution to risk management for *Hazard X* and indicates their adequacy for the respective level of spatial planning (+ = adequate measure on specific spatial level; o = neutral or no statement possible; - = not suitable on that spatial level).

Table 47: Adequacy of spatial planning measures for risk management of Hazard X on spatial planning levels
Source: ESPON Hazards 2003

	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6	Measure 7	Measure 8	Measure 9	Measure 10	Measure 11	Measure 12	Measure 13
European level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
National level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
Regional level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
Municipal level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-

Towards general planning guidelines for risk reduction

The following table shows a general view of the spatial planning contribution to the different categories of risk management for technological and natural hazards on different planning levels. These measures will be derived from the spatial planning measures for the single hazards.

Table 48: General spatial planning contribution to risk management on different planning levels
Source: ESPON Hazards 2003

	Measure 1	Measure 2	Measure ...	...	...	...	...	...	...	...	...	...	...	...
European level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
National level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
Regional level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-
Municipal level	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-	+/o/-

2.7.2 Issues for further consideration

- A thorough scanning of the ESDP through a risk management perspective could help devise interesting policy recommendations at the EU-level. Thus far, natural hazards are considered under the headings of natural and cultural heritage, not as problem issue of its own, posing limitations to spatial development. An ESDP related discussion should, of course, also draw on other key EU-level documents (e.g. European environmental policy, specific directives such as the SEVESO II directive) and look at them from a spatial perspective.
- Promising new innovations and different tools for risk reduction (DSS, GIS-based, social innovations e.g. participatory measures etc.) should be taken into account.
- Also, national plans for hazard mitigation and their role in local settings should be considered.
- According to the UNISDR principles for land use management for risk reduction, "a decentralised fiscal policy strengthens the capacity of local governments to raise revenue and to consolidate their finances in the interest of effective local administration." Such guidelines are important but they go beyond the scope of spatial planning. The identification of such issues could be analysed as the *context* for regional planning. Many fields of inquiry and practice come close to spatial planning and have effects on it, which need to be taken notice of. For instance, financial mechanisms (taxes, insurance) provide incentives for construction etc. – which may be either congruent or counterproductive in relation to spatial planning.
- Subsidiarity (term defined in chapter 1.5.1.1) is clearly an issue worth discussing. According to Enemark (2001), for instance, land use competencies should rest within the lowest best-suited level of jurisdiction so as to combine responsibility for decision making with accountability for financial and environmental consequences. In other words, against the background of the subsidiarity principle it has to be clarified in which case which spatial/administrative level is the most adequate.
- Similarly, points relating to the political economy of risk reduction, such as questions on whether the instruments used for mitigation should rely on state regulation or the market mechanism, are important to note. What, for instance is the role of "partnerships" between public and private actors – especially land/house owners, enterprises and insurance companies – (embraced by the ESDP), especially the insurance companies, in risk reduction? Here, one should be pragmatic and rely on empirical evidence.
- What are the concrete implications of these guidelines? Should there be benchmarking planning practices for hazards?

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3. ANALYSIS OF EXISTING MONITORING SYSTEMS AND PROPOSALS TO IMPROVE MONITORING SYSTEMS OF HAZARDS

The following chapter analyses existing monitoring systems that are relevant for the 1.3.1 project on a worldwide and/or on a pan-European basis. There are many more monitoring systems than those described in this article, but national, local or regional monitoring systems are not discussed in this chapter because their focused territory is too narrow. Also, many monitoring systems are especially designed for regional or local characteristics and could not cover a heterogenic territory as that of EU 27+2. A selection of links to some interesting monitoring systems outside of the EU or on regional levels is given at the end of the chapter. For "good practice" examples of monitoring systems and/or planning response concepts to hazards on local and regional levels please see the chapter 1.5.1 *Conclusions from case study reports.*

Monitoring is an important tool for the early detection of natural and technological hazards impact on the built up environment and humans. It thus has a major role in the prevention or minimisation of damage or the detection of improvement in damage prevention. A monitoring system assists in the early detection of potential negative impacts in case hazards turned into an accident or catastrophe. Thus, monitoring systems can help to reduce the costs of reaching and maintaining a given level safety, protection and quality. Monitoring systems may also be used to evaluate the outcome of environmental policies, to assist in the development of strategies for hazard prevention and management. They can also serve as research platforms for the development of analytical methods and models on hazards and hazardous processes. The range of purposes for which monitoring systems can be designed encompasses such a vast range of time scales, variables and processes that it is not possible to give specific guidance on the design of a monitoring system to meet all the objectives that have to be respected. The design of monitoring systems should be made from a consideration of the specific objectives of the particular hazard to be monitored.

A general question is what kind of monitoring systems are useful on a European scale and which one's are rather useful on local or regional scales. Some issues like, e.g. nuclear power plants, should be assessed and controlled on a EU wide and even international level in order to reach high common standards on safety and ensure transparency. But it may be doubted if it is necessary to have a pan-European monitoring system on landslides. Landslides depend very much on the local geology and the local climate and it is therefore recommendable that this issue should be monitored on a regional or local scale.

The role of the EU Commission regarding the set up and the scaling of monitoring systems on hazards could be to initiate and ensure that appropriate monitoring systems are installed. EU funding sources can be used as a tool to ensure appropriate installation of monitoring systems.

The following table shall give an input for discussion on the type of hazards and proposed scales of monitoring systems.

Table 49: Proposed scale of monitoring systems
Source: Espon 1.3.1 2003

Natural hazards		Technological hazards	
Hazard	Scale of monitoring system	Hazard	Scale of monitoring system
Volcanic eruptions	European and overregional	Dam failures	Regional and overregional
Floods	Overregional	Hazards from nuclear power plants	European
Landslides / avalanches	Local/regional	Hazards from production plants with hazardous production processes or substances	Overregional and local
Earthquakes	European and overregional	Hazards from hazardous waste deposits, nuclear waste or ore minig stockpiles	Regional and local
Droughts	European and overregional	Hazards from the marine transport of hazardous goods (oil etc.)	European
Forest Fires	European		
Storms	European		
Extreme precipitation (heavy rainfall, hail)	European and local		
Extreme temperatures (heat waves, cold waves)	European and local		

The coverage and the ability to function of monitoring systems also depends on political decisions. In the case of certain hazards, e.g. floods it must first be generally understood and accepted that floods are of cross-border concern, both in terms of causes and impacts. It is doubtful if a monitoring system can be successfully applied in areas where the cooperation stops at national or county borders. In the case of floods it would be necessary to install cross-border cooperation reaching from planning over protective measures to early warning systems. Also, plans on concerted help and alleviation in case of a catastrophe could be part of such a monitoring system.

3.1 Analysis of some existing monitoring systems

The only global monitoring system on a natural hazard that is currently installed is the **Global Fire Monitoring Centre (GFMC).** The GMFC is an early warning, monitoring and general information system that supports national and international agencies involved in land-use planning, disaster management or in other fire-related tasks and can utilize this information for planning and decision making. The GFMC fire documentation, information and monitoring system is accessible through its Internet website: http://www.fire.uni-freiburg.de/

A very good example of an over regional monitoring programme in a similar climatological environment is the **Arctic Monitoring and Assessment Programme (AMAP).** The primary objectives of AMAP are to provide reliable and sufficient information on the status of, and threats to, the Arctic environment, and to provide scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants. AMAP measures the level, and assesses the effects of anthropogenic pollutants in all compartments of the Arctic environment, including humans. It documents trends of pollution and sources and pathways of pollutants. It examines the impact of pollution on Arctic flora and fauna, especially those used by indigenous people. Finally, it reports on the state of the Arctic environment and gives advice to Ministers on priority actions needed to improve the Arctic condition. http://www.amap.no/

Another over regional monitoring system in the Artic is the **Northern territorial centre on monitoring of the environment pollution (NRPA).** NRPA's Emergency Unit maps and monitors radioactivity in the environment by analysing samples of fish, soil, vegetation, mushrooms, water and food. The main focus of monitoring is the vulnerable food chain lichen-reindeer-humans. Several studies have been conducted since the 1960's, examining radioactivity in reindeers and the Saami reindeer herders.
http://www.svanhovd.no/engelsk/engelsk.html

For more information on the Arctic, please also see the **Nordic Council: Protection of the Artic Marine Environment (PAME).**
http://www.arctic-council.org/files/inari2002/PAMEattach4.pdf. Among other issues, this document focuses on monitoring hazardous activities, such as artic off shore oil and gas extraction and transport.

An example for an over regional cooperation system that covers more than one specific climatic zone and includes monitoring is **The Helsinki Commission (HELCOM)**. HELCOM works to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental co-operation between Denmark, Estonia, the European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden. HELCOM is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" - more usually known as the Helsinki Convention. http://www.helcom.fi/

3.2 International and/or EU institutions that collect data and perform research on natural and technological hazards and types of accidents, but are not explicitly designated as monitoring systems.

The International Tanker Owners Pollution Federation Limited (ITOPF) is a non-profit making organisation, funded by the vast majority of the world's ship-owners. They devote considerable effort to a wide range of technical services, the most important of which is responding to oil spills. The technical advisers have attended on-site at over 450 spills in more than 85 countries. However, this is mainly a response system that does not even cover all worlds' ship-owners. http://www.itopf.com/index.html

For the chemistry industry there is the **European Process safety Centre (EPSC).** The EPSC is an international industry-funded organization that provides an independent technical focus for process safety in Europe. Its goal is to provide a forum for discussion of best practices on various technical process safety-related topics amongst the members in order to improve the safety record of the European chemical industry. http://www.epsc.org/index.html

Emergency Events Database - EM-DAT. The WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED) maintains the EM-DAT, which was created with the initial support of the WHO and the Belgian Government. The main objective of the database is to serve the purposes of humanitarian action at national and international levels. It is an initiative aimed to rationalise decision making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. For example, it allows on to decide whether floods in a given country are more significant in terms of its human impact than earthquakes or whether a country is more vulnerable than another for computing resources is. EMDAT contains essential core data on the occurrence and effects of over

12,800 mass disasters in the world from 1900 to present. The database is compiled from various sources, including UN agencies, non-governmental organisations, insurance companies, research institutes and press agencies.
http://www.cred.be/emdat/

EUROPEAN COMMISSION, Joint Research Centre, Institute for the Protection and Security of the Citizen, Unit of Technological and Economic Risk Management, **Technological and Economic Risk Management (TERM)**
http://ipsc.jrc.cec.eu.int/TAERM-unit.html

TERM's mission is to contribute to the safety, security and trustworthiness of technological and societal systems by developing innovative methods, tools and strategies for the assessment and management of risk and uncertainty and for supporting decision-making processes. Methods for gathering, assessing and modelling data, information and knowledge are deployed using, in particular, web-based technologies. The main fields of activity are: management of risk for natural and technological hazards; management of emergency situations; use of advanced statistics and computer science for the fight against fraud; strategic decision-making; official statistics, econometrics and policy performance indicators

The most important TERM sectors regarding this project are summarized below:

- **Major Accident Hazards Bureau (MAHB)**
  Sector Head: J.S. Duffield
  The sector provides scientific and technical support to the implementation and monitoring of the "Seveso II" Directive on major technological hazards; operates the Major Accident Reporting System (MARS), the Community Documentation Centre on Industrial Risks (CDCIR) and the Seveso Plant Information Retrieval System (SPIRS) fulfilling the information exchange obligations towards the Member States. After the recent extension of MARS to OECD and UN/ECE countries, MAHB has become the world centre for major industrial accident reporting and root cause analysis.
  The sector manages the technical working groups providing guidance to the Member States on specific items of the Directive. Sector activities are now being extended to support Candidate Countries. The principal customers are the European Commission and all those concerned with process plant safety including legislative and regulatory aspects.
  Further information: http://mahbsrv.jrc.it/. A major output of MAHB is the **Seveso Directive** http://mahbsrv.jrc.it/Framework-Seveso2-Contents.html.

- Allocated below the MAHB is also the **Major Accidents Reporting System (MARS)**.
  The MARS is a distributed information network, consisting of 15 local databases on a MS-Windows platform in each Member State of the European Union and a central UNIX-based analysis system at the European Commission's Joint Research Centre in Ispra (MAHB) that allows complex text retrieval and pattern analysis http://mahbsrv.jrc.it/mars/Default.html. The EC's accident database MARS is complemented by SPIRS, a distributed database system which was set up in order to provide access to risk related information from major hazardous industrial establishments in Europe for all interested parties http://mahbsrv.jrc.it/spirs/Default.html.

- **Natural Risk**
  Sector Head: A.G. Colombo
  The main task of the sector is to operate the Natural and Environmental Disaster Information Exchange System (NEDIES) project, which is now being extended to support

Candidate Countries. Activities include the preparation of lesson-learnt reports and guidance documents on countermeasures for different disaster types, including some large technological accidents not falling under the Seveso Directive (e.g., train accidents and tunnel accidents).
Further information: http://nedies.jrc.it.

- **Human Factors**
  Sector Head: P.C. Cacciabue
  The sector is involved in the analysis and optimisation of the relationship between people and their activities, and the integration of human sciences and systems engineering in systemic applications and working environment frameworks. Activities include accident investigation, design of interfaces and procedures, safety assessment, and training. The application areas are transport, nuclear safety, process industries, manufacturing and humanitarian de-mining.
  Further information: http://humanfactors.jrc.it

- **Integration of Information for Risk and Emergency Management**
  Sector Head: J.P. Nordvik
  The sector develops integrated systems for the management of industrial and transport accidents, environmental monitoring, analysis of risk, civil protection planning and strategic decision-making, development of models and information fusion methodologies and software tools to support EU policies aiming at technological risk abatement. The activities support regional and national authorities. The sector also supports the Transport and Energy DG for the operation of the European Co-ordination Centre for Aviation Incident Reporting Systems (ECCAIRS) as an EU information collection point and as a reporting system for air traffic incidents in Member States; designs and implements ECCAIRS network nodes in the Member States; and collects and analyses data.
  Further information: http://eccairs-www.jrc.it

- **Decision Support for Risk and Emergencies**
  Sector Head: D. Bain
  The sector focuses on research and development to improve the quality of decision-making for the management of risk and emergencies, evaluation of the impact of EU policies on sustainability criteria, transport planning. The sector further develops tools to navigate complex, multi-criteria problem streams, characterised by high uncertainty, a mix of quantitative, qualitative and fuzzy data and contrasting agendas of multiple stakeholders. The tools incorporate multi-criteria evaluation methods, Decision Support Systems, spatial analysis (GIS), systems inter-operability and participatory research.

The **Euro-Mediterranean Disaster Information Network (EU-MEDIN)** project aims to improve the interaction and synergy between the actors of the European research in the field of Natural Risks and Disasters. It addresses all organizations, institutions or individuals interested in disasters management research and development issues. http://www.eu-medin.org/

The **International Atomic Energy Agency (IAEA)** serves as the world's central intergovernmental forum for scientific and technical co-operation in the nuclear field, and as the international inspectorate for the application of nuclear safeguards and verification measures covering civilian nuclear programmes http://www.iaea.or.at/

International Decade for Natural Disaster Reduction (IDNDR): Report on Early Warning for Technological Hazards http://www.unisdr.org/unisdr/docs/early/techno/techno.htm

The **Forum of European Geological Surveys (FOREGS)** has established a working group on natural hazards, to target policies on natural hazards in order to reduce the impacts of natural hazards and contribute to sustainable development in Europe.
http://www.pgi.waw.pl/foregs/meetings/meeting_2001/wgr_natural_hazards.pdf. In this context, FOREGS intends to closely cooperate with **EuroGeoSurveys, EGS,** http://www.pgi.waw.pl/foregs/meetings/meeting_2001/wgr_natural_hazards.pdf

The Institute for **Environment and Sustainability** (**IES**) is one of the institutes that constitute the **Joint Research Centre** (**JRC**) of the European Commission. One of the important contributions in the field of hazards research is the FP5 "Natural Hazards Project" (http://natural-hazards.jrc.it/). This project is targeted to provide scientific and technical support (risk indicators and damage maps) for the conception of implementation and monitoring of EU policies linked to the protection of the environment and of the citizens against floods and forest fires. Please also see the first interim report of the Espon project 1.3.1, page 41 ff for further information.

The **UNDP Emergency Response Division (ERD)** is preparing a **World Vulnerability Report (WVR)** that will focus on government strategies that can help avoid or minimize damage from floods, drought, earthquakes and other natural disasters. A central feature of the report, originally scheduled for release in 2001, will be a **Global Risk Vulnerability Index (GRVI)** that will compare countries according to their level of risk over time and demonstrate how patterns of risk and vulnerability have evolved. The index will identify countries' social and economic vulnerabilities, along with hazards caused by natural conditions and human activities that contribute to risk. A pilot of the vulnerability index, combining several indicators to represent a country's level of disaster risk, is to be tested by collaborating centres in Africa, Asia and Latin America. The index will then be refined and improved for global application. Parallel with this process, UNDP will facilitate information sharing and communication between organizations involved in vulnerability and risk indexing through a specialized web page, publications and meetings. More Information can be found at http://www.undp.org/erd/disred/index.htm.

Munich Re provides the **Natcat*SERVICE*** database. This database collates and processes data on market losses on the basis of regions and results (this database can be accessed via the Financial Information Service of Reuters). The NatCat*SERVICE* can be used as a market loss index for an insurance derivative transaction. The MRNatCat*SERVICE* provides data (date, region, damage [monetary and loss of lives], description of event) about the following natural disasters: Earthquakes, volcanic eruptions, storms (winter storms, snow storms, thunder storms, hail storms, tornados), floods (river floods, coastal floods, torrent floods), others (heat waves / droughts, cold waves, forest fires, lightning strikes, land- and rock slides, avalanches). The MRNatCat*SERVICE* covers data worldwide for the last 25-30 years. The database is not public, access to certain data is given to Munich Re Underwriter, clients, governments, NGO's, scientific bodies, Universities, media etc. Internet source: http://www.munichre.com.

The **Swiss Re** holds the **Sigma database** about natural hazards. The categories include: Earthquake, Flood, Storms, Drought, Frost and Other. Sigma includes 7,000 events with 300 new events added each year. Losses are recorded if any one of the following criteria are sufficient for an event's inclusion in the database: (i) More than 20 fatalities, (ii) more than

2000 homeless, (iii) insured losses exceed more than $14m in respect of Marine and $28m in respect of Aviation or $35m in respect of all other losses, (iv) total losses in excess of $70m. An event in Sigma that affects a number of nations, e.g. Hurricane Mitch, is recorded only once. The Sigma database is not public. The annual sigma catastrophe publication available to whoever is involved in natural hazards issues, insurance companies, brokers, global companies, banks, media, scientific institutions. Information can be found at the Swiss Re website http://www.swissre.com/.

Links to selected over regional natural hazards monitoring systems and projects

United Nations Economic and Social Commission for Asia and the Pacific
http://www.markmyweb.com/icstd/SPACE/resap/metsat/metsat.asp

The British National Space Centre
http://www.bnsc.gov.uk/index.cfm?pid=372

Dartmouth Flood Observatory
http://www.dartmouth.edu/artsci/geog/floods/

Canada, remote sensing for natural hazards monitoring, Canada Centre for Remote Sensing
http://www.ccrs.nrcan.gc.ca/ccrs/misc/issues/hazards_e.html

Glacier Lake Outburst Flood monitoring in the Himalayas
http://rolwaling.tripod.com/glof/

The Natural Hazards Research Centre, University of Canterbury, Christchurch, New Zealand.
http://www.nhrc.canterbury.ac.nz/

National Institute of Water & Atmospheric Research, New Zealand
http://www.niwa.cri.nz/rc/hazards/

Natural hazards research at academic institutions in the United States
http://www.naturalhazards.org/discover/research.html

United States Geological Survey research on natural hazards:
http://www.usgs.gov/themes/factsheet/093-99/,

USA, remote sensing and natural hazards monitoring, National Geophysical Data Centre
http://www.ngdc.noaa.gov/

Global Change Master Directory, NASA's directory of earth science data
http://gcmd.gsfc.nasa.gov/Resources/pointers/hazards_general.html

4. DEVELOPMENT OF NEW INDICATORS

This chapter intends to form the basis for the further development of indicators within ESPON 1.3.1 project. The development of indicators will be approached in the scope of further research in the project and via networking with the other TPG's

4.1 Definitions

For the work with indicators it is important to delimit the meanings of the terms ‘parameter’, ‘indicator’ and ‘index’. All three elements of an indicator system are relevant in the process of indicator development. According OECD (1993, p. 6) these terms mean:

Parameter: A property that is measured or observed (in the graphic displayed below ‘parameter’ is represented through ‘data’).

Indicator: A parameter or value derived from a parameter; which points to; provides information about; or describes the state of a phenomenon, environment, or area with a significance extending beyond that directly associated with a parameter value.

> An indicator must reflect changes of a period of time keyed to the problem, it must be reliable and reproducible and, whenever possible, it should be calibrated in the same terms as the policy goals or targets linked to it. (Hammond 1995, p. 11)
>
> An indicator is a quantitative measure of an impact without stating whether the change itself is positive or negative (Schneider, 1995).
>
> Indicators are representative latent variables or characters that are used in the case of missing meta data or to simplify complex data sets (*Hübler/Otto-Zimmermann, 1989*).

Index: A set of aggregated or weighted parameters or indicators.

“The key point to be made about an indicator is that it is a measure that has significance that is broader than the measure itself; that is, the measure represents a much wider issue, condition, phenomenon or circumstance than what is directly measured” EPA (1996, p. 5). The three terms are also connected with each other in a sort of hierarchy of information content (see figure 10). Via aggregation of data (measured parameters, see above) a more complex statement can be made about a state of the property of interest. Figure 10 shows the dependency of the levels in the hierarchy of an indicator system.

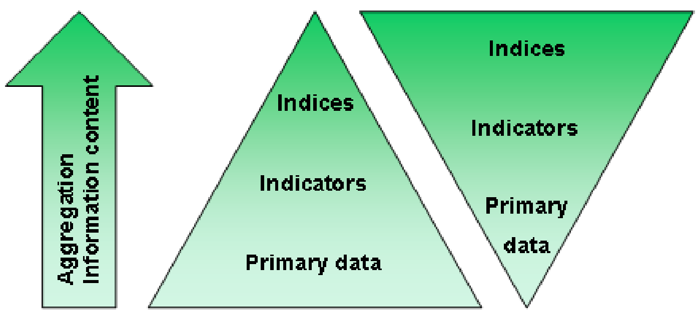

Figure 10: The Information pyramid (following World bank 2002, p. 17)

Indicators must comply with two basic requirements (Schmidt 1985) that form their properties (definitions from Bollen 2001, p. 7285):

Indicator validity concerns whether the indicator really measures the latent variable it is supposed to measure.

Reliability of an indicator focuses on the consistency or 'stability' of an indicator in its ability to capture the latent variable.

4.2 Framework for indicator development

The development of indicators in ESPON Hazards has to cope wit two basic requirements. First the indicators should be precisely targeted to the needs of risk management and cover all relevant hazards. As has been shown in chapter 1.5.3 the development of risk bound indicators needs a special effort. Secondly, the DPSIR model should be used as the theoretical framework for the development of indicators. Chapter 1.1 shows the attempt to form indicator chains for territorial indicators

Starting from the point that many risk bound indicators until now do not exist and envisaging the long-term development of indicators, the distinction between short, medium and long-term (ST, MT and LT) indicators is important (cp. EEA 2003, p. 6). Furthermore the naming of 'prospective indicators' (cp. EPA 1996, p. 8) may be useful to include potential indicators that for the time being cannot be developed due to, e.g. lack of data of methodological difficulties. The following table summarizes the hierarchy of newly to develop indicators as they may be approached by ESPON Hazards. Table 50 presents criteria distinguishing between indicators (tentative, following EEA 2003, p. 6 and EPA 1996, p. 8).

Table 50: criteria for distinguishing between short, medium and long term as well as prospective indicators

A. Short term indicators	High policy relevance Methodology of development is clear Data are available for most countries Data expected for all countries within one or two years Indicator can illustrate temporal trend and comparability between countries
B. Mid term indicators	High policy relevance Methodology of development is clear Data available for some countries (less than 7) Data could be available for most countries three or four years
C. Long term indicators	High policy relevance Methodology is under development Data are either scarce, or difficult to aggregate, or yet to define
D. Prospective indicators	Methodology can not yet be described there is no prospect to have data available to cover Europe but the indicator has a high likelihood of being collected in the future high policy relevance

The development of indicators takes place in several steps (following Schmidt 1985 pp. 135-136 and Bollen 2001, p. 7286):

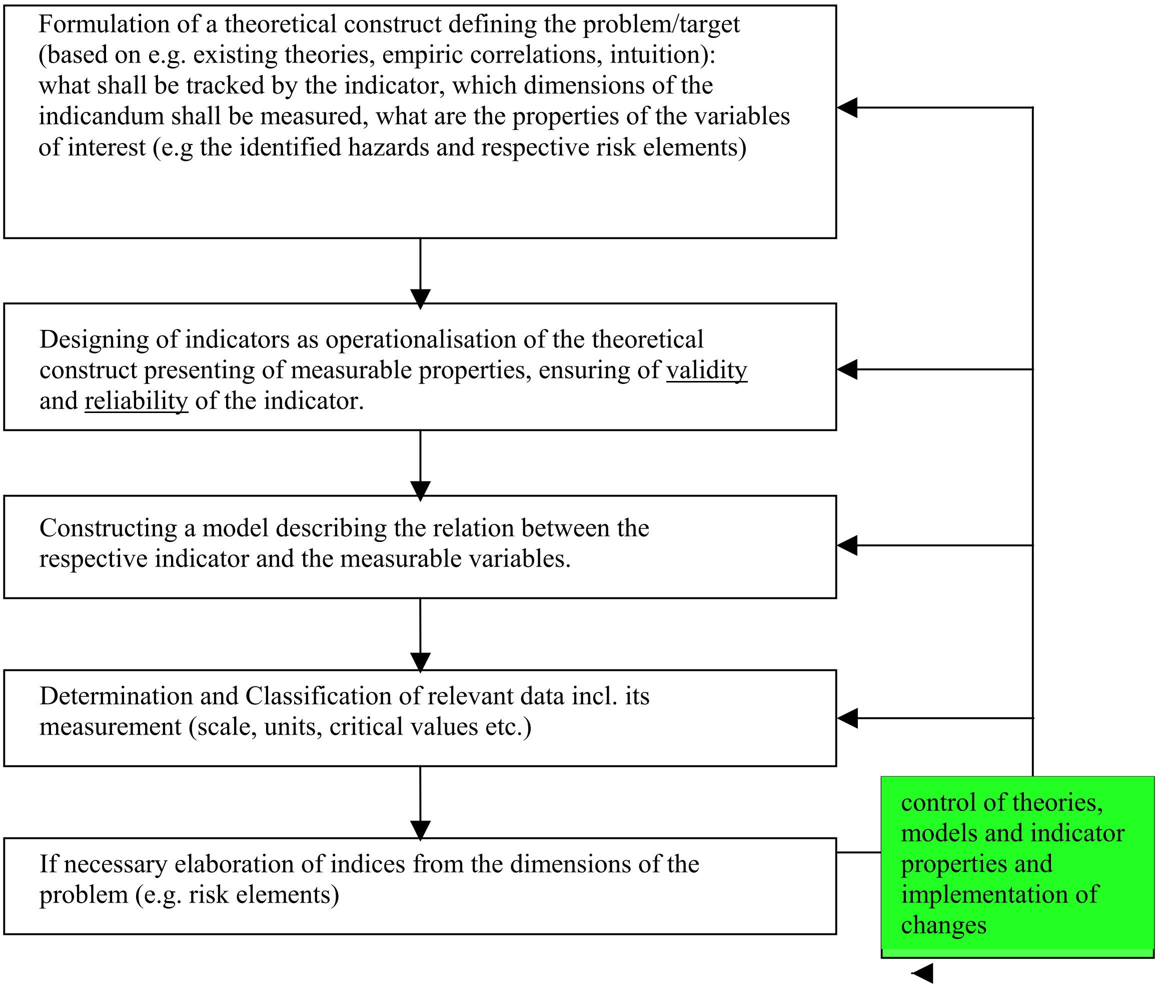

Figure 11: Steps of indicator development

OECD 1993 describes criteria that indicators should fulfil to avoid misinterpretation. These criteria describe the "ideal" indicator and not all of them will be met in practice (following OECD 1993, p. 7):

Policy relevance and utility for users

An environmental indicator should:

- Provide a **representative picture** of problem related conditions according the DPSIR chain
- Be simple, **easy to interpret** and able to show **trends over time**;
- Be **responsive to changes** in the environment and related human activities;
- Provide a basis for pan European **comparisons**;
- Be applicable to issues of regional scale but of national/European significance;
- Have a **threshold or reference value** against which to compare it so that users are able to assess the significance of the values associated with it.

Analytical soundness

An environmental indicator should:

- Be theoretically well founded in technical and scientific terms;
- Be based on international standards and international consensus about its validity;
- Lend it to being linked to economic models, forecasting and information systems.

Measurability

The data required to support the indicator should be:

- Readily available or made available at a reasonable cost/benefit ratio;
- Adequately documented and of known quality;
- Updated at regular intervals in accordance with reliable procedures.

For indicators already presented by ESPON Hazards please see chapters 1.1, 1.2 and 1.5.3 of the 2nd interim Report

The indicators that are developed on the basis of the already existing indicators in this project (see chapter 1.1) strongly depend on the demands of the EU commission and on the networking with other TPG's. The third interim report of this project will focus on these issues. Also, the project will continue to re-issue data requests that were not responded so far and also issue new data requests needed for this project.

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Risk and vulnerability maps of Natural and Technological Hazards and Regional typologisation in Europe

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The area of the European Union, the new member states and associated countries contain different types of technological and natural hazards and risks that in some way can have effects on the development of the regions. Natural hazards comprise, e.g. floods, droughts and earthquakes while technological hazards concern, e.g. fallouts from nuclear power plants, oil spills and hazardous production of goods. In order to facilitate risk mitigation through planning, relevant hazards were selected on criteria that fulfil the requirements of spatial planners.

The ESPON 2006 project 1.3.1 focuses on the typologisation of risks and hazards as well as the risk profile of regions (hazard potential and vulnerability). The result is a better understanding and management of risks to facilitate targeted responses and policies, pointing out comparable situations across EU 27+2. A common understanding of the terms used is ensured by a glossary that covers all relevant expressions in connection to hazards and planning. In order to assess the effects of hazards and planning responses on operational level, four case study areas apply the developed methodology on local and regional level.

The selected hazards set the basis for the development of a typology of regions regarding hazard and risk profiles. Because of the different nature of hazards, the typology is developed separately for each hazard. Subsequently, the separate assessments for the individual hazards will be superimposed to reveal the most threatened areas regarding multiple hazards. The integration of the vulnerability of a region (damage potential, coping capacity) allows distinguishing between those regions that are only hazardous areas and those, which are risky areas. These synthetic risk profiles are presented in cartographic form – as risk maps for the European regions. Finally, the aim is to create a synthetic risk map for all EU 27+2 regions.

Based on the experiences made with the vulnerability and risk maps, as well as in the case study areas, recommendations for spatial planning towards risk reduction are elaborated.

Furthermore the project focuses on the appropriate design of monitoring systems on hazards. Because of the European continent's great variability as regarding the natural and socio economic parameters, it appears to be more useful on an operational level to install regional and over regional monitoring systems instead of pan-European monitoring systems.

Finally light is shed on the development of new indicators. The most needed indicators are response indicators. In order to develop these it will be necessary to closely examine existing Regional, National and European legislations and guidelines. In combination with this it will be necessary to focus on the different levels of decision-making to enable pan-European comparison on existing mitigation strategies on hazards.

Draft Indicators for Measuring Risk Reduction Efforts (ZENEB 2002, p. 32ff)

Indicators*		Sources of information*	Volcanic eruptions*	Floods*	Land slides /Avalanches	Earthquakes *	Droughts*	Forest fires	Storms*	Extreme precipitation	Extreme temperatures	nuclear power	hazardous production	hazardous/nuclear waste	marine transport
			Relevance of Indicators for Each Hazard Theme Draft Indicators, Core Aspects												
A. Government commitment to risk reduction and institutional structure															
1. Shift in government's approach from disaster response to disaster risk management focusing on risk reduction															
1.1 A total risk management national policy and regulatory framework is in force, covering mitigation and prevention, preparedness and recovery	policy		x	x	x	x	x	x	x	x	x	x	x	x	x
1.2 National structure for disaster risk reduction	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
1.3 % of national budget for disaster risk reduction	financing		x	x	x	x	x	x	x	x	x	x	x	x	x
1.4 Participation in regional co-operation (institutions, strategies) on the subject	activities		x	x	x	x	x	x	x	?	?	x	x	x	x
1.5 Economic incentives, tax regulations etc., promoting pro-mitigation behaviour	financing/education		x	x	x	x	x	x	x	?	?	x	x	x	x
1.6 Inclusion of risk reduction measures in recovery process	compliance		x	x	?	x	x	?	x	?	?	?	?	?	?
2. Decentralization of disaster risk reduction and response structures															
2.1 Local authorities charged with local disaster risk management	policy		x	x	x	x	x	x	x	(x)	(x)	o	o	(x)	o
2.2 Existence of trained risk reduction committees at community level	structural		x	x	x	x	x	x	x	(x)	(x)	o	x	x	o
2.3 Allocation of financial resources at municipal, provincial or state level	financing		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
3. Empowerment of national disaster risk reduction and response structures															
3.1 Adequate budget for national structure	financing/structural		x	x	x	x	x	x	x	x	x	x	x	x	x
3.2 Existence of staff experienced in disaster risk reduction	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
B. Risk identification															
4. Availability of risk identification information															
4.1 Magnitude, frequency, duration, location, timing and probability of occurrence of all major hazards affecting the country being established on a sound scientific basis	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.2 Elements at risk (population, infrastructure, socio-economically important activities) inventoried	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.3 Vulnerability of the major categories of elements exposed to each hazard assessed to obtain a systematic, transparent, comprehensive and geographically specific assessment of risk	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.4 Disaster costs and losses systematically reported and logged in a national disaster event database conforming to international standards	planning		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
4.5 Availability of local risk information as basis for mitigation measures	planning		x	x	x	x		x	x	(x)	(x)	(x)	x	x	(x)
C. Risk prevention and mitigation															
5. Adequate land-use planning															
5.1 Land-use planning incorporating disaster risk		ICC	x	x	x	x	x	o	x	o	o	o	x	x	0
6. Risk adapted codes, norms and standards															
6.1 Existence and control of codes, norms, standards responding to specific risk															
· Building codes		NCSBCS, UIA,		x	x	x		x	x	(x)	(x)	(x)	x	x	o
· Other infrastructure (roads, bridges, lifelines); etc.	policy / compliance	ICC		x	x	x		x	x	(x)	(x)	(x)	x	x	o
6.2 Retrofitting of infrastructure adapted to risk specific standards (roads, bridges, hospitals etc.)	compliance		x	x	x	x		(x)	x	x	x	(x)	o	o	o
6.3 Compliance with international codes, norms, standards concerning specific risk	compliance			x	x	x		x	x	(x)	(x)	x	x	x	x
7. Hazard prevention measures															
7.1 Construction of hazard control structures (e.g. dikes, retaining walls, lahar deviation structures, well and aqueduct construction, irrigation channels)	activity		x	x	x	x	x	x	x	(x)	(x)	x	(x)	(x)	x
8. Protection and management of natural resources															
8.1 Implementation of water management measures															
· Conservation and increase of water reserves, water demand reduction, recycling and distribution	compliance				o		x	(x)		o	x	o	o	o	o
· Dams, renaturalization of riverbanks and -beds, flooding areas	measures	ICID		x	o			(x)		o	x	o	o	o	o
8.2 % major protected areas of national territory	S	HDR, EVI		x	o		x	o		(x)	(x)	o	o	o	o
8.3 Laws to promote and enforce conservation of national resources in risk areas	policy			x	x		x	x		o	o	(x)	x	x	x
8.4 Trends in deforestation rate	S	HDR, EVI		x	x		x	x		?	?	o	o	o	o
8.5 Trends in land degradation	S	EVI		x	x		x	x		?	(x)	o	o	o	o
8.6 Desertification control techniques	activity	EVI			(x)		x	o		x	x	o	o	o	o
8.7 Incorporate environment impact assessment in projects aimed at building hazard control structures and water-management	compliance		x	x	x	x	x	x	x	o	o	(x)	x	x	(x)
9. Dissemination and availability of disaster risk and risk reduction information															
9.1 Dissemination of national information and experience on risk and risk reduction to raise public awareness	education		x	x	x	x	x	x	x	x	x	x	x	x	x
9.2 Availability of academic education related to risk management	education		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
9.3 Availability of vocational training related to risk management	education		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
9.4 At-risk communities are aware of, and actively managing, risk	S policy/planning		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x
10. Prevention and mitigation projects															
10.1 % of communities at risk covered by prevention and mitigation projects (GO and NGO)	S planning		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x

Indicators*		Sources of information*	Relevance of Indicators for Each Hazard Theme Draft Indicators, Core Aspects												
			Volcanic eruptions*	Floods*	Land slides /Avalanches	Earthquakes *	Droughts*	Forest fires	Storms*	Extreme precipitation	Extreme temperatures	nuclear power	hazardous production	hazardous/nuclear waste	marine transport
D. Risk transfer															
11. Insurance mechanisms for public infrastructure and private assets															
11.1 Availability and utilization of disaster risk insurance	transfer		x	x	x	x	x	x	x	(x)	(x)	x	x	x	x
11.2 Degree to which individuals and private enterprise exposed to hazards have transferred risks	transfer		x	x	x	x	x	x	x	(x)	(x)	(x)	x	x	x
12. Other risk-spreading instruments															
12.1 Existence of national safety funds such as catastrophe bonds, weather-indexed hedge funds, compensatory funds, calamity funds	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
12.2 Existence of micro-credit facilities that could be involved in recovery lending	structural		x	x	x	x	x	x	x	x	x	x	x	x	x
12.3 Private banks (including micro-credit institutes) offering loans for disaster risk reduction measures	policy response?		x	x	x	x	x	x	x	x	x	x	x	x	x
12.4 International banks include risk reduction measures in their projects	policy		x	x	x	x	x	x	x	x	x	x	x	x	x
12.5 Existence of seed banks	structural			x	o		x	o		x	x	o	o	o	o
E. Disaster preparedness															
13. Contingency planning															
13.1 Existence and implementation of contingency planning at national level	planning		x	x	(x)	x	x	x	x	x	x	x	x	x	x
13.2 Existence and implementation of contingency planning at local level	planning		x	x	x	x		x	x	(x)	o	x	x	x	(x)
13.3 Coverage of training in first aid or community-based preparedness including	education/financing		x	x	x	x		x	x	o	o	x	x	x	(x)
14. Forecasting and early warning systems															
14.1 Existence of forecasting systems	planning	WMO/WWW		x	x		x	o	x	x	x	o	o	o	o
14.2 Existence of early warning systems	planning	UK IDNDR-Commitee	x	x	x		x	x	x	x	x	x	x	x	x
14.3 Local participation in early warning systems	education		x	x	x		x	x	x	o	o	x	x	x	x
14.4 Seismological network established and working, to monitor seismic activities to elaborate and adjust seismic models and codes	planning					x									
15. Effective emergency response networks (local/national)															
15.1 Effective communication system between response entities	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.2 Public confidence in emergency response structure			x	x	x	x	x	x	x	x	x	x	x	x	x
15.3 Reconstruction plans and arrangements prepared	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.4 Adequate relief capacity can be mobilized in case of likely disaster scenarios	planning		x	x	x	x	x	x	x	x	x	x	x	x	x
15.5 Existence of safe refuge sites in high risk areas	planning		x	x	x	x		?	x	(x)	(x)	x	x	x	x
F. Political and economic-social context															
16. Good governance to insure effective disaster and risk management															
16.1 Trends in Corruption Perception Index		TI	x	x	x	x	x	x	x	x	x	x	x	x	x
16.2 % of population satisfied with work of government			x	x	x	x	x	x	x	x	x	x	x	x	x
17. Democratization															
17.1 Trends in voter turnout level at elections (%)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
17.2 Trends in press freedom (correct, difficult, very difficult)		RSF	x	x	x	x	x	x	x	x	x	x	x	x	x
17.3 Gender empowerment measure index: GEM-value	education	HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
17.4 Trends in access to information flows (radio, TV, telephones, internet)	educatin	ITU, HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18. Economic-social progress															
18.1 % of total government expenditure invested in education & health	financing	HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.2 Trends in literacy index		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.3 Trends in daily per capita supply of calories/protein		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.4 Poverty reduction measures (combination of trends in share of income or consumption, trends in PI-value and in GDP per capita)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.5 Demographic trends: fertility rate comparison (urbanization)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x
18.6 Trends in % of population with access to safe drinking water			x	x	x	x	x	x	x	x	x	x	x	x	x
18.7 Trends in number of hospital beds in high risk areas			x	x	x	x	x	x	x	x	x	x	x	x	x
19. Income security by diversification															
19.1. Trends in diversification level of income: agriculture, industry and services as % of GDP (see HDR)		HDR	x	x	x	x	x	x	x	x	x	x	x	x	x

1 ANDALUSIA

1.1 GENERAL

1.1.1 Key Data on the Region

The Regional Government of Andalusia occupies the southern most third of the Iberian Peninsula. Two characteristics stand out: its large area (87.267 km^2) and the influence of the littoral in its southern limit, with more than 870 Km of shoreline.

Geology

Several geological characteristics should be highlighted, such as the region's location in the global tectonic context in the confluence of the African and Euro Asiatic tectonic plates. This fact characterises the tectonics of the region with a high grade of dynamism. This dynamism translates in an important seismic activity on the region, with manifestations of moderate intensity and frequency.

Second, the relatively recent geological history of Andalusia. That means that the region is subjected to important processes of geological formation and stabilisation that translate into an important instability and continuous redefinition of the relieve.

Finally, the great contrast between the tree geological macro-unities that integrate the region (Sierra Morena, Guadalquivir valley and Cordilleras Béticas). This complexity is the result of pronounced differences in lithology, geological history and processes. For all this, a wide spectrum of natural risks related to geological factors is present in the region.

Sierra Morena

Lithologically it is characterised by very old materials (Precambrian and Palaeozoic)

Guadalquivir valley

Situated between Sierra Morena and the Cordilleras Béticas, has a triangular shape that narrows from west to east. It is the most recent unity in origin, characterised by the horizontality of the materials of its deposits, and by its brittleness. In the proximities of the riverbeds the soil richness contributes decisively to the fact that the population is concentrated around these areas, where the danger of floods is high resulting in clear situations of risk, with continuous catastrophic episodes through the history.

Cordilleras Béticas

This mountainous unity is located in the southern area of Andalusia, closing the Guadalquivir valley with a more or less continuous line of mountains. It is an Alpine relieve of recent origin (Tertiary) which main characteristic is its great structural complexity. Here the most important seismic manifestations of the region are detected, as well as a number of phenomena related to the neo-tectonic activity represented by the active faults.

Climate
The Andalusian climate can be related to the Mediterranean type, characterised by moderate temperatures and very irregular regime of precipitations. This irregularity in precipitations is evidenced in inter-annual irregularity and intra-annual irregularity.

Inter-annual irregularity is characterised by the existence of extremely dry years that when follow one another consecutively, could result in situations of drought of consideration and intensity depending on the zone.

Intra-annual irregularity presents alternate periods of poor rainfall with others less foreseeable where torrential rainfall of great intensity is present.

In a whole, torrential rainfall is a frequent phenomena in the region, being the origin of the majority of the floods, as well as one of the factors with more weight in the unleashing of intense processes of erosion, land slides, etc.

The proximity to the sea is another factor to bear in mind. The unleashing of storms around the coast usually generates strong rainfall and wind with extreme affects due to the wave action and surges.

Social and economic aspects
Andalusia is the region more populated of Spanish, with nearly 7.500.000 inhabitants with a very irregular spatial distribution.

Lately, the phenomenon of population concentration has acquired great transcendence. In Andalusia this has manifested in the growth of the great urban areas, with the consequent development of metropolitan areas as well as an increasing occupation of the coastal fringe.

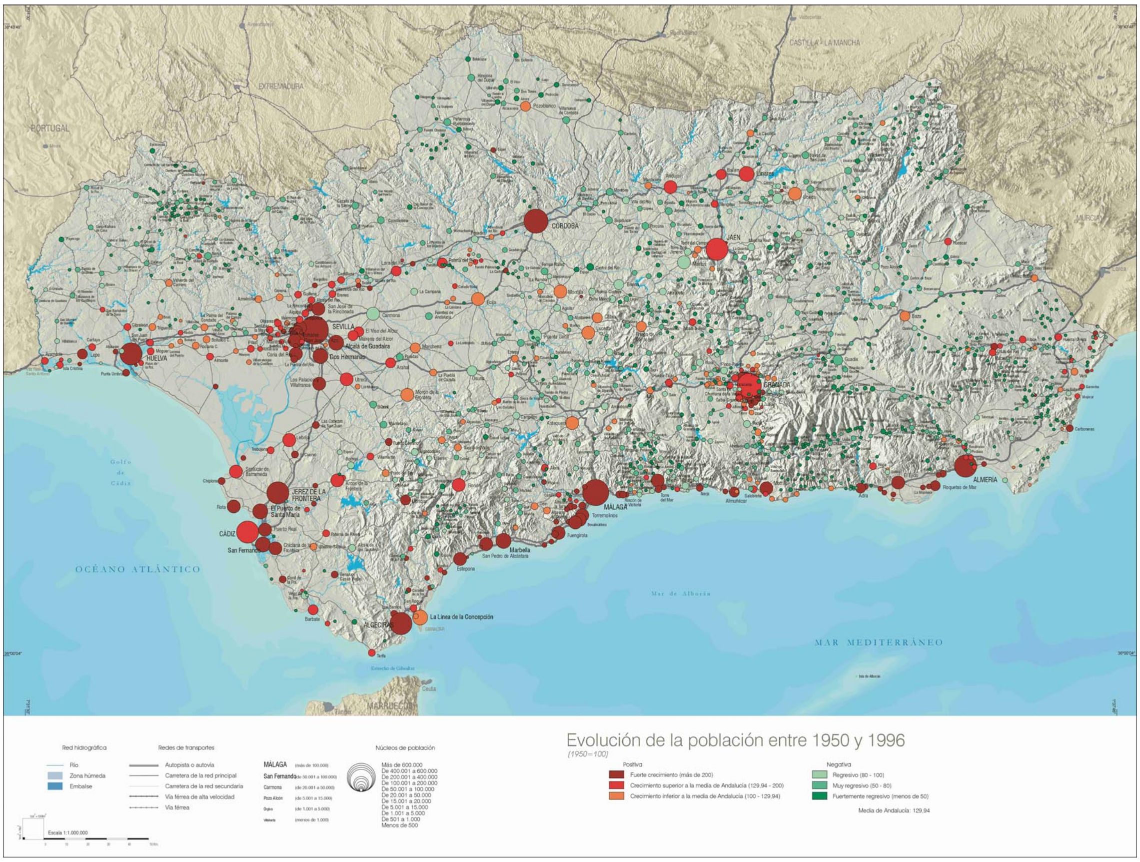

Figure 1: The evolution of the population between 1950 and 1996

This process of population concentration means the opposite process of depopulation mainly in the rural and mountain areas. In those cases the derived problems of the new conditions of population distribution and composition are of a very different nature. Extensive areas of low-density population appear introducing serious difficulties in terms of planning and provision of basic infrastructure. These circumstances make those areas particularly vulnerable to the occurrence of extreme climatic phenomena (heat and cold waves and floods), forest fires or other kind of natural event relatively frequent in rural and mountain ambits.

Industry

There are three basic aspects to be taken into account in relation to industrial activities: those activities that may bear risks for the population, the location of these activities, and the transport networks of dangerous goods linked to the industrial activity.

In Andalusia there is noticeable concentration of industrial infrastructure surrounding urban areas due to the attraction of the cities and the influence of policies that promoted industrial concentration. Overlying this basic spatial distribution, and along the Guadalquivir valley, there is another structure which includes a variety industrial enclaves linked to the agro-alimentary sector. In Andalusia there is a link between industrial concentration and demographic concentration

In relation with the transport of dangerous goods there are two factors to be taken into account: first the nature of the Andalusian industrial production and second the location of the industrial enclaves in relation with transport networks. In relation with the first point is to be highlighted the prominent role that basic industrial production has in the region (chemical and energy). This translates in great fluxes, which in the case of overland transport implies lengthy durations. This is due, among other reasons, to the concentration of industries in southwestern Andalusia, whereas main access to Central Spain are in the central and northeastern part of the region.

1.1.2 Relevant Hazards

Natural Hazards

Floods
The importance of the floods in Andalusia is explained by a combination of factors. On the one hand the irregular regime of precipitation, which produces long periods of low rainfall, which are interrupted by heavy and high intensity rainfall intervals. On the other hand the shape of the drainage network. There are two models of drainage system: the first is characterised by the existence of an important hydrological hierarchy, with a main watercourse running through an absolutely flat topography (Guadalquivir Valley), to which a dense network of tributaries flow from both margins, these repeat the previous scheme with the confluence of multiple minor water courses. This effective channel network to the main collectors provokes in some instances an excess of the draining capacity inducing flooding of the flat topography surrounding the main watercourses. The second is characterised by the mainly existence of watercourses with a short and steep profile which is very pronounced except for its final segment near the river mouth. The magnitude and intensity of the flows that these water courses discharge, which is enhanced by both the torrential precipitation and the steep profile of the basin, usually provokes flooding around the river mouth area, favoured by the low line relieves and the damming effect of the sea. This is the model that characterises rives and *ramblas* draining the Mediterranean basin.

In relation with anthropic activities the main factor is the occupation of the areas liable to flooding in both hydrologic settings. In both cases this is caused by the flatness of the relieve as well as the fertility of the soils. It is to be also considered that in the second of the hydrological models, the availability of agricultural land is limited to the coastal fringe.

The location of areas with potential risk of flooding has been established by the *Comisión Nacional de Protección Civil* in a report carried out for all hydrologic basins in Spain. In Andalusia areas liable to flooding are nearly 20% of those in Spain (1036).

In terms of forecast systems for flooding, each of the river basins has several meteorological and gauging stations, in some instances there are complex hydrological monitoring and control systems, including early warning systems specific for flooding events (*Sistema Automático de Información Hidrológica. SAIH*)

Seismic Activity

In the context of the Iberian Peninsula, the Region of Andalusia is the most seismically active of all. This is because of its location in relation with plate tectonics, as well as the relatively recent of its Alpine orogenic processes, which contributes decisively to the seism-tectonic dynamics that affects Andalusia especially remarkable in the southeastern quadrant of the region. This sector can be characterised as intensity VIII in a representation of seismic risk, and peaks around the city of Granada, reaching IX. Another high hazard area affects most of the Huelva province and southwestern Sevilla.

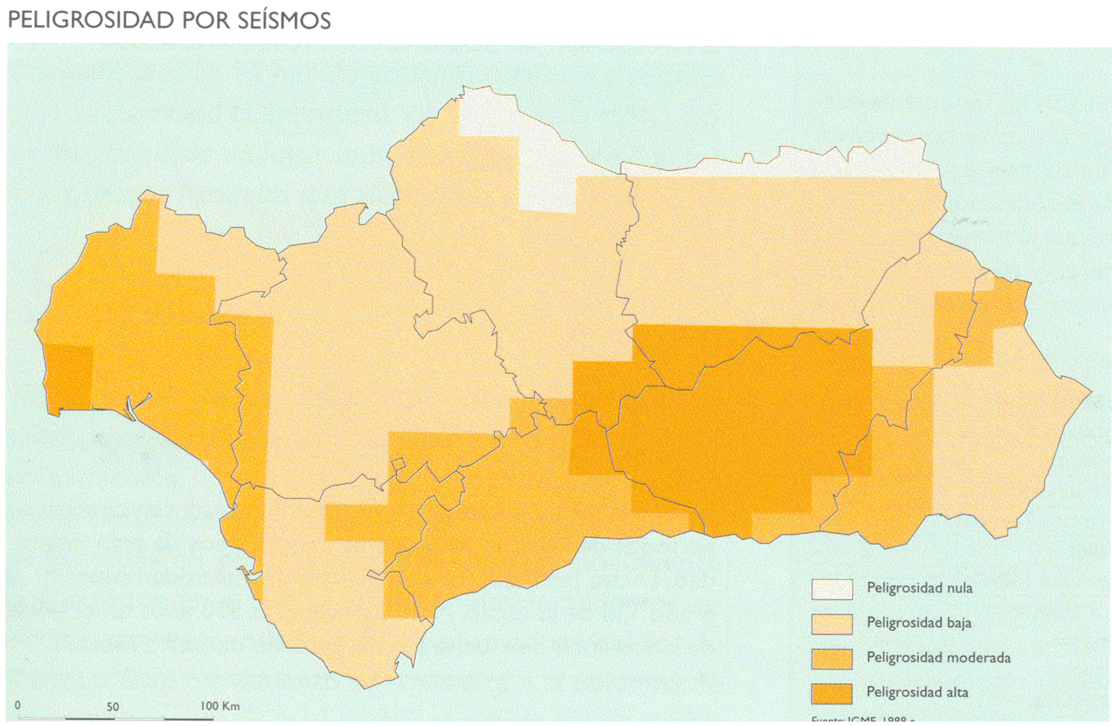

Figure 2: Earthquake danger (zero-low-moderate-high)

Geological Hazards

Included in this category are landslides and karst associate phenomena. Another hazards such as expansive soils or erosion, despite the high losses that usually generate, do not induce emergency-type situations.

In terms of karstic phenomena, only collapsing of cavities can potentially generate catastrophic situations. The location of these processes can be ascribed to limestone sierras of the Cordilleras Béticas.

There are no precise forecasting methods to predict neither landslides nor karst processes, and only structural works as well as land use planning can be used to mitigate the impacts of these geological hazards.

Meteorological and Climatic Hazards

The extreme variability of climatic conditions induces a variety of hazardous situations. Among these a few could be highlighted:

Heat waves are a phenomenon that frequently occurs around the Mediterranean in which Andalusia is included, and its effects have been particularly severe on specific population groups (elderly or sick people). In Andalusia the Guadalquivir valley is the most liable area to the occurrence of this heat waves.

Could waves can equally be considered as problematic for the above mentioned population groups. In this case the mountain areas and particularly those in the interior, are the ones with a higher risk.

The littoral fringe can be considered as a special area where extreme climatic are to be highlighted. Coastal storms may provoke hazardous on settlements exposed to the sea and strong winds that characterise these events. Particularly relevant are the impacts that affect fisheries as well as maritime transport. The magnitude of these events and considering a threshold of wind of 75 km/h as indicative of provability of damage, large areas of the Andalusian region can be classified as hazardous, where frequently gusts exceed this threshold reaching speeds of about 100 km/h.

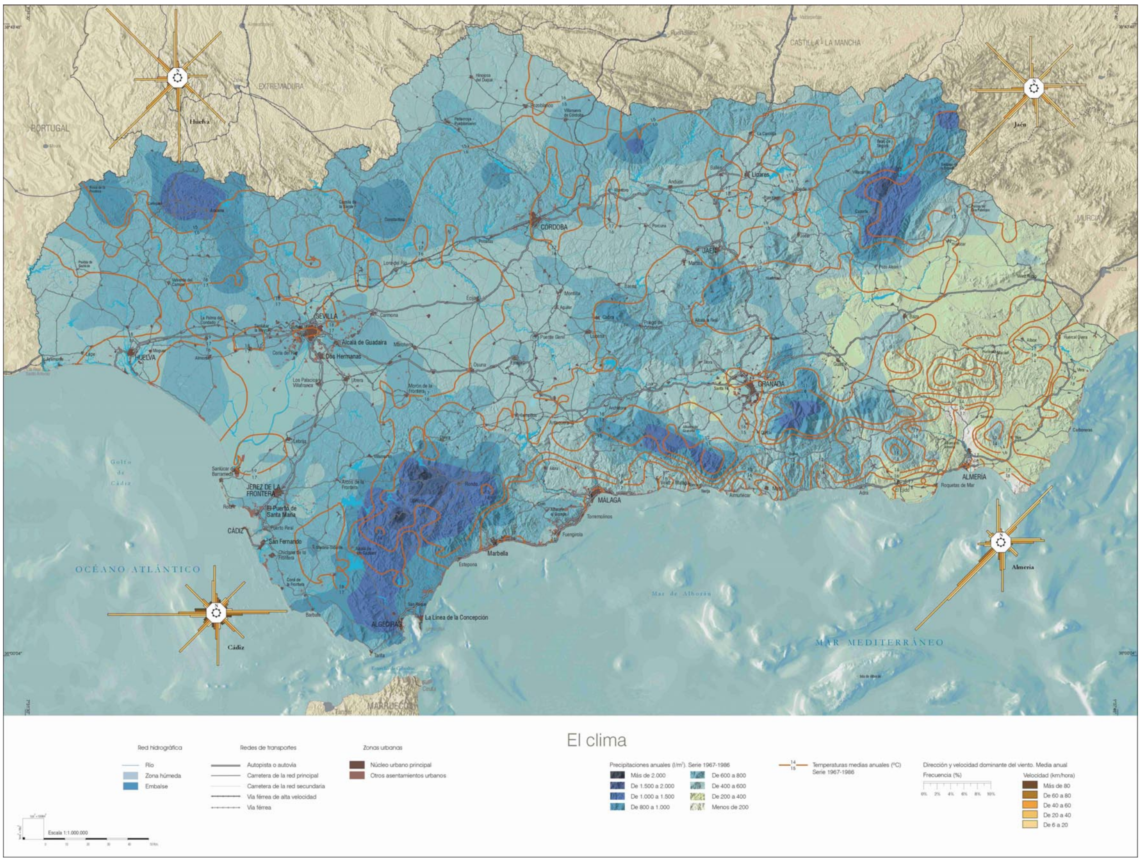

Figure 3: Climate of Andalusia

Technological Hazards

The increasing industrial activity in Andalusia, whichever their type may be (productive or provision) has introduced an inherent a rise in technological hazards conditioned by the location of industrial settlements that has lead to considering the need of development of specific planning policy.

There are a wide variety of substances involved, mainly around Basic Chemical production, dominant segment among Andalusian industry.

Other industrial activities include the agro-alimentary activity, energetic, and metallurgic, wood and paper manufacturing and transformation.

All those industrial activities have a volume and movement of substances and goods as hazardous as those of the generating or recipient industries, not affecting zones that are not clearly delimited but vast transport networks.

General Industry

In relation with industrial hazards, the following sectors have been highlighted by the industrial activity data published for the region:

Agro-alimentary industry, which is characterised by its heterogeneous location and the presence of well-defined hazardous situations (explosion of powders, flammable substances fires, toxic and hazardous waste…). Especial mention should be given in this section to the sugar industry and the *almazaras* for vegetal oil production.

Industry related to energetic production, where the location of thermal power plants should be highlighted as well as the more prominent role of the natural gas as an alternative, which translates in industrial terms in the creation of cogeneration plants.

The basic transformation industry (wood, textile, metallurgic…) or that or manufacture (plastic, paper, machinery…), that have a growing presence around highly populated areas.

Chemical industry is dealt with separately.

Chemical Industry

The chemical industry uses and stores hazardous substances as well as having dangerous industrial processes. Occasionally, this industry represents a risk not only for its infrastructure but also for their surroundings, due to the concentration of its installations, the synergy effect and the proximity to settlements.

In the Andalusian region the chemical industry shows great strength in the Basic Chemical, and more specific around two main lines: inorganic chemical (mainly production of sulphuric acid and gases in the industrial centres of Huelva) and petrochemical (petroleum derivates and storage of energetic produce, mainly located in Algeciras Bay).

The variety of processes and substances around those industrial centres explains the likelihood of occurrence of multiple scenarios of hazard related to chemicals. Specific planning of these risks is thus needed given the proximity of populated areas to these industries.

Transport of Dangerous Goods

The following basic factors that determine the structure of fluxes of dangerous goods are established from the observation of the industrial situation in Andalusia:

The nature of the industrial production of Andalusia; to highlight basic sectors such as chemical industry and energetic production, strongly dependent on the outside, not just for the needs of primary material and fuel, but also for provision of base produce to other industries, located mainly outside the region, establishing the presence of diverse hazardous substances along the communication networks at considerable quantity and frequency.

There is strong input and output of dangerous substances by the industrial areas in respect to the main transport systems. While the natural exit that agglutinates high densities of traffic, is located around the centre and northeast of the region, the main industrial focus are settled around the littoral areas, mainly in the south-western end.

The conditioning in recent years of road networks has to be also taken into account, especially two networks that connect with the exterior, one through the northeast and cross through the centre of the region and littoral area towards the areas more populated. In these road networks an increment of transport is being noticed, especially that of combustible and semi-elaborated substances for manufacturing industry.

Toxic and Dangerous Waste

Human activity in modern society brings with it the generation of substances derived from industrial activities. Some of these substances are toxic in themselves or potentially generators of toxic or dangerous compounds that could provoke emergency situations (fires, explosions, toxic leaks). This has lead to the creation of specific centres of storage or treatment of waste. The emissions to the atmosphere, to the rivers or to the sea, are mainly originated in areas of strong industrialisation or mining extractions.

Hazards from radioactive materials are included in this section due to the presence in Andalusia of radioactive waste treatment centres, waste from nuclear power plants from other regions or from centres where radioactive material is used, such as hospitals or research centres.

Other Hazards: Forest Fires

There are several the factors that contribute to the incidence of the forest fires in Andalusia: the existence of an important natural vegetation cover in Sierra Morena and the Cordilleras Béticas, the recurrence of a long, very hot and dry and summer period, and the increasingly widespread use of this natural areas as leisure zones.

1.1.3 Basic Risk assessment

The publication "Catastrophic risks and planning in Andalusia" (*Consejería de Obras Públicas y Transporte*) has been used as reference for the basic risk assessment. In this document, published by the Department of Planning of the Regional Government of Andalusia, an analysis of the potential incidence of the different natural and technologic risks is carried out in order to incorporate this in planning documents.

Seismicity
It represents an important source or risk on the region, not only for the area that is affected by it (half of the region is moderately hazardous, and a tenth is highly hazardous), but also for the intensity that its manifestations can achieve (there are more than 30 earthquakes with epicentres in Andalusia registered with intensities above VIII at the scale MSK).

Tsunamis
These represent considerable risk along the southwestern coast, despite its low potential frequency.

Landslides are a widely spread hazard around the Cordilleras Béticas, near some enclaves of the Guadalquivir valley.

Karst associated cavities represent risks around the Cordilleras Béticas where this phenomenon has noticeable intensity, although impact is generally economic from damaged infrastructures and buildings.

Flooding constitutes the most important natural hazard in the region. It affects the southeast zone of the region along the Guadalquivir and its main left margin tributaries. Andalusia has 316 flooding hotspots (22'6 % of the total of Spain). To its considerable superficial extension it is coupled a significant temporal recurrence which makes it the natural hazard that induces highest losses.

Droughts
Due to its high frequency and its lengthy duration (from a few months to several years) and its wide spatial distribution, droughts are the archetypical natural hazard. That is why it is one of the main risks affecting Andalusia, along with floods.

Forest Fires
This hazard is a recurrent disaster, highly frequent during summer months all around the forests of Andalusian region. Their impact is dominantly ecological and some economical, although also to be considered are live losses during fire extinction.

Major accident associated to industrial activities
Especially those from power and chemical sectors. The petrochemical complexes of Huelva and Algeciras, their large ports with traffic of dangerous substances, and other more diversified industries located along the Guadalquivir valley concentrate this type of hazard. It is thus a wide spread hazard in the region.

Nuclear activities
There are no nuclear plants in the region. The only hazardous installation related with nuclear activities is the radioactive waste deposit of El Cabril.

Transport of Dangerous
These are concentrated along the main communication axes between Andalusia and Central Spain (along Guadalquivir valley) and the East (along the Mediterranean coast).

1.2 BACKGROUND

1.2.1 Framework Legislation

The Spanish Constitution considers that Land Planning is a public function responsibility of the Regional Government with legislative, regulatory and executive authority. Nevertheless, the State preserves territorial competences as well as the local administration. Thus the main objective of Land Planning is to coordinate the different policies and actuations of the regional government with those of the State and the local government, as well as with the European policy.

Of these policies (including legislative norms and planning), urban planning is the most directly related to land planning. Urban concretes and develops at local level the planning dispositions carried out at the regional level (instruments of land planning).

The *Ley de Ordenacion del Territorio de Andalusia 1/94* (Andalusian Land Planning Act 1/94) is the legislative framework and the instrument for supra-local planning in the region. The instruments for territorial planning are the *Plan de Ordenación del Territorio de*

Andalusia (Regional Land Plan), *Planes de Ordenación de Ámbito Subregional* (Sub-regional Land Plans) and *Planes con Incidencia en la Ordenación del Territorio* (Specific Activities Land Plan).

The *Ley 7/2002 de Ordenación Urbanística de Andalucia* (Andalusian Urban Planning Act) affects specifically local planning within the framework of the national law for land use (Ley del Suelo). This law dictates the instruments for local and supra-local planning (this are described in the following chapter).

Among the horizontal policies the *Ley 4/89 de Espacios Naturales Protegidos de Andalucia* (Protected Natural Environments of Andalucía) establishes the network of protected areas that require specific planning instruments capable of defining conditions for land use and exploitation of natural resources (Planes de Ordenación de los Recursos Naturales).

The *Ley Estatal de Aguas of 1985* (The Waters Act) establishes protection buffer areas along the rivers in relation to flooding hazards.

The *Ley de Costas 22/88 of 1988* (Coastal Act) establishes set back areas in relation with hazards in the coastal regions.

With regards forest fires, there are two applicable policies: the *Ley Forestal de Andalucia* (The Forests Act of Andalucía) and the *Ley específica de Incendios Forestales of 2002* (Forest Fires specific Act) which deals with both preventive and mitigating measures with respect to this natural hazard.

Hazards derived from the transportation of dangerous goods is regulated by both, the *Ley de Ordenación de los Transportes Terrestres de 1987* (Land Transport Plan) which is related to local planning, and the *Reglamento Nacional del Transporte de Mercancías Peligrosas, Real Decreto74/1992* (National Regulatory act for the Transport of Dangerous goods).

The *Ley de Protección Ambiental de Andalucia de 1992* (Environmental Protection Act of Andalucía) comprises all the regulations affecting polluting activities in the region. This law establishes the need for environmental impact statements when new urban developments are planned in local planning.

1.2.2 Planning Framework/content

Regional Planning
The LOTA (*Ley andaluza 1/94 de Ordenación del Territorio*) establishes different instruments for integral planning of very flexible nature because of its general planning purpose (although there are other binding norms that could be directly applied):
Plan de Ordenación del Territorio de Andalucia. Territorial framework for the application of the State and European Union planning and *vice versa*. Regional Government writes and ratifies it:
Writing: Council for the Government of Andalusia.
Ratification: Andalusian Parliament.
It requires the consent of the Commission for Land and Urban Planning of Andalusia to be ratified.

Planes de Ordenación del Territorio de ámbito subregional. Subregional land plans that establish the basic aspects that affect the territorial structure and that must be taken into account on any scale. Among its contents there is the delimitation of zones for the protection and improving of landscapes, natural resources, and historical heritage. These are binding for specific with incidence on the territory and for local planning. There are three types of determinations:

- Directives: binding in terms of goals but not the instruments and measures.
- Recommendations: of indicative nature for administrations.
- Norms: binding and of direct implementation.

These documents are written by regional Offices (*Consejo de gobierno*) or municipal Offices (*ayuntamientos*). The Consejo de Gobierno carries out its approval and ratification after positive report of the *Comisión de Ordenación del Territorio y Urbanismo de Andalucia* and of the *Comisiones Provinciales de Ordenación del Territorio y Urbanismo*.
Specific Plans with Incidence on Land Planning. This is not a specific instrument for planning but it is an instrument of agreement for actions on the territory. The law determines a list of sectorial actions that are considered in this instrument and establishes a procedure for its writing and ratification. These are also written and ratified by the *Consejo de Gobierno* on request of the *Consejero de Obras Públicas* (Regional Minister for Public Works).

Local Planning
The LOUA (*Ley 7/2002 de Ordenación Urbanística de Andalucia*) regulates urban planning at regional level in the framework of the state law that establishes land uses (right of property).
This new Andalusia law inserts explicitly all urban planning into a larger context for territorial planning to which legislation it refers frequently enhancing the synergies between these two policies.
The proposed planning scheme maintains the arrangement in cascade, inherited from prior legislation by which instruments of a lower range develop and concretise those of higher levels, thus differentiating two levels of planning: general and development.

Among the local planning instruments there are:
Planes Generales de Ordenación Urbanística (urban general plan) applicable to municipalities. This is the main instrument for urban planning and its main objective is to become an integrant instrument for physical planning (territorial, environmental and sectorial) that concur in the municipal scale. Its writing is carried out by the Municipal Government (exceptionally by the Regional Government) and it is ratified by the Regional Office for Urban Planning through the *Comisión Provincial de Ordenación del Territorio y Urbanismo de Andalucia.*
Planes de Ordenación Intermunicipal: This inter-municipal planning instrument aims at organisation of continuous areas with similar territorial problems between two or more municipalities (for instance metropolitan areas).
Plan de Sectorización: This plan deals with the division of the land with plan for urbanisation in sectors for its future urbanisation in the long term.

Among the development plans there are:
Partial plans (*Planes Parciales de Ordenación*).
Special plans (*Planes Especiales*).
Detailed study (*Estudio de Detalle*).

Instruments that contribute to the integration of other urban planning instruments are:
Norms for management of urban planning (*Normativas Directoras para la Ordenación Urbanística*).
Municipal Ordinances for Urbanisation and Building (*Ordenanzas municipales de Edificación y Urbanización*).
Catalogues.

1.2.3 Involved/ responsible official boards/ authorities

The Parliament of Andalusia has ratified among others, the *Ley 7/2002 de Ordenación Urbanística de Andalucia* (LOUA) and the *Ley 1/94 de Ordenación del Territorio* (LOTA). These are the two basic juridical norms that regulate the activities in relation with land and urban planning in Andalusia. The Parliament is also responsible for the final ratification of the main planning instruments, such as the POTA (*Plan de Ordenación del Territorio de Andalucia*).
In terms of management and executive power, it is the Andalusian Government (*Junta de Andalucia*) who is responsible for the implementation for the various instruments contemplated in the legislation. To this end, the Regional Office for Public Works, Transport and Urbanisation (*Consejería de Obras Públicas, Transportes y Urbanismo*) through the DG of Land Planning, carries out the tasks of writing and executing regional and subregional scale plans, which need to be ratified by the Regional Government (*Consejo de Gobierno de la Junta de Andalucia*).
Regional or provincial committees for land and urban planning represent the various stakeholders. These comities provide reports that are binding for ratification at higher levels.
Municipalities have the responsibilities for writing the local urban Plan, which is the basic instrument that is then ratified by the Regional Office for Public Works, Transport and Urbanisation (*Consejería de Obras Públicas, Transportes y urbanismo*) after positive report fro the corresponding provincial committee.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans and cartography at regional level

In this section two land planning instruments are described: the POTA (*Plan de Ordenación del Territorio de Andalucia*) and the Subregional Land Plans (*Planes de Ordenación de Ámbito Subregional*).

At the moment of writing, the Regional Government of Andalusia is developing the POTA, there are two Subregional Plans approved, and two more are technically passed.

POTA (Plan de Ordenación del Territorio de Andalucia)

It is the leading instrument of the land planning structure of Andalusia. Its goal is to establish the basic elements for the organisation of the structure of the Andalusian territory being binding reference to the other land plans. Its resolutions are therefore binding for the Subregional Plans.

From a normative standpoint the resolutions of the POTA may have various effects depending on its qualification as directives, recommendations, or norms of direct applicability (*directrices, recomendaciones o normas de aplicacion directa*).
The writing of the POTA was preceded by the development of Bases and Strategies (*Bases y Estrategias*), which are currently ratified, and whose goal is to lead to the finalisation of the Plan.
Article 7.1 point f) of the LOTA says that the instruments for land planning are responsible of the delimitation of catastrophic risk areas and the definition of territorial action criteria that need to be taken into account for prevention of these risks.

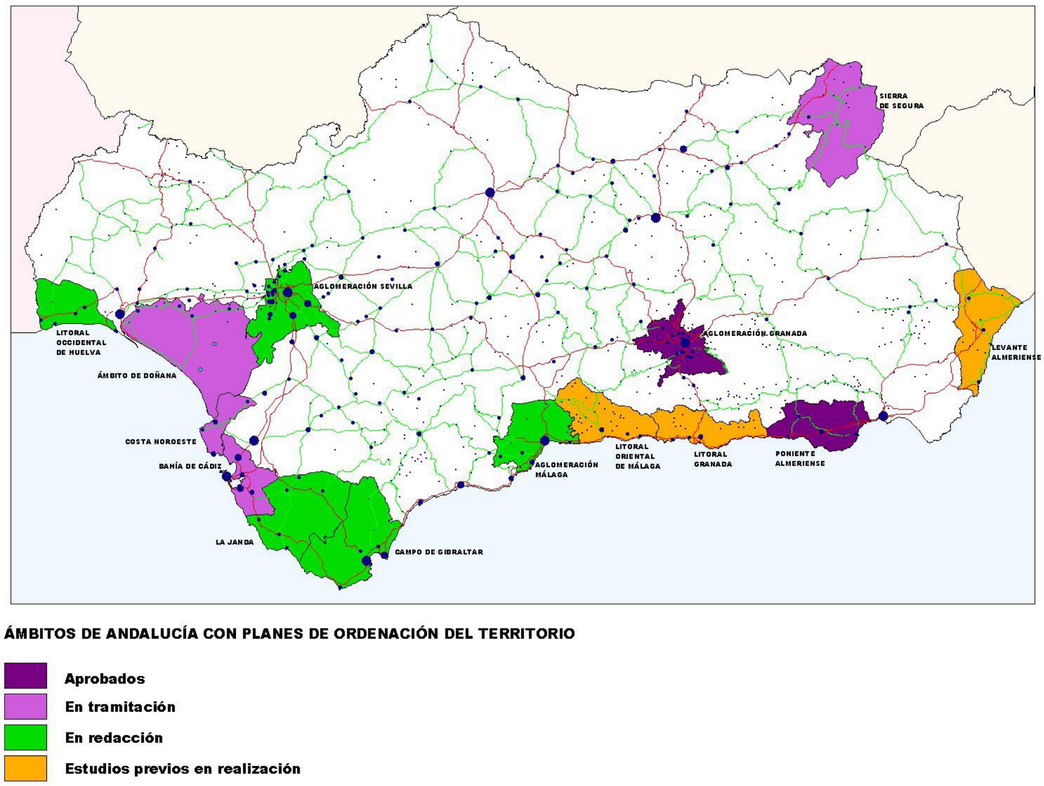

Figure 4: Areas with land use plans (approved-submitted-in preparation-pre feasibility studies

Subregional Land Plans

The LOTA establishes that Subregional Land Plans should have the following contents:

- Objectives and territorial proposals for the scope of the Plan.
- Basic infrastructure and distribution of equipment and services applicable at supra-municipal scale.
- Indication of zones for compatibility and ordination of uses, and for protection and improvement of landscapes, natural resources and cultural and historical heritage.

The law also establishes that any other issue that is considered necessary can be incorporated. Finally the Plan should determine the urban and sectorial plan which need to be adapted, establish investment priorities and determinations.
These determinations, in accordance with the LOTA, are binding for the Specific Plans with Incidence on Land Planning and for local urban planning. These determinations can be

directives, recommendations, or norms of direct applicability (*directrices, recomendaciones o normas de aplicacion directa*), and these are binding on urbanising and non-urbanising land.
Now a days there are two Subregional Plans approved: Metropolitan area of Granada, and the Eastern Almería Area, and there are two more on the public information phase: Northwest coast of Cadiz and Sierra of Segura.

Contents of the existing Subregional Plans

The contents of these have been grouped into different sections for clarification:

Structuring of the territory. The contents of these plans must include a determination of the communication and transport networks as well as a definition of the hierarchy of the population centres with specific functions. To these essential elements the open space facilities must be added as instruments that articulate the territory.

Ordination and compatibility of uses. Only those zones where conflicts exists between users need to be taken into account and only territorial plans can be use as the main instrument for its resolution. This limitation is self inflicted to the effect that only those aspects of strategic and supra-municipal nature would be considered.

Natural, cultural and landscape resources. Strategic options in relation with these resources include both protection and appraisal.

Basic supra-municipal infrastructures. Overland infrastructures are dealt with in the plans at different levels depending on their functionality upon the territory, although the technical characteristics of these are not defined. It would be sectorial planning that will define these. The same approach is taken in relation to water provision and surety. In terms of power supply and telecommunication infrastructure, these plans essentially define corridors along which this infrastructure will run, or the area that are excluded (e.g. telecommunication masts), as well as characteristics of power lines when these run across heavily frequented ornithological sites.

Normative nature of Subregional Plans

The LOTA conditions greatly the focus of these plans, which implies that their determinations are realised through the development of local planning that is responsible for materialising and defining the proposals.
The proposals of the Plan are established through normative determinations and positive actions.
Norms are defined essentially by the establishment of prohibitions or positive obligations with respect to planning criteria, which must be applicable within urban planning. An example of the first would be the restriction of certain land uses, and of the second that urban plans must incorporate certain features such as delimitation of flooding areas around rivers and streams or criteria in relation with landscaping. Also included are specific objectives of the POTA, which are very specific given that its amendment would imply a full revision or modification.

In relation to the Directives (*Directrices*) these represent the bulk of the determinations of these Plans. These are mandates which aim at specifying the goals to be achieved, and leaves sectorial Administrations or municipalities to decide on which strategy to follow in order to achieve them.
Finally, Recommendations (*Recomendaciones*) are scarce within the normative of these Plans.

1.3.2 Relevant data sets available at regional level

The Regional Government of Andalucía has ample competences in all aspects related to territorial management: land planning, agriculture, environment, etc.
The various regional government offices (departments) have developed a series of information systems, databases that support management and planning needs.
Likewise there are other agencies, which depend directly from the Regional Government, that are involved specifically in producing cross border information (*Instituto de Estadísticas de Andalucía, Instituto de Cartografía de Andalucía, etc)*.
Direct outcomes of this policie are the many statistical series of socio economic nature (population, industrial census, etc) from the *Instituto de Estadística* updated and disseminated frequently.
There are many databases concerning the physical environments, which enable evaluation of natural hazards: digital terrain models, orthophotos, satellite images, vegetation, land use, geology, climate, etc. These databases are in the Andalusian Environmental Information System (*Sistema de Información ambiental de Andalucía, Consejería de Medio Ambiente*).
Another relevant source of data is the Regional Department of Public Works and Transport through its Office for Land and Urban Planning (*Ordenación del Territorio y Urbanismo: La Consejería de Obras Públicas y Transportes*). This Department is developing the Territorial Information System, compiling basic cartography as well as road networks, population centres, aquifers, landscapes, administrative and planning boundaries, demographic and economic activity data, etc.
The Andalusian region, and in particular the Regional Government comprises sufficient datasets that can support all the management and planning tasks that affect its territory, which in many cases can support planning measures for preventing natural hazards.
As well as these generic datasets from the various departments, specific reports have been developed for the analysis of catastrophic natural risks.
To this end there have been considerable efforts carried out by the DG of Land Planning (*Dirección General de Ordenación del Territorio de la Consejería de Obras Públicas*) in developing cartography and assessments of flooding hazards, which determined “hot spots” and areas of maximum risk. These are detailed assessments. The same office has also completed more generic evaluations related to technological and natural hazards from which synthesised cartography has been produced to support planning activities on a broad scale.
Specific studies related mainly with seismic and geological risks have also been developed from the National Geographic Institute and the Geologic and Mines Institute of Spain.
Detailed assessment and reports of forest fires, erosion, droughts, among other risks, are produced by the Regional Environmental Office (*Consejería de Medio Ambiente de Andalucía*).

1.3.3 Elements of available planning documents with relation to hazards and risks

Regional Land Plan of Andalusia, POTA (Plan de Ordenación del Territorio de Andalucía).

This document, as indicated before, is currently in preparation. To date the bases and strategies for the Plan have been approved. This preliminary document establishes, in relation with natural and technological hazards, the following recommendations:

1. To make a careful study of the current state of knowledge on risks and environmental unbalance of the region.

"The objective is to achieve the degree of knowledge at the sufficient territorial level of detail to enable the formulation of efficient measures. The heterogeneity of previous studies and their spatial scale, recommends a complete analysis on a regional scale for each type of hazards and, on an integrated way, to enable the implementation of action plans and programs in the whole of Andalucía. In this respect it is necessary to advance towards a zonation of Andalucía based on the intensity and frequency of environmental degradation and natural and technological hazards".

2. To establish territorial criteria to diminish risks.

It is necessary to develop concrete strategies for preventing and controlling each type of hazards. The initial criteria in this respect should include:

- Ordination of land uses for all drainage basins and the inclusion of measures for restoration of riverside forests in basins with flow regimes that are liable to induce flooding. Planning and design of infrastructures to control and canalise events, which considers the generic incidence of the specific projects including the potential multiple use of basin-regulation works.
- Assessment of environmental effects derived from changes in land use or agricultural practices and management in potential erosion risk areas.
- Convenience of treatment and assessment of actions along coastal segments of similar dynamic characteristics. Integration of land planning criteria from the Coastal Act (*Ley de Costas*) and the Regional Directives for the Andalusian littoral (*Directrices Regionales del Litoral Andaluz*), which would minimise risks, associated with marine and coastal dynamics.
- Enforcement of the Seismic Resistance Normative (*Norma Sismorresistente*) on instances where the institutional system for management of planning and construction allows it. To include in territorial and urban planning references to the Seism-tectonic Map (*Mapa Sismotectónico*) and from the Geo-tectonic and Natural Hazards Map of Cities (*Mapa Geotectónico y de Peligrosidad Natural de Ciudades*).

Subregional Land Plans

Mitigating measures taken from one of the two Subregional Plans already approved in Andalucía are analysed in this section. These are from the plan for the Western Almería Subregion (*Comarca del Poniente de Almería*).

Located in the Andalusian southeast, this coastal environment is characterised by conflicts generated by the competitiveness that exists to use their scarce water resources between both the tourism and intensive agriculture industry. Between the main risks, it is significant the lack of technological hazards as opposed to natural hazards that dominate, particularly in relation with flooding and over exploitation of water resources.

In terms of protection of natural resources and landscapes the following proposals are included:

- The establishment of a coherent model that satisfies water demands and that is consistent with sustainable practices. A total of €138.6M are planned to be invested in infrastructure and waste management. Desalination plants are also proposed as the best option to respond to water demand and reduce pressure on aquifers. The plan includes the construction of one or two of these plants, which will achieve a maximum capacity of 17 Hm^3/yr. As well as this it proposes the connection of all the municipalities water supply networks and the construction of nine water purifier stations, four of which could recycle up to 12 Hm^3/yr of urban sewerage water for irrigation.

- Likewise measures for prevention of natural hazards are included, mainly by identifying rivers liable to flooding and actions that can be carried out to avoid the hazard as well as the development of rules aiming at the regulation of uses for future prevention. All 53 plans for prevention of flooding in urban areas recently approved by the Government Council (*Plan de Prevenciones de Avenidas e Inundaciones en Cascos Urbanos*) are included in the document.

1.3.4 Useful and transferable instruments/indicators for a risk reduction management.

The andalusian legislation for land planning assumes explicitly that land planning must be an efficient instrument for the prevention of hazards. The LOTA (*Ley 1/1994 de Ordenación del Territorio de Andalucía*) need to identify hazard prone areas and to define the territorial criteria for prevention.
The role of territorial planning is never considered as a focal point for prevention, but as an element linking sectoral policies, and only applicable to those risks in which the territorial component have a relevant role.
As an example of this there is the explicit inclusion of sections referring to natural hazards (flooding, technological, geological, meteorological, etc) in the Bases and Strategies for the Land Plan of Andalucía (*Bases y Estrategias del Plan de Ordenación del Territorio de Andalucía*). Another relevant document in relation with the prevention of catastrophic risks (*Riesgos Catastróficos y Ordenación del Territorio en Andalucía, 1999*) was elaborated by the Office for Territorial Planning, and includes among other issues a synthesised assessment of the incidents of various risks as a function of their territorial relevance. Synthesised cartography has been elaborated showing the spatial distribution of the various hazards.
Despite all of the above it must be said that the issue of risks on a regional and subregional scale has been addressed unevenly. Natural hazards have been addressed in greater extent than those of technological nature. On the other hand, some risks are, by its own nature, difficult to include in land and territorial planning (tsunamis, droughts, etc). On the contrary, some other hazards have a great territorial component and high danger (nuclear hazard, and specifically in Andalucía forest fires), which are hardly addressed given that they are widely treated in sectoral legislation and operational procedures (*Ley de Incendios Forestales de Andalucía, Plan INFOCA, etc*) which are binding for land and urban planning.
There are other groups of risks, like geological hazards, that are specifically treated in territorial planning documents. The Seism-tectonic Map of Spain (*Mapa Sismotectónico de España*, scale 1:100.000) is adequate for regional and subregional plans and the Geo-tectonic Map for Natural Hazards in Cities (*Mapas Geotectónicos de Peligrosidad Natural en las Ciudades*, scales 1:25.000 and 1:5.000) for greater detail. Based on these documents, limitations are set for construction on unstable zones (faults, landslides, etc).
Floods are among the most dealt with hazards in land and urban planning. It is a critical hazard with wide spatial distribution, in which spatial planning plays an important role, since it restricts land uses in those areas under greater risk. There are many studies and reports that categorise and locate flooding black spots on different scales. In any case there is a lack of large-scale maps, necessary for the appropriate treatment required for municipal planning.

In relation with technological risks, these are the hazards that territorial planning takes the least into account. There is a lack of a proper catalogue and identification of under risk areas. This would allow the development of criteria for management of uses and planning of infrastructure that would reduce the occurrence of these hazards.

1 CENTRAL REGION OF PORTUGAL

1.1 GENERAL

Definitions of terms used in this Annex

Spatial Planning – is referred to as the general term describing the planning approach system in Portugal at the national, regional and municipal levels. They embodied three different kinds of plans: National Plans, Regional Plans and Municipal Plans (PMOT's). In these types of documents it is laid out the spatial development major goals to be achieved in order to promote a balanced relation among human beings, activities, equipments, and further infrastructure such as accessibilities.

Regional Plan – The regional plans in Portugal can cover different length of territories. Therefore, it is possible to have regional plans covering the full length of the territory labelled as NUTS II, or those that can cover solely more than one NUTS III, and finally those which are based on parts of NUTS III territories, as it is the case of PROZAG.

Municipal Spatial Plans (PMOTs) – These plans are in nature, administrative regulations, that determines the type of usage that can be done into the different kinds of soils. It comprises the total area of the municipality or solely part of it. It comprehends other types of plans: Municipal Plan (PDM), urban plans and Detail Plans.

Municipal Plans (PDM) - In this kind of plan, it is established the spatial structure to be applied to the full length of the municipal territory. Soils classifications, urban indexes, are to be defined according to the way that economic activities, dwellings, equipments and other types of infrastructure such as the transport system have been set in place.

Urban Plan - this is the kind of plan that covers urban and non-urban areas- that though, can become reclassified as such- in order to give an organic structure to the urban territory, by establishing: a) The outer boundary of urban areas; b) Urban criteria; c) The end usage of dwellings; d) Heritage buildings that are in need of being protected; e) Areas that are to be elected as shelter for certain kinds of equipments; f) Green areas are mapped, and finally, is where the main net of transport system is outlined.

Details Plans - as the name suggests, this is a kind of plan that distinguish itself for substantiate and define in a clearly way, the typology of occupations available when the use of municipal territory are to be concerned. In case of urban areas, the Detail Plans instruct of how to build in certain areas of the municipality, what short of requirements are to be followed in order to preserve the façade of certain types of buildings etc.

Special Spatial Plans – Portuguese Central Administration is the accountable body for setting up these kinds of plans. Special Spatial Plans provide with the principles and rules of how to occupy and transform land areas, in order to maintain and preserve public interests. They include other plans such as of those dealing with protected areas spatial plans , public shallow lakes spatial plans and Coastal spatial plans.

National Ecological Reserve (REN) – This is a concept that often is wrongly taken for Natural Parks. At least in Portuguese terminology, this concept gains a much wider scope allowing it to comprehend natural areas, coastal areas, estuary areas, lagoons, shallow lakes, streamlets, areas of maximum infiltrations and declivous areas. All of them are part of REN.
Therefore, REN is defined as all basic types of diverse biophysics structures that through certain kinds of impediments to their usage are able to protect its own ecosystems from an unbalanced development. Nevertheless, these areas try to balance human activities and a lively, health environment.

Principles of Regional Planning - are included in the Decree-lawnº 380/99 of September 22nd of 1999. This legislation provides with the guidelines for spatial development requirements that need to be followed at the national, regional and municipal level.

Natural Area – Land with a special constitutionary status due to its importance for the nature/ecosystem conservation.

Region – Area commonly labelled as NUT II. There are 7 NUT II in Portugal: 5 in the territory of continental Portugal and the other 2 in the Açores and Madeira Island.

District – Administrative area with a specific authority, which has been assigned certain super-municipal administrative competencies.

Municipality – lowest and at the same time most concrete level in the administrative and planning hierarchy level and land use planning. Municipalities have a guarantee right of self-government according to the article...

Inter-municipal level Planning (matches the definition of German partner of Regional Level Planning) – level of spatial relevance that is superior to local level and inferior to the regional level (applies for instance to issues like natural or technical hazards that reach an extent which exceeds the ability of a municipality to manage the incident and/or that happens in an area bigger than of one municipality).
As it is defined in the decree-law nº 328/99 – “ the inter-municipal plan of spatial planning is a territorial development instrument which guarantee a good articulation between regional spatial plans and the municipal spatial plans”.

1.1.1 Key data on the region

The central region of Portugal occupies an area of 23,666 km2 (25.7% of the Portuguese land area) and includes 78 counties. The region contains 10 NUTS III level areas.

Geo-ecology: It is marked out by being crossed through the main mountain chain in Portugal, which culminates in mountain Serra da Estrela (1991m). It includes the hydrographical basins of some of the most important Iberian Rivers (Mondego, Vouga, Dão, Lis) and part of Douro (through Côa) and Tagus (through Zêzere) and several water reserves, including thermal and mineral waters, of the greatest strategic importance for the region and for the country.

This region holds important resources of quality soils, rock reserves, particularly granite, which is being used in many industrial and commercial activities, on top of an extensive and complex botanical and fauna of great environmental, scientific and tourist interest.

Additionally, the region has extensive swathes of forest, particularly of pine and eucalyptus, representing 1/3 of the Portuguese forestry area.
Population: The population is almost 1.8 million inhabitants (17.2% of the national total), of which 65% is made up of active population.

Education: The region has an established education system, including universities and polytechnic institutes, which area spread evenly through the region. Today about 76 000 students attend higher education, of which 89% are educated in public teaching establishments.

Figure 1: Central Region of Portugal – Urban Agglomerations

Agricultural and forestry: A strong heritage of small cattle and poultry farming and forestry that, despite the profound structural transformations, continues to play a relevant role in regional economy. Small farms dominate as, integrated within a family-based traditional economy. Wine, olive oil, fruit, milk and wood are still important products in the regional economy.

Industry: The region has stood out due to its diversity, development and innovation, particularly in areas of manufacturing industry, the growth of which has been both quantitative and qualitative. The introduction of new industry brands is evident, among which one should highlight telecommunications, the new information technologies and, up to a certain extent, components for the automobile industry,- The sectors with a more or less long tradition in the region, such as ceramics and moulds, have undergone the greatest progress in innovation, both in the products and in the processes.

Tourism: Tourism, in its multiplicity of market segments, is a field of the regional economy with excellent prospects,- The qualitative and quantitative emergence is already evident, in the Coastal Beira and in Inner Beira, in terms of supply and demand.
The diversity of tourist resources forms the region's major strength. Strategically, it is in the coming together of history and nature, expressed as culture, in many forms,- This lays the raw material on which the development of a quality tourist industry is based.

1.1.2 Relevant Hazards

In the central region of Portugal, populations' security are mainly threatened by three natural hazards:

a) **floods hazard**, specially in the valleys of Mondego, Vouga and Liz river;
b) **forest fires**;

and one technological hazard:

c) **water contaminations** in industrialised areas;

Technological hazards tend to occur every now and then, especially those, which relates with **radioactivity contamination**. These happenings tend to relate with fact that the central region of Portugal holds several uranium mines, on top of suffering from the nearby presence of the central nuclear power station of Almaraz, located on the Spanish border.

1.1.3 Basic risk Assessment

Basic risk assessments are being done in order to enhance population security:

<u>Floods</u>
In the Valley of Mondego River there is a well-marked delimitation of an area, which is normally affected by the 100-year flood. An emergency action plan was devised accordingly,- by the district civil protection services.
The valleys of Vouga e Liz do not hold any risks map and consequently there is no emergency action plan.

<u>Forest fires</u>
The Canadian Index on forest fires vulnerability is released on a regular basis, from which the national fire brigades draw indicators to their emergency plans on forest fires.

<u>Landslides</u>
This hazard could become problematic in case of high values of rainfall in areas with severe relief. In the Central region of Portugal the problem of severe relief in mountainous regions is increased by deforestation. This is caused many times by forest fires and bad planning of construction in the past. Thus landslides are now a relevant problem and there are no official plans of prevention. Serviço Nacional de Protecção Civil implements emergency plans.

<u>Water contamination</u>
There is no emergency plan to answer water contamination. There are several prevention plans in Portuguese legislation to ensure protection, especially according the water use. Radioactivity emergency plans are related to exploitation activity of the uranium mines that shall prevent the exposure of people to radioactivity.

1.2 BACKGROUND

1.2.1 Framework Legislation

The most important Portuguese legislation on spatial planning is rather recent.
The law nº 48/98, of 11th of August 1998, establishes the guidelines for spatial planning and urban policy. This law was regulated through the decree-law nº 380/99, of 22nd of September 1999, in which the legal system of spatial management planning instruments are drawn at national, sectoral, regional and municipality levels.
The decree-law nº 555/99, of 16th of December 1999, which was altered by the decree-law nº 177/2001, of 4th of June, establishes a new legal regime for urban operations at a municipality level (urban plans and detailed plans), a new legal regime for division of urban lands into parcels as well for building activities.
The law - decree n. 34/92 of 4th December 1992, establishes radioactivity protection, prevention and actions in mining industry.
The law - decree n. 382/99 of 22nd September 1999, which establishes protection perimeters for groundwater uses in public water exploration that serves more than 500 people.

1.2.2 Planning framework /context

The decree-law nº 380/99 sets in place all instruments available to spatial planning and urban policies. The spatial planning management system laid down through this decree-law establishes three different levels of action and coordination when planning activities are concerned: the national, regional and municipal levels.

These three integrated (hierarchical) levels aimed at insuring that the different public interests are able to express themselves spatially, in a conciliate/ agreeable manner and, in order to promote a sustainable economic and social development as well as territorial cohesion.

These instruments of spatial management identify human, physical and natural resources, essential to a sustainable use/management of the territory. They also set up basic criteria and minimum levels of usage of those resources in order to insure that the natural heritage is able to keep on renewing itself.

At a **national level** three strategic documents were created:

i. <u>The national policy programme for spatial planning</u>

ii. <u>Sectoral plans</u>

iii. <u>Special plans</u>, which include **protected areas spatial plans, coastlands spatial plans** and **shallow lakes spatial plans.** These spatial plans set limits to the use of territory in order to preserve the nature and its biodiversity. At the same time they ensure an open space to the usage of population.

On a **regional level** only exists one strategic document type, the *regional spatial plans*.

In a sub-regional level, it is able to find the so-called *Inter-municipalities plans.*

And finally, there are the *municipal spatial plans* including three types of strategic documents:

i. City council strategic plans
ii. Urban plans
iii. Detailed plans

The binding character of the aforementioned strategic documents

Only the Municipal spatial plans are able to bind public and private bodies to comply with their rules. All the others bind solely public institutions.

1.2.3 Involved /responsible official boards/ authorities

Listed below you will find the responsible official boards for each of the different strategic plan.

i. **The national policy programme for spatial planning**
 Authority: Head office of spatial planning and urban development

ii. **Sector Plans**
 Authority: Ministry of a sector

iii. **Regional Spatial Plans**
 Authority: CCRC (Comissão de Coordenação da Região Centro)[5]

iv. **Special plans, Municipal plans and sector plans** are monitored by the Regional Head Office of Environment and Spatial Planning (DRAOT).

1.3 PLANNING DOCUMENTATION

1.3.1 Plans, maps available at regional level

a) Regional Spatial Plans in the Central Region of Portugal

There is no strategic spatial plan covering the full length of all the territory of the central region of Portugal. There is a shorter regional plan called **PROZAG** (Regional spatial

[5] CCRC and DRAOT have merged as an unique service called CCDR(Comissão de Coordenação e Desenvolvimento Regional)

plan for the surrounding area of three different artificial lakes of Aguieira, Coiço e Fronhas) which covers six municipalities overall.
This plan was approved in 25/09/92, bonding all public and private bodies to comply with new regulation on land-use management and water supply.
PROZAG can be regarded as an umbrella strategic plan, providing the guidelines to other "lower" plans. These concerns cities and councils involved in this area, with which they have to comply.
The major goal of this plan was to protect the water quality of shallow lands of Aguieira, Coiço e Fronhas, since it serves not only to supply a wide area of population but also to irrigate Baixo Mondego lands.
As PROZAG was created while before the new regulation applicable to regional spatial plans came out, (Decree-law nº 380/99) it did not cover all the areas that should be object of planning. At the present moment, the regional spatial plans are being revised under the lights of this new regulation.

"Special Plans" of the Central Region of Portugal

b) Spatial plans for coastland areas

All the coastland of the central region of Portugal, with a covering area of 140 km2 by 3 km2 of depth, encompasses 11 municipalities. These are equally object of a spatial strategic planning called "Special plan for coastland areas".
This special plan, which has been approved in October of 2000, is meant for :

a) value different usage of coastland areas;
b) protect natural ecosystems and ensure a sustainable exploitation of resources;
c) value existing settlements without disregard of the coastal dynamics;

***i.* Spatial plans for artificial lagoons/ shallow lakes**

There are still few other special plans for artificial lagoons in Zêzere River, particularly those, that are connects to Cabril, Stº Luzia, Bouça e Castelo de Bode artificial lagoons.

***ii.* Spatial plan for protected areas**

Spatial planning for the Natural Parks of Serra da Estrela, Serra de Aires e Candeeiros and the Natural Reserves of Paul de Arzila and of dunes of S. Jacinto has been recently approved.

c) Portuguese's good practices examples on management risk of natural and technological hazards - The risk reduction through land-use planning

Since the 1990's Portuguese legal rules on land-use planning have experienced significant changes due to the introduction of a new regulated concept- the National Ecological Reserves (REN).
Throughout the national territory, pockets of land areas have been identified, delimited and ruled in order to preserve the importance of the different biodiversity ecosystems. The outcome of such work has brought extremely important measures when reducing the potential of risk of natural and technological hazards.

Measures such as:
1. Bounding the "side-walk areas" of rivers preventing them to be used with building activities, or similar activities, which ultimately, would decrease the level of water infiltration on the soil. This was one of those good land-use planning measures that, is believed to reduce the level of hazards, even if not always applied;

2. The maximum borderline of a 100-year flood has been delimited. Consequently, restrictions to the use and the type of use of the inflicted land areas have been determined.

3. Land areas have been classified according to their level of infiltration and guidelines have been given to the type of use of the different kind of soils.

4. Delimitation of the use of declivous zones (> than 30% of declivity) have been established;

5. The type of use of coast land areas and wetlands determined;

In the 1990's, this kind of regulation was absorbed and made present in most of the City Council Strategic Plans.
In order to avoid the dereliction of sensitive environmental areas, it is believed this kind of good practice has given great contributions to the risk reduction of floods and water contamination, and even, to the land derails.

There are other examples of good practice in order to minimise the risk of floods.
While the previous one could be placed as a good practice example indicator, falling within the "Driving Force concept" of DPSIR chain, this next one, could be easily identified as a good practice example indicator of response.

The creation of artificial lagoons/shallow lakes and other similar types of constructions were set to help to respond to the flood hazard.
The artificial lagoons of Aguieira e Fronhas were built to protect the city of Coimbra and the village of Montemor o Velho, by creating the possibility of accumulating high volumes of water, and also, decreasing the high levels of floods in the downstream trunk of Mondego river. Despite of the fact the risk of floods has been reduced there is still the risk of overflowing due to the 100 year flood.

1.3.2 Relevant data sets available at regional level

Since the spatial planning does not evaluate formally any type of risks, no data on hazards can be extracted form these documents.

Nevertheless, there are other types of documents such as the Mondego's river basin plan, from which is possible to extract some relevant information on potentially hazards situation, namely those related with floods.

Out of the 7 potentially hazards situations mentioned in the table below, the more relevant ones, are:

A. Flood hazard, vastly mentioned in this report. The Mondego's river basin plan does hold some data on the maximum flow of intensity when the 100 year flood is being considered, and therefore, able to provide us with certain kind of information of how to control this potential risky situation;

B. Dams "break down" – Another relevant hazard type to be considered relates to the Mondego and Zezêre dams' potential danger of breaking apart (dam failures). More than 30 dams and weirs are known in the central region, from which 8 of them are considerably large structures.
   These potentially dangerous situations are only envisaged in those cases in which flood surge could exceed the 500^{th} year flood.

   Due to the location of some of those dams, namely the dam of Castelo de Bode, in the case of accident, the extent of impacts would clearly exceed the regional level, affecting the region of Lisbon and Vale do Tejo.

C. Dike "break down" – this is another potentially risky situation that took place during the winter of 2000/01 when flood waves in Mondego River exceeded by far flow capacities of the existing dikes which fall apart overflowing the village of Montemor o Velho and several others villages from Baixo Mondego.

Table 1: Natural and Technological hazards in the planning of Centre Region

Natural and technological hazards	**spatial relevance** in the planning region: + = high, o = low, - = none
Natural hazards	
Floods	+
Landslides/ avalanches Rock collapses Landslides	 0 0
Earthquakes	0
Droughts	+
Forest fires spatially in Pinhal Interior Nut III (Inland region)	+
Storms wind storms	 +
Extreme precipitation (heavy rainfall and hail)	+
Extreme temperatures (heat waves)	0
Technological Hazards	
Hazards from nuclear power plants	0
Hazards from hazardous -storage of nuclear waste Old uranium mine with ground water contact near Mangualde e Urgeiriça	 +
dam failure	+
Hazards from other sources	0

1.3.3 Elements of available planning documents with relation to hazards and risks

Protection Civil plans

As mentioned in the first interim report, the national council for emergencies and civil protection (CNPCE) is the responsible official board for the coordination of all civil protection services.

1st Level – Institution: National Centre of Emergencies and Civil Protection (CNPCE)
Scope of Action: National Territory

Accountable body/ Figureheads:

- ***Planning body*** - NCECP depends directly on the Prime Minister of Portugal;
- ***Operation level*** – NCECP guides the activities of the National Services of Fire Brigades (SNB) and the National Service of Civil Protection (SNPC)
- ***Strategic Document*:** National Plan for Emergencies and Civil Protection

Within CNPCE, there are sectoral committees, which depend directly upon government even if in operational terms depends upon the president of CNPCE.
Those committees are accountable for the elaboration of emergency plans that should be put in place in case of accidents, having also, the possibility of preventing them since they have at their disposal an advanced risk forecast simulation system.

CNPCE is a full member of senior civil emergency planning committee.

2nd Level – Institution: District Centre for operations of Emergency and Civil Protection
Scope of Action: District Area

Accountable body/ Figureheads:

- ***Responsible –*** *Governador Civil (Mayor of County Council)*
- ***Operation level*** - District Services of Fire Brigades and District Service of Civil Protection, which are being merged.
- ***Strategic Document:*** District Plan for Emergencies and Civil Protection, plus special emergencies plans for flooding, fire forest and seismic activity, etc. These strategic documents have a full physical description of the basin, where the different levels of alerts are laid out, - The different procedures in case of risks are established,- and finally, a contact list of human and material resources,- needed in case of accident,- are listed.

3rd Level – Institution: Municipal Centres of Emergencies and Civil Protection
Scope of Action: Municipal area

Accountable body/ Figureheads:

- ***Responsible*** – City's Mayor
- ***Operation level*** – town councillor for Civil Protection, the chief of Fire Brigades, the chief of GNR (police operating in rural areas), director of City council Infra- structures, director of EDP (Portugal Electricity Enterprise), director of the Red Cross, director of hydric resources of INAG, director of *Misericórdias* (Charity health and social care Institution)
- **Strategic Document:** Municipal Plan for Emergencies and Civil Protection. This plan holds information on:
  - Mission statement
  - Responsibilities of each civil protection agent in case of accidents
  - List of contacts of each one of those entities
  - List of material and human resources within the municipal area (this includes private bodies as well)
  - General characterizations of the main risks and the levels in which they have to mobilize the right agents according to the level of risk (green, yellow, orange and red).

  In case of an accident, the 3rd level is the first one that is responsible for mobilizing all necessary civil protection agents, and if proves to be insufficient due to the dimension of the phenomenon or due to the scarceness of human or material resources. They will be accountable for mobilizing the 2nd and, if necessary, the 1st level of this chain.

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ANNEXES OF 2 CENTRAL REGION OF PORTUGAL

Annex I What will be text be?

Annex II Preliminary maps of selected hazards, vulnerability and risk of the Central Region of Portugal

Annex III Development of new indicators

Annex I What will be text be?

TERRITORY, SETTLEMENT AND POPULATION

Territory	*Centro*
Total area	23 666,4 km²
Weight of total area in the country	25,7 %
Number of NUTE III	10
Number of Boroughs	78
Number of Wards	1 109
Área média dos concelhos	303,4 Km²
Área média das freguesias	21,3 km²
Occupation of the territory:	
Agricultural area	27,4 %
Forestry area	43,6 %
Urban area	10,8 %
Other uses	18,2 %

Settlement	
Population density (2001)	75,3 hab/km²
Structure of the settlement (% of population by places, 1991):	
Places up to 1,999 inhabitants	72,1 %
Places with 2,000 to 4,999 inhabitants	7,9 %
Places with 5,000 to 9,999 inhabitants	1,4 %
Places with 10,000 to 19,999 inhabitants	3,1 %
Places with 20,000 or more inhabitants	15,5 %
Population in the major urban centres (2001)	727 980 hab.
Weight in the total population of the Centre Region	40,8 %

Population	
Resident population (2001)	1 782 254 hab.
Weight in the resident population in the country (2001)	17,2 %
Population present (2001)	1 749 168 hab.
Families (2001)	640 741
Average size of families (2001)	2,8 pess/fam.
Variation in resident population 1991/2001	3,5 %
Age structure of the population (2001):	
0 a 14 years old	266 915
15 a 24 years old	245 904
25 a 64 years old	919 305
65 years old and over	350 130
Male/Female ratio	0,93
Fertility rate (2000)	41,8 %
Birth rate (2000)	10,1 ‰
Mortality rate (2000)	11,6 ‰
Ageing index (2000)	131,0 %

ECONOMIC BASE

Overall indicators	
Regional GDP (1998)	13 550 M€
Weight of the regional GDP in the country	13,4 %
GDP per capita (1998)	7 922 €
GDP per capita (PPC) – EU = 100 (1998)	65
Ratio in national productivity (1999)	82 %
Regional employment (1998)	778 000
Unemployment rate (2001)	2,5 %
Activity rate (2001)	57,1 %
Female activity rate (2001)	52,1 %
Gross forming of fixed capital (1997)	2 915 M€
GAV (1998)	11 677 M€
Structure of the GAV by sectors (1998):	
Agriculture, arboriculture and fishing	5,3 %
Industry, construction, electricity, gas and water	36,4 %
Services	58,3 %
Population employed by sectors of activity (1998):	
Agriculture, arboriculture and fishing	18,5 %
Industry, construction, electricity, gas and water	33,1 %
Services	48,4 %
Number of companies with head offices in the region (2000)	195 611
Sales volume of companies in the region (2000)	22 521 M€
Imports (2000)	3 723 M€
Exports (2000)	3 652 M€

Agriculture	*Centro*
Agricultural area (1999)	935 173 ha
Agricultural Area in Use (1999)	588 755 ha
AAU by unit (1999)	4,62 ha
Number of agricultural units (1999)	128 119
Blocks of agricultural exploration (1999)	6,4
Weight of agriculture in the regional GAV (1998)	4,8 %
Weight of agriculture in regional employment (1998)	18,1 %
Number of permanent workers per unit (1999)	2,5
Idade média da mão-de-obra agrícola (1999)	51,2 anos
Wine production (1999)	1 407 508 hl
Olive oil production (1999)	157 155 hl
Cattle stock (1999)	1 613 968 heads

Fishing (2000)	
Total fish landed	16 551 ton.
Value of fish landed	20 M€

ECONOMIC BASE

Industry (1998)	
Number of manufacturing companies	12 528
Staff working in manufacturing industry	166 615
GAVpm in manufacturing industry	2 712 M€
Food and drink	9,2 %
Textiles, clothing and footwear	12,7 %
Wood, paper and graphic arts	16,1 %
Chemicals. Rubber and plastics	8,7 %
Non-metallic minerals	20,3 %
Base metals	1,7 %
Metallic products	10,0 %
Machines, equipment and devices	13,1 %
Transportation materials	4,3 %
Others	3,9 %
Weight of manufacturing industry in the regional GAV	25,8 %
Weight of manufacturing industry in regional employment	21,4 %
Number of mining companies	367
Staff working in mining industry	2 942
GAVpm in mining industry	78,2 M€

Trade and services (1998)	
Weight of trade in the regional GAV	12,8 %
Weight of trade in regional employment	14,4 %
Weight of real estate activities and services to business in the regional GAV	9,8 %
Weight of real estate activities and services to business in regional employment	2,7 %
Weight of education in the regional GAV	8,7 %
Weight of education in regional employment	6,5 %

Tourism	
Number of hotel establishments (1999)	538
Number of restaurants (1999)	2 643
Staff working in hotels and restauration (1999)	26 466
Lodging capacity of hotel establishments (2000)	20 161 beds
Nights spent in hotel establishments (2000)	2 000 134
Rate of occupation of hotel establishments (2000)	28,2 %
Average stay per guest in hotel establishments	1,9 nights
GAVpm (1998)	176,5 M€

HABITATION AND CONSTRUCTION	
Total buildings (2001)	757 476
Total dwellings (2001)	949 796
Licences granted for construction of buildings (2000)	13 800

EQUIPMENTS AND SERVICES

Teaching	
Number of students enrolled (2000/2001)	387 280
Pre-school	11,3 %
Primary School	50,6 %
Secondary School	16,8 %
Professional Schools	1,8 %
Higher Education	19,5 %
Number of teaching establishments (2000/2001)	4 912
Pre-school	31,4 %
Primary School	63,7 %
Secondary School	2,7 %
Professional Schools	1,0 %
Higher Education	1,2 %

Health	
Number of hospitals (1998)	41
Hospital beds per 1,000 inhabitants (1998)	4,5
Doctors per 1,000 inhabitants (2000)	3,1
Pharmacies per 10,000 inhabitants (2000)	2,8

Telecommunications e Energy	
Telephones (PT) per capita (1999)	0,4
Domestic consumption of electricity per consumer (2000)	1,9 kW/h

Banks (2000)	
Banks, building societies and mutual agricultural credit institutions (establishment)	923
Deposits	15,8 M€
Credit granted	12,6 M€

Buying Power	
Buying Power index (2000) (Portugal=100)	77,5 %

Figure 2: Statistical data of the Central Region of Portugal

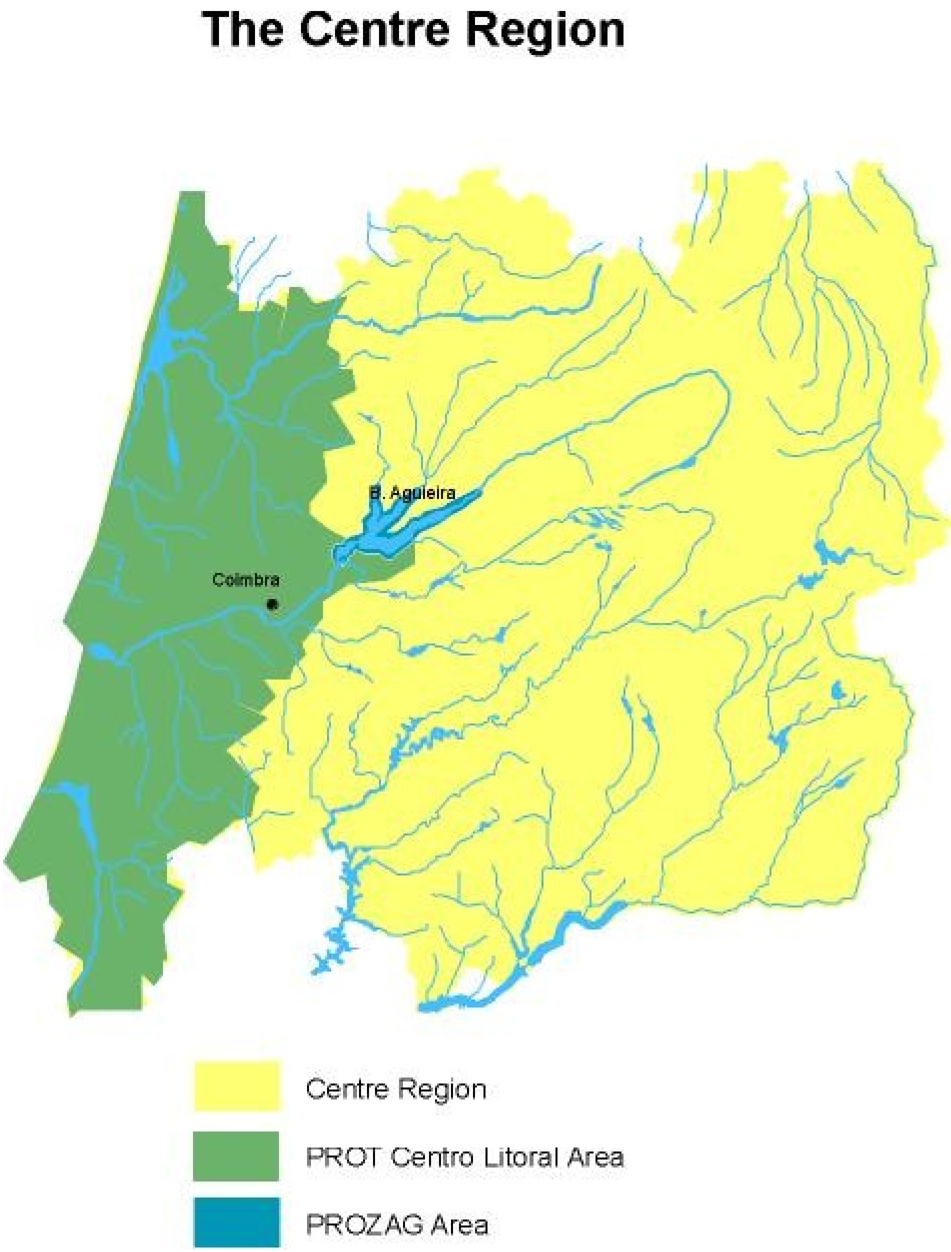

Figure 3: The Centre Region

Annex II Preliminary maps of selected hazards, vulnerability and risk of the Central Region of Portugal

Note: This chapter intends to be in relation to the spatial typologies developed in project 1.

Preliminary maps of selected hazards, vulnerability and risk

Note: The list/map of highly sensitive areas will be one of the main outputs of the project (also in this case we suggest to use the term (high) risk areas). At this stage the focus of our work should be on maps of the risk components such as maps about hazards (depending on the availability of data), damage potential etc. Concerning the term “sensitivity”: We have not explicitly defined "sensitivity"; this should be added to our glossary; a common understanding and a consideration of this term is of high importance as the type of sensitivity (of a region) also determines the type of response/coping capacity that will be needed. Another determinant for the needed coping capacity is the political system in general and as a part of this especially the planning system. Together, sensitivity and response capacity can serve as criteria for the selection of the case studies.

Preliminary maps of selected hazards

The relevance of forest fire hazard specially to the southern Europe and the fact that this risk maps were made available in the internet by Portuguese government authorities were the reason to decide to introduce that information in this report. Although ESPON Portuguese consortium did not gather sufficient information at this moment this hazard will be studied at the Central Portugal Region level. The request made to the ESPON 1.3.1 Project to study the hazards like earthquakes, droughts, floods, mining radioactivity contamination and nuclear power plants is the reason for these hazards being present in this second interim report, although some of them are not sufficiently studied at Portuguese Central Region scale. Nuclear power plant contamination is not significantly due to Almaraz Nuclear Power Plant situated some 200 Km upstream in Spanish territory in this region of Portugal. The affected regions are mainly in Tejo basin and the affluent rivers that belong to Central region are not affected by nuclear power plant area of influence.
The central region of Portugal occupies an area of 23,666 km2 (25.7% of the Portuguese land area) and includes 78 counties. The population is almost 1.8 million inhabitants (17.2% of the national total), of which 65% is made up of active population The region contains 10 NUTs III level areas. It is marked out by being crossed through the main mountain chain in Portugal, which culminates in mountain Serra da Estrela (1991m). It includes the hydrographical basins of some of the most important Iberian Rivers (Mondego, Vouga, Dão, Lis) and part of Douro (through Côa) and Tagus (through Zêzere) and several water reserves, including thermal and mineral waters, of the greatest strategic importance for the region and for the country (Fig. 1).
will be presented several GIS derived maps tha will be used in Risk analysis.

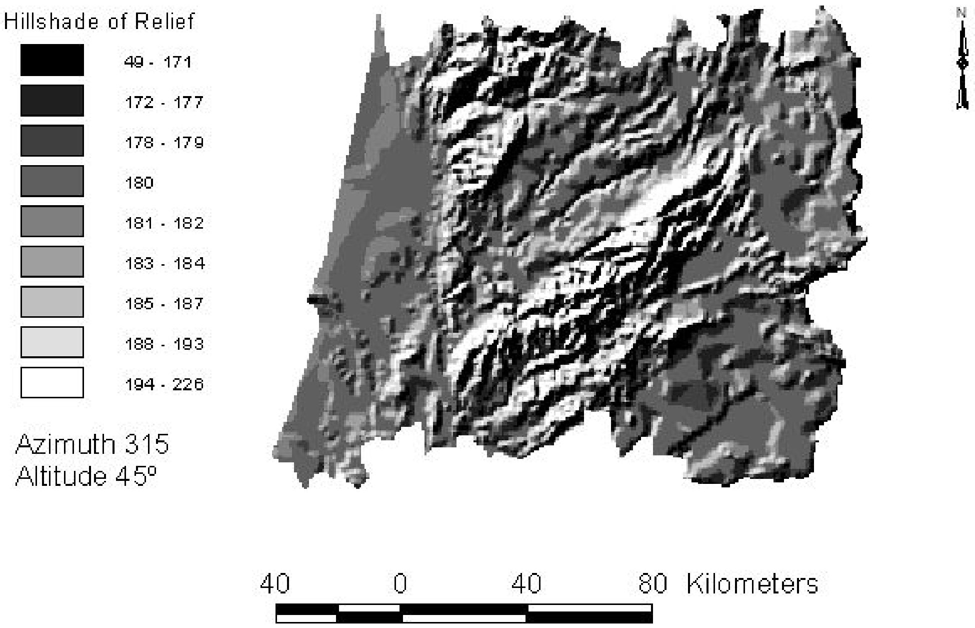

Figure 4: Elevation aspect of Central Region of Portugal

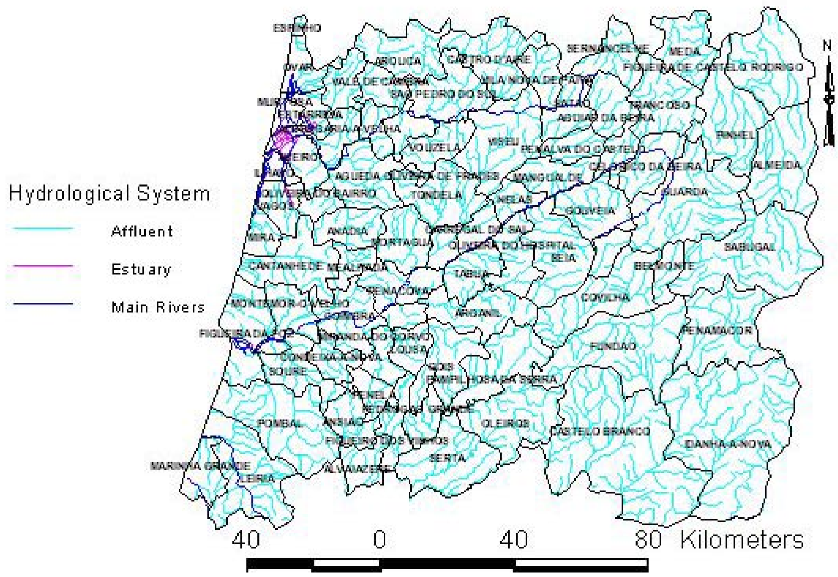

Figure 5: Hydrological System of Central Region

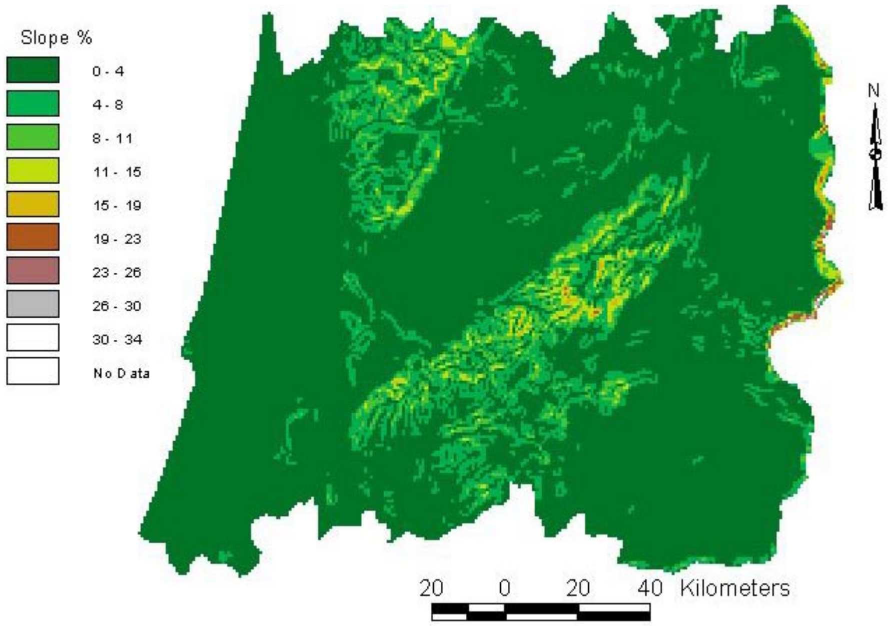

Figure 6: Slope map (%) of Central Region of Portugal

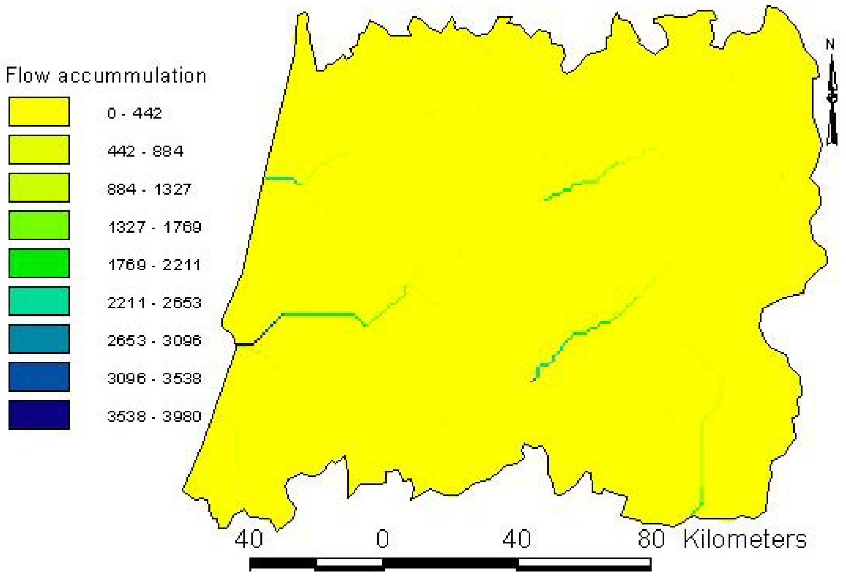

Figure 7: Flow accumulation from Central Region of Portugal

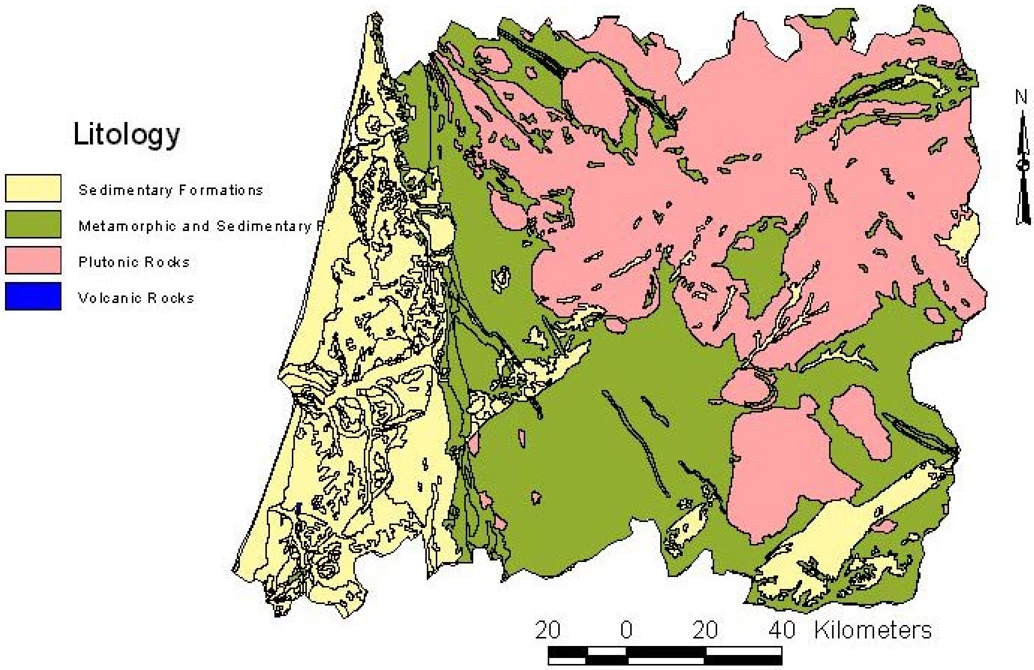

Figure 8: Main lithologies of Central Region of Portugal

Earthquake hazard map

According to the UNESCO definition in 1980, the seismic risk is related to the expected losses or damages for a certain element exposed to risk, during a certain length of time.
As described in chapter 4.4 of the First Interim Report, for the hazard seismicity & earthquakes, in the case study area of Central Portugal, the pressure indicators available are active faults, instrumental and historical seismically and the response indicator seismic zoning for constructions.
A short description of the mentioned pressure indicators will be given below. For the indicator active faults it is considered that a fault is active if it suffered a displacement in the present tectonic regime (usually considered for the Portuguese territory as the last 2 My) having, therefore, capability to produce new displacements in the future. In a pure geological sense, the activity of faults is measured by its slip-rate and is express in cm/yr or mm/yr. However, the data available classifies active faults in function of geological and geophysical criteria. It is not available yet a specific map with the active faults of the Central Portuguese region thus it will be derived from the 1:1 000 000 Neotectonic Map (Figure 9)

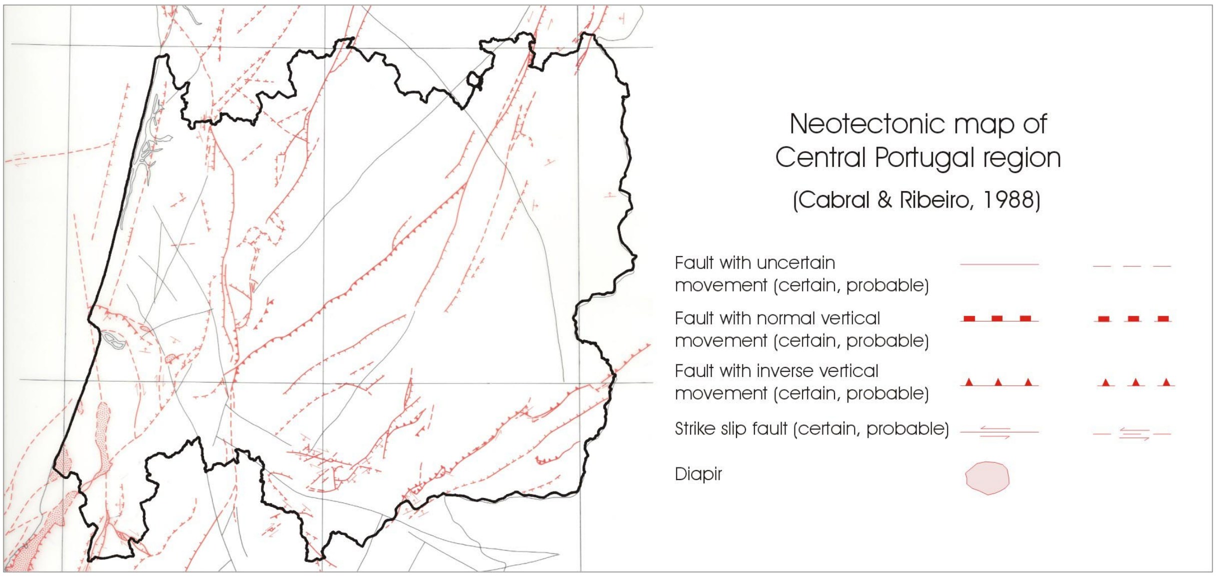

Figure 9: Neotectonic Map of Central Portugal (Cabral & Ribeiro, 1988)

The instrumental and historical seismicity is other pressure indicator. The seismicity detected for the seismographs and that which have historical descriptions of the damages give us information about the zones that are more vulnerable to the earthquakes. The seismic data are collected by a seismograph network and are published by the Instituto de Metereologia in monthly and annual bulletins. This institute has databases with the information about the historical seismicity.

The response indicator available is the seismic zoning for constructions. This indicator is included in the "Portuguese code for security and actions in buildings and bridges structures" (Regulamento de segurança e acções para estruturas de edifícios e pontes, decreto-lei nº235/83 do D.R. nº125, Iª série), where the seismic zones are defined for the Portuguese territory. This map (see next figure) is, so far, the best approach of a seismic hazard map for construction.
The quantification of the action that a earthquake may cause on the constructions is made in terms of the seismic coefficient α and then calculating the effect on the constructions through methods of dynamic analysis integrating the seismic data, the ground nature (that is classified in type I - hard and coherent soils and rock; II - hard, coherent and medium hard soils, incoherent and compact soils and III - coherent and soft and very soft soils and incoherent non compact soils) and the construction features.
This map (Figure 10) is currently used by the insurance companies, construction companies and for the environmental impact studies to quantify the seismic action for the constructions.

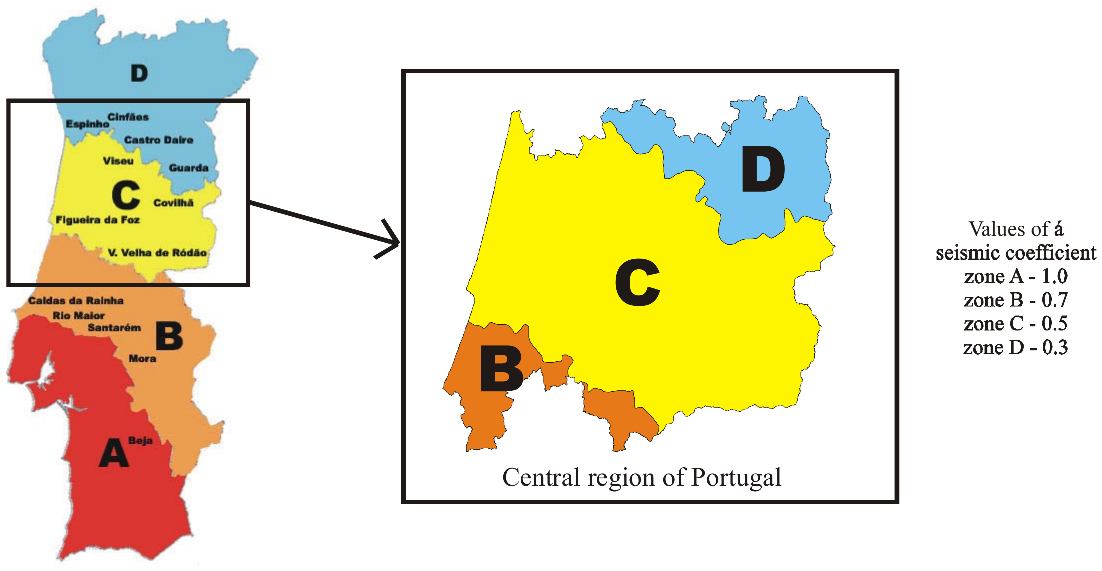

Figure 10: Seismic zoning from the Code for security and actions in buildings and bridges structures

The seismic zoning made for the portuguese territory reflects the conjugation of the inter plate seismicity resulting from the activity in the tectonic plate boundary Eurasia/Africa situated south-southwest of the territory (Azores-Gibraltar Fault) , and the intra plate seismicity, like the one resulting from the activity of the Vale Inferior do Tejo fault, situated near Lisbon. The resulting map shows a seismic zoning which is more important at the southwest of the territory, decreasing in northeast direction.

Floods hazard map

Flood period in Central Portugal goes from the autumn until spring. Flood affects the most important rivers but cause damage in several parts of Central Region of Portugal due to lack of appropriate land planning. Nowadays response capacity to water flow raising is higher in most of the rivers. In the Mondego River a system to regulate water flow to prevent flooding was implemented several years ago, nevertheless in 2000 a serious flood occurred in the city of Coimbra (Proença Cunha, 2002).

In Portugal a Flood Surveillance System was developed that joins several institutions to monitor and prevent flood. This system operates in dam control of water flow to avoid high water flow in short periods without recovery time[6].

The scheme of the surveillance is represented in Figure 11.

[6] The institutions involved are Instituto de Meteorologia (Weather Institute), INAG (Water Institute), Regional Authorities of Environment, Dam Management Entities, Serviço Nacional de Protecção Civil (SNPC) (Emergency and Protection National Service) and regional delegations of this institution. (http://snirh.inag.pt/snirh/download/relatorios/net_Livro_REDES_svarh_9.pdf)(*in Portuguese*)

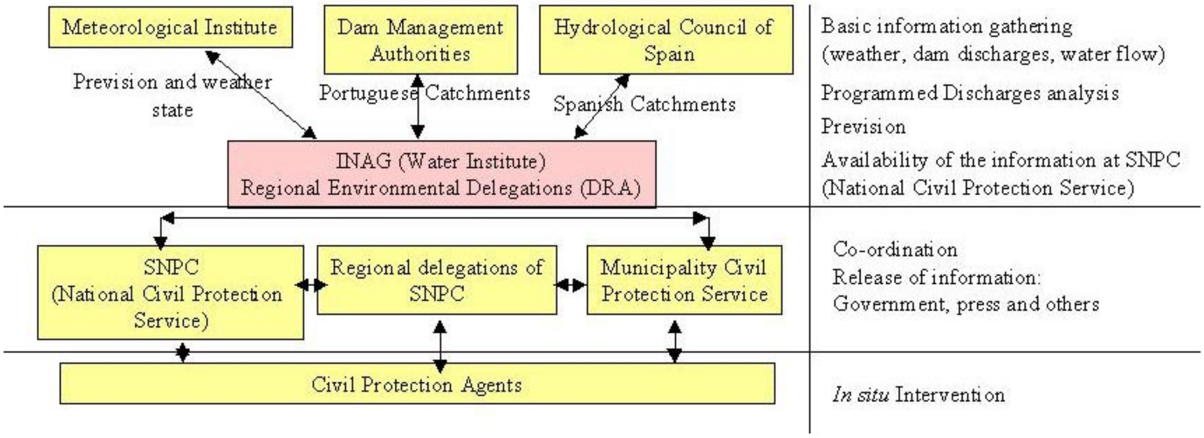

Figure 11: National Surveillance Plan

Flood Vulnerability areas

Vouga River, the stuarine conditions of the terminal part (half-delta) are susceptible to inibit water flow specially when sea waves are high and river water flow is dificult to enter in the sea. **Águeda river**, also register several floods that affects Águeda city.

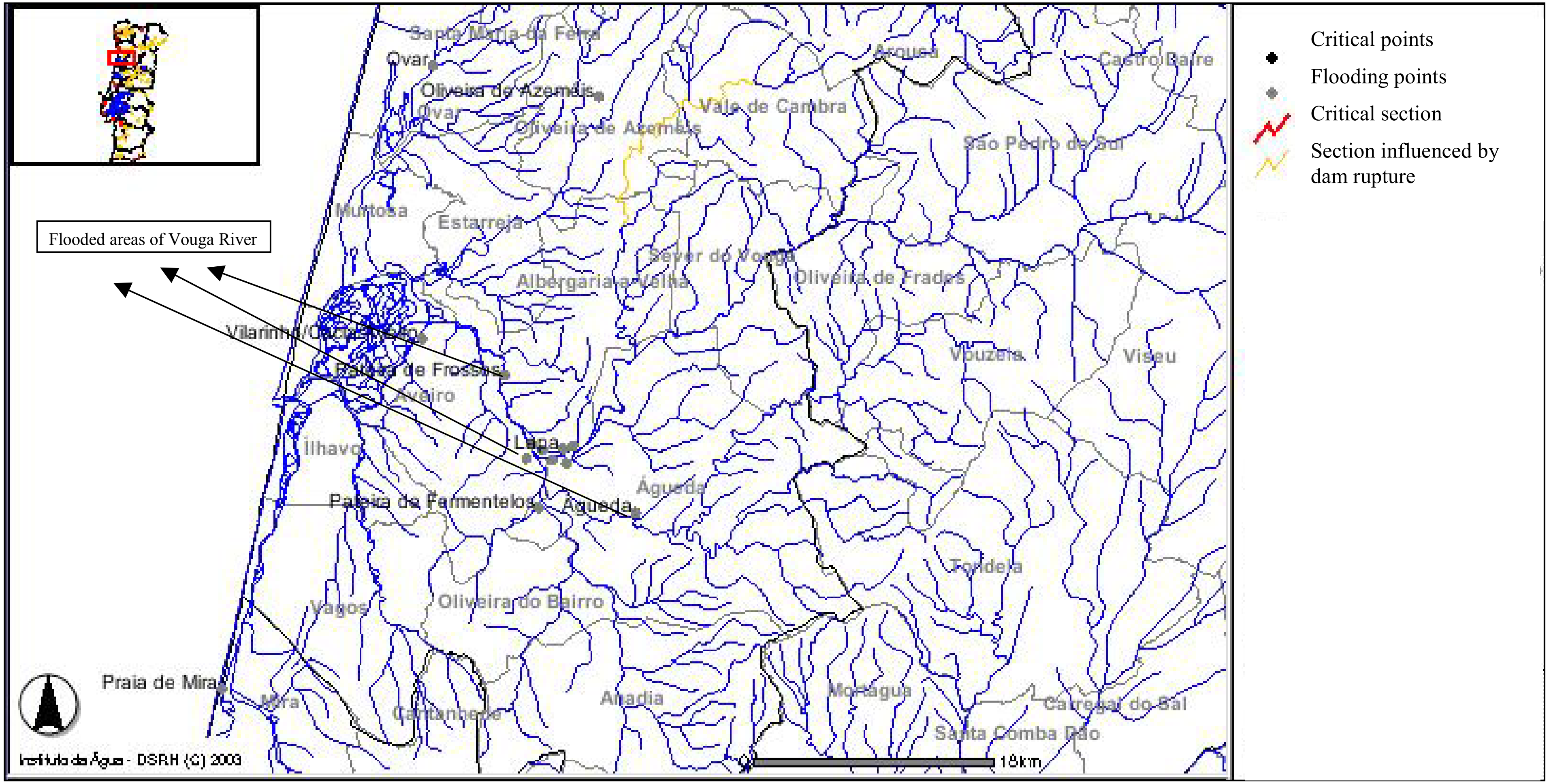

Figure 12: Vouga basin vulnerability map with registered flooded areas

Mondego River problems are caused by agriculture practices downstream from Coimbra city added to the fact that the main affluents of Mondego like, Alva, Ceira, Arunca, Ega also contributes with high water flow in some periods of the year (Figure 13).

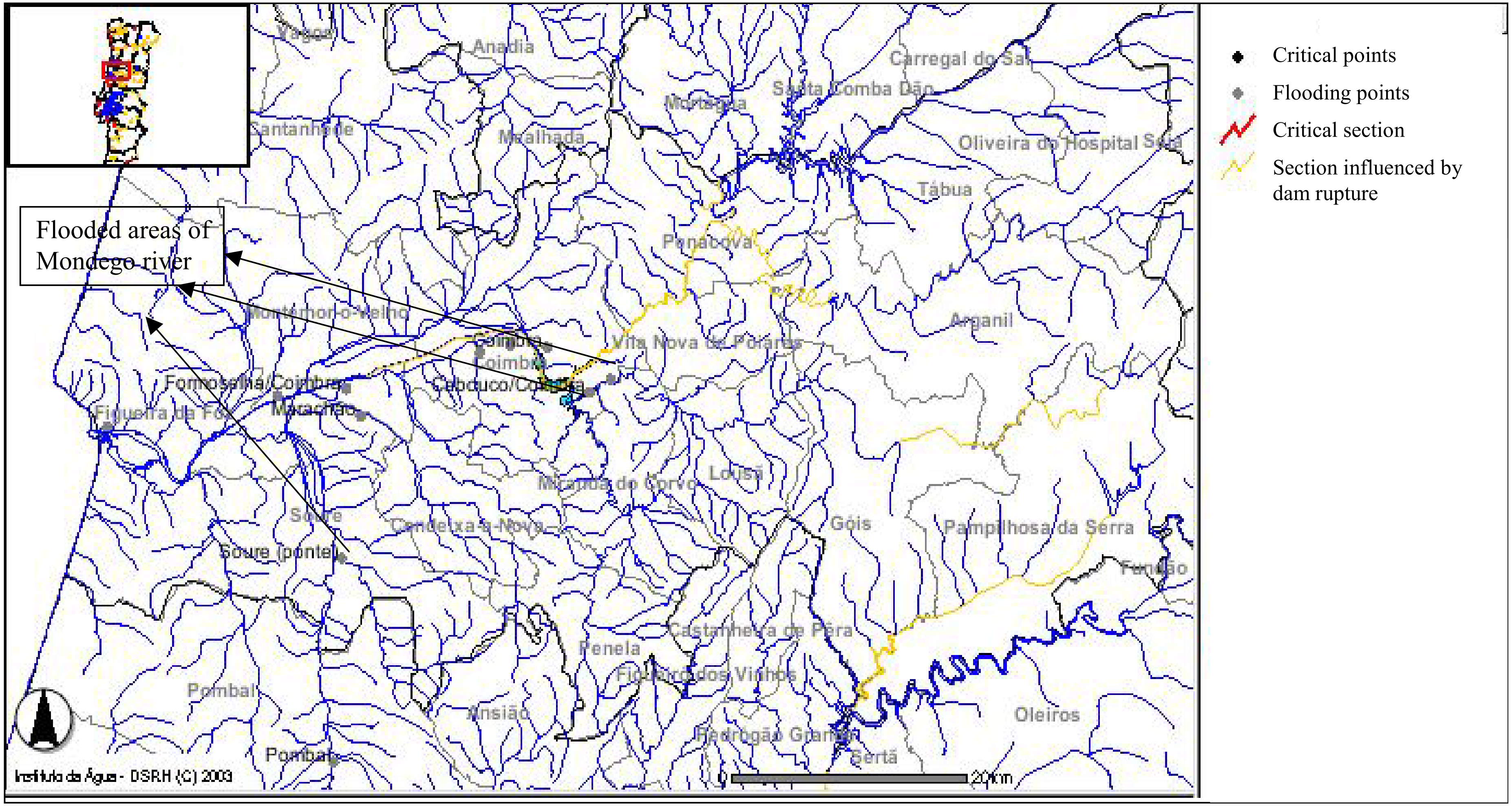

Figure 13: Mondego basin vulnerability map with registered flooded areas

Zezere River high vulnerability to flood areas are located in Fundão, Covilhã e Belmonte (Figure 14).

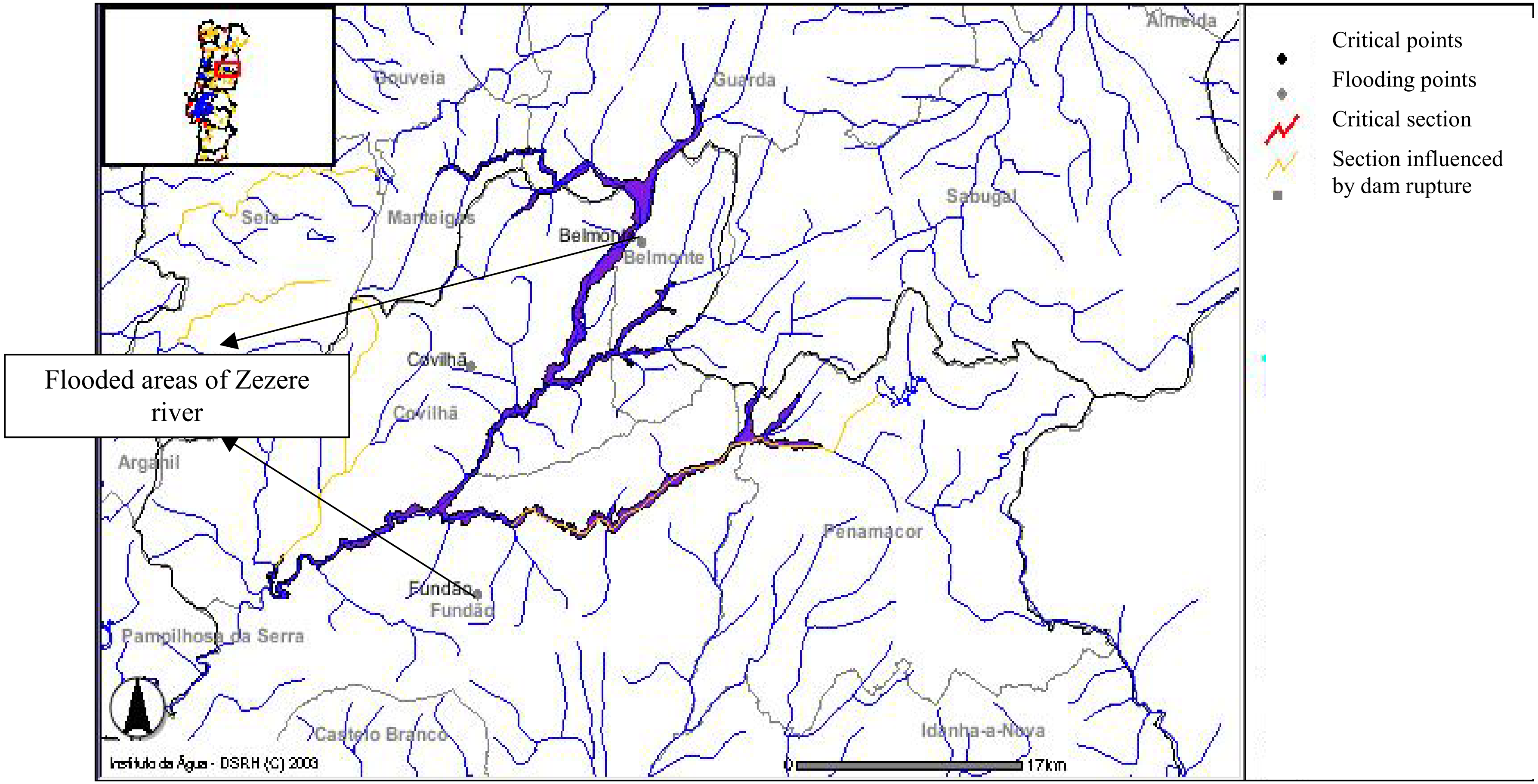

Figure 14: Zezere basin vulnerability map with registered flooded areas

Lis river considered by INAG the critical area affects the city of Leiria (Figure 15).

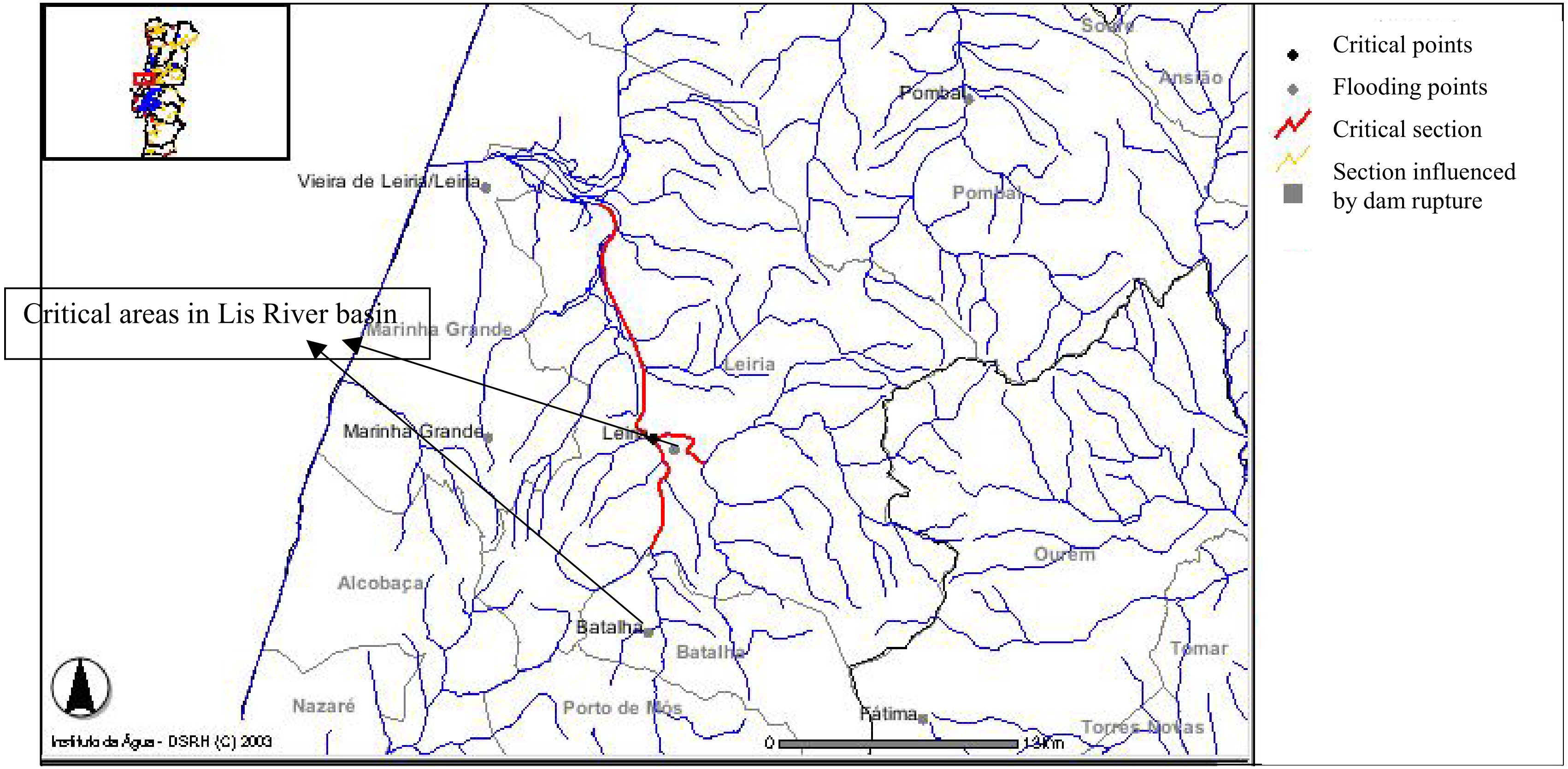

Figure 15: Lis basin vulnerability map with registered critical areas

Big dams are considered higher than 15 m and storage of 1 000 000 m^3 of water. In Portuguese legislation responsible entities for dam management are forced to define flooding vulnerability areas caused by rupture of a dam, with risk analysis based in hydrodinamic models, with emergency plans.

Portuguese legislation contains three documents:

- The **Regulamento de Segurança de Barragens** (**RSB**) establishes protection to people in case of the acident occurs and calculates the effect of the flooding wave and the risk map (article 42º). In 44º Article, o RSB establishes the Emergency Plan, in 45º article is included the warning and alert system.
- The **Normas de Projecto de Barragens** (**NPB**) include hydrological studies with evaluation of period of flooded areas and the efect of rupture of the dam with hydrodinamic models (Article 6º) and the study of warning signal in real time.
- The **Normas de Observação e Inspecção de Barragens** (**NOIB**), consists of definition of a observation plan included in Article 12º, in Article 17º, is established a comunication scheme in case of anomalous situation.

Droughts hazard map

Droughts are a natural phenomenon that occur cyclically in many regions of the World but unfortunately raised their frequency in the last years due to the necessity of water caused by the raise of population and the demands of modern society and also due to global climatic change.
The drought situations have been reported in Portugal for several periods. Between 1940/41 and 1994/95 relevant droughts was registered in 1943/44-1944/45 with a return period of 50 years.
In Portugal droughts are being studied by (Santos,1981; Cunha, 1982; Santos *et al.*, 1983; Correia *et al.,*1988; Rodrigues *et al.*, 1993; Vaz, 1993; Santos, 1996, 1998; Pimenta & Cristo, 1998 *in* Plano Nacional da Água (National Water Plan)).

Coastal areas of Central Region of Portugal are not usually affected by insuficient domestic water distribution in case of drought, but concerning water distribution in Castelo Branco and Guarda located in the interior Central region crops and cattle are much affected. This indicator need to be developed in Central region.

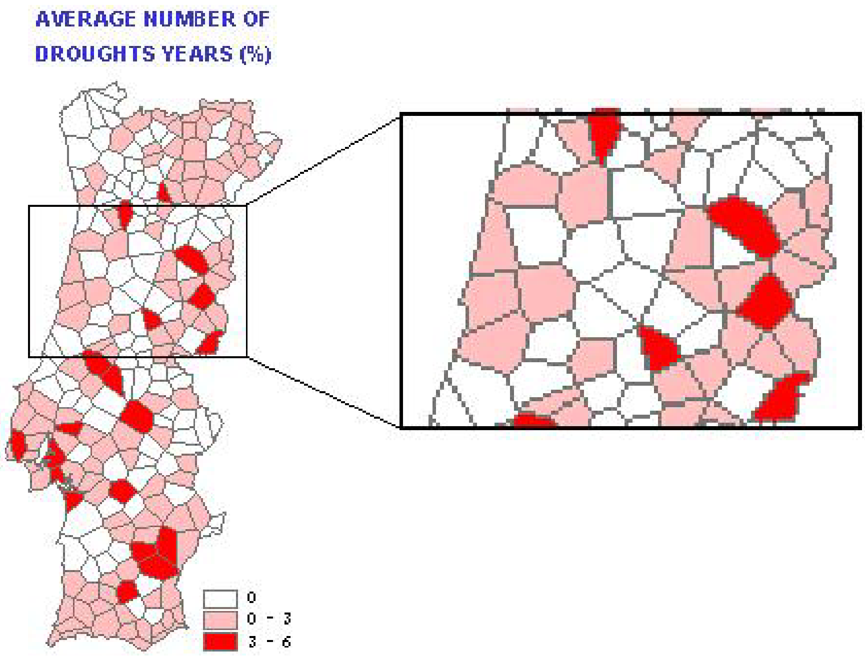

Figure 16: Average Number of droughts year (%) in Central Portugal

Source information: Plano Nacional da Água (National Water Plan)

The highly affected areas, meaning the areas with more average droughts per year are Guarda, Penamacor and Idanha-a-Nova (Figure 16).

Nuclear power plants hazard map

This hazard is not relevant in the Central Region of Portugal context.

Forest fires hazard map

Forest fires are one of the most important natural hazards affecting Portugal. This is considered a natural hazard not because is naturally occurred but because depends mostly in natural conditions to develop. Weather conditions, vegetation cover, elevation and accessibility, fireman intervention delay, are the most important contributions for fire development. The most important occurrencies are from July to September and the annual fire occurrency average from 1980-1996 were 12.500. The annual burned area is 87.000 hectares from wich 50.000 are from forest cover. Centre and North Portugal are the most afected regions for forest fires.
Law-Decree n.º 334/90 of 29 October prevents situations like controlled fires, waste burning, smoking, make fire, pic-nic, apiculture, electric lines, railways at short distance to the forest. Some of this activities are not permited only in the „season fire period" wich is regulated every year (Regulamentary decret n.º 55/81 of 18 December and n.º 36/88 of 17 October).

As it was explained before National Emergency Protection Agency is responsible for hazards prevention and answering to the emergency occurrence and risk assessment. This institution uses the Canadian Index on forest fire vulnerability already described in previous reports but due to the fact that data are not available another information was obtained.

In a easy access mapping, another methodology was performed to map risk and vulnerability areas from Direcção Geral de Florestas from 1994 in a project named CRIF (Cartografia de Risco de Incêndio Florestal) risk of forest fire mapping that will be presented at this stage of ESPON-HAZARD project because it is already available in internet (http://snig.igeo.pt/Portugues/Igd/html/frametemas.html).

Methodology
The used fire risk index was based in Chuvieco et Congalton (1989) (in CRIF, 1994). This model uses a raster bases (IDRISI) to organise the information. Risk maps are produced with the help of several layers of information resumed in this table with the coefficients to enter in the risk analysis.

Table 2: Fire risk index

Variable	*Maximum value of the variable*	*Variable coeficient of the model*	*Reclassification of the variable*	*Subclass reclassification of the variable*	*Subclass value*
Slope	*210*	*21%*	*0--10*	*3,81%*	*8*
			10--20	*11,43%*	*24*
			20--30	*22,38%*	*47*
			30--40	*66,67%*	*140*
			>40	*100%*	*210*
Sun Exposition	*47*	*4,7%*	*315-45*	*6,38%*	*3*
			45-135	*21,28%*	*10*
			135-225	*100%*	*47*
			225-315	*57,45%*	*27*
Population distribution	*38*	*3,8%*	*0--250*	*100%*	*38*
by Km^2			*250--1500*	*21,05%*	*8*
			>1500	*100%*	*38*
Class of	*399*	*39,9%*	*Class 1*	*100%*	*399*
landuse			*Class 2*	*73,343%*	*293*
			Class 3	*47,4736%*	*189*
			Class 4	*24,06%*	*96*
			Class 5	*15,03%*	*60*
			Class 6	*4,51%*	*18*
			Class 7	*1,5%*	*6*
Traffic net	*136*	*13,6%*	*<25*	*100%*	*136*
			25--50	*46,32%*	*63*
			50--100	*20,58%*	*28*
			100--150	*9,55%*	*13*
			4 dense	*50%*	*68*
			3 dense	*23,52%*	*32*
			2 dense	*10,29%*	*14*
			1 dense	*5,14%*	*7*
Hidro-	*59*	*5,9%*	*0--30*	*0*	*0*
graphynet			*>30*	*100%*	*59*
Surveillance station vision	*111*	*11,1%*	hidden	*100%*	*111*
basin			*1 vision site*	*11,71%*	*13*
			>=2 vision site	*6,31%*	*7*
TOTAL	*1000*	*100%*	#	#	#

Example of Lousã region (Figure 17) will be presented below, although several other regions also have available risk maps in internet. Map methodology applied and how the maps were achieved is also presented.

Clime characterisation: Maximum and minimum temperatures; precipitation, fog, wet, wind and than classification according to Thornthwaite. Soil type is obtained from soil characteristics.

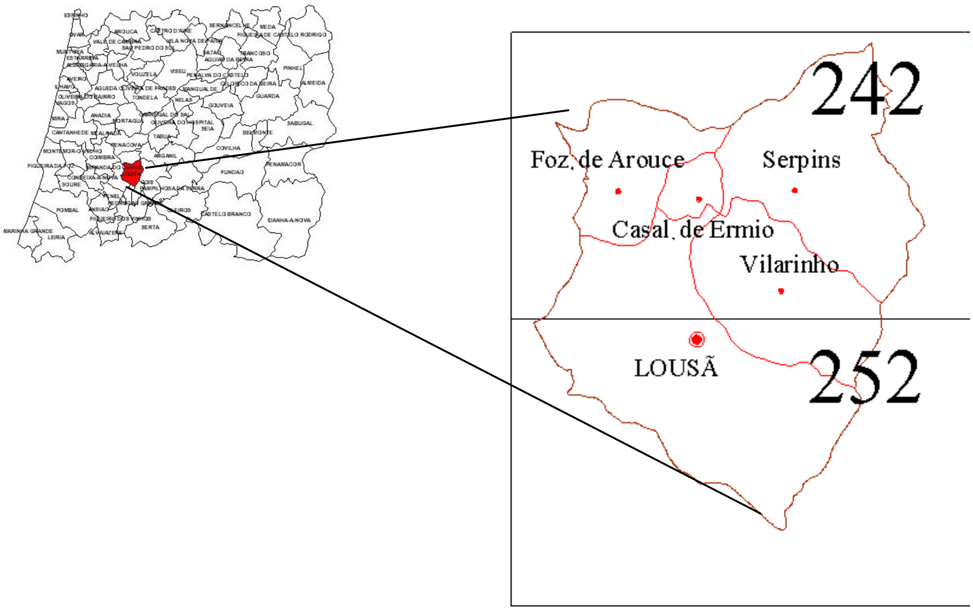

Figure 17: Region description (NUTS IV)

Demography situation like population density

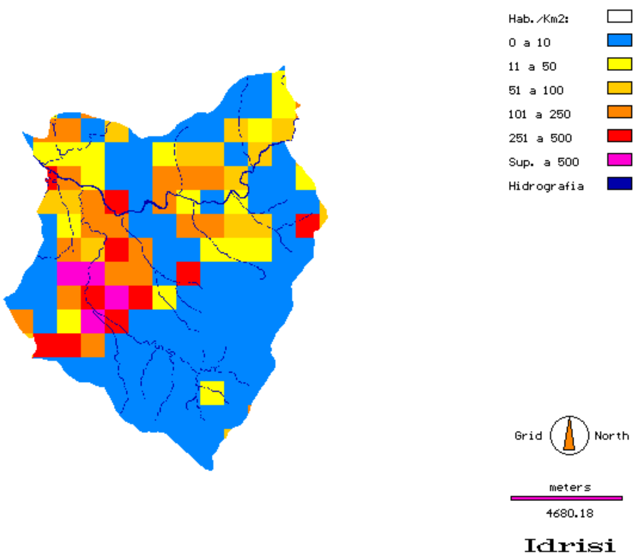

Figure 18: Population density

Physical characterisation of the region

Elevation map

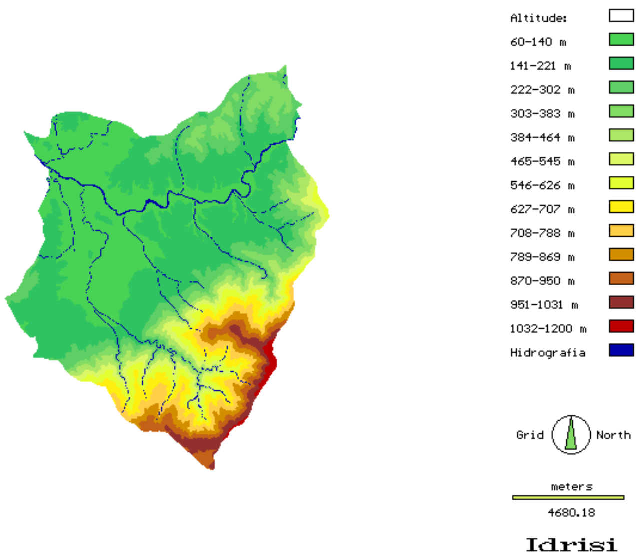

Figure 19: Elevation map

Sun exposure map

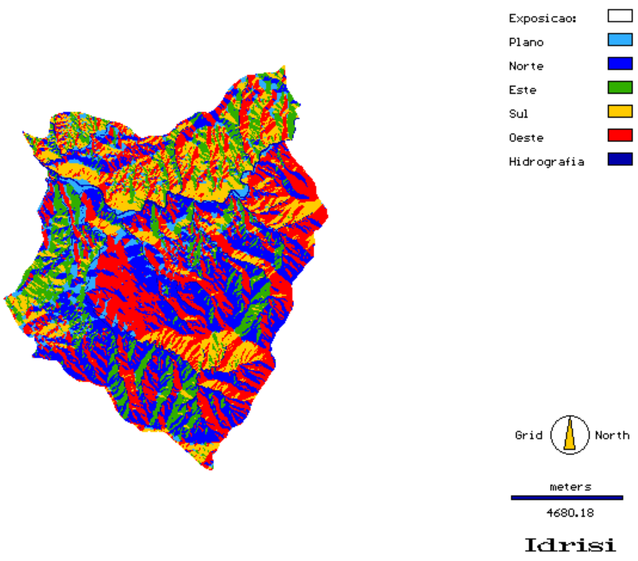

Figure 20: Sun exposure map

Slope map

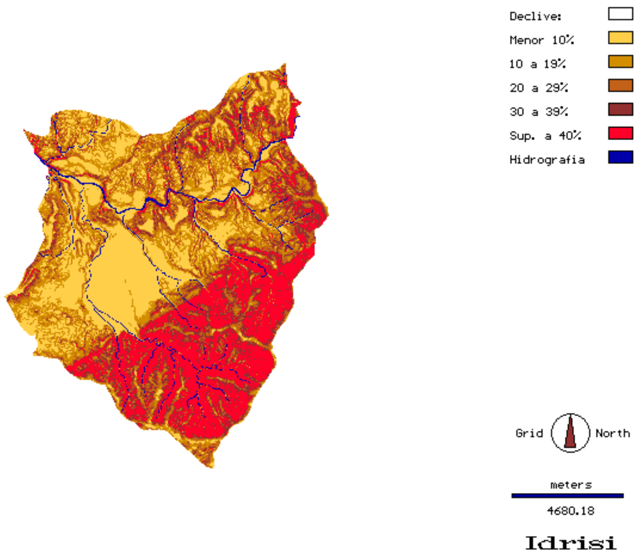

Figure 21: Slope map (%)

Landuse map

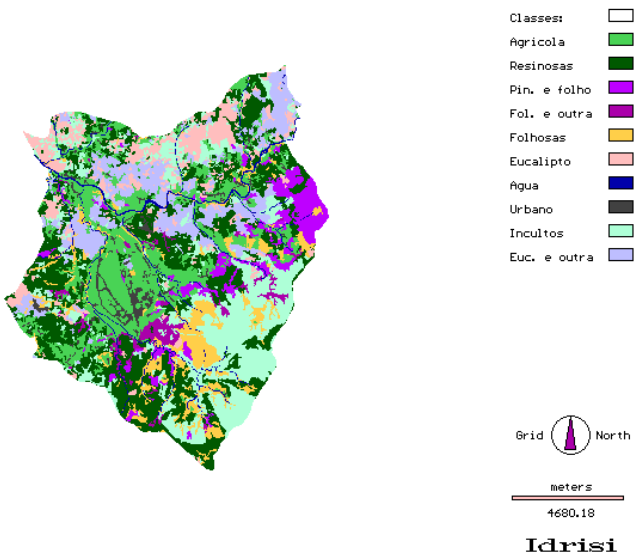

Figure 22: Land use map

Track locations by forest area map

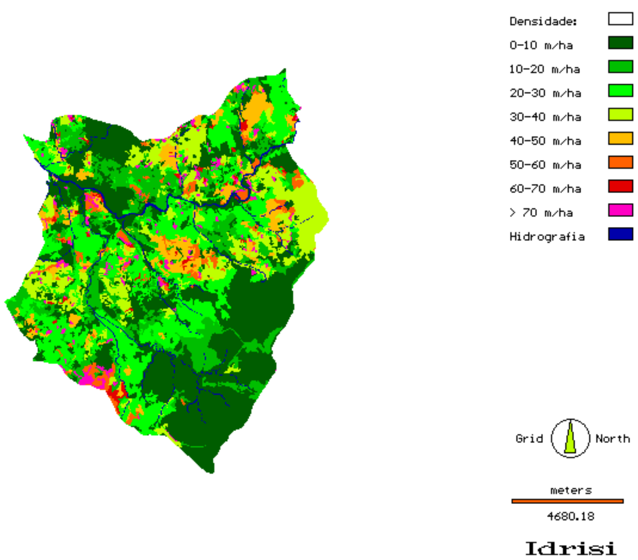

Figure 23: Track locations by forest area map

Map of visibility to surveillance station

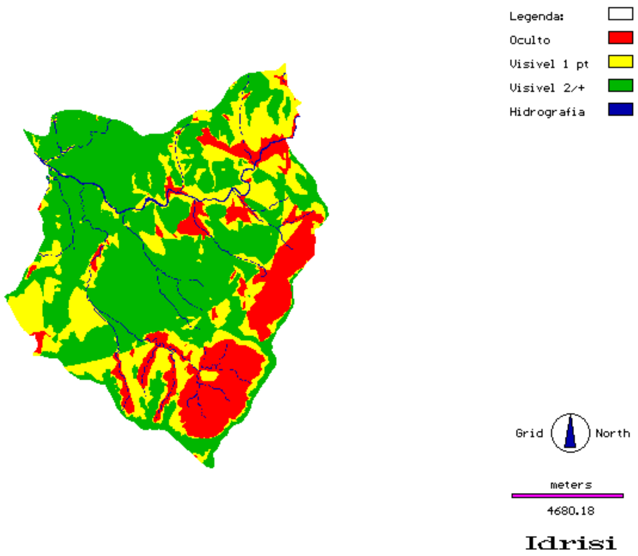

Figure 24: Visibility to Surveillance Station Map

Distance map to water bodies

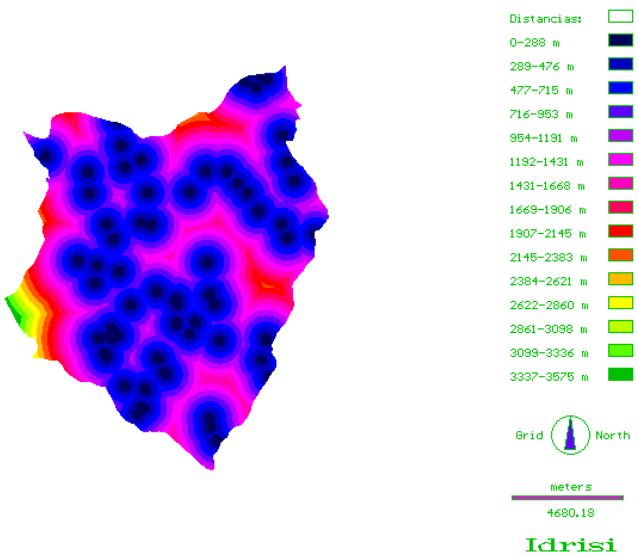

Figure 25: Distance from the water bodies

Uranium mine contamination hazard

Central Region of Portugal as a high quantity of abandoned uranium mines exploited since 1907 located mainly in granitic rocks and also in shales near the contact to granites (PARRA&FILIPE, 2003).

Information used to calculate the indicators of this hazard to obtain the risk map:
Instituto Geológico e Mineiro (IGM) Mining Information System (SIORMINP) for uranium mine locations and characteristics.
Instituto Geológico e Mineiro (IGM) Geochemical Database, in this particular case of uranium stream sediment results, data were obtained from Regional Portuguese Mapping of Stream Sediments in Aveiro University (FERREIRA, 2000), available in IGM.
Instituto do Ambiente (IA) Environmental Atlas (available in the internet), ArcView shapefile layers of contour elevation, lithology map, region urban centre map. Alfanumeric information in database like "number of people using a region water system", "number of systems per region".
Direcção Geral de Florestas-National Forest Inventory, the land use map.

When ESPON methodology is applied at the scale of Europe only few of the previously proposed indicators will be possible to use. The number of uranium mines per NUTS 3 as a pressure indicator and the number of water distribution systems per NUTS 3 as a pressure indicator. The reason of this restriction concerns the nature of information obtained to use at NUTS 3 level. Table 14 resumes the information used determine the hazard map.

Table 3: Determination system for hazard maps

NUTS3	Nºwater_systm/NUTS3	class_NºSist/NUTS3	Nºminas/NUTS3	class_minas/NUTS3	Sum	Hazard
BEIRA INTERIOR NORTE	176	IV	209	V	9	V
PINHAL LITORAL	30	II	0	I	3	II
PINHAL INTERIOR SUL	185	IV	0	I	5	III
BEIRA INTERIOR SUL	57	II	2	I	3	II
COVA DA BEIRA	63	III	24	IV	7	IV
SERRA DA ESTRELA	57	II	36	IV	6	III
DÃO LAFÕES	190	IV	76	V	9	V
PINHAL INTERIOR NORTE	225	V	27	IV	9	V
BAIXO MONDEGO	36	II	2	I	3	II
BAIXO VOUGA	59	II	1	I	3	II

The hazard map obtained is shown in Figure 26. The Degree 0 never appears in this map not because in some NUTS3 uranium mines do exist, but because the use of both indicators with the same weight leads to this classification. This hazard will probably include other indicators in the next report.

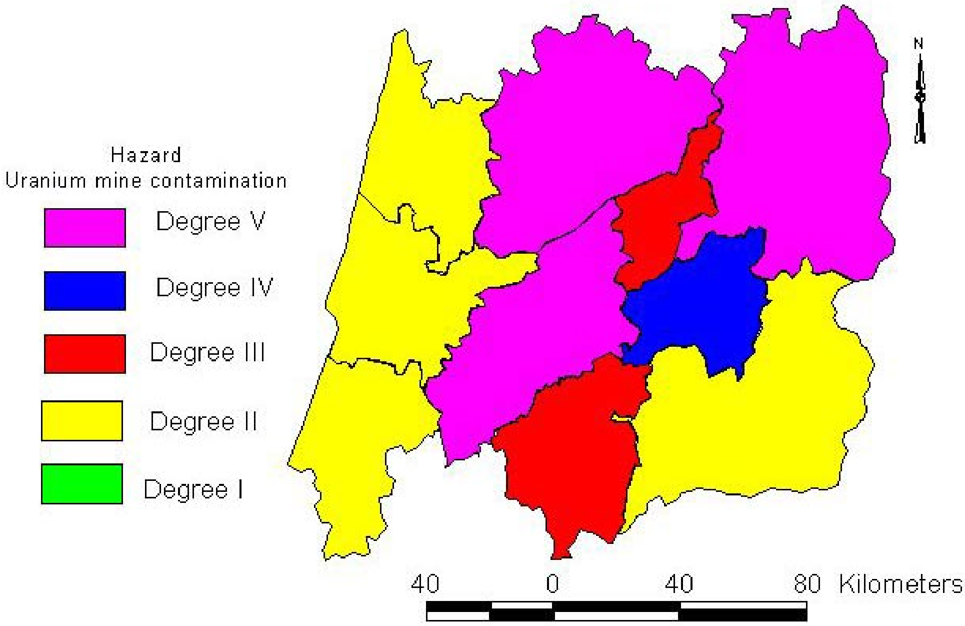

Figure 26: Map of vulnerability

Considering the only hazard studied for Central Region of Portugal at this moment "uranium mines contamination" the vulnerability maps determined according to GDP per capita (NUTS 3) and population density (NUTS 3).

The maps corresponds to the methodology proposed in Chapter 6 of First Interim Report where the division from I to V gives the Degree of vulnerability.

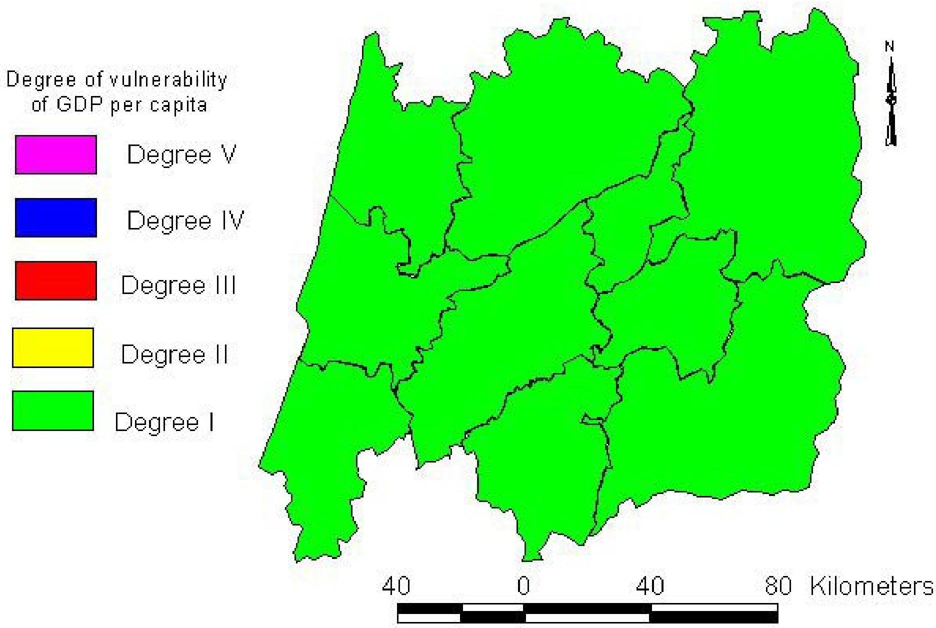

Figure 27: Degree of vulnerability due to GDP per capita

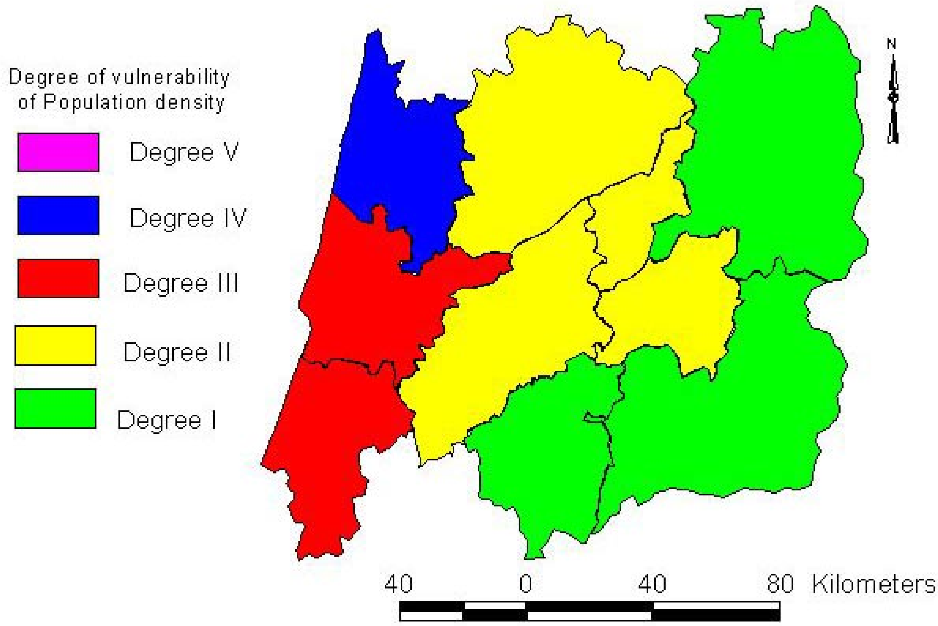

Figure 28: Degree of vulnerability due to Population Density

Uranium mines contamination risk map

Following the methodology proposed in ESPON project for NUTS 3 of Central Portugal the risk map obtained according to the Table 15.

Table 4: Uranium mining vulnerability map

Intensity of hazard Uranium mines contamination	Degree of vulnerability				
	I	II	III	IV	V
I					
II	Beira Interior Sul	Pinhal Litoral Baixo Mondego	Baixo Vouga		
III	Pinhal Interior Sul	Serra da Estrela			
IV		Cova da Beira			
V	Beira Interior Norte	Dão Lafões Pinhal Interior Norte			

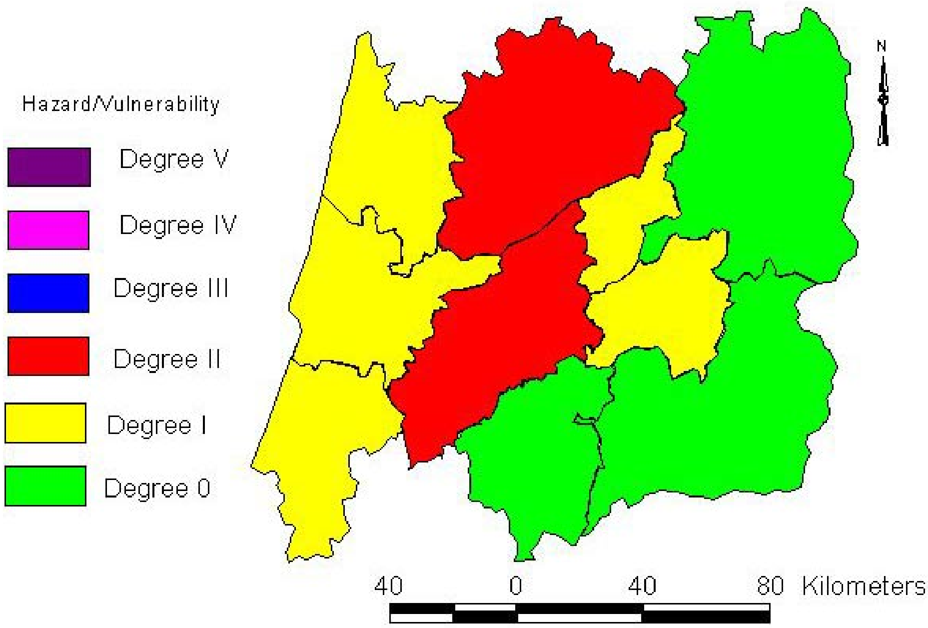

Figure 29: Uranium mines contamination risk map

The risk map will be for the NUTS3 of Central Region of Portugal

Towards an overall risk map and the identification of most sensitive regions

Note: This map will be one of the final results of the project. At this stage it is not yet possible to create this map, because we need the risk maps for all the other hazards, too.

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Geoaccumulation index indicator map (MÜLLER, 1979 *in* FERREIRA *et al*., 2001; FÖRSTNER *et al*., 1990) defined as:

$I_{geo}= \log_2 [C_n / 1,5 \times B_n]$

Where: C_n= chemical element concentration n in fine grain sediments of the present sediments results.

B_n= geochemical background from clay fraction sediments (average value in clays); the 1,5 factor was calculated by the authours to prevent lithologic changes in the background values.

This results were classified in 7 degrees represented in table 16.

Table 5: Geoaccumulation index

Igeo(class)	Geoacumulation Index	Pollution degree
6	>5	Very Strong Pollution
5	>4-5	Strond to Very Strong Pollution
4	>3-4	Strong Pollution
3	>2-3	Moderated to Strong Pollution
2	>1-2	Moderate Pollution
1	>0-1	Weak to Moderate Pollution
0	<0	Absent to Weak Pollution

The results obtained for Central Region of Portugal were from 0, 1, 2 and 5 Igeo classes and the 0 and 1 class were combined in one class that served the study porpuses (Figure 30).

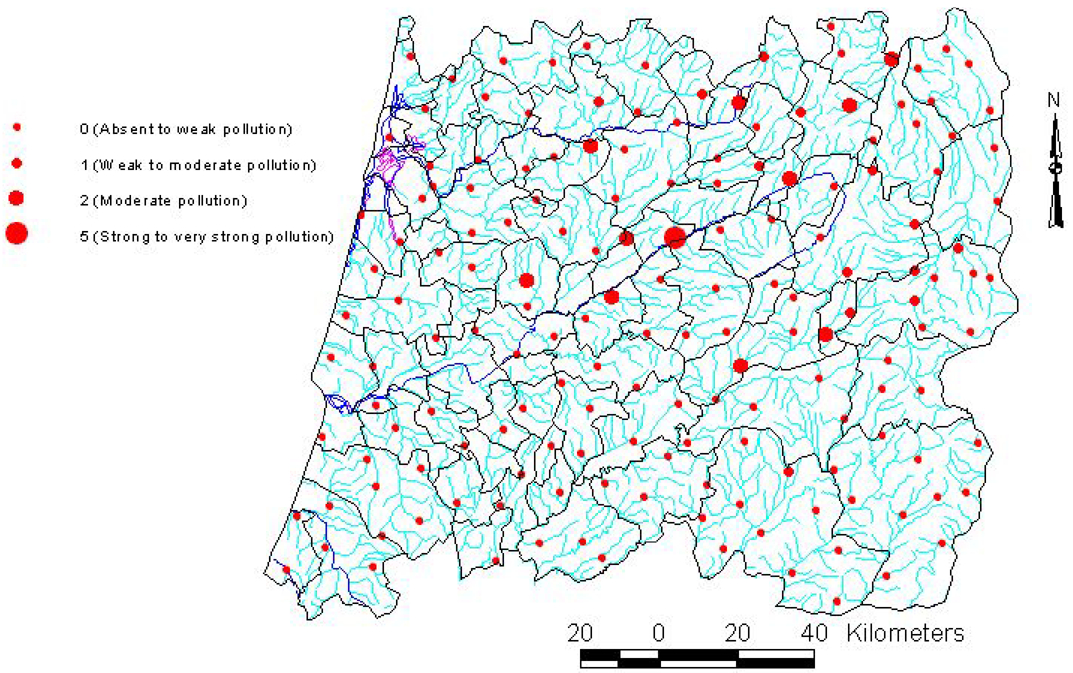


Figure 30: Geoaccumulation Index mapping for uranium

Lithology indicator map
The relevance of this indicator comes from the knowledge that high concetrations of uranium are mainly due to geostrutural belt (Zona Centro Ibérica ZCI) granitic rocks and shales near the contact to the granitic intrusions. Three classes were obtained one of low influence includes limestones, sandstones, slits, clays, the medium influend class includes shales and quartzites and the high influence class includes granitic rocks (Figure 8).

Inhabitants per water system distribution per region indicator map
This indicator was considered important due to the fact that water for human consumption is the highest risk for radioactivity contamination. This information was obtained only for the groups of systems per region. In the future should be developed with more detailed information (Figure 31).

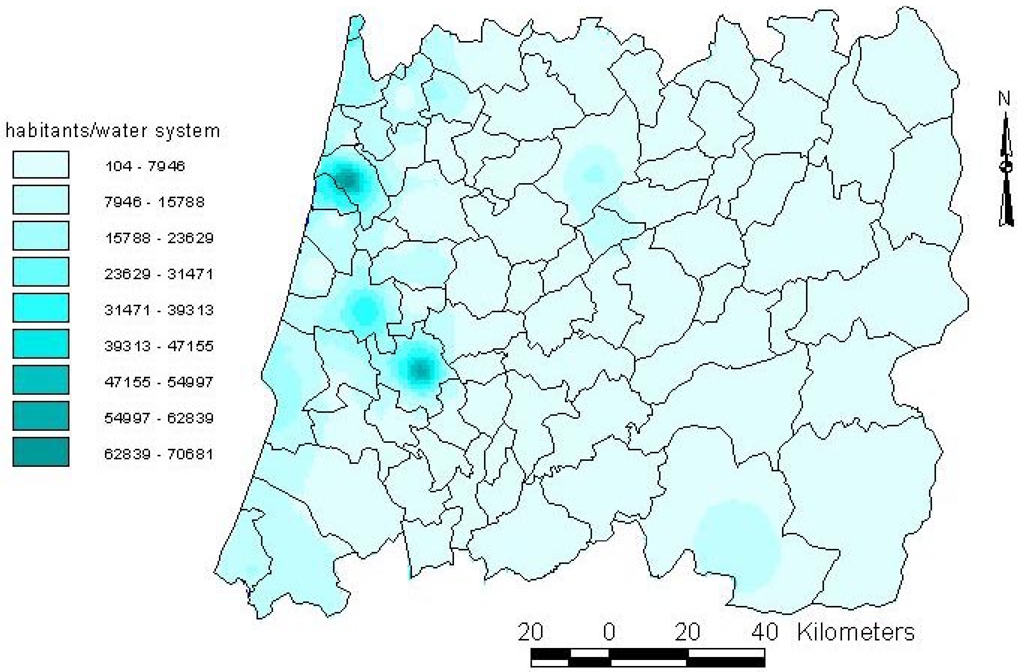


Figure 31: People per water system distribution per region indicator map

This was divided in three classes from few people per system to a lot of people per water system. First class with low influence from 104 people to 5145 people; second class from 5145 to 30351; third class from 30351 to 70681 people. Which shows that near the coast is where one water system is distributed to more people.

Number of water systems per region indicator map
This indicator was considered relevant because more systems per region implies more vulnerability. Small systems for small villages are more vulnerable to this kind of contamination because they are often uncontrolled (Figure 32).

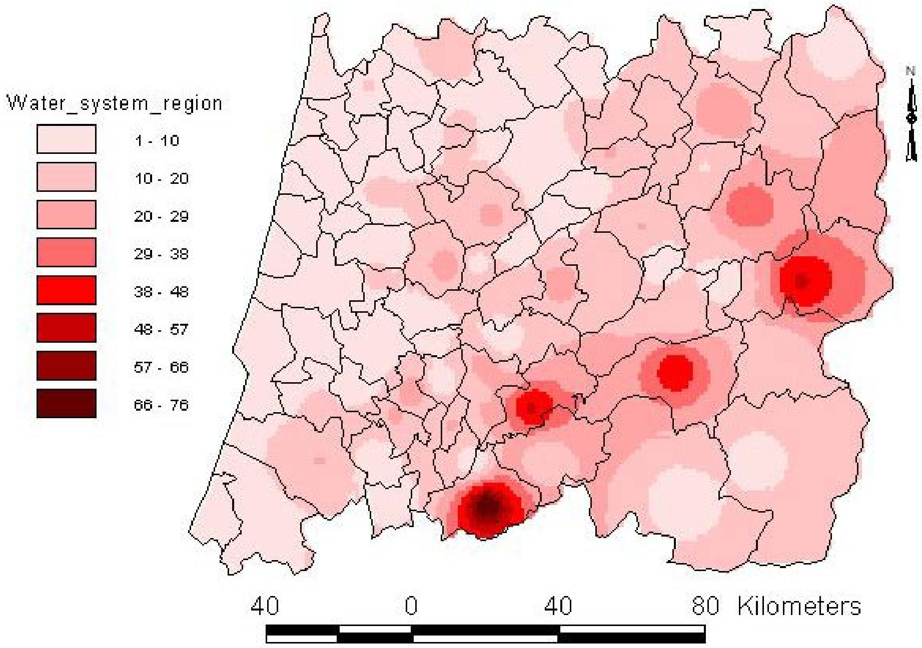
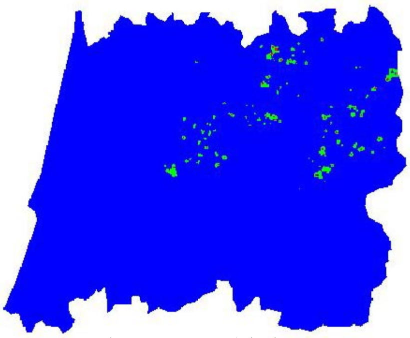
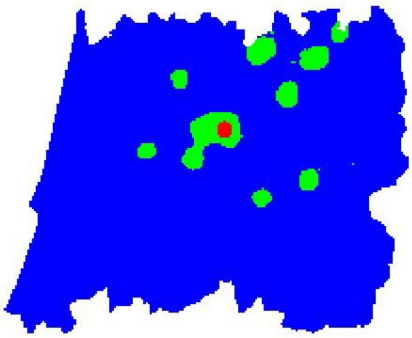


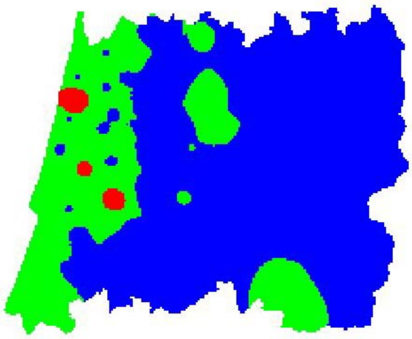
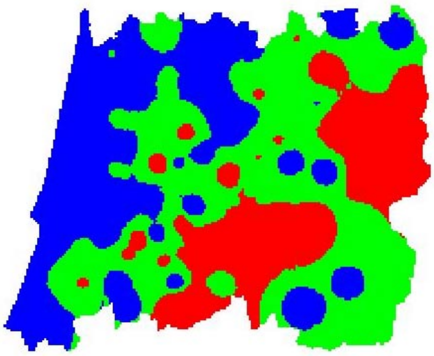
Figure 32: Water system per region

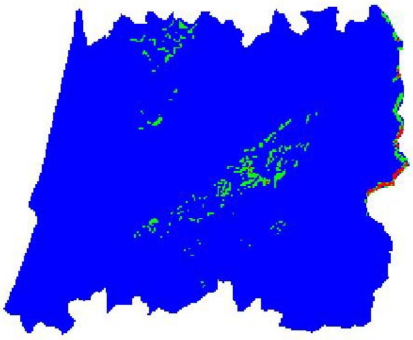
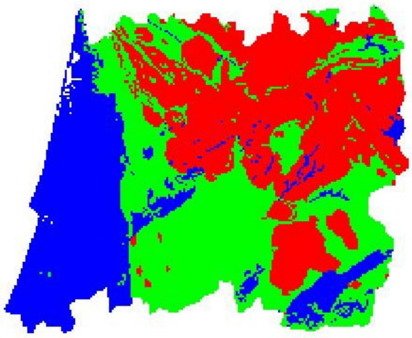
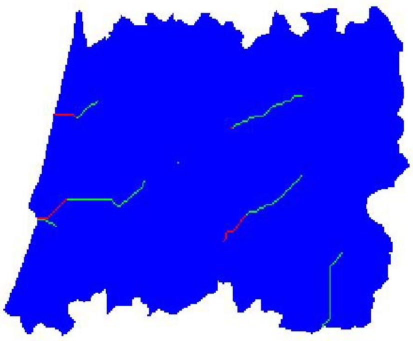
This indicator was also divided in three classes from 1-10 low influence class; 10-20 medium influence class; 20-76 high influence class.

The **hazard maps** calculated with three classes and the respective multiplication factors are presented in table 17.

Table 6: Hazard maps

Hazard Map	Calculation	Class	PF
Distance from uranium mines to landuse categories  (Land use categories X 10000)/Distance to uranium mines	0 - 20 20 – 40 40 - 60	1 2 3	Multiplication factor of 3
Geoaccumulation Index 	0-1 2 5	1 2 3	Multiplication factor of 3

Hazard Map	Calculation	Class	PF
People per water system per region 	104-5145 5145-30351 30351-70681	1 2 3	Multiplication factor of 2
Water system per region 	1-10 10-20 20-76	1 2 3	Multiplication factor of 2

Hazard Map	Calculation	Class	PF
Slope 	0-11% 11%-19% 19%-34%	1 2 3	Multiplication factor of 1
Lithology 	limestones, sandstones shales and quartzites granitic rocks	1 2 3	Multiplication factor of 1
Flow Accumulation 	0-884 884-2211 2211-3980	1 2 3	Multiplication factor of 1

Landslide hazard map

This hazard, though it is not extreme in continental Portugal, could become problematic in case of high values of rainfall in areas with severe relief and . In Portugal this hazard is still studied only at an academic level, not having a systematic gathering of data throughout the country.
Concerning the state indicator mentioned on the First Interim Report, the occurred landslides on Central Portugal, which is the main information for the compilation of that hazard map, it wasn't possible so far to collect all the information needed.
The Operational Commands of Emergency of the 6 districts that constitute de Central Portugal region were all contacted, in order to supply information about the occurred landslides. Due to unexpected circumstances that prevented this entity to supply the team project on time with the required data we are still receiving the information, not having yet sufficient data to produce the hazard map.
The other pressure indicators used for the construction of this map, such as the rainfall (Figure 33), the slope map (Figure 6) and the lithology map of Central Portugal region are already available (Figure 8). The maps of these 3 pressure indicators are shown at the next figures. The intersection between these 3 maps and the occurred landslides map will produce the landslides hazard map that we intend to produce at the next phase of the project.

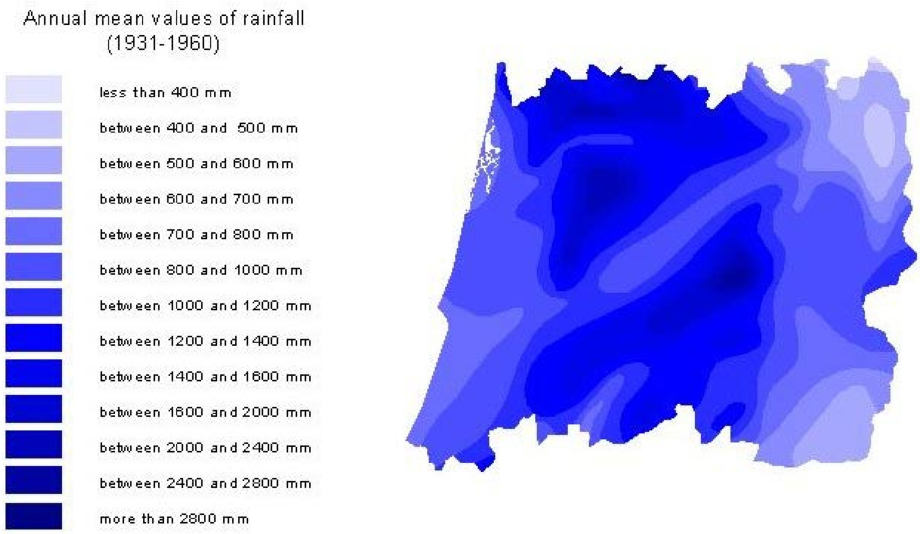


Figure 33: Annual mean values of rainfall from 1931 to 1960 (Atlas do Ambiente, IA).

Map of vulnerability

Not yet available

Preliminary maps of risks

Note: These maps will be the result of the combination of the single hazard maps with the vulnerability map.

Earthquake risk map

Note: Explanation of data used, possible problems and finally of the result.

Floods risk map

Mapping flood vulnerability areas was made by National Water Institute INAG and is available in the internet (http://mapas.inag.pt/Website/inundaHTML/viewer.htm) (Figure 28).

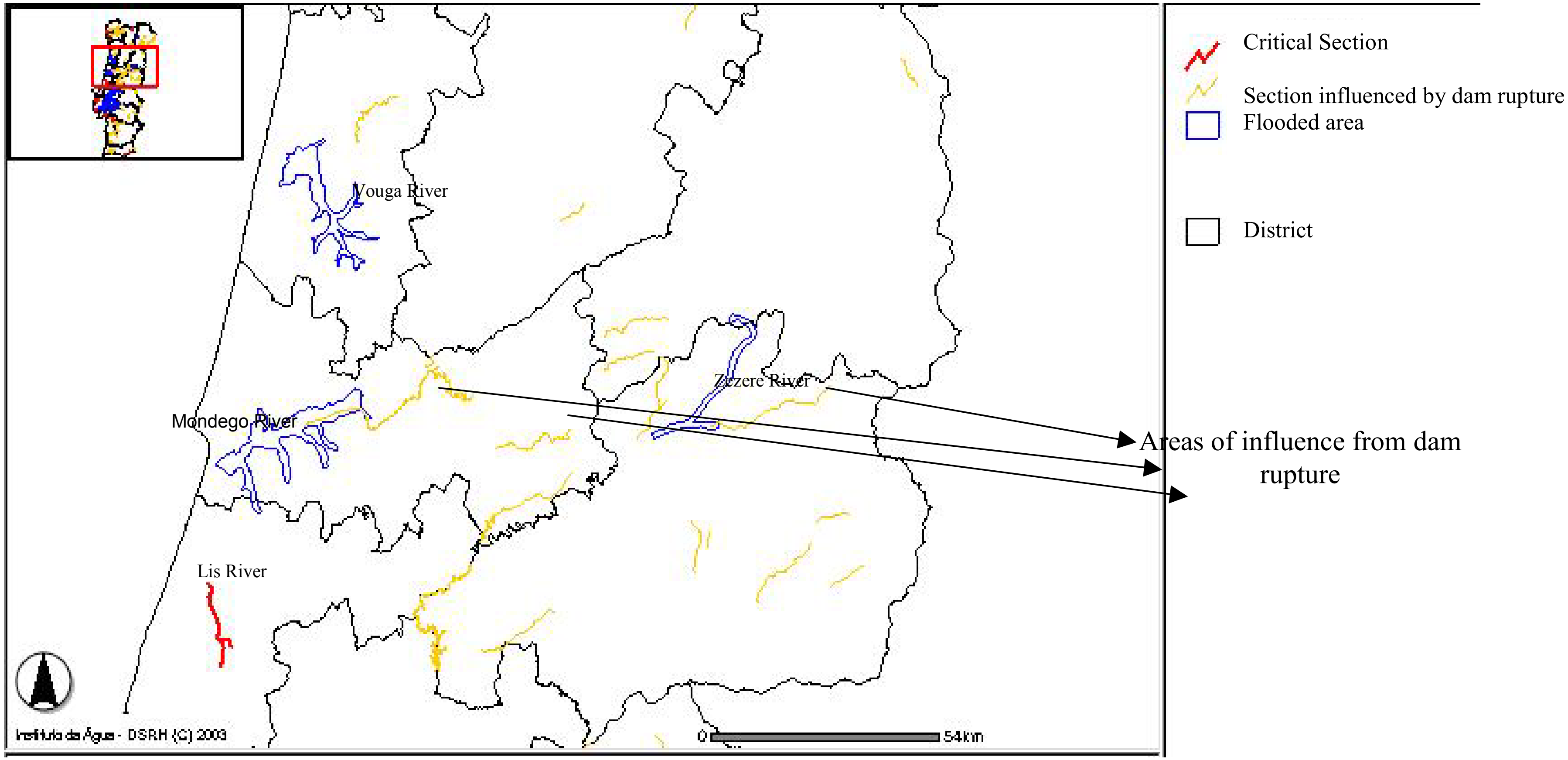


Figure 34: Flooding Risk Map for Portuguese Central Region

Droughts risk map

Not yet available.

Nuclear power plants risk map

Not yet available

Forest fires risk map

Lousã was considered according to the methodology applied a high to median-high fire risk. The high-risk areas are located in higher slope regions with low accessibility of top of Lousã Hills (Figure 29).

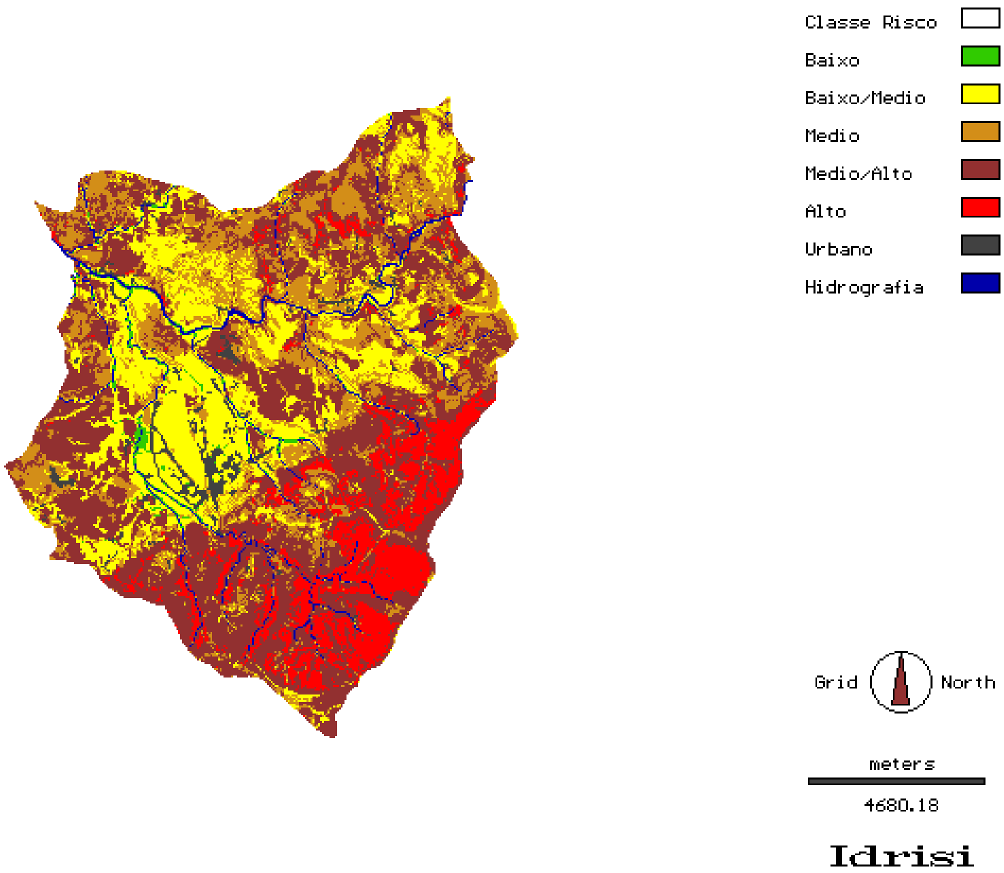


Figure 35: Forest Fire Risk map

Risk classification goes from zero (minimum risk) to 1000 (maximum risk).

This risk maps are completed to several Central Region NUTS areas (Figure 30).

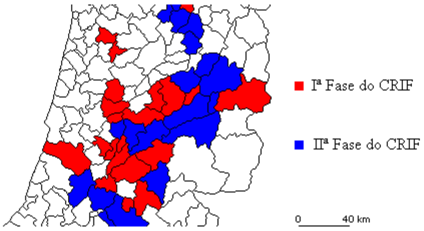


Figure 36 - Portuguese Central Region Risk map cover

The risk maps of Arganil, Figueiró dos Vinhos, Ferreira do Zêzere, Castanheira de Pera, Mação, Manteigas, Mortágua, Oleiros, Oliveira de Frades, Oliveira do Hospital, Pedrógão Grande, Penacova, Penela, Vila Nova de Poiares, Pombal, Sabugal, Seia, Sertã, Aguiar da Beira, Belmonte, Celorico da Beira, Covilhã, Fundão, Gouveia, Guarda, Lousã, Moimenta da Beira, Pampilhosa, Proença-a-Nova and Sernacelhe will be present in appendice.

Uranium mines contamination risk map

This map was obtained after risk analysis, considering different multiplication factors available that contributed in different ways to map Figure 44.

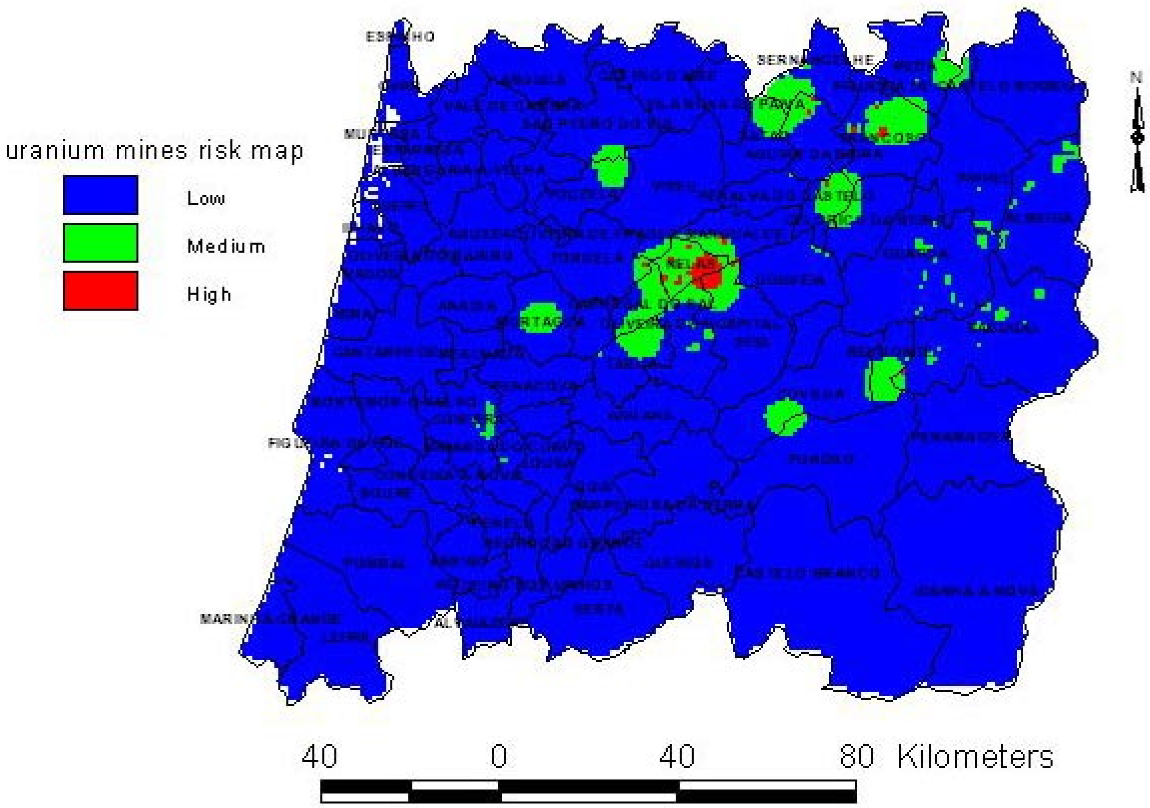


Figure 37 - Uranium mines contamination risk map

The Nelas region is the most vulnerable region to uranium mine contamination.
Due to the methodology used in this risk analysis *Response Indicators* for Central Region should consider:
-Water distribution prevention and control measures in the red and green zones
- Agriculture prevention to contamination measures in the red and green zones.

Towards an overall risk map and the identification of most sensitive regions

Note: This map will be one of the final results of the project. At this stage it is not yet possible to create this map, because we need the risk maps for all the other hazards, too.

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Annex III Development of new indicators

Most of the hazards presented in second interim report were not sufficiently studied because metadata related with these indicators was not yet available. Earthquakes, landslides and droughts are among those that will possibly be studied in a next stage as long as the required data will be available.

New indicators to be developed are presented after 5.1.3.

- Groundwater vulnerability
- Coastal erosion
- Coastal pollution

Earthquakes

Metadata needed to develop this hazard and risk analysis are:

- Active faults (neotectonic) mapping
- Detailed lithology mapping
- Historical and instrumental seismicity

The seismic zoning for constructions is, so far, the best approach of a seismic hazard map for construction in Portuguese territory. This mapping is used by the insurance companies, construction companies and for the environmental impact studies to quantify the seismic action for the constructions.

Landslides

Metadata needed to develop this hazard and risk analysis is:

- Occurred landslides
- Detailed lithology
- Rainfall
- Slopes (DTM)

The intersection between these indicators will produce the landslides hazard map at the next phase of the project.

Drought

Several indicators will be used according to the following information:

Drought natural causes

- Changes in weather conditions with:
  - Change in subtropical anti-ciclonic nuclei from its normal position

Drought unnatural causes

- Bad land planning
- Insufficient water storage infrastructures
- Over-exploitation of groundwater
- Deforestation especially due to forest fires

Drought direct effects:
- Deficient water distribution
- Damage in agriculture, industry and hydroelectric energy production
- Restriction to fishing in lakes and rivers

Drought indirect effects:
- Conditions favour to forest fire occurrence
- Sanitary problems
- Degradation of water quality
- Conditions favour favourable to erosion

Vulnerability areas can be calculated with:
- Quality and capacity of water supply
- Distance to water storage infrastructures
- Water quality in long term storage
- Accessibility to alternative water supply

Predition Methods to Droughts
In Portugal drought occurrence analysis is done in March by emergency protection entity Protecção Civil, to plan the response to this hazard in the dry period of the year that normally ends in September. Prediction models are used:
- Statistic- interaction ocean-atmosfere. Relation between atmosferic variability and ocean temperature variability.
- Dinamic – Global atmosfere circulation models. Relation between climatic standards in large areas.

Source information: http://www.meteo.pt/DMM-2003/web_secas_pag2.htm

Needed indicators to study drought hazards are dependent of the applied methodology. Several methodologies can be used based in climatic variables and in duration of drought or cumulative effects of droughts.

One example of classification of drought based in climatic indices of draughtiness relates registered quantity of precipitation in climatic stations and the area of influence of that precipitation. Classification can be:

Year	Quantity of registered precipitation
-Extremely dry	>90% of the total years in analysis
-Very dry	>80% of the years in analysis
-Dry	>70% of the years in analysis
-Normal	between 40 and 70% of the years in analysis

This classification measures total quantity of precipitation in a period of several years. If total quantity is very low, meaning that more than 90% of the years are dry the classification of that region is “Extremely dry” and so on.

Classification can also be based in percentage of affected area:

Drought	Affected area
-Local	<10%
-Extended	until 20%
-Very extended	20 to 30%
-Very much extended	30 to 50%
-Generalised	> 50%

Other climatic variables that may be considered to this hazard study:

- Total precipitation
- Duration of precipitation
- Water in soil
- Evapotranspiration
- Temperature (Nº days above a certain temperature)

Groundwater vulnerability

The aquifers vulnerability representation is a complex task. Effectively it is not possible to represent in a single map, specially in a small scale, all geologic, hydrogeologic and hydrochemic aspects that are determinative to foresee the behavior of the diverse contaminant substances. The propagation of these substances is affected by several factors such as the aquifers lithology, the depth of water table, the type and thickness of soil, characteristics (lithology and fissuration) of the unsaturated zone, recharge rate, topography, etc.

In the elaboration of Portugal Central Region aquifers vulnerability map, will be applied an expedite methodology based in the lithology and, probably in the confinement of aquifers of the undifferentiated hydrogeologic formations. This simple methodology shows advantages relatively to the application of quantitative indices of vulnerability. The main objections to the use of these indices are: 1) the parameters estimation is made from scarce or null hydrogeologic information, generating high levels of uncertainty; 2) the estimation of some parameters is based on speculative considerations; 3) the calculations are generally redundant because there are variables related between itself that are considered as independent; 4) the balance of parameters is somehow arbitrary; 5) the vulnerability maps are not representative for all types of pollutants.

With this perspective, in the next stage, the vulnerability classes will be defined according lithologies and types of aquifers (phreatic or confined) whose hydraulic conductivities reflect the greater or minor capacity to attenuate the propagation of any contamination.

The Portugal Central Region aquifers vulnerability map will be generated from raster analysis in GIS environment (ArcGis 8.2 - ESRI) from the Carta Geológica de Portugal (Geologic Map of Portugal, Figure 1), scale 1:500 000 (Serviços Geológicos de Portugal, 1992) Figure 2 represents the main aquifer systems with summary characterization for Portugal Central Region.

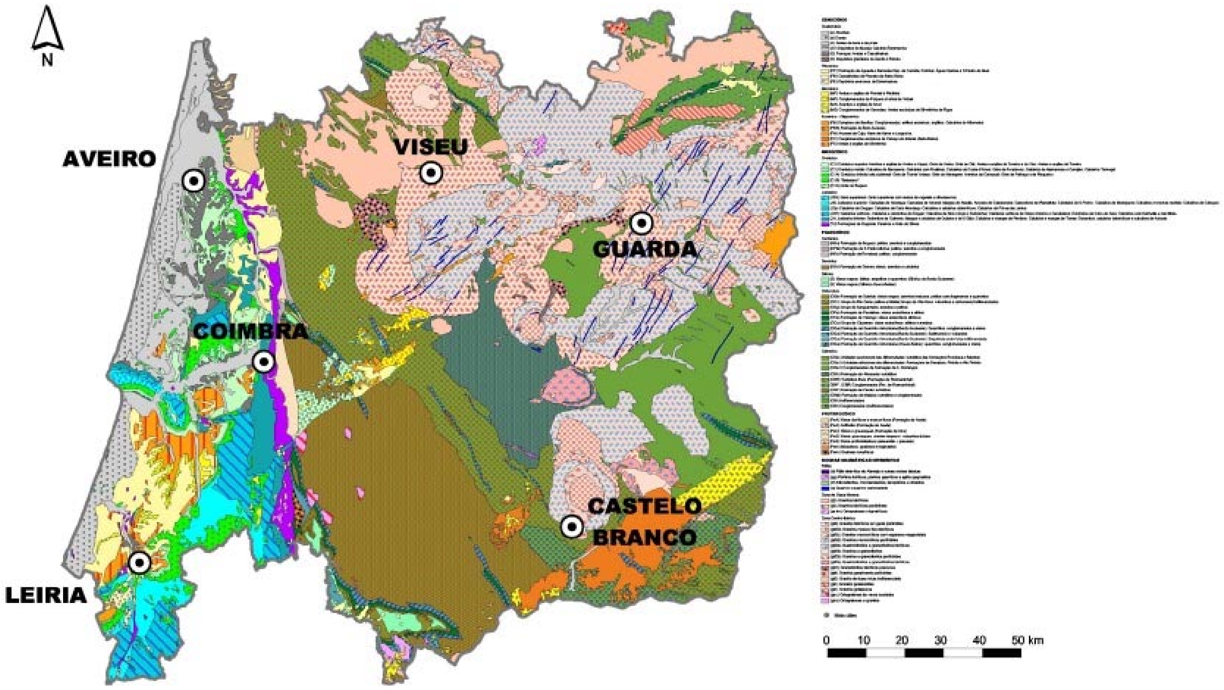

Figure 38: Portugal Central Region Geological Map – extracted from the Carta Geológica de Portugal (Geologic Map of Portugal), scale 1:500 000 (Serviços Geológicos de Portugal, 1992)

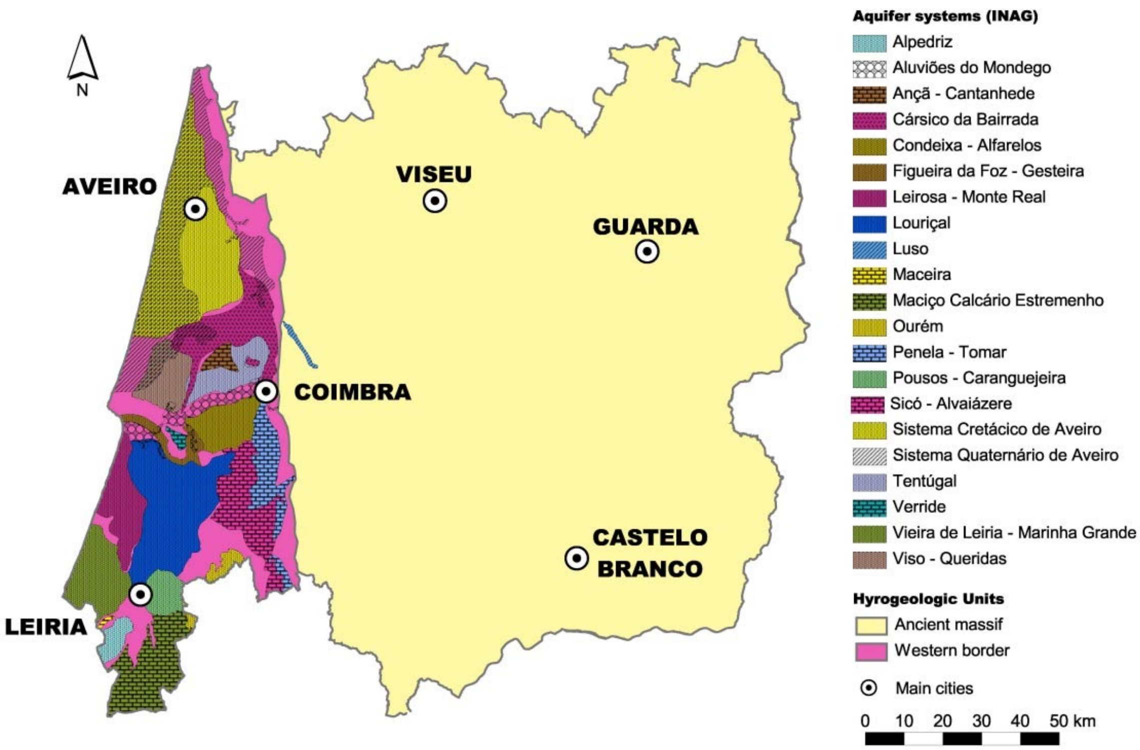

Figure 39: Portugal Central Region Aquifers Systems Map (INAG, 2000).

Coastal erosion

The importance of coastal zones to Central Portuguese Region is the motivation to develop this indicator. Several Work groups are or have been studying the coastal erosion phenomena like RIMAR evolving several institutions (universities, sea institutes, meteorological institute). Water institute has a control system called Sistema Nacional de Informação dos Recursos do Litoral (SNIRL) this system controls coastal activities and the monitoring maps cam be observed as follows. The information is available in the internet http://mapas.inag.pt/Website/SnirLitHTML/viewer.htm.

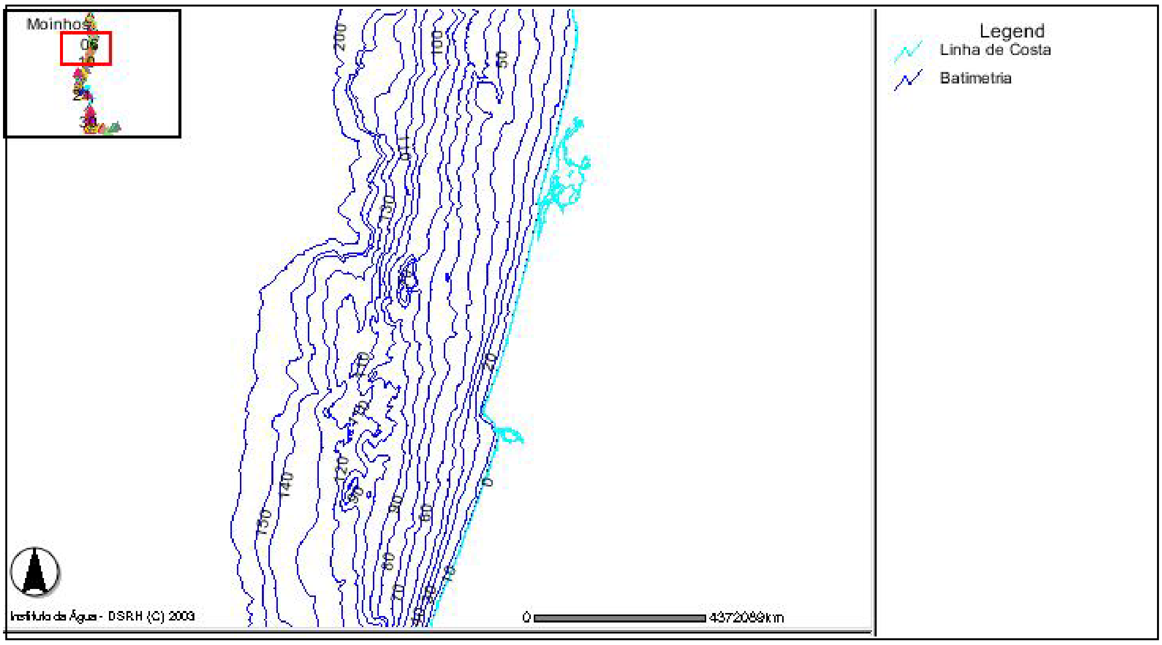

Figure 40: Batimetric mapping (Instituto da Água, SNIRL)

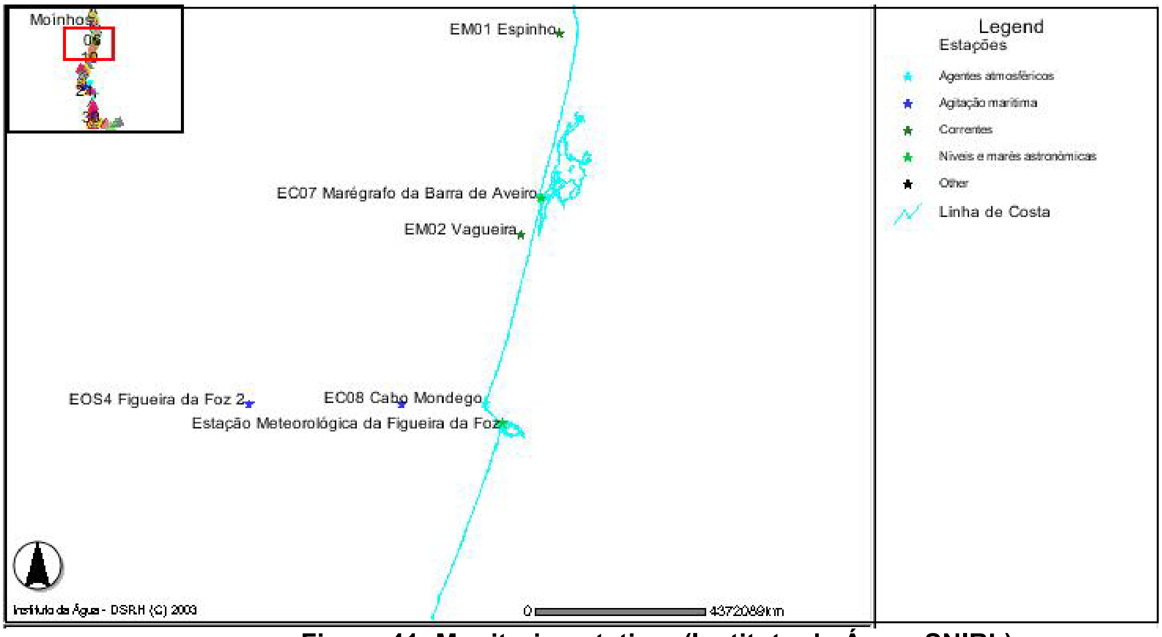

Figure 41: Monitoring stations(Instituto da Água, SNIRL)

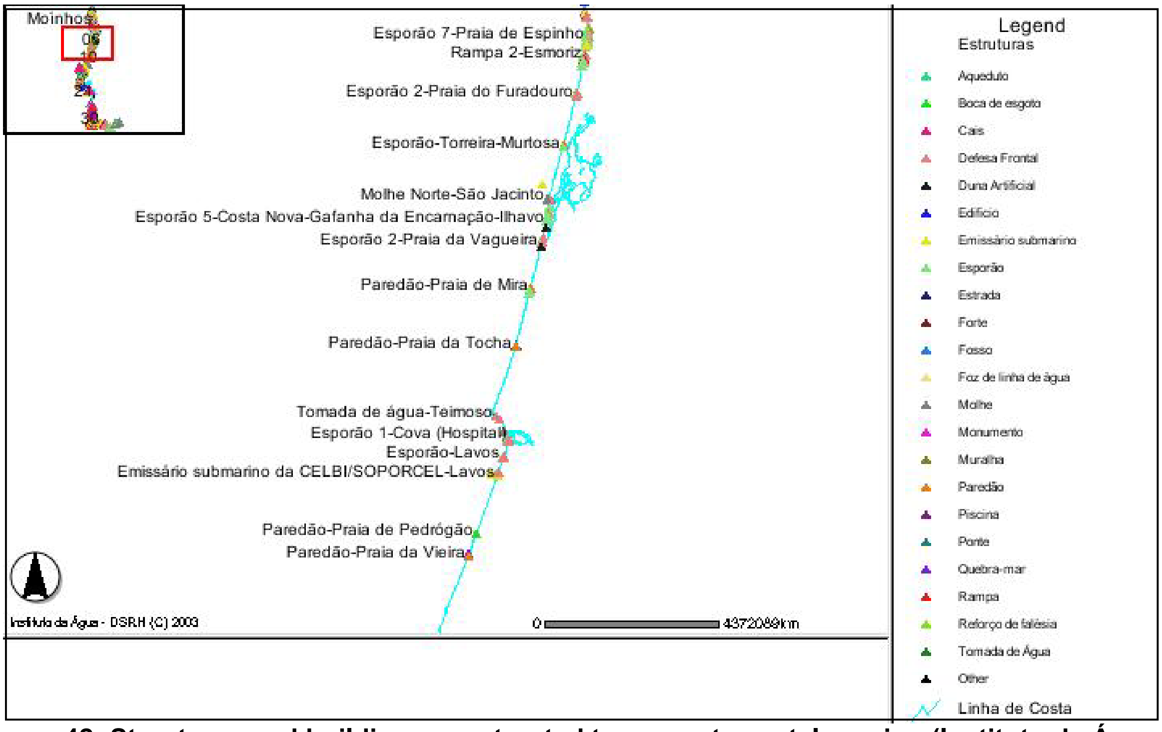

Figure 42: Structures and buildings constructed to prevent coastal erosion (Instituto da Água, SNRIL)

This building information is given on line by the institution. Risk and response indicator are being controlled by Water Institute.

A draft of the possible future study to be carried out by ESPON Portuguese team in case data is available for the project is presented below.

High density of population near the coast implies construction development that increases vulnerability and overexploitation of natural resources.

Hazard/Risk Type	Coastal erosion
Indicator	Population density
DPSIR model	Pressure indicator

The process of erosion is potencially acelerated in coastal unconsolidated terrains.

Hazard/Risk Type	Coastal erosion
Indicator	Lithology of coastal zones
DPSIR model	Pressure indicator

Several studies shows that regions where relevant tectonic events were registered are more vulnerable to coastal erosion.

Hazard/Risk Type	Coastal erosion
Indicator	Tectonic mapping
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Ocean corrents regime
DPSIR model	Pressure indicator

Coastal pollution

Several entities act in order to maintain surveillance in marine coast and are usually partners in projects to prevent model and diagnose marine pollution. These institutions are:
CILPAN – Centro Internacional de Luta Contra a Poluição do Atlântico Nordeste
Brigada Fiscal da Guarda Nacional Republicana
Instituto Marítimo-Portuário
Força Aérea Portuguesa
Estado Maior da Armada
Direcção Geral da Autoridade Marítima
Instituto Hidrográfico
Minstério da Defesa Nacional –Direcção de Infrastruturas
Laboratório de Apoio às actividades Aerospaciais do INETI
Instituto da Água
Instituto da Conservação da Natureza

These institutions detect and diagnose pressure and state indicators and develop response indicators in coastal pollution.

In case information is available coastal pollution will be also studied for Central Region of Portugal. Several pressure indicators can be used to diagnose this hazard.

Hazard/Risk Type	Coastal pollution
Indicator	Population density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Main rivers mouth
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Chemical Industry density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Animal raise infrastructure density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Stream sedimens contamination
DPSIR model	State indicator

Hazard/Risk Type	Coastal erosion
Indicator	Platform sediments contamination
DPSIR model	State indicator

1 REGION OF DRESDEN (PLANNING REGION UPPER ELBE VALLEY / EAST OREMOUNTAINS)

1.1 GENERAL

Definitions of terms used in this chapter, if necessary specified according to the objectives of the project, respectively the case study.

Spatial Planning *(Raumordnung)* is referred to as the general term describing the super-sectoral planning approaches in Germany at the regional, state or national levels including the Comprehensive Plan and 'Regional Plan'. Spatial Planning at the federal level sets the planning and development framework for the subordinated planning levels. A practical spatial planning competence in Germany is passed from the Federal Government to the Federal States (Länder).

Comprehensive Plan (CP) *(Landesentwicklungsplan)* is an official plan within the spatial planning system on the basis of the federal spatial planning act. It has to be developed for any German Land in order to apply federal requirements to the operational level of the Länder. The CP as the planning instrument of the Länder spatial planning legislation sets the planning framework for regional planning and prescribes goals and principles for further specification in the subordinated spatial development plans of the so-called planning regions further referred to as 'Regional Plan'.

Regional Plan (RP) (*Regionalplan*) as defined above

Land use planning (*Bauleitplanung*) represents the most detailed kind of spatial development planning at the municipal level based on the Federal Building Code.

Preparatory land use plans (*Flächennutzungsplan – vorbereitender Bauleitplan*) provide information on potential types of land uses (housing, green areas etc.).

Binding land use plans (*Bebauungsplan – verbindlicher Bauleitplan*) define precisely the extent to which a type of land use can be performed in a given area (e.g. how many stories, set back, maximum and minimum size of building etc.).

Aims of Regional Planning (*Ziele der Regionalplanung*) are included in the Federal Building Code. They are binding statements about spatial development requirements to be realised at the municipal level.

Principles of Regional Planning (*Grundsätze der Regionalplanung*) are included in the Federal Building Code as well. They are rather guidelines giving the scope of the spatial development requirements to be realised at the municipal level.

Sectoral planning / Planning sectors *(Fachplanung*) 'sector' in terms of 'sectoral planning' means the spatial planning under consideration of only one planning criteria (e.g. traffic, invironmental heritage, etc.). Sectoral approaches are (in the ideal case) weighted, balanced and merged in the context of comprehensive development planning (creation of plans at different planning levels). Sectoral as well as comprehensive planning can take place at different administrative levels.

Land or (pl.) Länder (*Bundesland*) - see 'Spatial Planning'.

Free State (*Freistaat*) – a Land with a special constitutionary status.

Regional Council (*Regierungpräsidium*) NUTS level 2

Region (*Planungsregion*) - planning region for which regional plans are elaborated.

District (*Landkreis*) - administrative area with a specific authority that has been assigned certain super-municipal administrative competencies of the Länder. NUTS level 3

Municipality (*Gemeinde*) - lowest and at the same time most concrete level in the planning hierarchy. Level of land use planning. Municipalities have a guaranteed right of self-government according to article 28 of the German constitution.

Federal level (*Bundesebene*) – national level.

Länder level (*Landesebene*) - administrative level for issues of spatial planning that concern one Land.

Regional level (*Regionalebene*) – level of spatial relevance that is superior to local level (applies for instances to issues like natural or technical hazards that reach an extent which exceeds the ability of a municipality to manage the incident and/or that happens in an area bigger than that of one municipality).

Binding character (*Verbindlichkeit*) – Planning documents of the Länder are legally binding for those the regional level which in turn are legally binding for those on the local level.

Priority area/site (*Vorranggebiet*) – an instrument of the German planning system. Priority areas or sites can be designated in structural planning in case the local or regional situation requires that a particular function (e.g. recreation, nature/landscape, mining, urban expansion) shall have priority on that area or site. Any planning or action must be compatible with this priority purpose (following a definition of UBA 1995).

Reserve area/site (*Vorbehaltsgebiet*) – an instrument of the German planning system Reserve areas or sites can be designated in structural planning in case the local or regional situation requires that an area shall be reserved for a particular function (e.g. nature/landscape, mining, flood zone). Any planning or action must be compatible with this priority purpose.

Spatial categories (*Raumkategorien*) – **1)** Densely populated area, **2)** Periphery of a densely populated area, **3)** Rural area with signs of densification, **4)** Rural area without any signs of densification (1. Verdichtungsraum, 2. Randzone eines Verdichtungsraumes, 3. Ländlicher Raum mit Verdichtungsansätzen, 4. Ländlicher Raum ohne Verdichtungsansätze) - Territorial classification according to the Saxon Regional Planning Law.

1.1.1 Key data on the region

Geo-ecology

The Planning Region Oberes Elbtal / Osterzgebirge is one of five planning regions in Saxony (see chapter planning context). It comprises the metropolitan region of Dresden with the Elbe River as a major feature. The region shows a very diverse natural structure.

The region stretches from mountainous areas in the south to lowlands in the north. In its southern part the Eastern Ore Mountains with an elevation of 900 m NN transit eastwards to the Elbe Sandstone Mountains with maximum elevations of about 600 m. Following the gradual decline of the landscape to the northern lowlands (ca. 100m NN) the major geologic and ecologic features change.

In sum a succession of three landscape types can be observed

- mountainous areas,
- loess influenced to loess dominated uplands and
- sandy lowlands and lowland Elbe River valley).

In the south, rocky formations and the high elevation up to 900m NN are accompanied by rich precipitation, acidic soil layers over gneiss and sandstone and mountainous types of vegetation with a large proportion of spruce forests. In the upper areas precipitation exceeds 1000mm/a.

To the north, the landscape is formed more smoothly and the decline in elevation is associated with growing influence of loess accumulations dating from the last ice age, making soils more fertile and easier to use. Average temperature rises and annual precipitation declines to its lowest values in the sand dominated lowland area. Simultaneously, land use is dominated by agriculture. Forests hardly occur in Elbe valley.

A speciality is the so-called Elbe river canyon with a depth of 300 m where the river has formed its deep channel through the sand stone formations. This stretch of landscape is named “Saxon-Bohemian Switzerland”. It displays the highest gradients of the region in form of upright rock formations and steep slopes bordering narrow gorges. Parts of this area are protected as National Park or Landscape Conservation Area. The meadows along the Saxon section of the Elbe River, which are regularly flooded, are proposed to the European Union as Natura 2000 sites.

A key element of the region is the valley of the Elbe River, which passes several towns like Bad Schandau, Pirna, Dresden, Meißen, Riesa and Torgau. The narrow river valley in the sandstone area widens shortly before Pirna, passes with a wide valley the City of Dresden, narrows again near the town Meißen and widens right after Meißen. It thus performs the transition from a barbell region upland river to a brass region lowland river.

The Elbe River drains one of six major river systems in Germany. Its sources are located in the Giant Mountains and the Bohemian Mountains. Its discharge in the planning region is mainly influenced by precipitation and by the outlet from large dams in the Czech Republic.

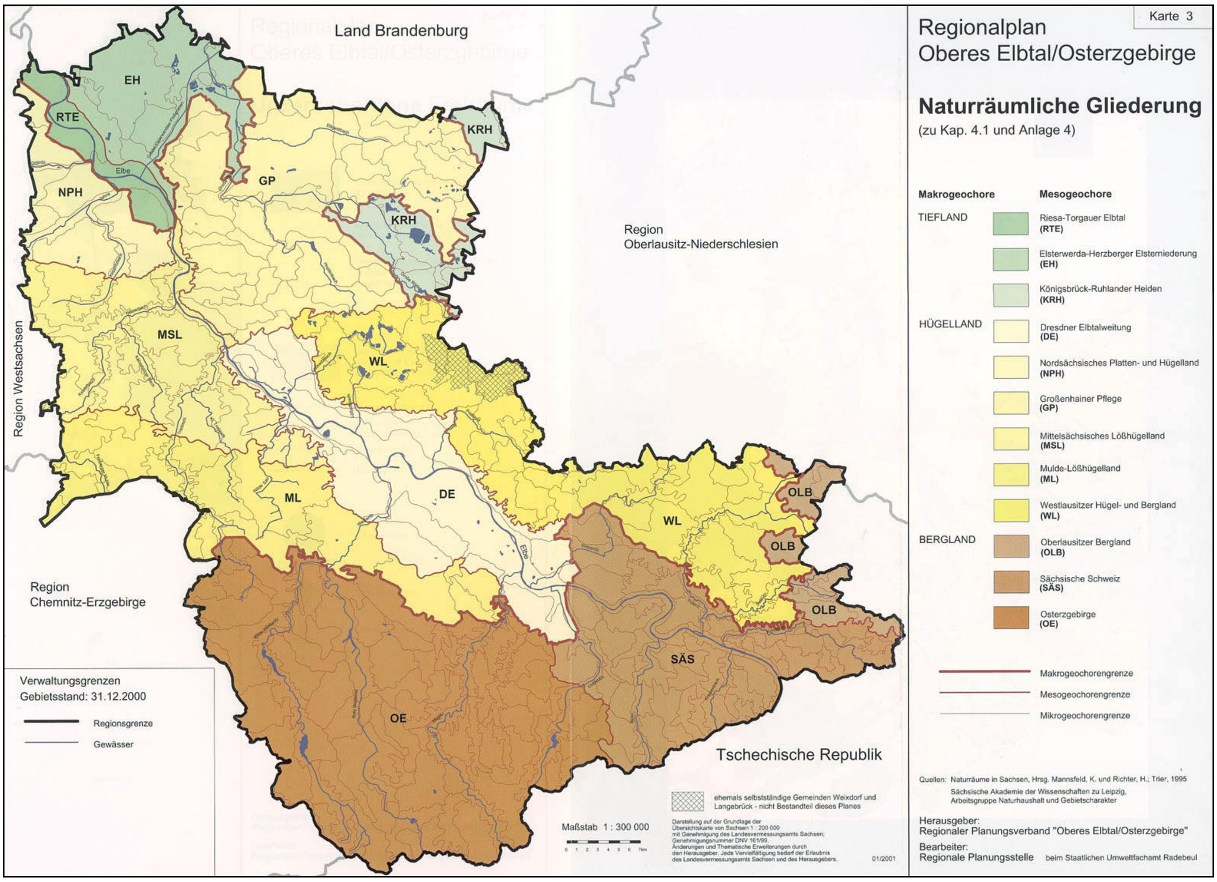

Figure 1: Planning region Oberes Elbtal / Osterzgebirge, geo-ecological units (Regional Plan, figure 2)

Social and economic aspects

The region Oberes Elbtal/Osterzgebirge is second in population but fourth in size and thus is the most densely populated out of five planning regions in Saxony. After 1990 (reunification of West and East Germany) major changes have occurred. Many traditional industrial branches have declined causing a quick rise of unemployment rates in the region. Today the most important branches of the region are information technology, engineering, food processing and tobacco industry, glass and ceramics industry, paper industry, publishing and printing which make up about 80% of employees in the manufacturing industries.

With the transition from a centralised to a federal planning system with guaranteed self-government at the local level, the spatial structure is changing rapidly. Loss of population in inner city locations is accompanied with urban sprawl at the edge of urbanized areas. Simultaneously the region as well as Saxony as a whole is suffering from declining population numbers and a growing proportion of elderly people.

Figure2: Planning Region Oberes Elbtal / Osterzgebirge[1]

The region consists of five administrative districts which in Germany represents the NUTS level 3: District Saxon Switzerland (Sächsische Schweiz), Weißeritz (river) District (Weißeritzkreis), City of Dresden, District Meißen, and District Riesa-Großenhain (for further information on spatial organisation see chapter "planning background"). The biggest share in population and simultaneously the by far highest population density is recorded for the area of the city of Dresden (capital city of the Free State of Saxony). The remaining rural part of the region disposes of some towns in which the majority of the region's population is concentrated.

[1] http://www.rpv-elbtalosterz.de/frset_region.htm, Mai 27th 2003

Table 1: Population and size of districts in the planning region (panning region web site)

Districts	Number of municipalities comprised	population		size		population density	GDP 2000
		number	%	km²	%	(persons/km²)	Mio Euro
Dresden	1	477 807	46,6	328	9,6	1 455	11059
Meißen	17	153 139	14,9	632	18,4	242	2473
Riesa-Großenhain	23	122 274	11,9	821	23,9	149	1833
Sächsische Schweiz	26	147 180	14,4	888	25,9	166	1917
Weißeritzkreis	20	125 460	12,2	766	22,3	164	1507
Region in total	**87**	**1 025 860**	**100**	**3 434**	**100**	**299**	**18789**
Free State of Saxony	**540**	**4 425 581**		**18 413**		**240**	

Table 2: Population and area size in relation to spatial categories (panning region web site, GDP at market prices: Statistical Reports 2000)

area category	number of municipalities	population (%)	area (%)
Densely populated area	10	67,2	17,1
Periphery of a densely populated area	15	6,9	17,3
Rural area with signs of densification	10	7,2	8,3
Rural area without any signs of densification	52	18,7	57,3

Table 3: land uses in the planning region

area used for/as City or Town / District	settlement and traffic	agriculture	forest	water	Surface mining	other uses
City of Dresden	37,4	36,53	21,16	1,95	0,33	2,64
Meißen	11,45	71,89	13,3	1,93	0,31	1,12
Riesa-Großenhain	8,79	70,04	12,51	2,37	0,23	6,06
Sächsische Schweiz	8,32	50,4	38,58	1,09	0,39	1,21
Weißeritzkreis	8,73	57,14	32,01	0,96	0,15	1,01
Region in total	11,89	59,21	24,57	1,6	0,28	2,45
Free State of Saxony	11,25	55,98	26,47	1,8	1,88	2,63

The region is rich in resources which are deposited close to the surface and thus easily to exploit. These are first of all:

- Gravel and Sand
- Rock for the Production of ballast, split and additives
- Rock for the construction purposes
- Clay for the building and ceramics industries including the clay for Meißen porcelain

1.1.2 Relevant hazards

The region has a stable general setting. There are no active geologic instabilities and no large periodically occurring meteorological events known. Most of the dangerous industries and mining have disappeared after 1990. What remains are relicts of dangerous use and waste.

In the past there had also been coal and ore mining in the region. Whereas most of the mining was finished decades ago in two locations until early 1990s uranium mining had continued. Relicts of this history are often large and even not totally known or mapped cavities in the underground and many mining waste heaps. Especially if the heaps remain from ore mining these may emit direct radiation or radioactive particles if exposed to the wind. Although this is estimated to have a rather local relevance (in means of especially exposed locations e.g. of a town) (Exposure to radiation caused by mining in Saxony and Thuringia 1990).

Natural Hazards

Not all hazards can be viewed as relevant at the regional (super municipal) level. Whereas floods always evolve in an area that simultaneously affects several municipalities most of the other natural hazards such as land slides or collapses of rock happen in an extent of at maximum several hundreds m^2 and thus are only relevant at a local level even though provisions may be taken by the region or the state.

Technological Hazards

Technological Hazards in the region may take their origin in single structures but hardly any information has so far been published on this issue in Saxony. Highly important are plants of **chemical and manufacturing industries** that deal with hazardous substances, respectively hazardous combinations of substances. 1998 there where 344 industrial plants registered under the German Emergency Ordinance (BImSchV 12) (Daten zur Umwelt 2000, page 48). The following map provides an overview about the concentrations of industrial plants having more than 100 employees in the region.

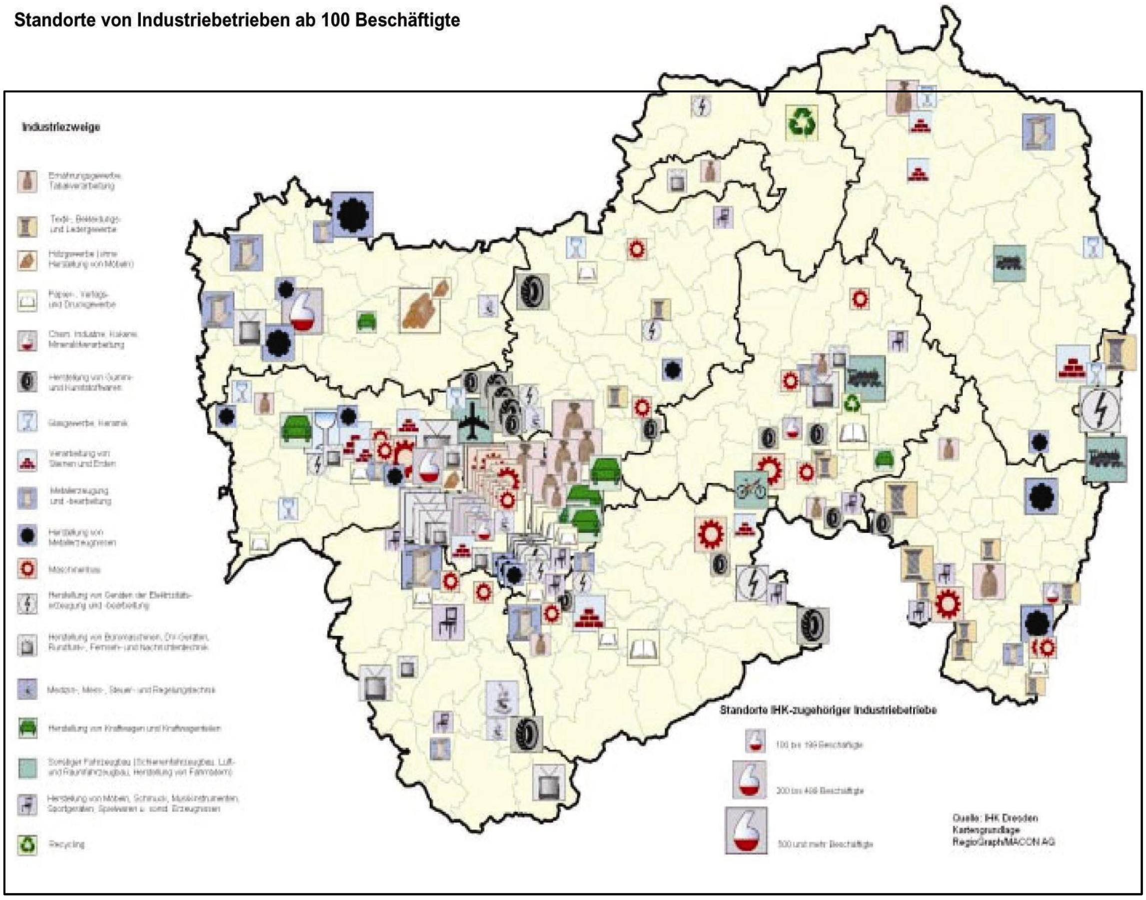

Figure 3: concentrations of industrial plants having more than 100 employees in the region Oberes Elbtal / Osterzgebirge (map encompasses the area of a regional council and thus covers more than planning region – the eastern five districts belong to an other planning region)

Also **chemical plants along Elbe and Vltava rivers** in Czech Republic have high relevance for the region. There are several plants close to the rivers and even directly exposed to it during high water events. The August 2002 Flood has once more proved the urgent need to address this issue when several tons hazardous substances were washed into the river and the flood water caused unexpected reactions in the plants releasing dangerous chlorine compounds and dioxins. In cases of accidents at these plants the Elbe River serves as direct and unavoidable 'risk path' for any emission and thus endangers people, private and public infrastructure and housing as well as the drinking water supply of the city of Dresden.

There are no nuclear power plants in or close to the region. The Research Centre Rossendorf with its nuclear physics department is a single structure situated close to Dresden dealing with radioactive substances. A special case is remnants of mining activities in the region. Relevant are on the one hand **heaps from non-ferrous metals** (zinc, silver, bismuth, cobalt and nickel) **mining and uranium mining** as well as sites with deposits from uranium extraction plants**.** There are thousands of old heaps many of which contain uranium ore as waste product. Most of the ancient heaps and pits are not any more visible but still can cause locally relevant Radon exhalations (the extent of ground water exposure is not yet defined) though direct (□) radiation is rather less important (Exposure to radiation caused by mining in Saxony and Thuringia, 1990). Biggest in size and most exposed are those from recent mining activities.

There are several possible risk paths by which the area surrounding these structures can be exposed to the hazard:

- direct radiation
- exceeded radon exhalation
- erosion by wind from heaps or dried out settling pits
- leachate

A mapping of exposed areas has not been published.

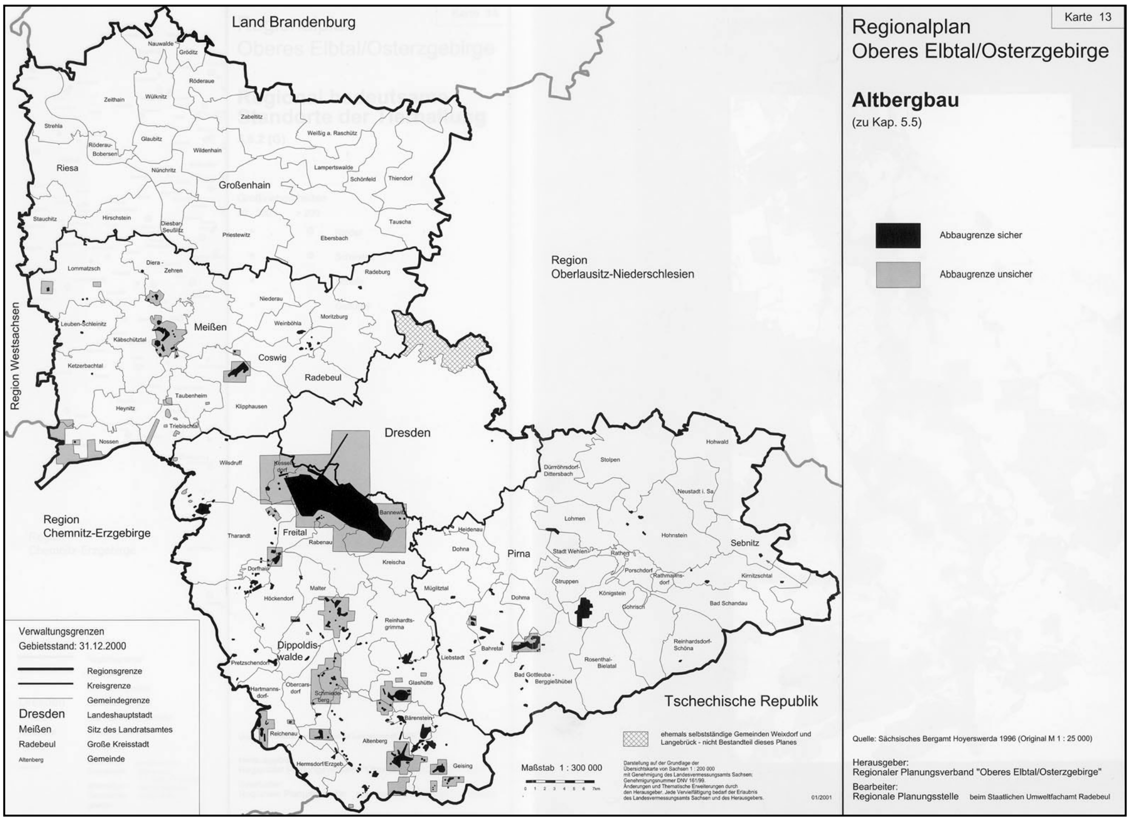

Figure 4: Areas and extensions of cavities in the underground (black known, grey unknown) (Regional Plan map 13)

<u>On the other hand</u> are large and not fully explored **cavities from past mining periods**. Hazards in the past have shown that these may have spatial importance that has so far not been fully explored and documented. Only local 'subsidence areas' in ancient locations areas are known. As far as it relates to uranium mining two locations are relevant: old uranium mines in Freital, close to Dresden as well as the recently (early 1990s) closed uranium mine in Königstein south of Dresden.

Another relevant hazard type to be considered in the region are major dams in the tributaries of the Elbe River. More than 3000 dams and weirs are known in the waters of Saxony several hundreds of them in the planning region. The extent of damage that dam failures may cause largely relate to the size (in terms of height and capacity) of the structure. For the first for ESPON Hazards should be considered relevant a structure defined "large dam" and bigger (e.g. "major dams") by the International Commission on Large Dams[2] (height ≥ 15 m, capacity ≥ 1 Million m^3, flood discharge at least ≥ 2000 m^3/s). Further on a more adapted definition should be found that can be applied to individual situation (e.g. those that in case of a collapse would cause an equal or larger flood wave than a five years flood right below the dam and an equal or larger flood wave than a two years flood in a distance of two kilometres). Until now no assessment of spatial relevance of dam structures has been published for Saxony. That this context is actually important was proven during the August 2002 Flood when flood waves in virtually all rivers exceeded storage capacities by far and the discharge of some dams ran out of control.

Even though the spatial consequences of dam failure in all cases would not exceed the regional level, risk from the failure of a major dam can be estimated to be of national importance compared to its damage potential in the densely populated area.

[2] ICOLD: http://www.icold-cigb.org

The relevant hazards for the region can generally be assessed as follows:

Table 4: Natural and technological hazards in the planning region Oberes Elbtal / Osterzgebirge (list of hazards as agreed upon in 1st Interim Report, ESPON Hazards 2003, extended by dam failure)

Natural and technological hazards	**spatial relevance** **on the planning region:** + = high, o = low, - = none
Natural hazards	
Volcanic eruptions	-
Floods	+
Landslides/ avalanches Rock collapses Landslides	 0 0
Earthquakes	-
Droughts	0
Forest fires	0
Storms Short wind storms	 0
Extreme precipitation (heavy rainfall, hail)	+
Extreme temperatures (heat waves, cold waves)	-
Technological Hazards	
Hazards from nuclear power plants	-
Hazards from production plants with hazardous production processes or substances Rossendorf	+
Hazards from hazardous waste deposits / storage of nuclear waste Old uranium mine with ground water contact near Königstein	+
Hazards from the marine transport of hazardous goods Freight ships at the Elbe river	+
dam failure	+

1.1.3 Basic risks assessment

As already mentioned above, the information basis for comprehensive risk assessment at the regional level is virtually not existing. A part of the basic risk assessment shall be performed by constructing a vulnerability matrix at the basis of the hazard typology presented in the First Interim Report.

As major input data for risk assessment so far has not been scrutinized for the regions in Saxony further investigation have to go ahead before the second step of the risk assessment can be performed. The only exemption may be the flood hazard along the Elbe River where flood zone mapping is underway and an evaluation may soon be made available by responsible state authorities.

Table 5: population density and GDP per capita (EU 15 = 100) (taken from tables above and European Commission 2000)

Districts	population		size		population density	GDP 2000
	number	%	km²	%	(persons/km²)	Mio Euro
Dresden	477 807	46,6	328	9,6	1 455	11059
Meißen	153 139	14,9	632	18,4	242	2473
Riesa-Großenhain	122 274	11,9	821	23,9	149	1833
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Weißeritzkreis	125 460	12,2	766	22,3	164	1507
EU 15	**1 025 860**	**100**	**3 434**	**100**	**299**	**18789**

Lacking information of the frequency of hazards the following table ('Typology of hazards' as presented in the first Interim Report but better 'Risk typology of hazards') shell be applied to display the potential vulnerability aggregated for the NUTS level 3 in the Planning Region Oberes Elbtal / Osterzgebirge

Table 6: Vulnerability of Districts (NUTS level 3) in the planning region Oberes Elbtal / Osterzgebirge

GDP per capita (EU 15 = 100)	Population density (EU 15 = 100)				
	I	II	III	IV	V
I					
II		• Sächsische Schweiz • Weißeritztalkreis	• Riesa-Großenhain		
III				Meißen	Dresden
IV					
V				Zeeland*	

Table 7: Vulnerability matrix of Districts (NUTS level 3) in the planning region Oberes Elbtal / Osterzgebirge

Degree of vulnerability	*GDP per capita (EU-average = 100)*	*Population density (EU-average = 100)*
Dresden	III	V
Meißen	III	IV
Riesa-Großenhain	II	III
Sächsische Schweiz	II	II
Weißeritzkreis	II	II

1.2 PLANNING BACKGROUND

1.2.1 Framework legislation

Federal Level

The German planning system is based upon the *Basic Law* (Grundgesetz) giving the general societal context as a framework for development and ensuring the so called self government right of municipalities – i.e. the lowest level in the administrative structure of Germany. Furthermore with its section 75 Nr. 4 the Basic Law gives the Federation a so called 'framework competence' to set a framework for spatial planning in Germany.

With the *Federal Spatial Planning Law* the Federal uses its framework competence providing the federal context for spatial planning at the regional level and obliging the Länder to manage Regional planning.

The *Federal Building Code* sets the legal framework for the physical planning and implementation of land use planning at the operative (local/municipal) level. The municipalities enact *local legislation* (ordinances) that allows the elaboration and implementation of plans. Section 1 Nr. 4 of the code obliges municipal plans to be in coordinance with aims of spatial planning.

Federal Nature Protection Act (Bundesnaturschutzgesetz – BNatSchG) setting the basic legal framework for the sectoral „Landscape Planning" in Germany (Landschaftsplanung)
Federal Imission Protection Law (Bundesimmissionsschutzgesetz – BimSchG) – gives the Länder the right to regulate security areas around dangerous structures through ordinances (sections 49 and 50, relating to Directive 82/96/EC)
Emergency ordinance (Störfallverordnung – BImSchV 12) – based by the Federal Imission Protection Law the Ordinance regulates (section 15) that the responsible boards (e.g. regional councils) estimate the probability of hazards to avoid domino effects in emergency situations.

Regional level (Länder and Planning Region)

Spatial planning is performed and is basically steered at the Länder level. Each Land is obliged to develop laws and ordinances for the regional planning setting goals and making provisions for the implementation. The most important respective document for the Free State of Saxony is the *Spatial Planning Law of the Free State of Saxony* setting the Framework for the elaboration of the Comprehensive Plan and the Regional Plans (RPs).

The *Comprehensive Plan* (CP) having legislation status itself (ordinance) besides the latter is the basis for the elaboration of Spatial Plans of the Planning Regions of Saxony (Regional Plans).

Regional Plans (RPs) in concert with CPs are documents (Ordinance by Regional Planning Association) setting legally binding so called 'aims' and 'principles' for the elaboration of municipal land use plans.

Environmental Protection Law of the Free State of Saxony (Landesnaturschutzgesetz – SächsNatSchG) – sets the legal planning requirements for Landscape Framework Planning in Saxony, in particular as relates the elaboration of so called Landscape Programs (Länder level) and Landscape framework plans (regional level)

Saxon Law for the management of emergencies from accidents with dangerous substances (Sächsisches Gefahren- und Unfallgesetz – SächsGefUnfallG) – Implementing Emergency ordinance

Examples of singular ordinances, regulating issues of certain structures, as permitted in the Federal Imission Protection Law:
Saxon Harbour Ordinance (Sächsische Hafenverordnung - SächsHafVO) – regulating security areas around harbours with hazardous substances
other ordinances …

EU – Level

Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (the "SEVESO II" Directive)

1.2.2 Planning framework / context

Regional planning in general

Regional Planning in Germany takes place in a two-step approach. The Länder set the legislative frame and basic statement on how the spatial system of the Länder is to be developed. Within their comprehensive plans (Landesentwicklungsplan) central places, main development axes and major transportation axes are named as well as areas of super regional or federal interest become designated. The statements of CPs are primarily meant to be precised in Regional Plans but serve at same time as binding statements for municipal planning (which makes CPs part of regional planning according its definition presented in chapter 1.5)

The actual regional planning takes place at the level of the so-called planning regions. Regional plans are comprehensive plans which precise aims and principles for spatial development (of LFT) for defined regions. It is legally binding for municipalities that mean that municipalities have to be in line with main declarations of the Regional Plan.

Table 8: Levels of German planning system

Federal Level	**Federal Republic of Germany** (Framework competence, general plans) **Minister Conference** for Spatial Development (coordination of activities)
Regional Level	**16 Federal States (Länder , NUTS level 2)** Comprehensive Plans (CP's) Spatial Programs aims and principles for spatial development **Planning Regions (below NUTS level 3)** Regional Plans aims and principles for spatial development Core information for municipal land use plans
Municipal (operative) Level	**Municipalities (NUTS level 4)** Physical Planning and Implementation preparatory land use plan legally binding land use plan

The German planning system at all planning levels requires the integration of concerns of nature and landscape. This is realized through elaboration sectoral Landscape Framework Plans, respectively Landscape Programs. Nature protection laws of the Federation and the Länder particularly regulate this.

Whereas the German planning system knows a large number of sectoral plans that through their integration make up 'the spatial plan' there is no sectoral 'risk or hazard planning'.

A crucial feature of the planning system is the so-called subsidiary principle. On the one hand this means that space relevant decisions are passed as far as possible "down" on the lower level. On the other hand a decision taken in one document cannot be "taken" or even stated again in an other legal document. For this reason many spatially relevant statements can not be seen in regional plans since they are terminatory regulated on a superior level.

Regional planning in Saxony

From the planning perspective Saxony is divided into five planning regions (steered by Regional Planning Associations). Every planning region is responsible for the elaboration of the regional plans that covers the whole area of the region.

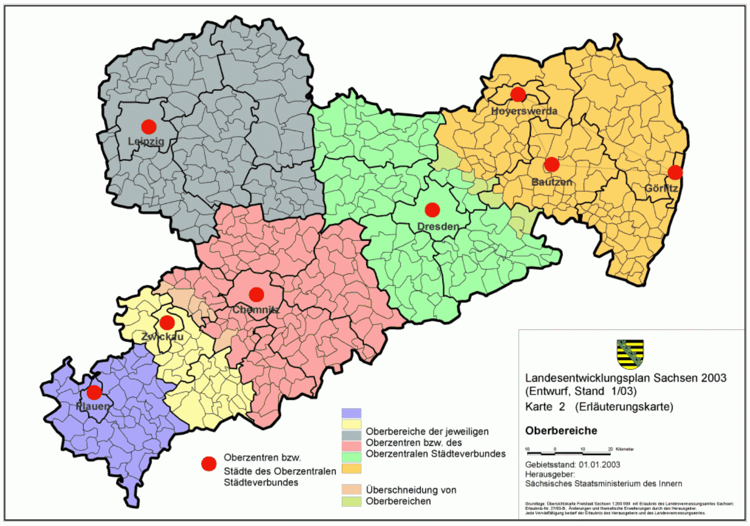

Figure 5: Free State of Saxony – districts and municipalities (draft Map[3])

3 http://www.sachsen.de/de/bf/staatsregierung/ministerien/smi/aktuell/fortschreibung_lep/auslegungsentwurf_lep/index.html , Mai 27th 2003

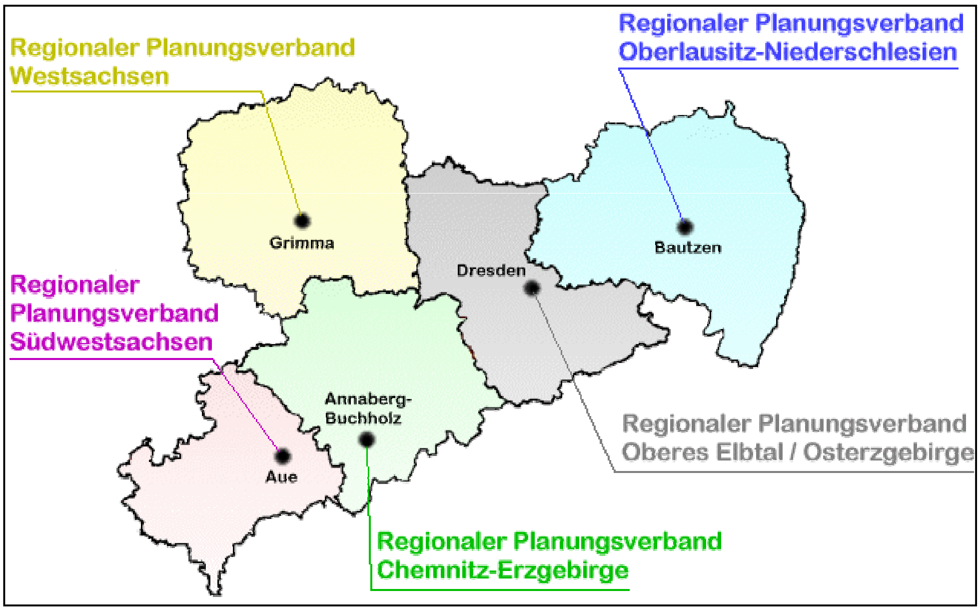

Figure 6: Planning regions of Saxony (http://www.regionalplanung-sachsen.de/, Mai 27th 2003)

As in all of Germany basic planning units are municipalities. Several municipalities make up a District. A planning region covers exactly a certain number of districts.

European context

NUTS levels of the European Union are not completely congruent with Saxon planning hierarchy. There are slight disproportions that appear at the level of regional planning. Whereas NUTS level 2 covers the so-called Regional Councils, NUTS level 3 applies to Districts several of which constitute a planning region (see above). Thus NUTS level 3 in the case of the present case study applies simultaneously to five parts of the region of question.

Figure 7: NUTS level 3 - Statistical regions in East Germany (Eurostat)

1.2.3 Involved / responsible off. boards / authorities

Saxony State Ministry of Internal Affairs (NUTS level 2)**:** elaborating CP and approving Regional Plans.

Regional Planning Board (below NUTS level 3): Working board of the Regional Planning Association elaborating and updating Regional Plans and monitors their implementation through municipal land use planning.

Regional Council (NUTS level 3): covers a larger area than a planning region (in Saxony three regional council areas). Authority for Approvals of municipal development policies (legally binding municipal plans) in general and large development project if certain project size is exceeded and thus watching the implementation of regional planning policy (RPs and CPs)

State Environmental boards (NUTS level 2): cover the same area as regional councils and provide sectoral information for Landscape planning (in important sectoral planning step at any planning level).

Municipalities (NUTS level 4): Municipalities of a region establish the Regional Planning Association with elected steering board.

Mining authority (Bergamt, NUTS level 2): responsible for data related to mining locations, cavities and related issues.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans, cartographies at the regional level and particularly relating to hazards at regional level

This chapter presents spatial plans of the regional level in the planning region Oberes Elbtal / Osterzgebirge and in particular their statements in relation to natural and technological hazards. This will also include statements from other administrative levels that have direct impact on spatial development in the regions.

Regional Planning in Saxony is performed in a two-step approach:

1. the CP of Saxony, which sizes requirements for spatial development of the Federal Government and transmit them to the Länder context and which sets the larger spatial development framework for the Regional plans
2. the RPs, which at the bases of the CP precise its requirements under consideration of regional context and thus constitute the “vital link” between super ordinate spatial development and its implementation at the operative local level

<u>Comprehensive Plan of Saxony</u>

Saxon's CP has only a view direct statements relating to hazard issues. Also the aims of spatial development do not contain statements that would allow to interpreted as meaning risk prevention. The CP recognizes particular call for action in the context of:

- hazard prevention in location with probability of landslides due to past surface coal mining (LEP1994, B-104)

- hazard prevention in areas of past uranium mining where direct radiation may exposed (LEP1994, B-104)
- preventive protection of water resources usable for drinking water abstraction (so called Water Protection Areas, LEP1994, B-64)
- protection of the population against imissions of noise, vibrancies and air pollution (LEP1994, B-136)

Most of these statements are rather made from the perspective of technical means of environmental protection than from a systematic risk prevention perspective.

Currently the new CP (2003) is under preparation. In the currently discussed version no systematically difference can be seen. The current table of contents of the CP 2003 draft version shall serve as an example how the plan is structured.

Table 9: Comprehensive Plan 2003 draft table of contents[4]

Chapter		page
2	Development of spatial structure	5
2.1	super ordinate spatial structure	5
2.2	European Metropolitan Region „Sachsendreieck" (Saxony Triangle)	6
2.3	Central places and municipal networks	8
2.4	Municipalities and municipalities with special municipal functions	17
2.5	Spatial categories	19
2.6	superordinate development axes and their integration into European Networks	23
3	Regional Development	24
3.1	Inter municipal cooperation	24
3.2	Transnational and cross boundary cooperation	25
3.3	Areas with special development and restoration functions	27

[4] (http://www.sachsen.de/de/bf/staatsregierung/ministerien/smi/aktuell/fortschreibung_lep/index.html, Mai 7th 2003)

Regional Plan Oberes Elbtal / Osterzgebirge (Regional Plan Upper Elbe Valley / East ore Mountains)

Similar as the CP the Regional Plan does not have an explicit risk based approach. The main issue related to hazard and risk is the statement about flood protection.

This relates to possibilities of regional planning to contribute to direct or indirect measures of preventive flood protection. These are specified as follows:

Table 10: direct indirect statements of the RP Oberes Elbtal/Osterzgebirge related to flood protection

planning tool (instrument)	**cartographic display**	**summary / aim or principle**
Priority areas for flood protection	Map of spatial uses 1:100000 Symbol (usual retention capacities smaller and larger than 1 Mio m^3)	**Aim** 4.4.6: completion of the system of flood retention structures in the Easter Ore Mountains and in the Müglitz river valley. **Requirement** 4.4.6: environmentally sound flood protection
Flood zones (assigned and planned)	Map Maintenance, Development and Restoration of the landscape 1:100000	**Principle** 4.2.2.6: Clearing and reopening of natural paddles along the Elbe river, allowing for ground protection in case of floods
		and further more …

As integral part of the RP the so-called Landscape Framework Plan (elaboration is regulated by Federal and Länder nature protection laws) may contain more precise information on landscape relating hazards. As far as it concerns regional planning in Saxony this cannot be analysed from any documentation since Saxony is the only Land performing the so-called primary integration. This means that Landscape Framework Planning issues are directly integrated into the RP. The amended (2002) Federal Nature Protection Law requires an explicit Landscape Framework Plan for more transparency. The binding character of regional plans is discussed in the chapter 'planning context'.

1.3.2 Relevant data sets available at regional level

Since regional planning in Saxony and Germany does not explicitly work with hazards, no data sets can be derived directly from regional planning documentation. Available and usable data sets in the region and the Free State of Saxony will be necessary and can be summarized in the scope of the foreseen interviews.

Two general issues have to be taken into account when collating data for the purpose of risk assessment: **type of data** and **scale of data** – both in the context of the **target hazard** the data is going to be used for.

<u>Type of data</u>

Dealing with spatial relevant risk assessment in the European Union is based upon the Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (SEVESO II). It aims at the prevention of major accidents and the limitation of their consequences for man and the environment (see Council Directive 96/82/EC and Christou/ Porter 1999).

> Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest …
>
> (Council Directive 96/82/EC, § 12)

The Seveso Directive targets accidents with hazardous substances. Nevertheless, the approach covering both socio-economic and ecologic issues should be leading to the broader perspective of risk assessment in planning contexts. Risk assessment in Europe needs to take into account socio economic as well as ecologic issues. Collating consistent data sets will thus be a first challenge on the way to comprehensive risk assessment at different spatial levels.

Whereas statistic data covering the socio economic perspective should be available throughout Europe, usable data on ecologic features and functions may pose problems in terms of availability and comparability.

The Saxon Länder Institute for Statistics offers a variety of socioeconomic data that might be useful for risk assessment (see Annex 2 of Annex I.1). This data can be derived at the levels of Länder, districts and municipalities. Further information, such as a register of hazardous industrial plants, hazard areas above cavities from ancient mining, areas affected by exhalation and radiation from mining waste (and many more) are much less standardized. The sources are very fragmented and do often not even cover comparable areas and scales (see below). To find and adopt such information should also be an issue of the interviews (see chapter 1.5.2).

Different other Institutions at levels of Länder, Regional Councils, Districts or municipalities may furthermore have data sets on ecological aspects. These can relate to spatial distribution and functioning / vulnerability of e.g. areas with different protection status, areas with special recreation value, areas with particularly sensitive functions and other.

<u>Scale of data</u>

The ESPON action 1.3.1 "Hazards" defines Regional Planning to be the level of planning directly superior to that of municipalities. Therefore, most favourably data sets at the municipal level should be used at regional level.

As regulating super municipal issues it usually is irrelevant for regional planning to work with data resolution beyond the municipal level. Sometimes even more aggregate data sets may be convenient for risk assessment. Nevertheless the scale issue should be carefully integrated into the process of making requirement to data sets. This is explained using hazards from the case study region Oberes Elbtal / Osterzgebirge.

The hazards presented in the chapter 'Relevant hazards' can be assessed according to their spatial relevance as follows:

Table 11: Natural and technological hazards in the planning region Oberes Elbtal / Osterzgebirge and their estimated spatial relevance

spatial scale / ***Natural and technological hazards***	**Local**	**Regional**	**Over regional**	**irrelevant**
	Specific spatial relevance: + = high, o = moderate, - = low			Hazard not irrelevant for the region
Natural hazards				
Volcanic eruptions				x
Floods	+	+	+	
Landslides/ avalanches				
Rock collapses	0	-	-	
Landslides	0	-	-	
Earthquakes				x
Droughts	(0)	(-)	-	
Forest fires	0	0	-	
Storms				
Short wind storms	+	0	0	
Extreme precipitation (heavy rainfall, hail)	+	+	0	
Extreme temperatures (heat waves, cold waves)				x
Technological Hazards				
Hazards from nuclear power plants				x
Hazards from production plants with hazardous production processes or substances Rossendorf	+	0	(-)	
Hazards from hazardous waste deposits / storage of nuclear waste Old uranium mine with ground water contact near Königstein	+	+	0	
Hazards from the marine transport of hazardous goods Freight ships at the Elbe river	+	+	+	
dam failure	+	+	(+)	
Hazards from other sources Airport entry lines	+			

As the table shows, the spatial relevance of the hazards recognized in the planning region is differing. According to the definition of the ESPON action 1.3.1 "Hazards", the task of Regional Plans is to make provisions for the municipal planning level. The Regional Level is thus 'just' indicating to municipalities that in certain areas certain issues of risk have to be taken into account. To do so regional planning needs data sets that allow to specify hazards and potential hazard areas down to a scale applicable by local authorities.

For potential hazards, in first step estimates the effected area. In a second step chooses the useful data set and scale. For areal hazards (most of technological hazards) the scale may often be on municipal or district level. For certain punctual or axial hazards such as land slides, rock collapses or floods much more precise data are necessary at the regional level.

1.3.3 Elements of available planning documents in relation to hazards and risks

The analysis of regional planning documentation in Saxony leads to the impression that hardly any elements of risk prevention are included. This is only partially true as far as it concerns the direct statements in the regional plans (with the exemption of flood protection).

In reality many risk mitigation issues are inherent to the plans but are not explicitly extractible. As already shown in the chapter 'Framework Legislation' there are many more Laws, Ordinances and other legal acts that make statements relating to hazards and their source areas. It was not possible to quote all of them – a list is given in the chapter "Legal background". These acts, often not directly related to spatial issues, contain statements on certain kinds of structures or even naming single structures they particularly relate to and thus make provisions on how spatial planning has to deal with them. Consequently, due to the strict application of the subsidiary principle, e.g. safety or hazard zones surrounding hazardous plants are inherent to regional plans. This even though they are not explicitly displayed since sectoral hazard or risk planning documentation does not exist. Subsidiary principle in this case means that legal acts and decisions which are approved at a level superior to that of regions are automatically either implemented by regional and local planning or simply not repeated since it already has been stated at the superior level. Instead, only applications that are not in conflict with the decisions are displayed.

The only sectoral documents prepared for the purpose of risk mitigation are maps displaying flood zones along rivers and water protection areas. The planning instrument 'water protection area' (usually designated as reserve areas) are under preparation and will soon serve as obligate documents to be included into spatial development documentation.

Other documents have a rather indicative character and are often not used for planning (e.g., maps of subsurface cavities, available in the mining authorities are only indicative maps on assumed cavities in the underground that contain no risk assessment.

Other documents are the already cited legal acts with fragments relating to spatially relevant hazardous structures.

Since the German approach to hazard and risk planning is such fragmented and no comprehensive situation can be drawn from the analysis of planning documentation there is a strong need to receive deeper information by means of the foreseen interviews with authorities and boards related to regional planning.

1.3.4 Useful and transferable Instruments / indicators for a risk reduction management

The German system of spatial planning in recent years has developed and applied a number of interesting tools for the handling of spatial activities.
The most interesting from the European perspective as identified are:

- Legally binding land use plans (*Bebauungsplan*)
- Landscape Plans (*Landschaftsplan*)
- Priority areas (*Vorranggebiet*)
- Reserve areas (*Vorbehaltsgebiet*)

- Water Protection Areas (*Wasserschutzgebiet*)
- Flood Zones (*Überschwemmungsgebiet*)
- Construction restriction zones (*Baubeschränkungsgebiet*)

Tools that may be called implementation strategies complement these. Adopted to the application in regional specification these tools are:

- Regional (joint) land use plans (*Regionaler Flächennutzungsplan*)
- Regional Planning boards (*Regionale Planungsstellen*)
- cooperation strategies *(Informal planning tools)*
- Public participation

1.3.4.1 References

Basic Law (Grundgesetz) …

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Federal Building Code (Baugesetzbuch – BauGB) in the wording of the Act to Amend the Federal Building Code and to Reorder Spatial Planning Law (BauROG) as issued on August 18th 1997(BGBl. I p. 2081).

Spatial Planning Law of the Free state of Saxony (Landesplanungsgesetz SächsLPlG) in its wording of the 14th of December 2001 (SächsGVBl. S. 716)

Federal Imission Protection Law (Bundesimmissionsschutzgeserz – BImSchG) in the wording of the announcement from September 26th 2002, BGBI. I page 3830

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ANNEXES OF 1 REGION OF DRESDEN

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5.4.1	Tourist infrastructure and traffic development
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5.4.4	Tourist Routs
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Annex 3	Regionalisierte Leitbilder für Natur und Landschaft
Annex 4	Regionale Maßnahmen des Naturschutzes und der Landschaftspflege
- Annex I	Repräsentative Charakterarten der Region Oberes Elbtal/Osterzgebirge
- Annex II (a)	Bestehende und geplante Naturschutzgebiete (NSG)
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Annex 7	Regionalplanerische Ausschlussbereiche für Windkraftanlagen (WKA)	
		Scale
Maps		
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Map 2	Geo-ecological units	M 1 : 100 000
Map 3	Land uses	M 1 : 300 000
Map 4	Undissected open spaces	M 1 : 300 000
Map 5	Maintenance, Development and restoration of the landscape	M 1 : 100 000
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Map 7	Regionally important migration paths, resting and collecting places of large migrating birds	M 1 : 300 000
Map 8	Regional measure of environmental protection and landscape conservation according Annex II of Annex 4	M 1 : 100 000
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Map 10	Tourism	M 1 : 200 000
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Map 12	Areas with limitations for building development	M 1 : 300 000
Map 13	Historical mining areas	M 1 : 300 000
Map 14	Regionally important locations of animal farming	M 1 : 300 000

Annex II: Abstract of potentially relevant data sets from the standard set of statistics available at district and municipal levels (socio-economic data)

Area and population

area – information on area size, enclosed municipalities, population, population density, population structure and dynamics

Net income of households

Employment situation (specified trades)

Education

information on schools, high schools teaching personnel, students, diploma holder

Public social services and payments

information on social aid payments, housing allowance, youth welfare service, payments to disabled persons

Health care

information on medical health care infrastructure, personal

Construction

information on permits, kinds of structures, housing,

Land use

information on area sizes occupied/used as/for buildings and open spaces, business, recreation, cemeteries, traffic, agriculture, forests, water, surface mining, other

Agriculture

information on business size, surface areas and kind of use, sorts of crop, animal farming,

Mining and manufacturing

information on types of businesses involved, personnel, wages, turn over, energy consumption

Construction trade

information on types of construction firms, personnel, wages, turn over

Tourism

information on kinds of accommodation (hotel etc.), guest beds offered in certain seasons, arrivals, over night stays

Motor vehicles

Business activities

information on business registrations, closed businesses, insolvencies

Trade with construction sites

Public finances

information on municipal taxes, municipal share on income and turn over taxes, debts and other,

Public service personal

1 ITÄ UUSIMAA

1.1 GENERAL

1.1.1 Key data on the region

Geological and ecological aspects

The region of Itä-Uusimaa (Eastern Uusimaa) is situated in southern Finland, east of the country's capital region and the region of Uusimaa. Southern and southwestern Finland are geologically the youngest regions in Finland. The most common types of bedrock in the Itä-Uusimaa region are granite and rapakivi. The most common quaternary overburden type is moraine, which was formed during the last phase of the ice age. Traces of the ice age can be found in many parts of the region's landscape in the form of end moraine and ridges. Groundwater is stored especially in ridges and the condition of the water has remained good despite of some changes in quality linked to human activities. On the coast and in the archipelago the thin quaternary overburden leaves the bedrock visible in many places.

Itä-Uusimaa is a predominantly low-lying and fertile region with plenty of fields and both deciduous and coniferous forests. Itä-Uusimaa is situated on the Gulf of Finland between the water systems of Kymi River in the east and Vantaa River in the west. Altogether seven rivers discharge to the Gulf of Finland within the boundaries of the Itä-Uusimaa region. The condition of the rivers and lakes is generally fairly good, but many rivers adjacent to clayey agricultural regions show high concentrations of nutrients. In the last twenty years the eutrophication of the region's lakes has been noticeable, and eutrophication is also present in some inland bays and the archipelago. The water circulation is slow due to the sheltering effect of the archipelago and thus the coastal waters are especially vulnerable to the sewage waters from industry, agriculture and settlements.

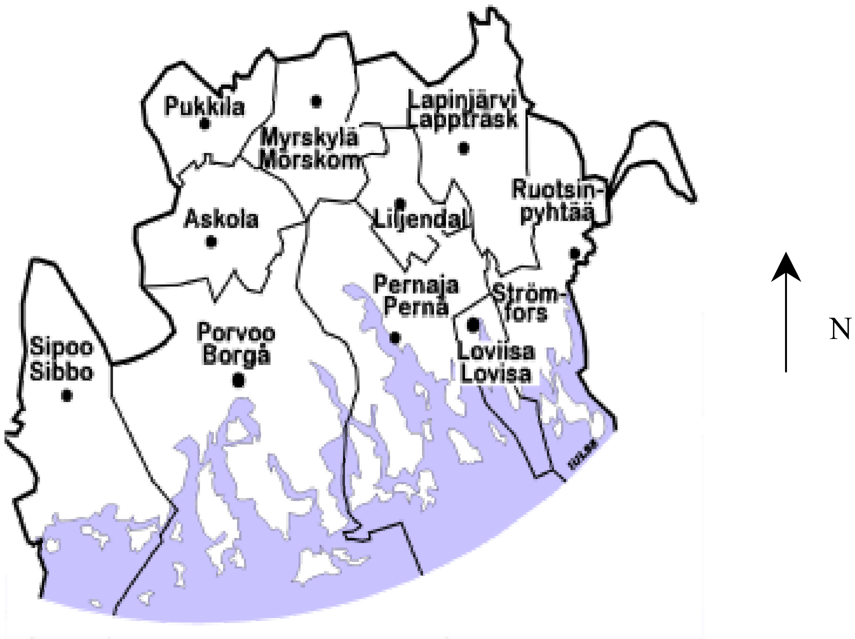

Figure 1: The region of Itä-Uusimaa and the ten municipalities (Itä-Uusimaa region 2003)

Social and economic aspects

Itä-Uusimaa consists of 10 municipalities that have a total population of 90 000 inhabitants. The largest town and the most important centre Porvoo (45 000 inhabitants) houses the regional council of Itä-Uusimaa. Sipoo is the second largest municipality with 18 000 inhabitants, whereas the third largest municipality, Loviisa, has a population of only 7 600. The municipalities of Itä-Uusimaa are mainly rural in their nature. However, Porvoo and Loviisa have small town centres with an urban structure. The population density varies notably between different municipalities, being 167 in the town of Loviisa and 9 in the rural communities of Lapinjärvi and Pernaja. Many of these municipalities increase their population substantially in the summertime, when people from urban areas retreat to their summer cottages.

Table 1: Population and population density (persons/km²) in the municipalities of Itä-Uusimaa (Itä-Uusimaa region 2003)

Municipality	**Population**	**Population density** (persons/km²)
Askola	4 446	21
Lapinjärvi	2 981	9
Liljendal	1 462	13
Loviisa	7 440	167
Myrskylä	1 992	10
Pernaja	3 823	9
Porvoo	45 730	70
Pukkila	1 949	14
Ruotsinpyhtää	2 934	11
Sipoo	18 177	50
Itä-Uusimaa	**90 934**	**33**
Finland	**5 206 000**	**17**

The proximity of Helsinki (40 kilometres west from Porvoo) and the growing capital region with over one million inhabitants creates traffic and pressure to the land use and natural resources of Itä-Uusimaa. The population growth in the entire Itä-Uusimaa has been moderate (13,3%) in the last twenty years. Sipoo, whose neighbouring town is Helsinki, has however grown with 40% and the regional centre Porvoo with 20%. Population reduction has occurred mainly in the easternmost municipalities of Lapinjärvi, Loviisa and Ruotsinpyhtää. Regional centres are important in providing people with necessary services since not all of the smaller municipal centres are able to do this. One solution to this is to annex one municipality to another, for example Porvoo almost doubled its population when the rural district of Porvoo and the town of Porvoo were united in 1997.

The majority of the population in Itä-Uusimaa (66,2 percent) is employed in the service sector, 26,6 percent in the industry and 5,3 percent in agriculture and forestry. There are, however, differences between the different municipalities. The largest concentrations of industry can be found in the two towns of Porvoo (oil refinery, industry cluster and port) and Loviisa (nuclear power plant and port). Itä-Uusimaa is a bilingual region with a Swedish-speaking population of 35 percent compared to the 5,6 percent in the whole country. The coastal municipalities tend to have a larger Swedish-speaking population than the inland municipalities.

1.1.2 Relevant hazards

<u>Natural hazards</u>

Natural hazards and their impacts in Finland and in the Itä-Uusimaa region are generally mild. The region is geologically stable, and the earthquakes that do occur from time to time are too mild to be considered a risk to the population, economy or environment. Most natural hazards are related to extreme weather conditions, such as extreme precipitation, storms, droughts and extremely low temperatures. However, such events are rare and even though they can cause considerable damage, they seldom cause casualties. For example forest fires, which are most common in the dry periods of the summer, seldom spread out to threaten residential areas.

Flooding is perhaps the most relevant natural hazard in Itä-Uusimaa. The flooding of rivers is often linked to the melting of snow and ice in the spring, especially in the lowlands of western Finland. In the region of Itä-Uusimaa, fluctuations of the discharge of rivers are fairly large due to the lack of larger lakes in the river systems. On the one hand these rivers flood easily, on the other hand water can be scarce during dry periods. The economic damage related to floods concerns mainly agriculture, whereas residential areas are seldom affected.

Occasionally storms raise the level of the Baltic Sea high enough to cause flooding in the coastal regions. Economic damage can be high especially in urban regions, but similarly to the other natural hazards in the region, casualties are rare.

Technological hazards

Technological hazards play a significant role in the hazard scape of the Itä-Uusimaa region. The two most relevant sources of potential technological hazard that originate inside the region itself are the industry cluster and port in Sköldvik (Porvoo) and the nuclear power plant in Hästholmen (Loviisa).

The nuclear power plant is situated 15 kilometres southeast from the centre of Loviisa on the island of Hästholmen. The first unit of the power plant was set into action in 1977; it was also the first nuclear power plant in Finland. The second unit was set into action three and a half years later. The plant meets over ten percent of the total electricity need in Finland and it employs approximately 600 people. The nuclear waste is stored in subterranean pits near the power plant. An accident in the power plant would not only threaten the town of Loviisa, but also the whole region and even more extensive areas. The possibility of placing a third nuclear reactor in Hästholmen is currently being discussed.

The port of Sköldvik is Finland's most important port for both export and import of crude material and products of chemical industry. The port and the adjoining oil refinery are situated in the industrial area of Sköldvik approximately 12 kilometres southwest from the centre of Porvoo. The port and the different companies in the industrial area employ altogether approximately 3500 people. Emissions of dangerous chemicals into the air are a potential risk to the population of Porvoo, whereas the environment faces a pollution risk from oil spills from the marine transportation and loading of oil and other harmful substances.

A smaller port in the Itä-Uusimaa region is situated in Loviisa, but it does not deal with dangerous substances since it is mainly used for the export of products of the forest industry and for the import of coal.

Road transportation of oil and other hazardous substances is a technological hazard related especially to the existence of the industrial cluster and port in Sköldvik. A serious infrastructural weakness that intensifies this hazard is the lack of a second road leading the industrial area. An accident on the road could hinder possible rescue measures when only small village roads could be used for this purpose. Traffic and road transportation of harmful substances poses a risk to a larger area as well, since the E18 –road from Turku to the Russian border passes through the Itä-Uusimaa region.

Potential technological hazards that threaten the region from the outside are mainly related to the marine transport of oil and other hazardous goods in the Gulf of Finland. The Russian port of Primorsk in the eastern tip of the gulf is important for exporting oil from Russia via the Baltic Sea. Oil transportation carries always a risk, but the often difficult ice conditions in the Baltic Sea, especially in the Gulf of Finland, intensify this risk when oil tankers not built for such conditions are being used. The technological risk of oil transportation is thus intensified by natural conditions.

Another hazard related to oil transportation and oil refineries in the Gulf of Finland are scattered oil spills that are difficult to perceive and to prevent. Without firm proof it is impossible to get the ships that rinse their oil tanks in international waters to take responsibility of their actions. It is estimated, that in the Baltic Sea there are 500-800 oil spills every year, and in 2001 the Border Guards reported 107 oil spills in or near the Finnish territorial waters. The Finnish marine Research Institute states that the continuous exposure to these oil spills can strain the Baltic maritime environment more than previous oil accidents in the Baltic Sea have done.

1.1.3 Basic risk assessment

The hazards in the region of Itä-Uusimaa listed in the previous chapter can all be considered relevant for the ESPON Hazards project. All of the natural hazards in the region represent the Cyclops-type of risk, which means that the probability of their occurrence is largely unknown, but the possible damage is quantifiable. The technological hazards represent the Damocles – type of risk, where the possible damage can be very high, but the probability of occurrence is very low. These two risk types were found relevant in the context of spatial development in chapter 6.1.2 of the 1st Interim Report.

Table 2: Assessment of risk type and spatial relevance of the natural and technological hazards found in the Itä-Uusimaa region

Hazards	**Risk type** (see p. 82 in the 1st Interim Report)	**Spatial relevance - locally** + = high, o = low, - = none	**Spatial relevance - regionally**	**Spatial relevance - nationally**
Natural hazards				
Flooding of rivers	Cyclops	+	+/o	-
Flooding of the Baltic Sea	Cyclops	+	+/o	-
Forest fires	Cyclops	+	o	-
Technological hazards				
Nuclear power plant and storage	Damocles	+	+	+
Oil refinery, industrial cluster and port	Damocles	+	+	o
Road transportation of oil and harmful substances	Damocles	+	+/o	o
Marine transportation of oil and harmful substances	Damocles	+	+	+
Oil Spills	Damocles	+	+	+

All of the selected hazards are spatial in their character (=they have spatial effects when they appear). However, the spatial planning response varies from one hazard to another (see Table 2), and not all of the above mentioned hazards are addressed in planning. The natural hazards are most relevant at the local scale, and to some extent also at the regional scale. Spatial relevance concerning natural hazards on the regional scale is virtually non-existent on the national scale.

The technological hazards tend to show more relevance on the wider regional and national scales than the natural hazards. The nuclear power plant in Loviisa is the most extensive hazard, although undoubtedly, the possibility of its occurrence is the lowest of all the relevant hazards. Marine transportation of oil and oil spills in the international waters threaten not only the Itä-Uusimaa region, but other areas on the Baltic Sea are threatened as well. These hazards are relevant in Itä-Uusimaa regionally as well as locally, since the region has such a long shoreline and an extensive archipelago.

1.2 BACKGROUND

1.2.1 Finnish planning framework and responsible authorities

National level

The Finnish planning system includes the national, regional and municipal levels. The Council of State has set national land use goals. These goals include the building and maintenance of main infrastructure networks and the policing of natural and built-up areas of national importance. In relation to the regional and municipal levels, the main task of the national government is to issue guidelines and supervise the observation of laws.

Ministry of the Environment acts as the highest authority that supervises and develops planning in Finland. It promotes, guides and controls planning on the regional level. Regulations of the *Land Use and Building Act* have to be used in the regional planning, building and land use of all regions and municipalities. In the hierarchical Finnish spatial planning system there are three levels of planning documentation that instruct land use in municipalities: regional plan (maakuntakaava), master plan (yleiskaava) and local detailed plan (asemakaava).

Table 3: Finnish planning framework

Level	Responsible authorities	Main task	Plan
National level	Council of State	sets national land use goals	
National level	Ministry of the Environment	supervises and develops planning in Finland	
Regional level	Regions (alliances of municipalities): Regional Councils	responsible for spatial planning on the regional level	Regional plan
Municipal level	Municipalities: Municipal Councils	main executive part in spatial planning in Finland	Master plan, Local detailed plans

Regional level
Municipalities act as basic planning units in the Finnish spatial panning system. The responsibility in the field of spatial planning in the regional level has been given to the 20 regions of Finland, who act as alliances of municipalities. The Regional Council, which has representation from each municipality, has the highest power of decision. The Regional Government steers regional planning according to the action plans approved by the regional council. *Regional plan* is a general plan for the land use of the whole region. It acts as a guiding instrument when master and local detailed plans are drawn up on the municipal level. National and regional goals are expressed in regional plans, which are submitted for approval to the Ministry of the Environment.

Regional environmental centres promote and steer regional planning and public construction in the municipalities of the respective region. A particular task of these centres is to supervise that the national objectives and regulations in spatial planning and building enacted in the law are being taken into account.

Municipal level
The self-governing municipalities have the main *executive* part in spatial planning, while the *master plan* is the main instrument in the *steering* of spatial planning in Finland. The master plan indicates the overall guidance of land use and the siting of various activities, whereas the *local detailed plan*s indicate the detailed land use and building in the municipality. In the hierarchical planning system the regional plan steers the master plan and the master plan steers the local plan. The legal effects work in the opposite direction, since the regional plan is not valid where a more detailed master plan exists, and the master plan is not valid where a more detailed local plan exists, respectively.

Every municipality has to have a *building code*. The building code includes regulations that are necessary for the realisation and preservation of a good living environment and for respecting cultural and natural values on the local level. Every municipality with a population of 6000 or more has to have a planner to take care of the spatial planning on the local level. Municipalities may have a joint planner and they also have the possibility to draw up joint master plans. Such joint plans require the approval of the Ministry of the Environment.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans available at regional level

The regional plan is the most important element of planning documentation concerning the whole Itä-Uusimaa region. The regional plan of Itä-Uusimaa used to consist of four separate plans that concentrated on different themes. In 2002 it was decided, that in the future the regional plan would be drawn up as one entity that includes all the different themes that used to be dealt with separately. At present, the new regional plan is being prepared, and the first outline will be ready by the end of the year 2004.

The regional plan of Itä-Uusimaa does not have a risk-based approach, and it does not recognise all the relevant natural and technological hazards enlisted in chapter 1.5.1.5.2. However, the two most relevant technological hazards of the region, namely the nuclear power plant in Loviisa and the industrial cluster and port in Porvoo are recognised in setting protective exclusion areas around them (see chapter 1.5.1.5.7). In addition to these exclusion areas, a consultation ring of two kilometres has been drawn around the Sköldvik industrial cluster according to the Seveso II –directive.

Master and local detailed plans recognise some hazards that are not recognised in the regional plan level. One example is flooding, which is more relevant on local than on regional level in Itä-Uusimaa (see Table 2). Flooding is taken into account in the Land Use and Building Act, which states that building sites should be chosen in such a way that no risk of flooding or landslides occur. In local detailed plans flood prevention is taken into account by setting a construction height for new areas. This height is specified in the building codes of separate municipalities.

1.3.2 Relevant data sets available at regional level

Data sets concerning hazards and risk reduction are scarce in the Itä-Uusimaa region. Regional planning documentation does not include this kind of information, although the existence of the most important technological hazards is recognized in the regional plan. More explicit data on these technological hazards is undoubtedly collected for the purposes of risk management inside the industrial areas.

One reason for the lack of data sets concerning hazards at regional level is the issue of scale. The whole region of Itä-Uusimaa has a population of 90 000 and planning resources are accordingly small. Since the number of hazards is limited and their magnitude is in most cases small, there is necessarily no need for regional or national data. It is more likely that the regional council or municipalities will collect data on topical issues only when the information is needed and not beforehand. In some cases the collection of data is initiated by the regional environmental authorities that contact the regional councils or municipalities.

Statistical data, which is not directly hazard-related but can be used for the purpose of this project, is available on the regional level. For example socio-economic indicators (e.g. population density) can be relevant in the assessment of regional vulnerability. Relevant data is provided by the Central Statistical Office of Finland and to some extent by the regional council of Itä-Uusimaa and the municipalities. The regional environmental authorities may also have data that would be interesting for the purposes of this project.

1.3.3 Elements of available planning documents with relation to hazards and risks

The regional planning documentation does not recognise all hazards relevant in the Itä-Uusimaa region. However, many hazards are taken into account in guidelines or separate risk plans made by environmental authorities, rescue departments or other actors in national, regional and local level. Separate risk plans are mainly hazard related or sectoral, whereas integrative risk management plans are less common.

The Flooding of rivers is a current issue in Finland due to the publication of a report on flooding by the Ministry of Agriculture and Forestry in the spring of 2003 (the so called Suurtulvaraportti). In the report seven proposals for action on mitigation in the case of extensive flooding were presented. The realisation of these proposals would improve and standardize flood control in the whole country. The main responsibility would lie on the national and regional environmental authorities, and the tasks would include a preparation of a databank on past floods and a preparation of a general plan on damage reduction. It remains to be seen how these proposals are taken into account in spatial planning on the regional level in the future.

Sea level change and its impacts on the environment and socio-economic development in the region of the Baltic Sea are presently being researched in the Interreg IIIB –project SEAREG. One way municipalities can prepare themselves for the rising sea level (either short-term during storms or long-term due to climate change) and avoid damage is to regulate building on the shoreline. Guidelines by the environmental authorities in Finland state that buildings on the shores of lakes and the Baltic Sea should be built in a way that floods do not reach or damage them. Exact regulations on building can be found in the Building Codes and local plans of municipalities.

Relevant technological hazards are taken into account in the regional plan of Itä-Uusimaa, as well as in separate risk management plans. In the regional plan the industrial cluster in Sköldvik is classified as an area of industrial activity and water transport, and the nuclear power plant in Hästholmen as an area of community management. In the regional plan both Sköldvik and Hästholmen have an inner and outer exclusion area. The inner exclusion area has a one-kilometre radius, the outer exclusion area a five-kilometre radius. The purpose of these areas is to control land use in the close vicinity of these possibly dangerous areas.

The regional plan of Itä-Uusimaa states that in the inner exclusion area of Hästholmen no permanent housing should be allowed and the construction of buildings is permitted only for the nuclear power plant's purposes. In the outer area the number of permanent residents is restricted at 200 and no such activities should be undertaken that include large masses of people or endanger the safe functioning of the power plant. In the inner exclusion area of Sköldvik no new housing should be built. In the outer area no new housing should be built without a specific purpose. One example of this kind of a specific purpose would be the enlargement of existing residential buildings.

The regional plan acts as a guiding instrument for the more detailed master and local detailed plans as explained in chapter 1.5.1.5.4. These plans must respect the contents of the regional plan. However, should there be disparity between the contents of different plans, it is always the more detailed plan that has legal validity. Both Hästholmen and Sköldvik have their own local detailed plans where the permitted building volume is defined according to the contents of the regional plan. Despite the regulations on permanent housing, recreational dwellings are ample in or near both areas. The locations on the coast by the archipelago have attracted plenty of people to build their summer cottages at a stone's throw from these technological hazards.

The industry cluster and port in Porvoo, as well as the nuclear power plant in Loviisa, have their own rescue departments and risk management plans. Inside the Sköldvik industrial area different companies have their own risk plans. The rescue departments operate inside their own areas and are prepared for different situations. The rescue departments in the towns of Porvoo and Loviisa have their own plans in case something goes wrong and immediate response is needed.

The marine and road transport of oil and other hazardous substances, as well as oil spills are not taken into account in planning documents. Possible accidents call for immediate reaction and therefore municipal rescue departments and regional environmental authorities have the greatest responsibility.

1.4 LESSONS TO LEARN

1.4.1 Useful and transferable instruments / indicators for a risk reduction management

At this early stage of the project, it is difficult to analyse the usefulness or transferability of the instruments used for risk reduction management in the region of Itä-Uusimaa for other European regions. For the same reason it is unclear, which aspects of this risk management can be called best practice. The interviews of responsible authorities should make the aspect of usefulness and transferability clearer. Possible instruments that could be useful and/or transferable in other regions include:

- spatial planning cooperation between municipalities (joint master plans)
- cooperation between a town and the industrial area in the case of a certain technological hazard
- exclusion areas around industrial areas dealing with harmful substances
- public participation in planning as stated in the Land Use and Building Act of 2000

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1 ANDALUSIA

1.1 GENERAL

1.1.1 Key Data on the Region

The Regional Government of Andalusia occupies the southern most third of the Iberian Peninsula. Two characteristics stand out: its large area (87.267 km^2) and the influence of the littoral in its southern limit, with more than 870 Km of shoreline.

Geology

Several geological characteristics should be highlighted, such as the region's location in the global tectonic context in the confluence of the African and Euro Asiatic tectonic plates. This fact characterises the tectonics of the region with a high grade of dynamism. This dynamism translates in an important seismic activity on the region, with manifestations of moderate intensity and frequency.

Second, the relatively recent geological history of Andalusia. That means that the region is subjected to important processes of geological formation and stabilisation that translate into an important instability and continuous redefinition of the relieve.

Finally, the great contrast between the tree geological macro-unities that integrate the region (Sierra Morena, Guadalquivir valley and Cordilleras Béticas). This complexity is the result of pronounced differences in lithology, geological history and processes. For all this, a wide spectrum of natural risks related to geological factors is present in the region.

Sierra Morena

Lithologically it is characterised by very old materials (Precambrian and Palaeozoic)

Guadalquivir valley

Situated between Sierra Morena and the Cordilleras Béticas, has a triangular shape that narrows from west to east. It is the most recent unity in origin, characterised by the horizontality of the materials of its deposits, and by its brittleness. In the proximities of the riverbeds the soil richness contributes decisively to the fact that the population is concentrated around these areas, where the danger of floods is high resulting in clear situations of risk, with continuous catastrophic episodes through the history.

Cordilleras Béticas

This mountainous unity is located in the southern area of Andalusia, closing the Guadalquivir valley with a more or less continuous line of mountains. It is an Alpine relieve of recent origin (Tertiary) which main characteristic is its great structural complexity. Here the most important seismic manifestations of the region are detected, as well as a number of phenomena related to the neo-tectonic activity represented by the active faults.

Climate

The Andalusian climate can be related to the Mediterranean type, characterised by moderate temperatures and very irregular regime of precipitations. This irregularity in precipitations is evidenced in inter-annual irregularity and intra-annual irregularity.

Inter-annual irregularity is characterised by the existence of extremely dry years that when follow one another consecutively, could result in situations of drought of consideration and intensity depending on the zone.

Intra-annual irregularity presents alternate periods of poor rainfall with others less foreseeable where torrential rainfall of great intensity is present.

In a whole, torrential rainfall is a frequent phenomena in the region, being the origin of the majority of the floods, as well as one of the factors with more weight in the unleashing of intense processes of erosion, land slides, etc.

The proximity to the sea is another factor to bear in mind. The unleashing of storms around the coast usually generates strong rainfall and wind with extreme affects due to the wave action and surges.

Social and economic aspects

Andalusia is the region more populated of Spanish, with nearly 7.500.000 inhabitants with a very irregular spatial distribution.

Lately, the phenomenon of population concentration has acquired great transcendence. In Andalusia this has manifested in the growth of the great urban areas, with the consequent development of metropolitan areas as well as an increasing occupation of the coastal fringe.

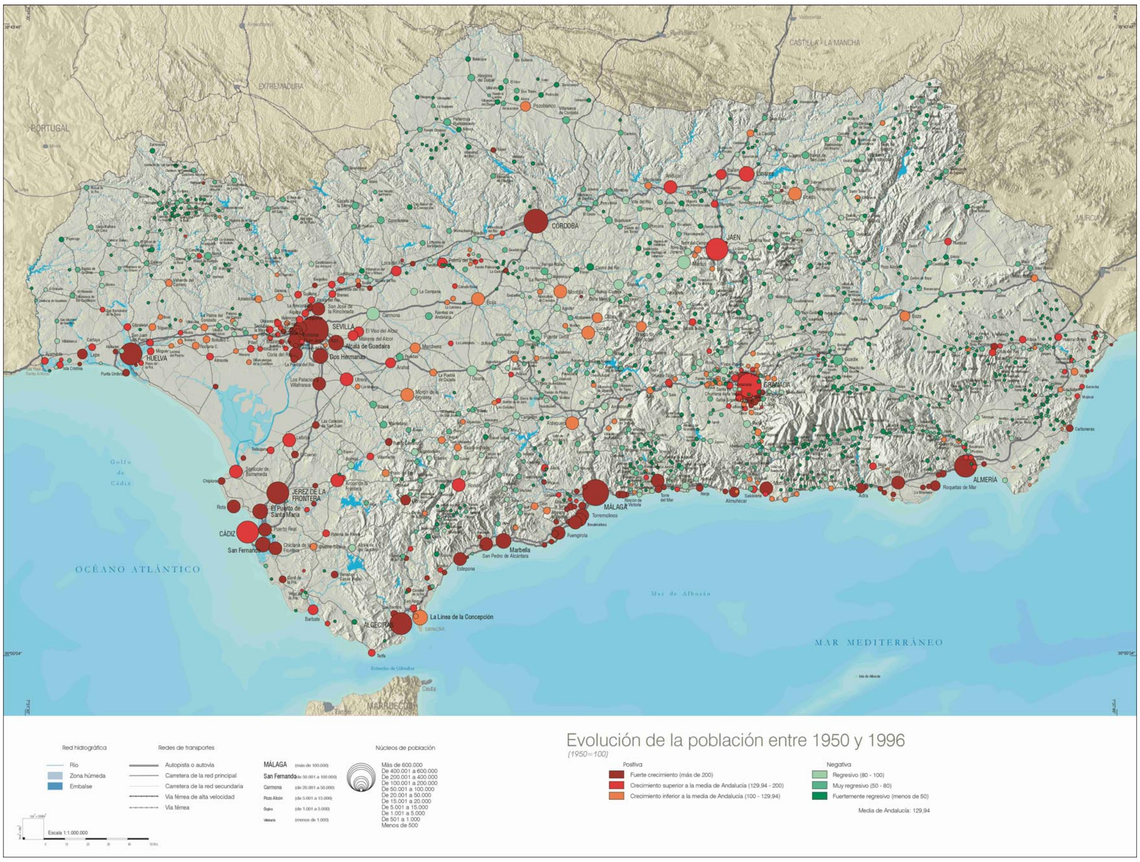

Figure 1: The evolution of the population between 1950 and 1996

This process of population concentration means the opposite process of depopulation mainly in the rural and mountain areas. In those cases the derived problems of the new conditions of population distribution and composition are of a very different nature. Extensive areas of low-density population appear introducing serious difficulties in terms of planning and provision of basic infrastructure. These circumstances make those areas particularly vulnerable to the occurrence of extreme climatic phenomena (heat and cold waves and floods), forest fires or other kind of natural event relatively frequent in rural and mountain ambits.

Industry

There are three basic aspects to be taken into account in relation to industrial activities: those activities that may bear risks for the population, the location of these activities, and the transport networks of dangerous goods linked to the industrial activity.

In Andalusia there is noticeable concentration of industrial infrastructure surrounding urban areas due to the attraction of the cities and the influence of policies that promoted industrial concentration. Overlying this basic spatial distribution, and along the Guadalquivir valley, there is another structure which includes a variety industrial enclaves linked to the agro-alimentary sector. In Andalusia there is a link between industrial concentration and demographic concentration

In relation with the transport of dangerous goods there are two factors to be taken into account: first the nature of the Andalusian industrial production and second the location of the industrial enclaves in relation with transport networks. In relation with the first point is to be highlighted the prominent role that basic industrial production has in the region (chemical and energy). This translates in great fluxes, which in the case of overland transport implies lengthy durations. This is due, among other reasons, to the concentration of industries in southwestern Andalusia, whereas main access to Central Spain are in the central and northeastern part of the region.

1.1.2 Relevant Hazards

Natural Hazards

Floods
The importance of the floods in Andalusia is explained by a combination of factors. On the one hand the irregular regime of precipitation, which produces long periods of low rainfall, which are interrupted by heavy and high intensity rainfall intervals. On the other hand the shape of the drainage network. There are two models of drainage system: the first is characterised by the existence of an important hydrological hierarchy, with a main watercourse running through an absolutely flat topography (Guadalquivir Valley), to which a dense network of tributaries flow from both margins, these repeat the previous scheme with the confluence of multiple minor water courses. This effective channel network to the main collectors provokes in some instances an excess of the draining capacity inducing flooding of the flat topography surrounding the main watercourses. The second is characterised by the mainly existence of watercourses with a short and steep profile which is very pronounced except for its final segment near the river mouth. The magnitude and intensity of the flows that these water courses discharge, which is enhanced by both the torrential precipitation and the steep profile of the basin, usually provokes flooding around the river mouth area, favoured by the low line relieves and the damming effect of the sea. This is the model that characterises rives and *ramblas* draining the Mediterranean basin.

In relation with anthropic activities the main factor is the occupation of the areas liable to flooding in both hydrologic settings. In both cases this is caused by the flatness of the relieve as well as the fertility of the soils. It is to be also considered that in the second of the hydrological models, the availability of agricultural land is limited to the coastal fringe.

The location of areas with potential risk of flooding has been established by the *Comisión Nacional de Protección Civil* in a report carried out for all hydrologic basins in Spain. In Andalusia areas liable to flooding are nearly 20% of those in Spain (1036).

In terms of forecast systems for flooding, each of the river basins has several meteorological and gauging stations, in some instances there are complex hydrological monitoring and control systems, including early warning systems specific for flooding events (*Sistema Automático de Información Hidrológica. SAIH*)

Seismic Activity

In the context of the Iberian Peninsula, the Region of Andalusia is the most seismically active of all. This is because of its location in relation with plate tectonics, as well as the relatively recent of its Alpine orogenic processes, which contributes decisively to the seism-tectonic dynamics that affects Andalusia especially remarkable in the southeastern quadrant of the region. This sector can be characterised as intensity VIII in a representation of seismic risk, and peaks around the city of Granada, reaching IX. Another high hazard area affects most of the Huelva province and southwestern Sevilla.

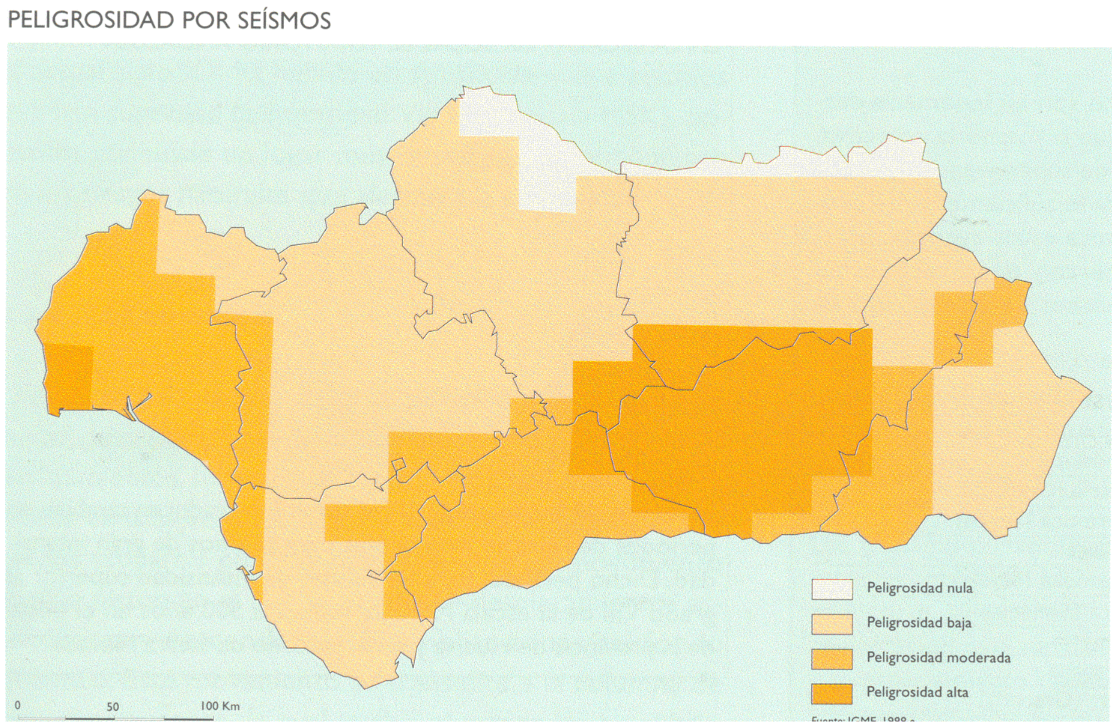

Figure 2: Earthquake danger (zero-low-moderate-high)

Geological Hazards

Included in this category are landslides and karst associate phenomena. Another hazards such as expansive soils or erosion, despite the high losses that usually generate, do not induce emergency-type situations.

In terms of karstic phenomena, only collapsing of cavities can potentially generate catastrophic situations. The location of these processes can be ascribed to limestone sierras of the Cordilleras Béticas.

There are no precise forecasting methods to predict neither landslides nor karst processes, and only structural works as well as land use planning can be used to mitigate the impacts of these geological hazards.

Meteorological and Climatic Hazards

The extreme variability of climatic conditions induces a variety of hazardous situations. Among these a few could be highlighted:

Heat waves are a phenomenon that frequently occurs around the Mediterranean in which Andalusia is included, and its effects have been particularly severe on specific population groups (elderly or sick people). In Andalusia the Guadalquivir valley is the most liable area to the occurrence of this heat waves.

Could waves can equally be considered as problematic for the above mentioned population groups. In this case the mountain areas and particularly those in the interior, are the ones with a higher risk.

The littoral fringe can be considered as a special area where extreme climatic are to be highlighted. Coastal storms may provoke hazardous on settlements exposed to the sea and strong winds that characterise these events. Particularly relevant are the impacts that affect fisheries as well as maritime transport. The magnitude of these events and considering a threshold of wind of 75 km/h as indicative of provability of damage, large areas of the Andalusian region can be classified as hazardous, where frequently gusts exceed this threshold reaching speeds of about 100 km/h.

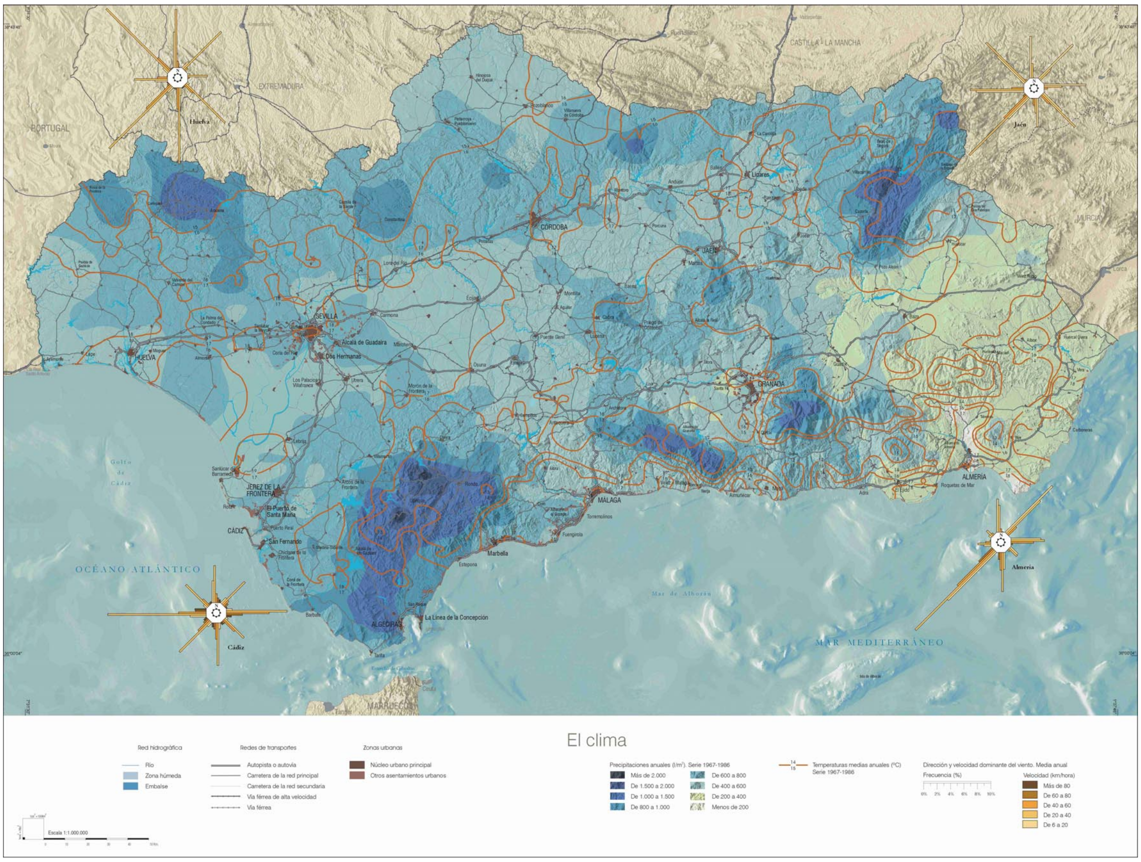

Figure 3: Climate of Andalusia

Technological Hazards

The increasing industrial activity in Andalusia, whichever their type may be (productive or provision) has introduced an inherent a rise in technological hazards conditioned by the location of industrial settlements that has lead to considering the need of development of specific planning policy.

There are a wide variety of substances involved, mainly around Basic Chemical production, dominant segment among Andalusian industry.

Other industrial activities include the agro-alimentary activity, energetic, and metallurgic, wood and paper manufacturing and transformation.

All those industrial activities have a volume and movement of substances and goods as hazardous as those of the generating or recipient industries, not affecting zones that are not clearly delimited but vast transport networks.

General Industry

In relation with industrial hazards, the following sectors have been highlighted by the industrial activity data published for the region:

Agro-alimentary industry, which is characterised by its heterogeneous location and the presence of well-defined hazardous situations (explosion of powders, flammable substances fires, toxic and hazardous waste…). Especial mention should be given in this section to the sugar industry and the *almazaras* for vegetal oil production.

Industry related to energetic production, where the location of thermal power plants should be highlighted as well as the more prominent role of the natural gas as an alternative, which translates in industrial terms in the creation of cogeneration plants.

The basic transformation industry (wood, textile, metallurgic…) or that or manufacture (plastic, paper, machinery…), that have a growing presence around highly populated areas.

Chemical industry is dealt with separately.

Chemical Industry

The chemical industry uses and stores hazardous substances as well as having dangerous industrial processes. Occasionally, this industry represents a risk not only for its infrastructure but also for their surroundings, due to the concentration of its installations, the synergy effect and the proximity to settlements.

In the Andalusian region the chemical industry shows great strength in the Basic Chemical, and more specific around two main lines: inorganic chemical (mainly production of sulphuric acid and gases in the industrial centres of Huelva) and petrochemical (petroleum derivates and storage of energetic produce, mainly located in Algeciras Bay).

The variety of processes and substances around those industrial centres explains the likelihood of occurrence of multiple scenarios of hazard related to chemicals. Specific planning of these risks is thus needed given the proximity of populated areas to these industries.

Transport of Dangerous Goods

The following basic factors that determine the structure of fluxes of dangerous goods are established from the observation of the industrial situation in Andalusia:

The nature of the industrial production of Andalusia; to highlight basic sectors such as chemical industry and energetic production, strongly dependent on the outside, not just for the needs of primary material and fuel, but also for provision of base produce to other industries, located mainly outside the region, establishing the presence of diverse hazardous substances along the communication networks at considerable quantity and frequency.

There is strong input and output of dangerous substances by the industrial areas in respect to the main transport systems. While the natural exit that agglutinates high densities of traffic, is located around the centre and northeast of the region, the main industrial focus are settled around the littoral areas, mainly in the south-western end.

The conditioning in recent years of road networks has to be also taken into account, especially two networks that connect with the exterior, one through the northeast and cross through the centre of the region and littoral area towards the areas more populated. In these road networks an increment of transport is being noticed, especially that of combustible and semi-elaborated substances for manufacturing industry.

Toxic and Dangerous Waste

Human activity in modern society brings with it the generation of substances derived from industrial activities. Some of these substances are toxic in themselves or potentially generators of toxic or dangerous compounds that could provoke emergency situations (fires, explosions, toxic leaks). This has lead to the creation of specific centres of storage or treatment of waste. The emissions to the atmosphere, to the rivers or to the sea, are mainly originated in areas of strong industrialisation or mining extractions.

Hazards from radioactive materials are included in this section due to the presence in Andalusia of radioactive waste treatment centres, waste from nuclear power plants from other regions or from centres where radioactive material is used, such as hospitals or research centres.

Other Hazards: Forest Fires

There are several the factors that contribute to the incidence of the forest fires in Andalusia: the existence of an important natural vegetation cover in Sierra Morena and the Cordilleras Béticas, the recurrence of a long, very hot and dry and summer period, and the increasingly widespread use of this natural areas as leisure zones.

1.1.3 Basic Risk assessment

The publication "Catastrophic risks and planning in Andalusia" (*Consejería de Obras Públicas y Transporte*) has been used as reference for the basic risk assessment. In this document, published by the Department of Planning of the Regional Government of Andalusia, an analysis of the potential incidence of the different natural and technologic risks is carried out in order to incorporate this in planning documents.

Seismicity
It represents an important source or risk on the region, not only for the area that is affected by it (half of the region is moderately hazardous, and a tenth is highly hazardous), but also for the intensity that its manifestations can achieve (there are more than 30 earthquakes with epicentres in Andalusia registered with intensities above VIII at the scale MSK).

Tsunamis
These represent considerable risk along the southwestern coast, despite its low potential frequency.

Landslides are a widely spread hazard around the Cordilleras Béticas, near some enclaves of the Guadalquivir valley.

Karst associated cavities represent risks around the Cordilleras Béticas where this phenomenon has noticeable intensity, although impact is generally economic from damaged infrastructures and buildings.

Flooding constitutes the most important natural hazard in the region. It affects the southeast zone of the region along the Guadalquivir and its main left margin tributaries. Andalusia has 316 flooding hotspots (22'6 % of the total of Spain). To its considerable superficial extension it is coupled a significant temporal recurrence which makes it the natural hazard that induces highest losses.

Droughts
Due to its high frequency and its lengthy duration (from a few months to several years) and its wide spatial distribution, droughts are the archetypical natural hazard. That is why it is one of the main risks affecting Andalusia, along with floods.

Forest Fires
This hazard is a recurrent disaster, highly frequent during summer months all around the forests of Andalusian region. Their impact is dominantly ecological and some economical, although also to be considered are live losses during fire extinction.

Major accident associated to industrial activities
Especially those from power and chemical sectors. The petrochemical complexes of Huelva and Algeciras, their large ports with traffic of dangerous substances, and other more diversified industries located along the Guadalquivir valley concentrate this type of hazard. It is thus a wide spread hazard in the region.

Nuclear activities
There are no nuclear plants in the region. The only hazardous installation related with nuclear activities is the radioactive waste deposit of El Cabril.

Transport of Dangerous
These are concentrated along the main communication axes between Andalusia and Central Spain (along Guadalquivir valley) and the East (along the Mediterranean coast).

1.2 BACKGROUND

1.2.1 Framework Legislation

The Spanish Constitution considers that Land Planning is a public function responsibility of the Regional Government with legislative, regulatory and executive authority. Nevertheless, the State preserves territorial competences as well as the local administration. Thus the main objective of Land Planning is to coordinate the different policies and actuations of the regional government with those of the State and the local government, as well as with the European policy.

Of these policies (including legislative norms and planning), urban planning is the most directly related to land planning. Urban concretes and develops at local level the planning dispositions carried out at the regional level (instruments of land planning).

The *Ley de Ordenacion del Territorio de Andalusia 1/94* (Andalusian Land Planning Act 1/94) is the legislative framework and the instrument for supra-local planning in the region. The instruments for territorial planning are the *Plan de Ordenación del Territorio de*

Andalusia (Regional Land Plan), *Planes de Ordenación de Ámbito Subregional* (Sub-regional Land Plans) and *Planes con Incidencia en la Ordenación del Territorio* (Specific Activities Land Plan).

The *Ley 7/2002 de Ordenación Urbanística de Andalucia* (Andalusian Urban Planning Act) affects specifically local planning within the framework of the national law for land use (Ley del Suelo). This law dictates the instruments for local and supra-local planning (this are described in the following chapter).

Among the horizontal policies the *Ley 4/89 de Espacios Naturales Protegidos de Andalucia* (Protected Natural Environments of Andalucía) establishes the network of protected areas that require specific planning instruments capable of defining conditions for land use and exploitation of natural resources (Planes de Ordenación de los Recursos Naturales).

The *Ley Estatal de Aguas of 1985* (The Waters Act) establishes protection buffer areas along the rivers in relation to flooding hazards.

The *Ley de Costas 22/88 of 1988* (Coastal Act) establishes set back areas in relation with hazards in the coastal regions.

With regards forest fires, there are two applicable policies: the *Ley Forestal de Andalucia* (The Forests Act of Andalucía) and the *Ley específica de Incendios Forestales of 2002* (Forest Fires specific Act) which deals with both preventive and mitigating measures with respect to this natural hazard.

Hazards derived from the transportation of dangerous goods is regulated by both, the *Ley de Ordenación de los Transportes Terrestres de 1987* (Land Transport Plan) which is related to local planning, and the *Reglamento Nacional del Transporte de Mercancías Peligrosas, Real Decreto74/1992* (National Regulatory act for the Transport of Dangerous goods).

The *Ley de Protección Ambiental de Andalucia de 1992* (Environmental Protection Act of Andalucía) comprises all the regulations affecting polluting activities in the region. This law establishes the need for environmental impact statements when new urban developments are planned in local planning.

1.2.2 Planning Framework/content

Regional Planning

The LOTA (*Ley andaluza 1/94 de Ordenación del Territorio*) establishes different instruments for integral planning of very flexible nature because of its general planning purpose (although there are other binding norms that could be directly applied):

Plan de Ordenación del Territorio de Andalucia. Territorial framework for the application of the State and European Union planning and *vice versa*. Regional Government writes and ratifies it:

Writing: Council for the Government of Andalusia.

Ratification: Andalusian Parliament.

It requires the consent of the Commission for Land and Urban Planning of Andalusia to be ratified.

Planes de Ordenación del Territorio de ámbito subregional. Subregional land plans that establish the basic aspects that affect the territorial structure and that must be taken into account on any scale. Among its contents there is the delimitation of zones for the protection and improving of landscapes, natural resources, and historical heritage. These are binding for specific with incidence on the territory and for local planning. There are three types of determinations:

- Directives: binding in terms of goals but not the instruments and measures.
- Recommendations: of indicative nature for administrations.
- Norms: binding and of direct implementation.

These documents are written by regional Offices (*Consejo de gobierno*) or municipal Offices (*ayuntamientos*). The Consejo de Gobierno carries out its approval and ratification after positive report of the *Comisión de Ordenación del Territorio y Urbanismo de Andalucia* and of the *Comisiones Provinciales de Ordenación del Territorio y Urbanismo*.
Specific Plans with Incidence on Land Planning. This is not a specific instrument for planning but it is an instrument of agreement for actions on the territory. The law determines a list of sectorial actions that are considered in this instrument and establishes a procedure for its writing and ratification. These are also written and ratified by the *Consejo de Gobierno* on request of the *Consejero de Obras Públicas* (Regional Minister for Public Works).

Local Planning
The LOUA (*Ley 7/2002 de Ordenación Urbanística de Andalucia*) regulates urban planning at regional level in the framework of the state law that establishes land uses (right of property).
This new Andalusia law inserts explicitly all urban planning into a larger context for territorial planning to which legislation it refers frequently enhancing the synergies between these two policies.
The proposed planning scheme maintains the arrangement in cascade, inherited from prior legislation by which instruments of a lower range develop and concretise those of higher levels, thus differentiating two levels of planning: general and development.

Among the local planning instruments there are:
Planes Generales de Ordenación Urbanística (urban general plan) applicable to municipalities. This is the main instrument for urban planning and its main objective is to become an integrant instrument for physical planning (territorial, environmental and sectorial) that concur in the municipal scale. Its writing is carried out by the Municipal Government (exceptionally by the Regional Government) and it is ratified by the Regional Office for Urban Planning through the *Comisión Provincial de Ordenación del Territorio y Urbanismo de Andalucia.*
Planes de Ordenación Intermunicipal: This inter-municipal planning instrument aims at organisation of continuous areas with similar territorial problems between two or more municipalities (for instance metropolitan areas).
Plan de Sectorización: This plan deals with the division of the land with plan for urbanisation in sectors for its future urbanisation in the long term.

Among the development plans there are:
Partial plans (*Planes Parciales de Ordenación*).
Special plans (*Planes Especiales*).
Detailed study (*Estudio de Detalle*).

Instruments that contribute to the integration of other urban planning instruments are:
Norms for management of urban planning (*Normativas Directoras para la Ordenación Urbanística*).
Municipal Ordinances for Urbanisation and Building (*Ordenanzas municipales de Edificación y Urbanización*).
Catalogues.

1.2.3 Involved/ responsible official boards/ authorities

The Parliament of Andalusia has ratified among others, the *Ley 7/2002 de Ordenación Urbanística de Andalucia* (LOUA) and the *Ley 1/94 de Ordenación del Territorio* (LOTA). These are the two basic juridical norms that regulate the activities in relation with land and urban planning in Andalusia. The Parliament is also responsible for the final ratification of the main planning instruments, such as the POTA (*Plan de Ordenación del Territorio de Andalucia*).
In terms of management and executive power, it is the Andalusian Government (*Junta de Andalucia*) who is responsible for the implementation for the various instruments contemplated in the legislation. To this end, the Regional Office for Public Works, Transport and Urbanisation (*Consejería de Obras Públicas, Transportes y Urbanismo*) through the DG of Land Planning, carries out the tasks of writing and executing regional and subregional scale plans, which need to be ratified by the Regional Government (*Consejo de Gobierno de la Junta de Andalucia*).
Regional or provincial committees for land and urban planning represent the various stakeholders. These comities provide reports that are binding for ratification at higher levels.
Municipalities have the responsibilities for writing the local urban Plan, which is the basic instrument that is then ratified by the Regional Office for Public Works, Transport and Urbanisation (*Consejería de Obras Públicas, Transportes y urbanismo*) after positive report fro the corresponding provincial committee.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans and cartography at regional level

In this section two land planning instruments are described: the POTA (*Plan de Ordenación del Territorio de Andalucia*) and the Subregional Land Plans (*Planes de Ordenación de Ámbito Subregional*).

At the moment of writing, the Regional Government of Andalusia is developing the POTA, there are two Subregional Plans approved, and two more are technically passed.

POTA (Plan de Ordenación del Territorio de Andalucia)

It is the leading instrument of the land planning structure of Andalusia. Its goal is to establish the basic elements for the organisation of the structure of the Andalusian territory being binding reference to the other land plans. Its resolutions are therefore binding for the Subregional Plans.

From a normative standpoint the resolutions of the POTA may have various effects depending on its qualification as directives, recommendations, or norms of direct applicability (*directrices, recomendaciones o normas de aplicacion directa*).
The writing of the POTA was preceded by the development of Bases and Strategies (*Bases y Estrategias*), which are currently ratified, and whose goal is to lead to the finalisation of the Plan.
Article 7.1 point f) of the LOTA says that the instruments for land planning are responsible of the delimitation of catastrophic risk areas and the definition of territorial action criteria that need to be taken into account for prevention of these risks.

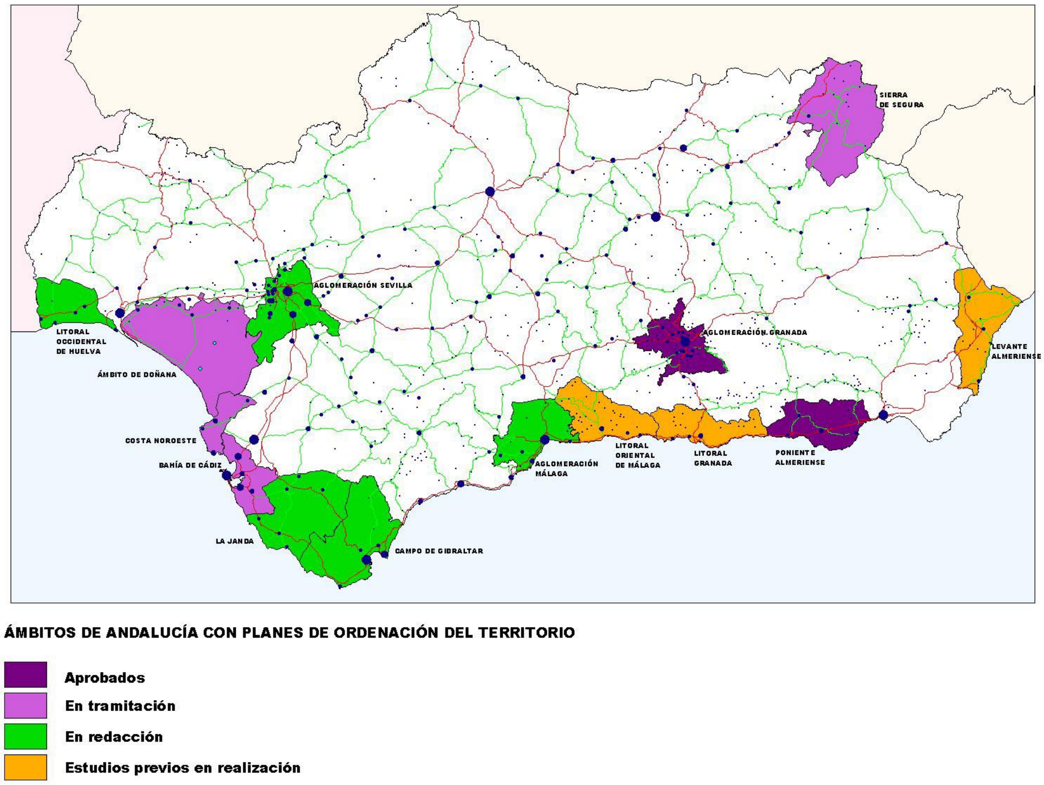

Figure 4: Areas with land use plans (approved-submitted-in preparation-pre feasibility studies

Subregional Land Plans

The LOTA establishes that Subregional Land Plans should have the following contents:

- Objectives and territorial proposals for the scope of the Plan.
- Basic infrastructure and distribution of equipment and services applicable at supra-municipal scale.
- Indication of zones for compatibility and ordination of uses, and for protection and improvement of landscapes, natural resources and cultural and historical heritage.

The law also establishes that any other issue that is considered necessary can be incorporated. Finally the Plan should determine the urban and sectorial plan which need to be adapted, establish investment priorities and determinations.
These determinations, in accordance with the LOTA, are binding for the Specific Plans with Incidence on Land Planning and for local urban planning. These determinations can be

directives, recommendations, or norms of direct applicability (*directrices, recomendaciones o normas de aplicacion directa*), and these are binding on urbanising and non-urbanising land.
Now a days there are two Subregional Plans approved: Metropolitan area of Granada, and the Eastern Almería Area, and there are two more on the public information phase: Northwest coast of Cadiz and Sierra of Segura.

Contents of the existing Subregional Plans

The contents of these have been grouped into different sections for clarification:

Structuring of the territory. The contents of these plans must include a determination of the communication and transport networks as well as a definition of the hierarchy of the population centres with specific functions. To these essential elements the open space facilities must be added as instruments that articulate the territory.

Ordination and compatibility of uses. Only those zones where conflicts exists between users need to be taken into account and only territorial plans can be use as the main instrument for its resolution. This limitation is self inflicted to the effect that only those aspects of strategic and supra-municipal nature would be considered.

Natural, cultural and landscape resources. Strategic options in relation with these resources include both protection and appraisal.

Basic supra-municipal infrastructures. Overland infrastructures are dealt with in the plans at different levels depending on their functionality upon the territory, although the technical characteristics of these are not defined. It would be sectorial planning that will define these. The same approach is taken in relation to water provision and surety. In terms of power supply and telecommunication infrastructure, these plans essentially define corridors along which this infrastructure will run, or the area that are excluded (e.g. telecommunication masts), as well as characteristics of power lines when these run across heavily frequented ornithological sites.

Normative nature of Subregional Plans

The LOTA conditions greatly the focus of these plans, which implies that their determinations are realised through the development of local planning that is responsible for materialising and defining the proposals.
The proposals of the Plan are established through normative determinations and positive actions.
Norms are defined essentially by the establishment of prohibitions or positive obligations with respect to planning criteria, which must be applicable within urban planning. An example of the first would be the restriction of certain land uses, and of the second that urban plans must incorporate certain features such as delimitation of flooding areas around rivers and streams or criteria in relation with landscaping. Also included are specific objectives of the POTA, which are very specific given that its amendment would imply a full revision or modification.

In relation to the Directives (*Directrices*) these represent the bulk of the determinations of these Plans. These are mandates which aim at specifying the goals to be achieved, and leaves sectorial Administrations or municipalities to decide on which strategy to follow in order to achieve them.
Finally, Recommendations (*Recomendaciones*) are scarce within the normative of these Plans.

1.3.2 Relevant data sets available at regional level

The Regional Government of Andalucía has ample competences in all aspects related to territorial management: land planning, agriculture, environment, etc.
The various regional government offices (departments) have developed a series of information systems, databases that support management and planning needs.
Likewise there are other agencies, which depend directly from the Regional Government, that are involved specifically in producing cross border information (*Instituto de Estadísticas de Andalucía, Instituto de Cartografía de Andalucía, etc)*.
Direct outcomes of this policie are the many statistical series of socio economic nature (population, industrial census, etc) from the *Instituto de Estadística* updated and disseminated frequently.
There are many databases concerning the physical environments, which enable evaluation of natural hazards: digital terrain models, orthophotos, satellite images, vegetation, land use, geology, climate, etc. These databases are in the Andalusian Environmental Information System (*Sistema de Información ambiental de Andalucía, Consejería de Medio Ambiente*).
Another relevant source of data is the Regional Department of Public Works and Transport through its Office for Land and Urban Planning (*Ordenación del Territorio y Urbanismo: La Consejería de Obras Públicas y Transportes*). This Department is developing the Territorial Information System, compiling basic cartography as well as road networks, population centres, aquifers, landscapes, administrative and planning boundaries, demographic and economic activity data, etc.
The Andalusian region, and in particular the Regional Government comprises sufficient datasets that can support all the management and planning tasks that affect its territory, which in many cases can support planning measures for preventing natural hazards.
As well as these generic datasets from the various departments, specific reports have been developed for the analysis of catastrophic natural risks.
To this end there have been considerable efforts carried out by the DG of Land Planning (*Dirección General de Ordenación del Territorio de la Consejería de Obras Públicas*) in developing cartography and assessments of flooding hazards, which determined "hot spots" and areas of maximum risk. These are detailed assessments. The same office has also completed more generic evaluations related to technological and natural hazards from which synthesised cartography has been produced to support planning activities on a broad scale.
Specific studies related mainly with seismic and geological risks have also been developed from the National Geographic Institute and the Geologic and Mines Institute of Spain.
Detailed assessment and reports of forest fires, erosion, droughts, among other risks, are produced by the Regional Environmental Office (*Consejería de Medio Ambiente de Andalucía*).

1.3.3 Elements of available planning documents with relation to hazards and risks

Regional Land Plan of Andalusia, POTA (Plan de Ordenación del Territorio de Andalucía).

This document, as indicated before, is currently in preparation. To date the bases and strategies for the Plan have been approved. This preliminary document establishes, in relation with natural and technological hazards, the following recommendations:

1. To make a careful study of the current state of knowledge on risks and environmental unbalance of the region.

"The objective is to achieve the degree of knowledge at the sufficient territorial level of detail to enable the formulation of efficient measures. The heterogeneity of previous studies and their spatial scale, recommends a complete analysis on a regional scale for each type of hazards and, on an integrated way, to enable the implementation of action plans and programs in the whole of Andalucía. In this respect it is necessary to advance towards a zonation of Andalucía based on the intensity and frequency of environmental degradation and natural and technological hazards".

2. To establish territorial criteria to diminish risks.

It is necessary to develop concrete strategies for preventing and controlling each type of hazards. The initial criteria in this respect should include:

- Ordination of land uses for all drainage basins and the inclusion of measures for restoration of riverside forests in basins with flow regimes that are liable to induce flooding. Planning and design of infrastructures to control and canalise events, which considers the generic incidence of the specific projects including the potential multiple use of basin-regulation works.
- Assessment of environmental effects derived from changes in land use or agricultural practices and management in potential erosion risk areas.
- Convenience of treatment and assessment of actions along coastal segments of similar dynamic characteristics. Integration of land planning criteria from the Coastal Act (*Ley de Costas*) and the Regional Directives for the Andalusian littoral (*Directrices Regionales del Litoral Andaluz*), which would minimise risks, associated with marine and coastal dynamics.
- Enforcement of the Seismic Resistance Normative (*Norma Sismorresistente*) on instances where the institutional system for management of planning and construction allows it. To include in territorial and urban planning references to the Seism-tectonic Map (*Mapa Sismotectónico*) and from the Geo-tectonic and Natural Hazards Map of Cities (*Mapa Geotectónico y de Peligrosidad Natural de Ciudades*).

Subregional Land Plans

Mitigating measures taken from one of the two Subregional Plans already approved in Andalucía are analysed in this section. These are from the plan for the Western Almería Subregion (*Comarca del Poniente de Almería*).

Located in the Andalusian southeast, this coastal environment is characterised by conflicts generated by the competitiveness that exists to use their scarce water resources between both the tourism and intensive agriculture industry. Between the main risks, it is significant the lack of technological hazards as opposed to natural hazards that dominate, particularly in relation with flooding and over exploitation of water resources.

In terms of protection of natural resources and landscapes the following proposals are included:

- The establishment of a coherent model that satisfies water demands and that is consistent with sustainable practices. A total of €138.6M are planned to be invested in infrastructure and waste management. Desalination plants are also proposed as the best option to respond to water demand and reduce pressure on aquifers. The plan includes the construction of one or two of these plants, which will achieve a maximum capacity of 17 Hm^3/yr. As well as this it proposes the connection of all the municipalities water supply networks and the construction of nine water purifier stations, four of which could recycle up to 12 Hm^3/yr of urban sewerage water for irrigation.

– Likewise measures for prevention of natural hazards are included, mainly by identifying rivers liable to flooding and actions that can be carried out to avoid the hazard as well as the development of rules aiming at the regulation of uses for future prevention. All 53 plans for prevention of flooding in urban areas recently approved by the Government Council (*Plan de Prevenciones de Avenidas e Inundaciones en Cascos Urbanos*) are included in the document.

1.3.4 Useful and transferable instruments/indicators for a risk reduction management.

The andalusian legislation for land planning assumes explicitly that land planning must be an efficient instrument for the prevention of hazards. The LOTA (*Ley 1/1994 de Ordenación del Territorio de Andalucía*) need to identify hazard prone areas and to define the territorial criteria for prevention.

The role of territorial planning is never considered as a focal point for prevention, but as an element linking sectoral policies, and only applicable to those risks in which the territorial component have a relevant role.

As an example of this there is the explicit inclusion of sections referring to natural hazards (flooding, technological, geological, meteorological, etc) in the Bases and Strategies for the Land Plan of Andalucía (*Bases y Estrategias del Plan de Ordenación del Territorio de Andalucía*). Another relevant document in relation with the prevention of catastrophic risks (*Riesgos Catastróficos y Ordenación del Territorio en Andalucía, 1999*) was elaborated by the Office for Territorial Planning, and includes among other issues a synthesised assessment of the incidents of various risks as a function of their territorial relevance. Synthesised cartography has been elaborated showing the spatial distribution of the various hazards.

Despite all of the above it must be said that the issue of risks on a regional and subregional scale has been addressed unevenly. Natural hazards have been addressed in greater extent than those of technological nature. On the other hand, some risks are, by its own nature, difficult to include in land and territorial planning (tsunamis, droughts, etc). On the contrary, some other hazards have a great territorial component and high danger (nuclear hazard, and specifically in Andalucía forest fires), which are hardly addressed given that they are widely treated in sectoral legislation and operational procedures (*Ley de Incendios Forestales de Andalucía, Plan INFOCA, etc*) which are binding for land and urban planning.

There are other groups of risks, like geological hazards, that are specifically treated in territorial planning documents. The Seism-tectonic Map of Spain (*Mapa Sismotectónico de España*, scale 1:100.000) is adequate for regional and subregional plans and the Geo-tectonic Map for Natural Hazards in Cities (*Mapas Geotectónicos de Peligrosidad Natural en las Ciudades*, scales 1:25.000 and 1:5.000) for greater detail. Based on these documents, limitations are set for construction on unstable zones (faults, landslides, etc).

Floods are among the most dealt with hazards in land and urban planning. It is a critical hazard with wide spatial distribution, in which spatial planning plays an important role, since it restricts land uses in those areas under greater risk. There are many studies and reports that categorise and locate flooding black spots on different scales. In any case there is a lack of large-scale maps, necessary for the appropriate treatment required for municipal planning.

In relation with technological risks, these are the hazards that territorial planning takes the least into account. There is a lack of a proper catalogue and identification of under risk areas. This would allow the development of criteria for management of uses and planning of infrastructure that would reduce the occurrence of these hazards.

1 REGION OF DRESDEN (PLANNING REGION UPPER ELBE VALLEY / EAST OREMOUNTAINS)

1.1 GENERAL

Definitions of terms used in this chapter, if necessary specified according to the objectives of the project, respectively the case study.

Spatial Planning *(Raumordnung)* is referred to as the general term describing the super-sectoral planning approaches in Germany at the regional, state or national levels including the Comprehensive Plan and 'Regional Plan'. Spatial Planning at the federal level sets the planning and development framework for the subordinated planning levels. A practical spatial planning competence in Germany is passed from the Federal Government to the Federal States (Länder).

Comprehensive Plan (CP) *(Landesentwicklungsplan)* is an official plan within the spatial planning system on the basis of the federal spatial planning act. It has to be developed for any German Land in order to apply federal requirements to the operational level of the Länder. The CP as the planning instrument of the Länder spatial planning legislation sets the planning framework for regional planning and prescribes goals and principles for further specification in the subordinated spatial development plans of the so-called planning regions further referred to as 'Regional Plan'.

Regional Plan (RP) (*Regionalplan*) as defined above

Land use planning (*Bauleitplanung*) represents the most detailed kind of spatial development planning at the municipal level based on the Federal Building Code.

Preparatory land use plans (*Flächennutzungsplan – vorbereitender Bauleitplan*) provide information on potential types of land uses (housing, green areas etc.).

Binding land use plans (*Bebauungsplan – verbindlicher Bauleitplan*) define precisely the extent to which a type of land use can be performed in a given area (e.g. how many stories, set back, maximum and minimum size of building etc.).

Aims of Regional Planning (*Ziele der Regionalplanung*) are included in the Federal Building Code. They are binding statements about spatial development requirements to be realised at the municipal level.

Principles of Regional Planning (*Grundsätze der Regionalplanung*) are included in the Federal Building Code as well. They are rather guidelines giving the scope of the spatial development requirements to be realised at the municipal level.

Sectoral planning / Planning sectors *(Fachplanung*) 'sector' in terms of 'sectoral planning' means the spatial planning under consideration of only one planning criteria (e.g. traffic, invironmental heritage, etc.). Sectoral approaches are (in the ideal case) weighted, balanced and merged in the context of comprehensive development planning (creation of plans at different planning levels). Sectoral as well as comprehensive planning can take place at different administrative levels.

Land or (pl.) Länder (*Bundesland*) - see 'Spatial Planning'.

Free State (*Freistaat*) – a Land with a special constitutionary status.

Regional Council (*Regierungpräsidium*) NUTS level 2

Region (*Planungsregion*) - planning region for which regional plans are elaborated.

District (*Landkreis*) - administrative area with a specific authority that has been assigned certain super-municipal administrative competencies of the Länder. NUTS level 3

Municipality (*Gemeinde*) - lowest and at the same time most concrete level in the planning hierarchy. Level of land use planning. Municipalities have a guaranteed right of self-government according to article 28 of the German constitution.

Federal level (*Bundesebene*) – national level.

Länder level (*Landesebene*) - administrative level for issues of spatial planning that concern one Land.

Regional level (*Regionalebene*) – level of spatial relevance that is superior to local level (applies for instances to issues like natural or technical hazards that reach an extent which exceeds the ability of a municipality to manage the incident and/or that happens in an area bigger than that of one municipality).

Binding character (*Verbindlichkeit*) – Planning documents of the Länder are legally binding for those the regional level which in turn are legally binding for those on the local level.

Priority area/site (*Vorranggebiet*) – an instrument of the German planning system. Priority areas or sites can be designated in structural planning in case the local or regional situation requires that a particular function (e.g. recreation, nature/landscape, mining, urban expansion) shall have priority on that area or site. Any planning or action must be compatible with this priority purpose (following a definition of UBA 1995).

Reserve area/site (*Vorbehaltsgebiet*) – an instrument of the German planning system Reserve areas or sites can be designated in structural planning in case the local or regional situation requires that an area shall be reserved for a particular function (e.g. nature/landscape, mining, flood zone). Any planning or action must be compatible with this priority purpose.

Spatial categories (*Raumkategorien*) – **1)** Densely populated area, **2)** Periphery of a densely populated area, **3)** Rural area with signs of densification, **4)** Rural area without any signs of densification (1. Verdichtungsraum, 2. Randzone eines Verdichtungsraumes, 3. Ländlicher Raum mit Verdichtungsansätzen, 4. Ländlicher Raum ohne Verdichtungsansätze) - Territorial classification according to the Saxon Regional Planning Law.

1.1.1 Key data on the region

Geo-ecology

The Planning Region Oberes Elbtal / Osterzgebirge is one of five planning regions in Saxony (see chapter planning context). It comprises the metropolitan region of Dresden with the Elbe River as a major feature. The region shows a very diverse natural structure.

The region stretches from mountainous areas in the south to lowlands in the north. In its southern part the Eastern Ore Mountains with an elevation of 900 m NN transit eastwards to the Elbe Sandstone Mountains with maximum elevations of about 600 m. Following the gradual decline of the landscape to the northern lowlands (ca. 100m NN) the major geologic and ecologic features change.

In sum a succession of three landscape types can be observed

- mountainous areas,
- loess influenced to loess dominated uplands and
- sandy lowlands and lowland Elbe River valley).

In the south, rocky formations and the high elevation up to 900m NN are accompanied by rich precipitation, acidic soil layers over gneiss and sandstone and mountainous types of vegetation with a large proportion of spruce forests. In the upper areas precipitation exceeds 1000mm/a.

To the north, the landscape is formed more smoothly and the decline in elevation is associated with growing influence of loess accumulations dating from the last ice age, making soils more fertile and easier to use. Average temperature rises and annual precipitation declines to its lowest values in the sand dominated lowland area. Simultaneously, land use is dominated by agriculture. Forests hardly occur in Elbe valley.

A speciality is the so-called Elbe river canyon with a depth of 300 m where the river has formed its deep channel through the sand stone formations. This stretch of landscape is named "Saxon-Bohemian Switzerland". It displays the highest gradients of the region in form of upright rock formations and steep slopes bordering narrow gorges. Parts of this area are protected as National Park or Landscape Conservation Area. The meadows along the Saxon section of the Elbe River, which are regularly flooded, are proposed to the European Union as Natura 2000 sites.

A key element of the region is the valley of the Elbe River, which passes several towns like Bad Schandau, Pirna, Dresden, Meißen, Riesa and Torgau. The narrow river valley in the sandstone area widens shortly before Pirna, passes with a wide valley the City of Dresden, narrows again near the town Meißen and widens right after Meißen. It thus performs the transition from a barbell region upland river to a brass region lowland river.

The Elbe River drains one of six major river systems in Germany. Its sources are located in the Giant Mountains and the Bohemian Mountains. Its discharge in the planning region is mainly influenced by precipitation and by the outlet from large dams in the Czech Republic.

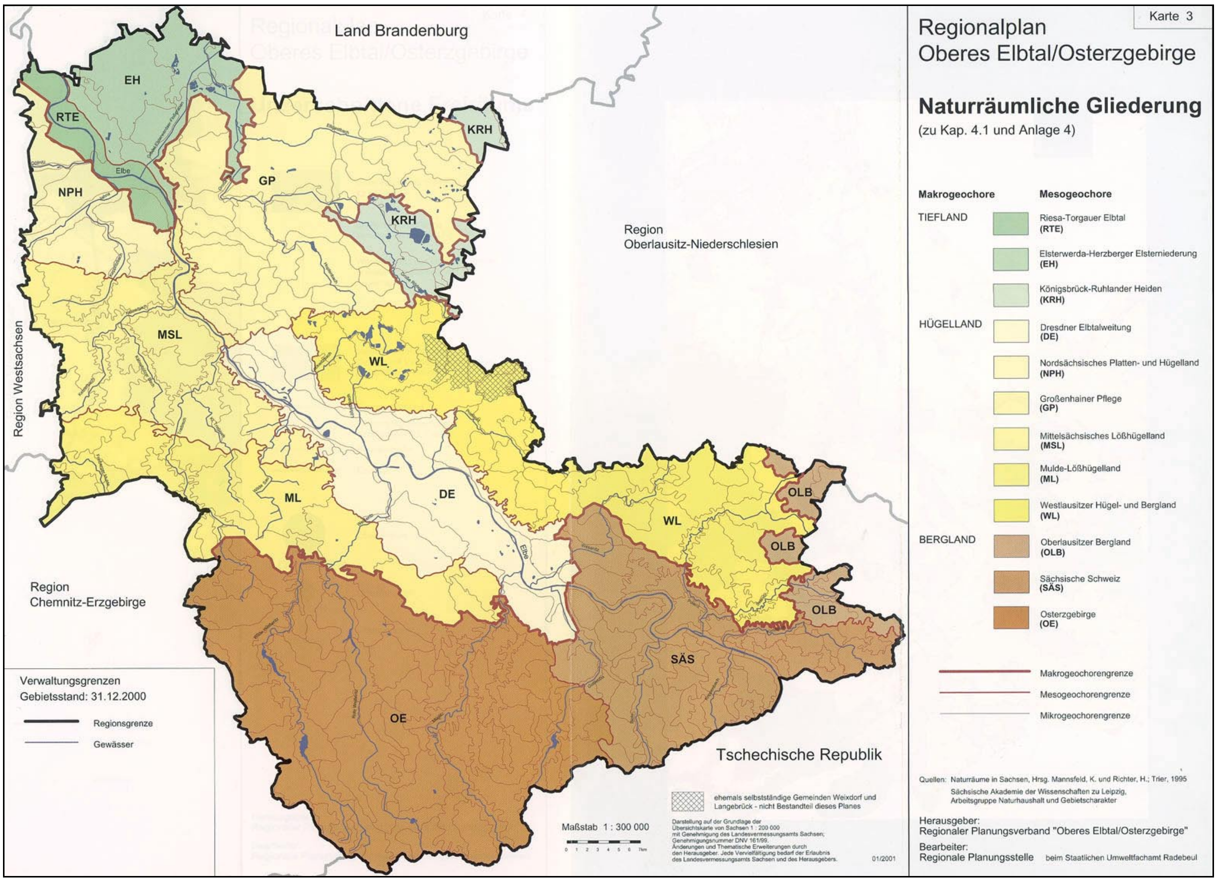

Figure 1: Planning region Oberes Elbtal / Osterzgebirge, geo-ecological units (Regional Plan, figure 2)

<u>Social and economic aspects</u>

The region Oberes Elbtal/Osterzgebirge is second in population but fourth in size and thus is the most densely populated out of five planning regions in Saxony. After 1990 (reunification of West and East Germany) major changes have occurred. Many traditional industrial branches have declined causing a quick rise of unemployment rates in the region. Today the most important branches of the region are information technology, engineering, food processing and tobacco industry, glass and ceramics industry, paper industry, publishing and printing which make up about 80% of employees in the manufacturing industries.

With the transition from a centralised to a federal planning system with guaranteed self-government at the local level, the spatial structure is changing rapidly. Loss of population in inner city locations is accompanied with urban sprawl at the edge of urbanized areas. Simultaneously the region as well as Saxony as a whole is suffering from declining population numbers and a growing proportion of elderly people.

Figure2: Planning Region Oberes Elbtal / Osterzgebirge[1]

The region consists of five administrative districts which in Germany represents the NUTS level 3: District Saxon Switzerland (Sächsische Schweiz), Weißeritz (river) District (Weißeritzkreis), City of Dresden, District Meißen, and District Riesa-Großenhain (for further information on spatial organisation see chapter "planning background"). The biggest share in population and simultaneously the by far highest population density is recorded for the area of the city of Dresden (capital city of the Free State of Saxony). The remaining rural part of the region disposes of some towns in which the majority of the region's population is concentrated.

[1] http://www.rpv-elbtalosterz.de/frset_region.htm, Mai 27th 2003

Table 1: Population and size of districts in the planning region (panning region web site)

Districts	Number of municipalities comprised	population		size		population density	GDP 2000
		number	%	km²	%	(persons/km²)	Mio Euro
Dresden	1	477 807	46,6	328	9,6	1 455	11059
Meißen	17	153 139	14,9	632	18,4	242	2473
Riesa-Großenhain	23	122 274	11,9	821	23,9	149	1833
Sächsische Schweiz	26	147 180	14,4	888	25,9	166	1917
Weißeritzkreis	20	125 460	12,2	766	22,3	164	1507
Region in total	**87**	**1 025 860**	**100**	**3 434**	**100**	**299**	**18789**
Free State of Saxony	**540**	**4 425 581**		**18 413**		**240**	

Table 2: Population and area size in relation to spatial categories (panning region web site, GDP at market prices: Statistical Reports 2000)

area category	number of municipalities	population (%)	area (%)
Densely populated area	10	67,2	17,1
Periphery of a densely populated area	15	6,9	17,3
Rural area with signs of densification	10	7,2	8,3
Rural area without any signs of densification	52	18,7	57,3

Table 3: land uses in the planning region

area used for/as City or Town / District	settlement and traffic	agriculture	forest	water	Surface mining	other uses
City of Dresden	37,4	36,53	21,16	1,95	0,33	2,64
Meißen	11,45	71,89	13,3	1,93	0,31	1,12
Riesa-Großenhain	8,79	70,04	12,51	2,37	0,23	6,06
Sächsische Schweiz	8,32	50,4	38,58	1,09	0,39	1,21
Weißeritzkreis	8,73	57,14	32,01	0,96	0,15	1,01
Region in total	11,89	59,21	24,57	1,6	0,28	2,45
Free State of Saxony	11,25	55,98	26,47	1,8	1,88	2,63

The region is rich in resources which are deposited close to the surface and thus easily to exploit. These are first of all:

- Gravel and Sand
- Rock for the Production of ballast, split and additives
- Rock for the construction purposes
- Clay for the building and ceramics industries including the clay for Meißen porcelain

1.1.2 Relevant hazards

The region has a stable general setting. There are no active geologic instabilities and no large periodically occurring meteorological events known. Most of the dangerous industries and mining have disappeared after 1990. What remains are relicts of dangerous use and waste.

In the past there had also been coal and ore mining in the region. Whereas most of the mining was finished decades ago in two locations until early 1990s uranium mining had continued. Relicts of this history are often large and even not totally known or mapped cavities in the underground and many mining waste heaps. Especially if the heaps remain from ore mining these may emit direct radiation or radioactive particles if exposed to the wind. Although this is estimated to have a rather local relevance (in means of especially exposed locations e.g. of a town) (Exposure to radiation caused by mining in Saxony and Thuringia 1990).

Natural Hazards

Not all hazards can be viewed as relevant at the regional (super municipal) level. Whereas floods always evolve in an area that simultaneously affects several municipalities most of the other natural hazards such as land slides or collapses of rock happen in an extent of at maximum several hundreds m^2 and thus are only relevant at a local level even though provisions may be taken by the region or the state.

Technological Hazards

Technological Hazards in the region may take their origin in single structures but hardly any information has so far been published on this issue in Saxony. Highly important are plants of **chemical and manufacturing industries** that deal with hazardous substances, respectively hazardous combinations of substances. 1998 there where 344 industrial plants registered under the German Emergency Ordinance (BImSchV 12) (Daten zur Umwelt 2000, page 48). The following map provides an overview about the concentrations of industrial plants having more than 100 employees in the region.

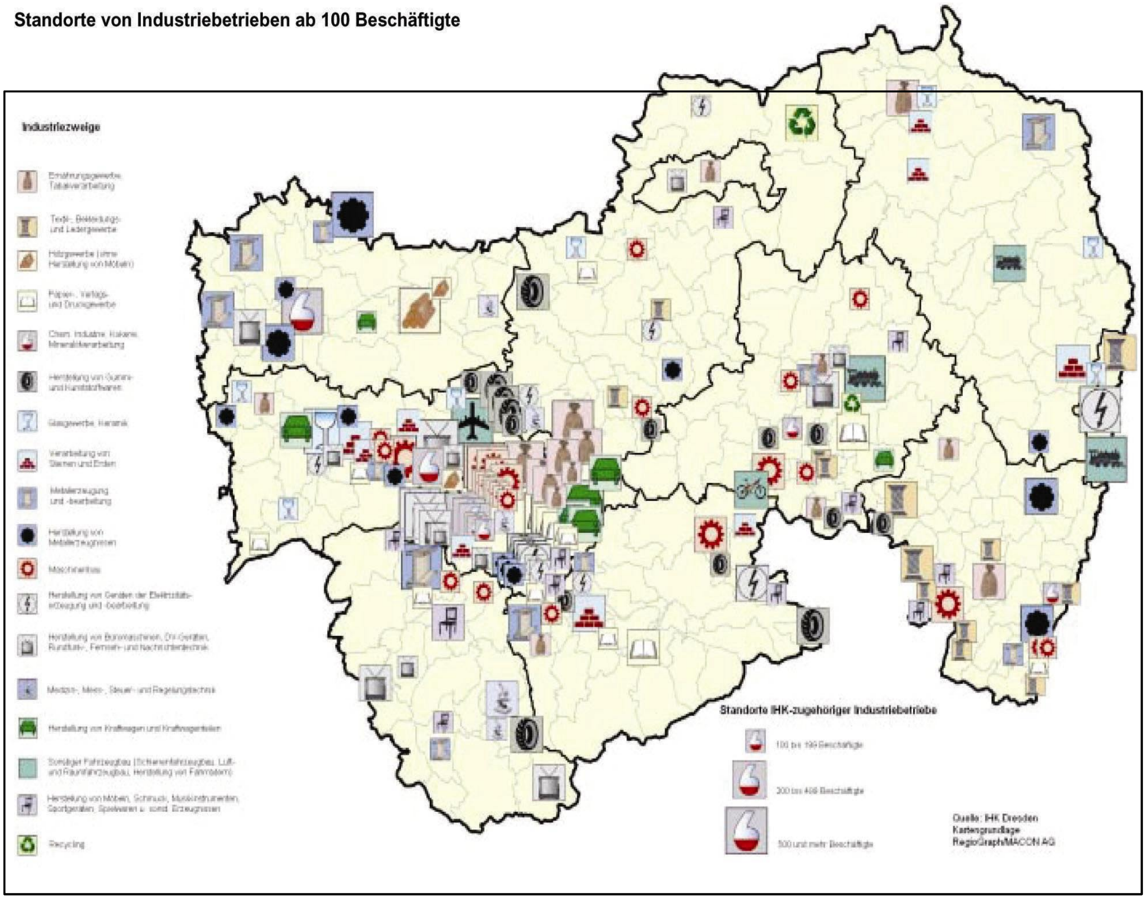

Figure 3: concentrations of industrial plants having more than 100 employees in the region Oberes Elbtal / Osterzgebirge (map encompasses the area of a regional council and thus covers more than planning region – the eastern five districts belong to an other planning region)

Also **chemical plants along Elbe and Vltava rivers** in Czech Republic have high relevance for the region. There are several plants close to the rivers and even directly exposed to it during high water events. The August 2002 Flood has once more proved the urgent need to address this issue when several tons hazardous substances were washed into the river and the flood water caused unexpected reactions in the plants releasing dangerous chlorine compounds and dioxins. In cases of accidents at these plants the Elbe River serves as direct and unavoidable 'risk path' for any emission and thus endangers people, private and public infrastructure and housing as well as the drinking water supply of the city of Dresden.

There are no nuclear power plants in or close to the region. The Research Centre Rossendorf with its nuclear physics department is a single structure situated close to Dresden dealing with radioactive substances. A special case is remnants of mining activities in the region. Relevant are on the one hand **heaps from non-ferrous metals** (zinc, silver, bismuth, cobalt and nickel) **mining and uranium mining** as well as sites with deposits from uranium extraction plants**.** There are thousands of old heaps many of which contain uranium ore as waste product. Most of the ancient heaps and pits are not any more visible but still can cause locally relevant Radon exhalations (the extent of ground water exposure is not yet defined) though direct (□̃) radiation is rather less important (Exposure to radiation caused by mining in Saxony and Thuringia, 1990). Biggest in size and most exposed are those from recent mining activities.

There are several possible risk paths by which the area surrounding these structures can be exposed to the hazard:

- direct radiation
- exceeded radon exhalation
- erosion by wind from heaps or dried out settling pits
- leachate

A mapping of exposed areas has not been published.

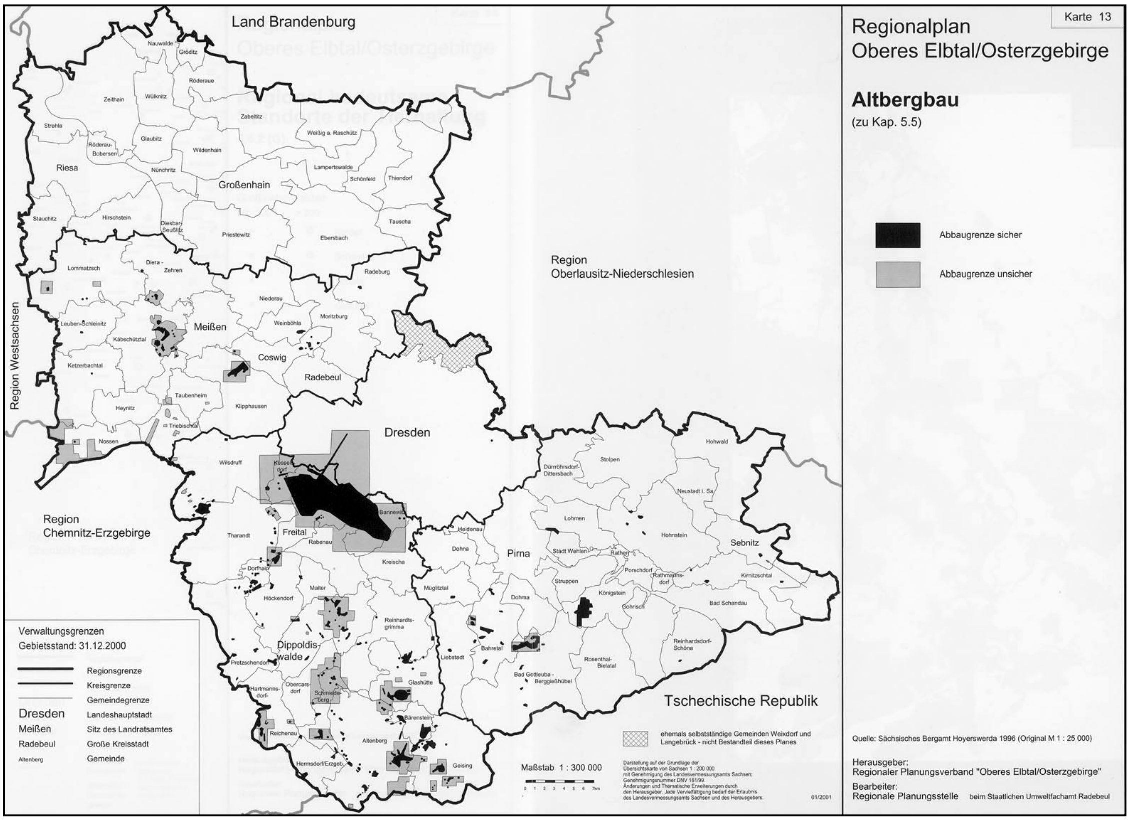

Figure 4: Areas and extensions of cavities in the underground (black known, grey unknown) (Regional Plan map 13)

On the other hand are large and not fully explored **cavities from past mining periods**. Hazards in the past have shown that these may have spatial importance that has so far not been fully explored and documented. Only local 'subsidence areas' in ancient locations areas are known. As far as it relates to uranium mining two locations are relevant: old uranium mines in Freital, close to Dresden as well as the recently (early 1990s) closed uranium mine in Königstein south of Dresden.

Another relevant hazard type to be considered in the region are major dams in the tributaries of the Elbe River. More than 3000 dams and weirs are known in the waters of Saxony several hundreds of them in the planning region. The extent of damage that dam failures may cause largely relate to the size (in terms of height and capacity) of the structure. For the first for ESPON Hazards should be considered relevant a structure defined "large dam" and bigger (e.g. "major dams") by the International Commission on Large Dams[2] (height ≥ 15 m, capacity ≥ 1 Million m^3, flood discharge at least ≥ 2000 m^3/s). Further on a more adapted definition should be found that can be applied to individual situation (e.g. those that in case of a collapse would cause an equal or larger flood wave than a five years flood right below the dam and an equal or larger flood wave than a two years flood in a distance of two kilometres). Until now no assessment of spatial relevance of dam structures has been published for Saxony. That this context is actually important was proven during the August 2002 Flood when flood waves in virtually all rivers exceeded storage capacities by far and the discharge of some dams ran out of control.

Even though the spatial consequences of dam failure in all cases would not exceed the regional level, risk from the failure of a major dam can be estimated to be of national importance compared to its damage potential in the densely populated area.

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[2] ICOLD: http://www.icold-cigb.org

The relevant hazards for the region can generally be assessed as follows:

Table 4: Natural and technological hazards in the planning region Oberes Elbtal / Osterzgebirge (list of hazards as agreed upon in 1st Interim Report, ESPON Hazards 2003, extended by dam failure)

Natural and technological hazards	**spatial relevance** **on the planning region:** + = high, o = low, - = none
Natural hazards	
Volcanic eruptions	-
Floods	+
Landslides/ avalanches Rock collapses Landslides	 0 0
Earthquakes	-
Droughts	0
Forest fires	0
Storms Short wind storms	 0
Extreme precipitation (heavy rainfall, hail)	+
Extreme temperatures (heat waves, cold waves)	-
Technological Hazards	
Hazards from nuclear power plants	-
Hazards from production plants with hazardous production processes or substances Rossendorf	+
Hazards from hazardous waste deposits / storage of nuclear waste Old uranium mine with ground water contact near Königstein	+
Hazards from the marine transport of hazardous goods Freight ships at the Elbe river	+
dam failure	+

1.1.3 Basic risks assessment

As already mentioned above, the information basis for comprehensive risk assessment at the regional level is virtually not existing. A part of the basic risk assessment shall be performed by constructing a vulnerability matrix at the basis of the hazard typology presented in the First Interim Report.

As major input data for risk assessment so far has not been scrutinized for the regions in Saxony further investigation have to go ahead before the second step of the risk assessment can be performed. The only exemption may be the flood hazard along the Elbe River where flood zone mapping is underway and an evaluation may soon be made available by responsible state authorities.

Table 5: population density and GDP per capita (EU 15 = 100) (taken from tables above and European Commission 2000)

Districts	population		size		population density	GDP 2000
	number	%	km²	%	(persons/km²)	Mio Euro
Dresden	477 807	46,6	328	9,6	1 455	11059
Meißen	153 139	14,9	632	18,4	242	2473
Riesa-Großenhain	122 274	11,9	821	23,9	149	1833
Sächsische Schweiz	147 180	14,4	888	25,9	166	1917
Weißeritzkreis	125 460	12,2	766	22,3	164	1507
EU 15	**1 025 860**	**100**	**3 434**	**100**	**299**	**18789**

Lacking information of the frequency of hazards the following table (‘Typology of hazards’ as presented in the first Interim Report but better ‘Risk typology of hazards’) shell be applied to display the potential vulnerability aggregated for the NUTS level 3 in the Planning Region Oberes Elbtal / Osterzgebirge

Table 6: Vulnerability of Districts (NUTS level 3) in the planning region Oberes Elbtal / Osterzgebirge

GDP per capita (EU 15 = 100)	Population density (EU 15 = 100)				
	I	II	III	IV	V
I					
II		• Sächsische Schweiz • Weißeritztalkreis	• Riesa-Großenhain		
III				Meißen	Dresden
IV					
V				Zeeland*	

Table 7: Vulnerability matrix of Districts (NUTS level 3) in the planning region Oberes Elbtal / Osterzgebirge

Degree of vulnerability	*GDP per capita (EU-average = 100)*	*Population density (EU-average = 100)*
Dresden	III	V
Meißen	III	IV
Riesa-Großenhain	II	III
Sächsische Schweiz	II	II
Weißeritzkreis	II	II

1.2 PLANNING BACKGROUND

1.2.1 Framework legislation

Federal Level

The German planning system is based upon the *Basic Law* (Grundgesetz) giving the general societal context as a framework for development and ensuring the so called self government right of municipalities – i.e. the lowest level in the administrative structure of Germany. Furthermore with its section 75 Nr. 4 the Basic Law gives the Federation a so called 'framework competence' to set a framework for spatial planning in Germany.

With the *Federal Spatial Planning Law* the Federal uses its framework competence providing the federal context for spatial planning at the regional level and obliging the Länder to manage Regional planning.

The *Federal Building Code* sets the legal framework for the physical planning and implementation of land use planning at the operative (local/municipal) level. The municipalities enact *local legislation* (ordinances) that allows the elaboration and implementation of plans. Section 1 Nr. 4 of the code obliges municipal plans to be in coordinance with aims of spatial planning.

Federal Nature Protection Act (Bundesnaturschutzgesetz – BNatSchG) setting the basic legal framework for the sectoral „Landscape Planning" in Germany (Landschaftsplanung)
Federal Imission Protection Law (Bundesimmissionsschutzgesetz – BimSchG) – gives the Länder the right to regulate security areas around dangerous structures through ordinances (sections 49 and 50, relating to Directive 82/96/EC)
Emergency ordinance (Störfallverordnung – BImSchV 12) – based by the Federal Imission Protection Law the Ordinance regulates (section 15) that the responsible boards (e.g. regional councils) estimate the probability of hazards to avoid domino effects in emergency situations.
Regional level (Länder and Planning Region)
Spatial planning is performed and is basically steered at the Länder level. Each Land is obliged to develop laws and ordinances for the regional planning setting goals and making provisions for the implementation. The most important respective document for the Free State of Saxony is the *Spatial Planning Law of the Free State of Saxony* setting the Framework for the elaboration of the Comprehensive Plan and the Regional Plans (RPs).

The *Comprehensive Plan* (CP) having legislation status itself (ordinance) besides the latter is the basis for the elaboration of Spatial Plans of the Planning Regions of Saxony (Regional Plans).

Regional Plans (RPs) in concert with CPs are documents (Ordinance by Regional Planning Association) setting legally binding so called 'aims' and 'principles' for the elaboration of municipal land use plans.

Environmental Protection Law of the Free State of Saxony (Landesnaturschutzgesetz – SächsNatSchG) – sets the legal planning requirements for Landscape Framework Planning in Saxony, in particular as relates the elaboration of so called Landscape Programs (Länder level) and Landscape framework plans (regional level)

Saxon Law for the management of emergencies from accidents with dangerous substances (Sächsisches Gefahren- und Unfallgesetz – SächsGefUnfallG) – Implementing Emergency ordinance

Examples of singular ordinances, regulating issues of certain structures, as permitted in the Federal Imission Protection Law:
Saxon Harbour Ordinance (Sächsische Hafenverordnung - SächsHafVO) – regulating security areas around harbours with hazardous substances
other ordinances …

EU – Level

Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (the "SEVESO II" Directive)

1.2.2 Planning framework / context

Regional planning in general

Regional Planning in Germany takes place in a two-step approach. The Länder set the legislative frame and basic statement on how the spatial system of the Länder is to be developed. Within their comprehensive plans (Landesentwicklungsplan) central places, main development axes and major transportation axes are named as well as areas of super regional or federal interest become designated. The statements of CPs are primarily meant to be precised in Regional Plans but serve at same time as binding statements for municipal planning (which makes CPs part of regional planning according its definition presented in chapter 1.5)

The actual regional planning takes place at the level of the so-called planning regions. Regional plans are comprehensive plans which precise aims and principles for spatial development (of LFT) for defined regions. It is legally binding for municipalities that mean that municipalities have to be in line with main declarations of the Regional Plan.

Table 8: Levels of German planning system

Federal Level	**Federal Republic of Germany** (Framework competence, general plans) **Minister Conference** for Spatial Development (coordination of activities)
Regional Level	**16 Federal States (Länder , NUTS level 2)** Comprehensive Plans (CP's) Spatial Programs aims and principles for spatial development **Planning Regions (below NUTS level 3)** Regional Plans aims and principles for spatial development Core information for municipal land use plans
Municipal (opera-tive) Level	**Municipalities (NUTS level 4)** Physical Planning and Implementation preparatory land use plan legally binding land use plan

The German planning system at all planning levels requires the integration of concerns of nature and landscape. This is realized through elaboration sectoral Landscape Framework Plans, respectively Landscape Programs. Nature protection laws of the Federation and the Länder particularly regulate this.

Whereas the German planning system knows a large number of sectoral plans that through their integration make up ‘the spatial plan’ there is no sectoral ‘risk or hazard planning’.

A crucial feature of the planning system is the so-called subsidiary principle. On the one hand this means that space relevant decisions are passed as far as possible “down” on the lower level. On the other hand a decision taken in one document cannot be “taken” or even stated again in an other legal document. For this reason many spatially relevant statements can not be seen in regional plans since they are terminatory regulated on a superior level.

Regional planning in Saxony

From the planning perspective Saxony is divided into five planning regions (steered by Regional Planning Associations). Every planning region is responsible for the elaboration of the regional plans that covers the whole area of the region.

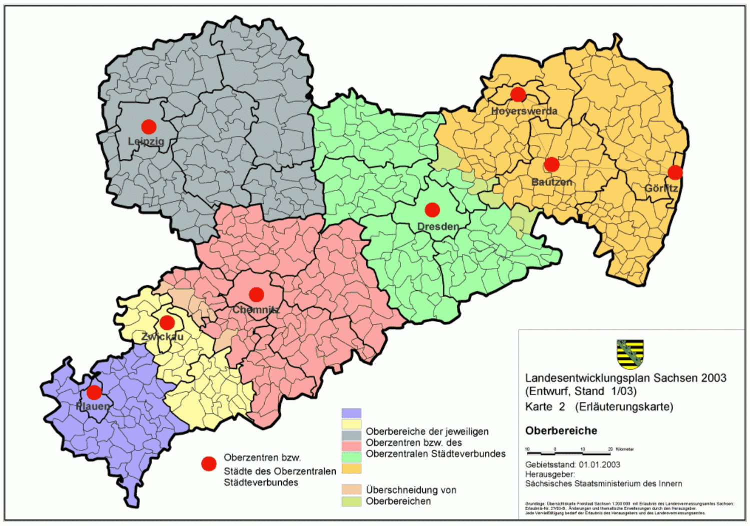

Figure 5: Free State of Saxony – districts and municipalities (draft Map[3])

3 http://www.sachsen.de/de/bf/staatsregierung/ministerien/smi/aktuell/fortschreibung_lep/auslegungsentwurf_lep/index.html , Mai 27th 2003

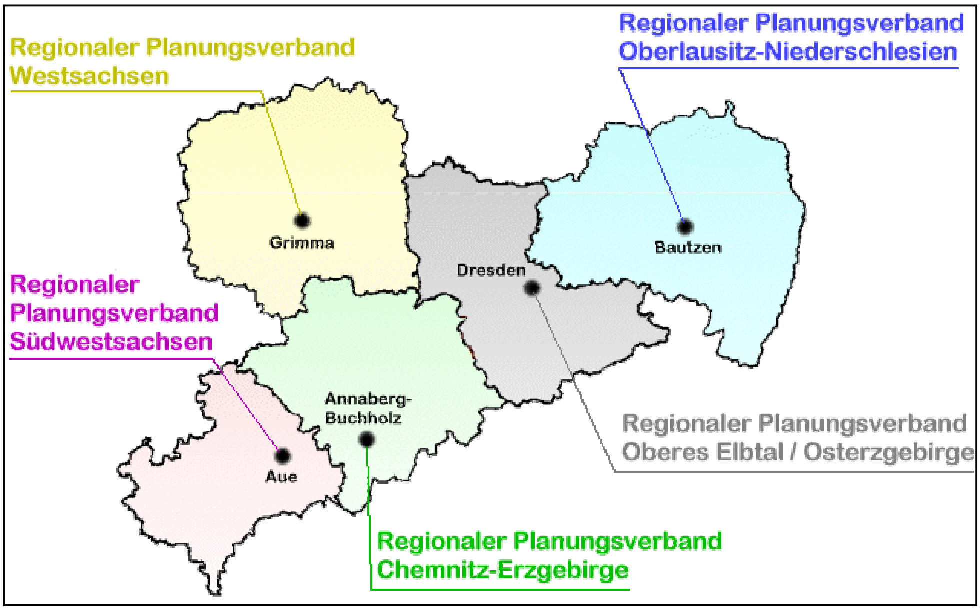

Figure 6: Planning regions of Saxony (http://www.regionalplanung-sachsen.de/, Mai 27th 2003)

As in all of Germany basic planning units are municipalities. Several municipalities make up a District. A planning region covers exactly a certain number of districts.

European context

NUTS levels of the European Union are not completely congruent with Saxon planning hierarchy. There are slight disproportions that appear at the level of regional planning. Whereas NUTS level 2 covers the so-called Regional Councils, NUTS level 3 applies to Districts several of which constitute a planning region (see above). Thus NUTS level 3 in the case of the present case study applies simultaneously to five parts of the region of question.

Figure 7: NUTS level 3 - Statistical regions in East Germany (Eurostat)

1.2.3 Involved / responsible off. boards / authorities

Saxony State Ministry of Internal Affairs (NUTS level 2)**:** elaborating CP and approving Regional Plans.

Regional Planning Board (below NUTS level 3): Working board of the Regional Planning Association elaborating and updating Regional Plans and monitors their implementation through municipal land use planning.

Regional Council (NUTS level 3): covers a larger area than a planning region (in Saxony three regional council areas). Authority for Approvals of municipal development policies (legally binding municipal plans) in general and large development project if certain project size is exceeded and thus watching the implementation of regional planning policy (RPs and CPs)

State Environmental boards (NUTS level 2): cover the same area as regional councils and provide sectoral information for Landscape planning (in important sectoral planning step at any planning level).

Municipalities (NUTS level 4): Municipalities of a region establish the Regional Planning Association with elected steering board.

Mining authority (Bergamt, NUTS level 2): responsible for data related to mining locations, cavities and related issues.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans, cartographies at the regional level and particularly relating to hazards at regional level

This chapter presents spatial plans of the regional level in the planning region Oberes Elbtal / Osterzgebirge and in particular their statements in relation to natural and technological hazards. This will also include statements from other administrative levels that have direct impact on spatial development in the regions.

Regional Planning in Saxony is performed in a two-step approach:

1. the CP of Saxony, which sizes requirements for spatial development of the Federal Government and transmit them to the Länder context and which sets the larger spatial development framework for the Regional plans
2. the RPs, which at the bases of the CP precise its requirements under consideration of regional context and thus constitute the “vital link” between super ordinate spatial development and its implementation at the operative local level

<u>Comprehensive Plan of Saxony</u>

Saxon's CP has only a view direct statements relating to hazard issues. Also the aims of spatial development do not contain statements that would allow to interpreted as meaning risk prevention. The CP recognizes particular call for action in the context of:

- hazard prevention in location with probability of landslides due to past surface coal mining (LEP1994, B-104)

- hazard prevention in areas of past uranium mining where direct radiation may exposed (LEP1994, B-104)
- preventive protection of water resources usable for drinking water abstraction (so called Water Protection Areas, LEP1994, B-64)
- protection of the population against imissions of noise, vibrancies and air pollution (LEP1994, B-136)

Most of these statements are rather made from the perspective of technical means of environmental protection than from a systematic risk prevention perspective.

Currently the new CP (2003) is under preparation. In the currently discussed version no systematically difference can be seen. The current table of contents of the CP 2003 draft version shall serve as an example how the plan is structured.

Table 9: Comprehensive Plan 2003 draft table of contents[4]

Chapter		**page**
2	Development of spatial structure	5
2.1	super ordinate spatial structure	5
2.2	European Metropolitan Region „Sachsendreieck“ (Saxony Triangle)	6
2.3	Central places and municipal networks	8
2.4	Municipalities and municipalities with special municipal functions	17
2.5	Spatial categories	19
2.6	superordinate development axes and their integration into European Networks	23
3	Regional Development	24
3.1	Inter municipal cooperation	24
3.2	Transnational and cross boundary cooperation	25
3.3	Areas with special development and restoration functions	27

[4] (http://www.sachsen.de/de/bf/staatsregierung/ministerien/smi/aktuell/fortschreibung_lep/index.html, Mai 7th 2003)

Regional Plan Oberes Elbtal / Osterzgebirge (Regional Plan Upper Elbe Valley / East ore Mountains)

Similar as the CP the Regional Plan does not have an explicit risk based approach. The main issue related to hazard and risk is the statement about flood protection.

This relates to possibilities of regional planning to contribute to direct or indirect measures of preventive flood protection. These are specified as follows:

Table 10: direct indirect statements of the RP Oberes Elbtal/Osterzgebirge related to flood protection

planning tool (instrument)	cartographic display	summary / aim or principle
Priority areas for flood protection	Map of spatial uses 1:100000 Symbol (usual retention capacities smaller and larger than 1 Mio m^3)	**Aim** 4.4.6: completion of the system of flood retention structures in the Easter Ore Mountains and in the Müglitz river valley. **Requirement** 4.4.6: environmentally sound flood protection
Flood zones (assigned and planned)	Map Maintenance, Development and Restoration of the landscape 1:100000	**Principle** 4.2.2.6: Clearing and reopening of natural paddles along the Elbe river, allowing for ground protection in case of floods
		and further more …

As integral part of the RP the so-called Landscape Framework Plan (elaboration is regulated by Federal and Länder nature protection laws) may contain more precise information on landscape relating hazards. As far as it concerns regional planning in Saxony this cannot be analysed from any documentation since Saxony is the only Land performing the so-called primary integration. This means that Landscape Framework Planning issues are directly integrated into the RP. The amended (2002) Federal Nature Protection Law requires an explicit Landscape Framework Plan for more transparency. The binding character of regional plans is discussed in the chapter 'planning context'.

1.3.2 Relevant data sets available at regional level

Since regional planning in Saxony and Germany does not explicitly work with hazards, no data sets can be derived directly from regional planning documentation. Available and usable data sets in the region and the Free State of Saxony will be necessary and can be summarized in the scope of the foreseen interviews.

Two general issues have to be taken into account when collating data for the purpose of risk assessment: **type of data** and **scale of data** – both in the context of the **target hazard** the data is going to be used for.

Type of data

Dealing with spatial relevant risk assessment in the European Union is based upon the Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (SEVESO II). It aims at the prevention of major accidents and the limitation of their consequences for man and the environment (see Council Directive 96/82/EC and Christou/ Porter 1999).

> Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest …
>
> (Council Directive 96/82/EC, § 12)

The Seveso Directive targets accidents with hazardous substances. Nevertheless, the approach covering both socio-economic and ecologic issues should be leading to the broader perspective of risk assessment in planning contexts. Risk assessment in Europe needs to take into account socio economic as well as ecologic issues. Collating consistent data sets will thus be a first challenge on the way to comprehensive risk assessment at different spatial levels.

Whereas statistic data covering the socio economic perspective should be available throughout Europe, usable data on ecologic features and functions may pose problems in terms of availability and comparability.

The Saxon Länder Institute for Statistics offers a variety of socioeconomic data that might be useful for risk assessment (see Annex 2 of Annex I.1). This data can be derived at the levels of Länder, districts and municipalities. Further information, such as a register of hazardous industrial plants, hazard areas above cavities from ancient mining, areas affected by exhalation and radiation from mining waste (and many more) are much less standardized. The sources are very fragmented and do often not even cover comparable areas and scales (see below). To find and adopt such information should also be an issue of the interviews (see chapter 1.5.2).

Different other Institutions at levels of Länder, Regional Councils, Districts or municipalities may furthermore have data sets on ecological aspects. These can relate to spatial distribution and functioning / vulnerability of e.g. areas with different protection status, areas with special recreation value, areas with particularly sensitive functions and other.

Scale of data

The ESPON action 1.3.1 "Hazards" defines Regional Planning to be the level of planning directly superior to that of municipalities. Therefore, most favourably data sets at the municipal level should be used at regional level.

As regulating super municipal issues it usually is irrelevant for regional planning to work with data resolution beyond the municipal level. Sometimes even more aggregate data sets may be convenient for risk assessment. Nevertheless the scale issue should be carefully integrated into the process of making requirement to data sets. This is explained using hazards from the case study region Oberes Elbtal / Osterzgebirge.

The hazards presented in the chapter 'Relevant hazards' can be assessed according to their spatial relevance as follows:

Table 11: Natural and technological hazards in the planning region Oberes Elbtal / Osterzgebirge and their estimated spatial relevance

spatial scale / ***Natural and technological hazards***	**Local**	**Regional**	**Over regional**	**irrelevant**
	Specific spatial relevance: + = high, o = moderate, - = low			Hazard not irrelevant for the region
Natural hazards				
Volcanic eruptions				x
Floods	+	+	+	
Landslides/ avalanches				
Rock collapses	0	-	-	
Landslides	0	-	-	
Earthquakes				x
Droughts	(0)	(-)	-	
Forest fires	0	0	-	
Storms				
Short wind storms	+	0	0	
Extreme precipitation (heavy rainfall, hail)	+	+	0	
Extreme temperatures (heat waves, cold waves)				x
Technological Hazards				
Hazards from nuclear power plants				x
Hazards from production plants with hazardous production processes or substances Rossendorf	+	0	(-)	
Hazards from hazardous waste deposits / storage of nuclear waste Old uranium mine with ground water contact near Königstein	+	+	0	
Hazards from the marine transport of hazardous goods Freight ships at the Elbe river	+	+	+	
dam failure	+	+	(+)	
Hazards from other sources Airport entry lines	+			

As the table shows, the spatial relevance of the hazards recognized in the planning region is differing. According to the definition of the ESPON action 1.3.1 "Hazards", the task of Regional Plans is to make provisions for the municipal planning level. The Regional Level is thus 'just' indicating to municipalities that in certain areas certain issues of risk have to be taken into account. To do so regional planning needs data sets that allow to specify hazards and potential hazard areas down to a scale applicable by local authorities.
For potential hazards, in first step estimates the effected area. In a second step chooses the useful data set and scale. For areal hazards (most of technological hazards) the scale may often be on municipal or district level. For certain punctual or axial hazards such as land slides, rock collapses or floods much more precise data are necessary at the regional level.

1.3.3 Elements of available planning documents in relation to hazards and risks

The analysis of regional planning documentation in Saxony leads to the impression that hardly any elements of risk prevention are included. This is only partially true as far as it concerns the direct statements in the regional plans (with the exemption of flood protection).

In reality many risk mitigation issues are inherent to the plans but are not explicitly extractible. As already shown in the chapter ‘Framework Legislation’ there are many more Laws, Ordinances and other legal acts that make statements relating to hazards and their source areas. It was not possible to quote all of them – a list is given in the chapter “Legal background”. These acts, often not directly related to spatial issues, contain statements on certain kinds of structures or even naming single structures they particularly relate to and thus make provisions on how spatial planning has to deal with them. Consequently, due to the strict application of the subsidiary principle, e.g. safety or hazard zones surrounding hazardous plants are inherent to regional plans. This even though they are not explicitly displayed since sectoral hazard or risk planning documentation does not exist. Subsidiary principle in this case means that legal acts and decisions which are approved at a level superior to that of regions are automatically either implemented by regional and local planning or simply not repeated since it already has been stated at the superior level. Instead, only applications that are not in conflict with the decisions are displayed.

The only sectoral documents prepared for the purpose of risk mitigation are maps displaying flood zones along rivers and water protection areas. The planning instrument ‘water protection area’ (usually designated as reserve areas) are under preparation and will soon serve as obligate documents to be included into spatial development documentation.

Other documents have a rather indicative character and are often not used for planning (e.g., maps of subsurface cavities, available in the mining authorities are only indicative maps on assumed cavities in the underground that contain no risk assessment.

Other documents are the already cited legal acts with fragments relating to spatially relevant hazardous structures.

Since the German approach to hazard and risk planning is such fragmented and no comprehensive situation can be drawn from the analysis of planning documentation there is a strong need to receive deeper information by means of the foreseen interviews with authorities and boards related to regional planning.

1.3.4 Useful and transferable Instruments / indicators for a risk reduction management

The German system of spatial planning in recent years has developed and applied a number of interesting tools for the handling of spatial activities.
The most interesting from the European perspective as identified are:

- Legally binding land use plans (*Bebauungsplan*)
- Landscape Plans (*Landschaftsplan*)
- Priority areas (*Vorranggebiet*)
- Reserve areas (*Vorbehaltsgebiet*)

- Water Protection Areas (*Wasserschutzgebiet*)
- Flood Zones (*Überschwemmungsgebiet*)
- Construction restriction zones (*Baubeschränkungsgebiet*)

Tools that may be called implementation strategies complement these. Adopted to the application in regional specification these tools are:

- Regional (joint) land use plans (*Regionaler Flächennutzungsplan*)
- Regional Planning boards (*Regionale Planungsstellen*)
- cooperation strategies *(Informal planning tools)*
- Public participation

1.3.4.1 References

Basic Law (Grundgesetz) …

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ANNEXES OF 1 REGION OF DRESDEN

Annex I : Table of content (Regional Plan Obere Elbe / Osterzgebirge)

Sectoral principles and goals

Annexes

Annex 7 Regionalplanerische Ausschlussbereiche für Windkraftanlagen (WKA)

		Scale
Maps		
Map 1	Spatial structure	M 1 : 300 000
Map 2	Geo-ecological units	M 1 : 100 000
Map 3	Land uses	M 1 : 300 000
Map 4	Undissected open spaces	M 1 : 300 000
Map 5	Maintenance, Development and restoration of the landscape	M 1 : 100 000
Map 6	Cultural landscape areas with high density of archaeological features	M 1 : 300 000
Map 7	Regionally important migration paths, resting and collecting places of large migrating birds	M 1 : 300 000
Map 8	Regional measure of environmental protection and landscape conservation according Annex II of Annex 4	M 1 : 100 000
Map 9	Regional Green corridors	M 1 : 300 000
Map 10	Tourism	M 1 : 200 000
Map 11	Accommodation capacities	M 1 : 300 000
Map 12	Areas with limitations for building development	M 1 : 300 000
Map 13	Historical mining areas	M 1 : 300 000
Map 14	Regionally important locations of animal farming	M 1 : 300 000

Annex II: Abstract of potentially relevant data sets from the standard set of statistics available at district and municipal levels (socio-economic data)

Area and population

area – information on area size, enclosed municipalities, population, population density, population structure and dynamics

Net income of households

Employment situation (specified trades)

Education

information on schools, high schools teaching personnel, students, diploma holder

Public social services and payments

information on social aid payments, housing allowance, youth welfare service, payments to disabled persons

Health care

information on medical health care infrastructure, personal

Construction

information on permits, kinds of structures, housing,

Land use

information on area sizes occupied/used as/for buildings and open spaces, business, recreation, cemeteries, traffic, agriculture, forests, water, surface mining, other

Agriculture

information on business size, surface areas and kind of use, sorts of crop, animal farming,

Mining and manufacturing

information on types of businesses involved, personnel, wages, turn over, energy consumption

Construction trade

information on types of construction firms, personnel, wages, turn over

Tourism

information on kinds of accommodation (hotel etc.), guest beds offered in certain seasons, arrivals, over night stays

Motor vehicles

Business activities

information on business registrations, closed businesses, insolvencies

Trade with construction sites

Public finances

information on municipal taxes, municipal share on income and turn over taxes, debts and other,

Public service personal

1 ITÄ UUSIMAA

1.1 GENERAL

1.1.1 Key data on the region

Geological and ecological aspects

The region of Itä-Uusimaa (Eastern Uusimaa) is situated in southern Finland, east of the country's capital region and the region of Uusimaa. Southern and southwestern Finland are geologically the youngest regions in Finland. The most common types of bedrock in the Itä-Uusimaa region are granite and rapakivi. The most common quaternary overburden type is moraine, which was formed during the last phase of the ice age. Traces of the ice age can be found in many parts of the region's landscape in the form of end moraine and ridges. Groundwater is stored especially in ridges and the condition of the water has remained good despite of some changes in quality linked to human activities. On the coast and in the archipelago the thin quaternary overburden leaves the bedrock visible in many places.

Itä-Uusimaa is a predominantly low-lying and fertile region with plenty of fields and both deciduous and coniferous forests. Itä-Uusimaa is situated on the Gulf of Finland between the water systems of Kymi River in the east and Vantaa River in the west. Altogether seven rivers discharge to the Gulf of Finland within the boundaries of the Itä-Uusimaa region. The condition of the rivers and lakes is generally fairly good, but many rivers adjacent to clayey agricultural regions show high concentrations of nutrients. In the last twenty years the eutrophication of the region's lakes has been noticeable, and eutrophication is also present in some inland bays and the archipelago. The water circulation is slow due to the sheltering effect of the archipelago and thus the coastal waters are especially vulnerable to the sewage waters from industry, agriculture and settlements.

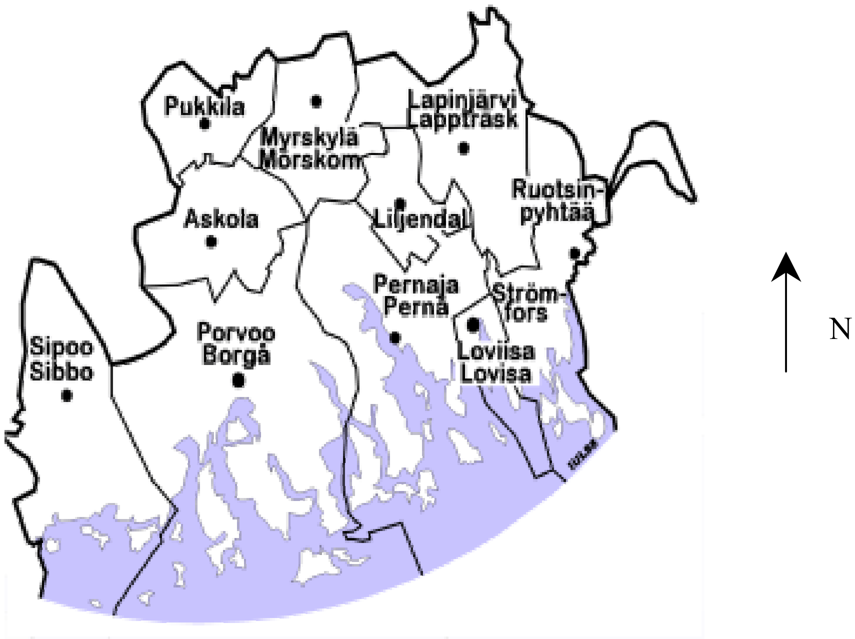

Figure 1: The region of Itä-Uusimaa and the ten municipalities (Itä-Uusimaa region 2003)

<u>Social and economic aspects</u>

Itä-Uusimaa consists of 10 municipalities that have a total population of 90 000 inhabitants. The largest town and the most important centre Porvoo (45 000 inhabitants) houses the regional council of Itä-Uusimaa. Sipoo is the second largest municipality with 18 000 inhabitants, whereas the third largest municipality, Loviisa, has a population of only 7 600. The municipalities of Itä-Uusimaa are mainly rural in their nature. However, Porvoo and Loviisa have small town centres with an urban structure. The population density varies notably between different municipalities, being 167 in the town of Loviisa and 9 in the rural communities of Lapinjärvi and Pernaja. Many of these municipalities increase their population substantially in the summertime, when people from urban areas retreat to their summer cottages.

Table 1: Population and population density (persons/km²) in the municipalities of Itä-Uusimaa (Itä-Uusimaa region 2003)

Municipality	Population	Population density (persons/km²)
Askola	4 446	21
Lapinjärvi	2 981	9
Liljendal	1 462	13
Loviisa	7 440	167
Myrskylä	1 992	10
Pernaja	3 823	9
Porvoo	45 730	70
Pukkila	1 949	14
Ruotsinpyhtää	2 934	11
Sipoo	18 177	50
Itä-Uusimaa	**90 934**	**33**
Finland	**5 206 000**	**17**

The proximity of Helsinki (40 kilometres west from Porvoo) and the growing capital region with over one million inhabitants creates traffic and pressure to the land use and natural resources of Itä-Uusimaa. The population growth in the entire Itä-Uusimaa has been moderate (13,3%) in the last twenty years. Sipoo, whose neighbouring town is Helsinki, has however grown with 40% and the regional centre Porvoo with 20%. Population reduction has occurred mainly in the easternmost municipalities of Lapinjärvi, Loviisa and Ruotsinpyhtää. Regional centres are important in providing people with necessary services since not all of the smaller municipal centres are able to do this. One solution to this is to annex one municipality to another, for example Porvoo almost doubled its population when the rural district of Porvoo and the town of Porvoo were united in 1997.

The majority of the population in Itä-Uusimaa (66,2 percent) is employed in the service sector, 26,6 percent in the industry and 5,3 percent in agriculture and forestry. There are, however, differences between the different municipalities. The largest concentrations of industry can be found in the two towns of Porvoo (oil refinery, industry cluster and port) and Loviisa (nuclear power plant and port). Itä-Uusimaa is a bilingual region with a Swedish-speaking population of 35 percent compared to the 5,6 percent in the whole country. The coastal municipalities tend to have a larger Swedish-speaking population than the inland municipalities.

1.1.2 Relevant hazards

Natural hazards

Natural hazards and their impacts in Finland and in the Itä-Uusimaa region are generally mild. The region is geologically stable, and the earthquakes that do occur from time to time are too mild to be considered a risk to the population, economy or environment. Most natural hazards are related to extreme weather conditions, such as extreme precipitation, storms, droughts and extremely low temperatures. However, such events are rare and even though they can cause considerable damage, they seldom cause casualties. For example forest fires, which are most common in the dry periods of the summer, seldom spread out to threaten residential areas.

Flooding is perhaps the most relevant natural hazard in Itä-Uusimaa. The flooding of rivers is often linked to the melting of snow and ice in the spring, especially in the lowlands of western Finland. In the region of Itä-Uusimaa, fluctuations of the discharge of rivers are fairly large due to the lack of larger lakes in the river systems. On the one hand these rivers flood easily, on the other hand water can be scarce during dry periods. The economic damage related to floods concerns mainly agriculture, whereas residential areas are seldom affected.

Occasionally storms raise the level of the Baltic Sea high enough to cause flooding in the coastal regions. Economic damage can be high especially in urban regions, but similarly to the other natural hazards in the region, casualties are rare.

Technological hazards

Technological hazards play a significant role in the hazard scape of the Itä-Uusimaa region. The two most relevant sources of potential technological hazard that originate inside the region itself are the industry cluster and port in Sköldvik (Porvoo) and the nuclear power plant in Hästholmen (Loviisa).

The nuclear power plant is situated 15 kilometres southeast from the centre of Loviisa on the island of Hästholmen. The first unit of the power plant was set into action in 1977; it was also the first nuclear power plant in Finland. The second unit was set into action three and a half years later. The plant meets over ten percent of the total electricity need in Finland and it employs approximately 600 people. The nuclear waste is stored in subterranean pits near the power plant. An accident in the power plant would not only threaten the town of Loviisa, but also the whole region and even more extensive areas. The possibility of placing a third nuclear reactor in Hästholmen is currently being discussed.

The port of Sköldvik is Finland's most important port for both export and import of crude material and products of chemical industry. The port and the adjoining oil refinery are situated in the industrial area of Sköldvik approximately 12 kilometres southwest from the centre of Porvoo. The port and the different companies in the industrial area employ altogether approximately 3500 people. Emissions of dangerous chemicals into the air are a potential risk to the population of Porvoo, whereas the environment faces a pollution risk from oil spills from the marine transportation and loading of oil and other harmful substances.

A smaller port in the Itä-Uusimaa region is situated in Loviisa, but it does not deal with dangerous substances since it is mainly used for the export of products of the forest industry and for the import of coal.

Road transportation of oil and other hazardous substances is a technological hazard related especially to the existence of the industrial cluster and port in Sköldvik. A serious infrastructural weakness that intensifies this hazard is the lack of a second road leading the industrial area. An accident on the road could hinder possible rescue measures when only small village roads could be used for this purpose. Traffic and road transportation of harmful substances poses a risk to a larger area as well, since the E18 –road from Turku to the Russian border passes through the Itä-Uusimaa region.

Potential technological hazards that threaten the region from the outside are mainly related to the marine transport of oil and other hazardous goods in the Gulf of Finland. The Russian port of Primorsk in the eastern tip of the gulf is important for exporting oil from Russia via the Baltic Sea. Oil transportation carries always a risk, but the often difficult ice conditions in the Baltic Sea, especially in the Gulf of Finland, intensify this risk when oil tankers not built for such conditions are being used. The technological risk of oil transportation is thus intensified by natural conditions.

Another hazard related to oil transportation and oil refineries in the Gulf of Finland are scattered oil spills that are difficult to perceive and to prevent. Without firm proof it is impossible to get the ships that rinse their oil tanks in international waters to take responsibility of their actions. It is estimated, that in the Baltic Sea there are 500-800 oil spills every year, and in 2001 the Border Guards reported 107 oil spills in or near the Finnish territorial waters. The Finnish marine Research Institute states that the continuous exposure to these oil spills can strain the Baltic maritime environment more than previous oil accidents in the Baltic Sea have done.

1.1.3 Basic risk assessment

The hazards in the region of Itä-Uusimaa listed in the previous chapter can all be considered relevant for the ESPON Hazards project. All of the natural hazards in the region represent the Cyclops-type of risk, which means that the probability of their occurrence is largely unknown, but the possible damage is quantifiable. The technological hazards represent the Damocles – type of risk, where the possible damage can be very high, but the probability of occurrence is very low. These two risk types were found relevant in the context of spatial development in chapter 6.1.2 of the 1st Interim Report.

Table 2: Assessment of risk type and spatial relevance of the natural and technological hazards found in the Itä-Uusimaa region

Hazards	**Risk type** (see p. 82 in the 1st Interim Report)	**Spatial relevance - locally** + = high, o = low, - = none	**Spatial relevance - regionally**	**Spatial relevance - nationally**
Natural hazards				
Flooding of rivers	Cyclops	+	+/o	-
Flooding of the Baltic Sea	Cyclops	+	+/o	-
Forest fires	Cyclops	+	o	-
Technological hazards				
Nuclear power plant and storage	Damocles	+	+	+
Oil refinery, industrial cluster and port	Damocles	+	+	o
Road transportation of oil and harmful substances	Damocles	+	+/o	o
Marine transportation of oil and harmful substances	Damocles	+	+	+
Oil Spills	Damocles	+	+	+

All of the selected hazards are spatial in their character (=they have spatial effects when they appear). However, the spatial planning response varies from one hazard to another (see Table 2), and not all of the above mentioned hazards are addressed in planning. The natural hazards are most relevant at the local scale, and to some extent also at the regional scale. Spatial relevance concerning natural hazards on the regional scale is virtually non-existent on the national scale.

The technological hazards tend to show more relevance on the wider regional and national scales than the natural hazards. The nuclear power plant in Loviisa is the most extensive hazard, although undoubtedly, the possibility of its occurrence is the lowest of all the relevant hazards. Marine transportation of oil and oil spills in the international waters threaten not only the Itä-Uusimaa region, but other areas on the Baltic Sea are threatened as well. These hazards are relevant in Itä-Uusimaa regionally as well as locally, since the region has such a long shoreline and an extensive archipelago.

1.2 BACKGROUND

1.2.1 Finnish planning framework and responsible authorities

National level

The Finnish planning system includes the national, regional and municipal levels. The Council of State has set national land use goals. These goals include the building and maintenance of main infrastructure networks and the policing of natural and built-up areas of national importance. In relation to the regional and municipal levels, the main task of the national government is to issue guidelines and supervise the observation of laws.

Ministry of the Environment acts as the highest authority that supervises and develops planning in Finland. It promotes, guides and controls planning on the regional level. Regulations of the *Land Use and Building Act* have to be used in the regional planning, building and land use of all regions and municipalities. In the hierarchical Finnish spatial planning system there are three levels of planning documentation that instruct land use in municipalities: regional plan (maakuntakaava), master plan (yleiskaava) and local detailed plan (asemakaava).

Table 3: Finnish planning framework

Level	Responsible authorities	Main task	Plan
National level	Council of State	sets national land use goals	
National level	Ministry of the Environment	supervises and develops planning in Finland	
Regional level	Regions (alliances of municipalities): Regional Councils	responsible for spatial planning on the regional level	Regional plan
Municipal level	Municipalities: Municipal Councils	main executive part in spatial planning in Finland	Master plan, Local detailed plans

Regional level
Municipalities act as basic planning units in the Finnish spatial panning system. The responsibility in the field of spatial planning in the regional level has been given to the 20 regions of Finland, who act as alliances of municipalities. The Regional Council, which has representation from each municipality, has the highest power of decision. The Regional Government steers regional planning according to the action plans approved by the regional council. *Regional plan* is a general plan for the land use of the whole region. It acts as a guiding instrument when master and local detailed plans are drawn up on the municipal level. National and regional goals are expressed in regional plans, which are submitted for approval to the Ministry of the Environment.

Regional environmental centres promote and steer regional planning and public construction in the municipalities of the respective region. A particular task of these centres is to supervise that the national objectives and regulations in spatial planning and building enacted in the law are being taken into account.

Municipal level
The self-governing municipalities have the main *executive* part in spatial planning, while the *master plan* is the main instrument in the *steering* of spatial planning in Finland. The master plan indicates the overall guidance of land use and the siting of various activities, whereas the *local detailed plan*s indicate the detailed land use and building in the municipality. In the hierarchical planning system the regional plan steers the master plan and the master plan steers the local plan. The legal effects work in the opposite direction, since the regional plan is not valid where a more detailed master plan exists, and the master plan is not valid where a more detailed local plan exists, respectively.

Every municipality has to have a *building code*. The building code includes regulations that are necessary for the realisation and preservation of a good living environment and for respecting cultural and natural values on the local level. Every municipality with a population of 6000 or more has to have a planner to take care of the spatial planning on the local level. Municipalities may have a joint planner and they also have the possibility to draw up joint master plans. Such joint plans require the approval of the Ministry of the Environment.

1.3 PLANNING DOCUMENTATION

1.3.1 Plans available at regional level

The regional plan is the most important element of planning documentation concerning the whole Itä-Uusimaa region. The regional plan of Itä-Uusimaa used to consist of four separate plans that concentrated on different themes. In 2002 it was decided, that in the future the regional plan would be drawn up as one entity that includes all the different themes that used to be dealt with separately. At present, the new regional plan is being prepared, and the first outline will be ready by the end of the year 2004.

The regional plan of Itä-Uusimaa does not have a risk-based approach, and it does not recognise all the relevant natural and technological hazards enlisted in chapter 1.5.1.5.2. However, the two most relevant technological hazards of the region, namely the nuclear power plant in Loviisa and the industrial cluster and port in Porvoo are recognised in setting protective exclusion areas around them (see chapter 1.5.1.5.7). In addition to these exclusion areas, a consultation ring of two kilometres has been drawn around the Sköldvik industrial cluster according to the Seveso II –directive.

Master and local detailed plans recognise some hazards that are not recognised in the regional plan level. One example is flooding, which is more relevant on local than on regional level in Itä-Uusimaa (see Table 2). Flooding is taken into account in the Land Use and Building Act, which states that building sites should be chosen in such a way that no risk of flooding or landslides occur. In local detailed plans flood prevention is taken into account by setting a construction height for new areas. This height is specified in the building codes of separate municipalities.

1.3.2 Relevant data sets available at regional level

Data sets concerning hazards and risk reduction are scarce in the Itä-Uusimaa region. Regional planning documentation does not include this kind of information, although the existence of the most important technological hazards is recognized in the regional plan. More explicit data on these technological hazards is undoubtedly collected for the purposes of risk management inside the industrial areas.

One reason for the lack of data sets concerning hazards at regional level is the issue of scale. The whole region of Itä-Uusimaa has a population of 90 000 and planning resources are accordingly small. Since the number of hazards is limited and their magnitude is in most cases small, there is necessarily no need for regional or national data. It is more likely that the regional council or municipalities will collect data on topical issues only when the information is needed and not beforehand. In some cases the collection of data is initiated by the regional environmental authorities that contact the regional councils or municipalities.

Statistical data, which is not directly hazard-related but can be used for the purpose of this project, is available on the regional level. For example socio-economic indicators (e.g. population density) can be relevant in the assessment of regional vulnerability. Relevant data is provided by the Central Statistical Office of Finland and to some extent by the regional council of Itä-Uusimaa and the municipalities. The regional environmental authorities may also have data that would be interesting for the purposes of this project.

1.3.3 Elements of available planning documents with relation to hazards and risks

The regional planning documentation does not recognise all hazards relevant in the Itä-Uusimaa region. However, many hazards are taken into account in guidelines or separate risk plans made by environmental authorities, rescue departments or other actors in national, regional and local level. Separate risk plans are mainly hazard related or sectoral, whereas integrative risk management plans are less common.

The Flooding of rivers is a current issue in Finland due to the publication of a report on flooding by the Ministry of Agriculture and Forestry in the spring of 2003 (the so called Suurtulvaraportti). In the report seven proposals for action on mitigation in the case of extensive flooding were presented. The realisation of these proposals would improve and standardize flood control in the whole country. The main responsibility would lie on the national and regional environmental authorities, and the tasks would include a preparation of a databank on past floods and a preparation of a general plan on damage reduction. It remains to be seen how these proposals are taken into account in spatial planning on the regional level in the future.

Sea level change and its impacts on the environment and socio-economic development in the region of the Baltic Sea are presently being researched in the Interreg IIIB –project SEAREG. One way municipalities can prepare themselves for the rising sea level (either short-term during storms or long-term due to climate change) and avoid damage is to regulate building on the shoreline. Guidelines by the environmental authorities in Finland state that buildings on the shores of lakes and the Baltic Sea should be built in a way that floods do not reach or damage them. Exact regulations on building can be found in the Building Codes and local plans of municipalities.

Relevant technological hazards are taken into account in the regional plan of Itä-Uusimaa, as well as in separate risk management plans. In the regional plan the industrial cluster in Sköldvik is classified as an area of industrial activity and water transport, and the nuclear power plant in Hästholmen as an area of community management. In the regional plan both Sköldvik and Hästholmen have an inner and outer exclusion area. The inner exclusion area has a one-kilometre radius, the outer exclusion area a five-kilometre radius. The purpose of these areas is to control land use in the close vicinity of these possibly dangerous areas.

The regional plan of Itä-Uusimaa states that in the inner exclusion area of Hästholmen no permanent housing should be allowed and the construction of buildings is permitted only for the nuclear power plant's purposes. In the outer area the number of permanent residents is restricted at 200 and no such activities should be undertaken that include large masses of people or endanger the safe functioning of the power plant. In the inner exclusion area of Sköldvik no new housing should be built. In the outer area no new housing should be built without a specific purpose. One example of this kind of a specific purpose would be the enlargement of existing residential buildings.

The regional plan acts as a guiding instrument for the more detailed master and local detailed plans as explained in chapter 1.5.1.5.4. These plans must respect the contents of the regional plan. However, should there be disparity between the contents of different plans, it is always the more detailed plan that has legal validity. Both Hästholmen and Sköldvik have their own local detailed plans where the permitted building volume is defined according to the contents of the regional plan. Despite the regulations on permanent housing, recreational dwellings are ample in or near both areas. The locations on the coast by the archipelago have attracted plenty of people to build their summer cottages at a stone's throw from these technological hazards.

The industry cluster and port in Porvoo, as well as the nuclear power plant in Loviisa, have their own rescue departments and risk management plans. Inside the Sköldvik industrial area different companies have their own risk plans. The rescue departments operate inside their own areas and are prepared for different situations. The rescue departments in the towns of Porvoo and Loviisa have their own plans in case something goes wrong and immediate response is needed.

The marine and road transport of oil and other hazardous substances, as well as oil spills are not taken into account in planning documents. Possible accidents call for immediate reaction and therefore municipal rescue departments and regional environmental authorities have the greatest responsibility.

1.4 LESSONS TO LEARN

1.4.1 Useful and transferable instruments / indicators for a risk reduction management

At this early stage of the project, it is difficult to analyse the usefulness or transferability of the instruments used for risk reduction management in the region of Itä-Uusimaa for other European regions. For the same reason it is unclear, which aspects of this risk management can be called best practice. The interviews of responsible authorities should make the aspect of usefulness and transferability clearer. Possible instruments that could be useful and/or transferable in other regions include:

- spatial planning cooperation between municipalities (joint master plans)
- cooperation between a town and the industrial area in the case of a certain technological hazard
- exclusion areas around industrial areas dealing with harmful substances
- public participation in planning as stated in the Land Use and Building Act of 2000

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1 CENTRAL REGION OF PORTUGAL

1.1 GENERAL

Definitions of terms used in this Annex

Spatial Planning – is referred to as the general term describing the planning approach system in Portugal at the national, regional and municipal levels. They embodied three different kinds of plans: National Plans, Regional Plans and Municipal Plans (PMOT's). In these types of documents it is laid out the spatial development major goals to be achieved in order to promote a balanced relation among human beings, activities, equipments, and further infrastructure such as accessibilities.

Regional Plan – The regional plans in Portugal can cover different length of territories. Therefore, it is possible to have regional plans covering the full length of the territory labelled as NUTS II, or those that can cover solely more than one NUTS III, and finally those which are based on parts of NUTS III territories, as it is the case of PROZAG.

Municipal Spatial Plans (PMOTs) – These plans are in nature, administrative regulations, that determines the type of usage that can be done into the different kinds of soils. It comprises the total area of the municipality or solely part of it. It comprehends other types of plans: Municipal Plan (PDM), urban plans and Detail Plans.

Municipal Plans (PDM) - In this kind of plan, it is established the spatial structure to be applied to the full length of the municipal territory. Soils classifications, urban indexes, are to be defined according to the way that economic activities, dwellings, equipments and other types of infrastructure such as the transport system have been set in place.

Urban Plan - this is the kind of plan that covers urban and non-urban areas- that though, can become reclassified as such- in order to give an organic structure to the urban territory, by establishing: a) The outer boundary of urban areas; b) Urban criteria; c) The end usage of dwellings; d) Heritage buildings that are in need of being protected; e) Areas that are to be elected as shelter for certain kinds of equipments; f) Green areas are mapped, and finally, is where the main net of transport system is outlined.

Details Plans - as the name suggests, this is a kind of plan that distinguish itself for substantiate and define in a clearly way, the typology of occupations available when the use of municipal territory are to be concerned. In case of urban areas, the Detail Plans instruct of how to build in certain areas of the municipality, what short of requirements are to be followed in order to preserve the façade of certain types of buildings etc.

Special Spatial Plans – Portuguese Central Administration is the accountable body for setting up these kinds of plans. Special Spatial Plans provide with the principles and rules of how to occupy and transform land areas, in order to maintain and preserve public interests. They include other plans such as of those dealing with protected areas spatial plans , public shallow lakes spatial plans and Coastal spatial plans.

National Ecological Reserve (REN) – This is a concept that often is wrongly taken for Natural Parks. At least in Portuguese terminology, this concept gains a much wider scope allowing it to comprehend natural areas, coastal areas, estuary areas, lagoons, shallow lakes, streamlets, areas of maximum infiltrations and declivous areas. All of them are part of REN.
Therefore, REN is defined as all basic types of diverse biophysics structures that through certain kinds of impediments to their usage are able to protect its own ecosystems from an unbalanced development. Nevertheless, these areas try to balance human activities and a lively, health environment.

Principles of Regional Planning - are included in the Decree-lawnº 380/99 of September 22nd of 1999. This legislation provides with the guidelines for spatial development requirements that need to be followed at the national, regional and municipal level.

Natural Area – Land with a special constitutionary status due to its importance for the nature/ecosystem conservation.

Region – Area commonly labelled as NUT II. There are 7 NUT II in Portugal: 5 in the territory of continental Portugal and the other 2 in the Açores and Madeira Island.

District – Administrative area with a specific authority, which has been assigned certain super-municipal administrative competencies.

Municipality – lowest and at the same time most concrete level in the administrative and planning hierarchy level and land use planning. Municipalities have a guarantee right of self-government according to the article...

Inter-municipal level Planning (matches the definition of German partner of Regional Level Planning) – level of spatial relevance that is superior to local level and inferior to the regional level (applies for instance to issues like natural or technical hazards that reach an extent which exceeds the ability of a municipality to manage the incident and/or that happens in an area bigger than of one municipality).
As it is defined in the decree-law nº 328/99 – " the inter-municipal plan of spatial planning is a territorial development instrument which guarantee a good articulation between regional spatial plans and the municipal spatial plans".

1.1.1 Key data on the region

The central region of Portugal occupies an area of 23,666 km2 (25.7% of the Portuguese land area) and includes 78 counties. The region contains 10 NUTS III level areas.

Geo-ecology: It is marked out by being crossed through the main mountain chain in Portugal, which culminates in mountain Serra da Estrela (1991m). It includes the hydrographical basins of some of the most important Iberian Rivers (Mondego, Vouga, Dão, Lis) and part of Douro (through Côa) and Tagus (through Zêzere) and several water reserves, including thermal and mineral waters, of the greatest strategic importance for the region and for the country.

This region holds important resources of quality soils, rock reserves, particularly granite, which is being used in many industrial and commercial activities, on top of an extensive and complex botanical and fauna of great environmental, scientific and tourist interest.

Additionally, the region has extensive swathes of forest, particularly of pine and eucalyptus, representing 1/3 of the Portuguese forestry area.
Population: The population is almost 1.8 million inhabitants (17.2% of the national total), of which 65% is made up of active population.

Education: The region has an established education system, including universities and polytechnic institutes, which area spread evenly through the region. Today about 76 000 students attend higher education, of which 89% are educated in public teaching establishments.

Figure 1: Central Region of Portugal – Urban Agglomerations

Agricultural and forestry: A strong heritage of small cattle and poultry farming and forestry that, despite the profound structural transformations, continues to play a relevant role in regional economy. Small farms dominate as, integrated within a family-based traditional economy. Wine, olive oil, fruit, milk and wood are still important products in the regional economy.

Industry: The region has stood out due to its diversity, development and innovation, particularly in areas of manufacturing industry, the growth of which has been both quantitative and qualitative. The introduction of new industry brands is evident, among which one should highlight telecommunications, the new information technologies and, up to a certain extent, components for the automobile industry,- The sectors with a more or less long tradition in the region, such as ceramics and moulds, have undergone the greatest progress in innovation, both in the products and in the processes.

Tourism: Tourism, in its multiplicity of market segments, is a field of the regional economy with excellent prospects,- The qualitative and quantitative emergence is already evident, in the Coastal Beira and in Inner Beira, in terms of supply and demand.
The diversity of tourist resources forms the region's major strength. Strategically, it is in the coming together of history and nature, expressed as culture, in many forms,- This lays the raw material on which the development of a quality tourist industry is based.

1.1.2 Relevant Hazards

In the central region of Portugal, populations' security are mainly threatened by three natural hazards:

a) **floods hazard**, specially in the valleys of Mondego, Vouga and Liz river;
b) **forest fires**;

and one technological hazard:

c) **water contaminations** in industrialised areas;

Technological hazards tend to occur every now and then, especially those, which relates with **radioactivity contamination**. These happenings tend to relate with fact that the central region of Portugal holds several uranium mines, on top of suffering from the nearby presence of the central nuclear power station of Almaraz, located on the Spanish border.

1.1.3 Basic risk Assessment

Basic risk assessments are being done in order to enhance population security:

<u>Floods</u>
In the Valley of Mondego River there is a well-marked delimitation of an area, which is normally affected by the 100-year flood. An emergency action plan was devised accordingly,- by the district civil protection services.
The valleys of Vouga e Liz do not hold any risks map and consequently there is no emergency action plan.

<u>Forest fires</u>
The Canadian Index on forest fires vulnerability is released on a regular basis, from which the national fire brigades draw indicators to their emergency plans on forest fires.

<u>Landslides</u>
This hazard could become problematic in case of high values of rainfall in areas with severe relief. In the Central region of Portugal the problem of severe relief in mountainous regions is increased by deforestation. This is caused many times by forest fires and bad planning of construction in the past. Thus landslides are now a relevant problem and there are no official plans of prevention. Serviço Nacional de Protecção Civil implements emergency plans.

<u>Water contamination</u>
There is no emergency plan to answer water contamination. There are several prevention plans in Portuguese legislation to ensure protection, especially according the water use. Radioactivity emergency plans are related to exploitation activity of the uranium mines that shall prevent the exposure of people to radioactivity.

1.2 BACKGROUND

1.2.1 Framework Legislation

The most important Portuguese legislation on spatial planning is rather recent.
The law nº 48/98, of 11th of August 1998, establishes the guidelines for spatial planning and urban policy. This law was regulated through the decree-law nº 380/99, of 22nd of September 1999, in which the legal system of spatial management planning instruments are drawn at national, sectoral, regional and municipality levels.
The decree-law nº 555/99, of 16th of December 1999, which was altered by the decree-law nº 177/2001, of 4th of June, establishes a new legal regime for urban operations at a municipality level (urban plans and detailed plans), a new legal regime for division of urban lands into parcels as well for building activities.
The law - decree n. 34/92 of 4th December 1992, establishes radioactivity protection, prevention and actions in mining industry.
The law - decree n. 382/99 of 22nd September 1999, which establishes protection perimeters for groundwater uses in public water exploration that serves more than 500 people.

1.2.2 Planning framework /context

The decree-law nº 380/99 sets in place all instruments available to spatial planning and urban policies. The spatial planning management system laid down through this decree-law establishes three different levels of action and coordination when planning activities are concerned: the national, regional and municipal levels.

These three integrated (hierarchical) levels aimed at insuring that the different public interests are able to express themselves spatially, in a conciliate/ agreeable manner and, in order to promote a sustainable economic and social development as well as territorial cohesion.

These instruments of spatial management identify human, physical and natural resources, essential to a sustainable use/management of the territory. They also set up basic criteria and minimum levels of usage of those resources in order to insure that the natural heritage is able to keep on renewing itself.

At a **national level** three strategic documents were created:

i. The national policy programme for spatial planning

ii. Sectoral plans

iii. Special plans, which include **protected areas spatial plans, coastlands spatial plans** and **shallow lakes spatial plans.** These spatial plans set limits to the use of territory in order to preserve the nature and its biodiversity. At the same time they ensure an open space to the usage of population.

On a **regional level** only exists one strategic document type, the *regional spatial plans*.

In a sub-regional level, it is able to find the so-called *Inter-municipalities plans.*

And finally, there are the *municipal spatial plans* including three types of strategic documents:

i. City council strategic plans
ii. Urban plans
iii. Detailed plans

The binding character of the aforementioned strategic documents

Only the Municipal spatial plans are able to bind public and private bodies to comply with their rules. All the others bind solely public institutions.

1.2.3 Involved /responsible official boards/ authorities

Listed below you will find the responsible official boards for each of the different strategic plan.

i. **The national policy programme for spatial planning**
Authority: Head office of spatial planning and urban development

ii. **Sector Plans**
Authority: Ministry of a sector

iii. **Regional Spatial Plans**
Authority: CCRC (Comissão de Coordenação da Região Centro)[5]

iv. **Special plans, Municipal plans and sector plans** are monitored by the Regional Head Office of Environment and Spatial Planning (DRAOT).

1.3 PLANNING DOCUMENTATION

1.3.1 Plans, maps available at regional level

a) Regional Spatial Plans in the Central Region of Portugal

There is no strategic spatial plan covering the full length of all the territory of the central region of Portugal. There is a shorter regional plan called **PROZAG** (Regional spatial

[5] CCRC and DRAOT have merged as an unique service called CCDR(Comissão de Coordenação e Desenvolvimento Regional)

plan for the surrounding area of three different artificial lakes of Aguieira, Coiço e Fronhas) which covers six municipalities overall.
This plan was approved in 25/09/92, bonding all public and private bodies to comply with new regulation on land-use management and water supply.
PROZAG can be regarded as an umbrella strategic plan, providing the guidelines to other "lower" plans. These concerns cities and councils involved in this area, with which they have to comply.
The major goal of this plan was to protect the water quality of shallow lands of Aguieira, Coiço e Fronhas, since it serves not only to supply a wide area of population but also to irrigate Baixo Mondego lands.
As PROZAG was created while before the new regulation applicable to regional spatial plans came out, (Decree-law nº 380/99) it did not cover all the areas that should be object of planning. At the present moment, the regional spatial plans are being revised under the lights of this new regulation.

"Special Plans" of the Central Region of Portugal

b) Spatial plans for coastland areas

All the coastland of the central region of Portugal, with a covering area of 140 km2 by 3 km2 of depth, encompasses 11 municipalities. These are equally object of a spatial strategic planning called "Special plan for coastland areas".
This special plan, which has been approved in October of 2000, is meant for :

a) value different usage of coastland areas;
b) protect natural ecosystems and ensure a sustainable exploitation of resources;
c) value existing settlements without disregard of the coastal dynamics;

***i.* Spatial plans for artificial lagoons/ shallow lakes**

There are still few other special plans for artificial lagoons in Zêzere River, particularly those, that are connects to Cabril, Stº Luzia, Bouça e Castelo de Bode artificial lagoons.

***ii.* Spatial plan for protected areas**

Spatial planning for the Natural Parks of Serra da Estrela, Serra de Aires e Candeeiros and the Natural Reserves of Paul de Arzila and of dunes of S. Jacinto has been recently approved.

c) Portuguese's good practices examples on management risk of natural and technological hazards - The risk reduction through land-use planning

Since the 1990's Portuguese legal rules on land-use planning have experienced significant changes due to the introduction of a new regulated concept- the National Ecological Reserves (REN).
Throughout the national territory, pockets of land areas have been identified, delimited and ruled in order to preserve the importance of the different biodiversity ecosystems. The outcome of such work has brought extremely important measures when reducing the potential of risk of natural and technological hazards.

Measures such as:

1. Bounding the "side-walk areas" of rivers preventing them to be used with building activities, or similar activities, which ultimately, would decrease the level of water infiltration on the soil. This was one of those good land-use planning measures that, is believed to reduce the level of hazards, even if not always applied;

2. The maximum borderline of a 100-year flood has been delimited. Consequently, restrictions to the use and the type of use of the inflicted land areas have been determined.

3. Land areas have been classified according to their level of infiltration and guidelines have been given to the type of use of the different kind of soils.

4. Delimitation of the use of declivous zones (> than 30% of declivity) have been established;

5. The type of use of coast land areas and wetlands determined;

In the 1990's, this kind of regulation was absorbed and made present in most of the City Council Strategic Plans.
In order to avoid the dereliction of sensitive environmental areas, it is believed this kind of good practice has given great contributions to the risk reduction of floods and water contamination, and even, to the land derails.

There are other examples of good practice in order to minimise the risk of floods.
While the previous one could be placed as a good practice example indicator, falling within the "Driving Force concept" of DPSIR chain, this next one, could be easily identified as a good practice example indicator of response.

The creation of artificial lagoons/shallow lakes and other similar types of constructions were set to help to respond to the flood hazard.
The artificial lagoons of Aguieira e Fronhas were built to protect the city of Coimbra and the village of Montemor o Velho, by creating the possibility of accumulating high volumes of water, and also, decreasing the high levels of floods in the downstream trunk of Mondego river. Despite of the fact the risk of floods has been reduced there is still the risk of overflowing due to the 100 year flood.

1.3.2 Relevant data sets available at regional level

Since the spatial planning does not evaluate formally any type of risks, no data on hazards can be extracted form these documents.

Nevertheless, there are other types of documents such as the Mondego's river basin plan, from which is possible to extract some relevant information on potentially hazards situation, namely those related with floods.

Out of the 7 potentially hazards situations mentioned in the table below, the more relevant ones, are:

A. Flood hazard, vastly mentioned in this report. The Mondego's river basin plan does hold some data on the maximum flow of intensity when the 100 year flood is being considered, and therefore, able to provide us with certain kind of information of how to control this potential risky situation;

B. Dams "break down" – Another relevant hazard type to be considered relates to the Mondego and Zezêre dams' potential danger of breaking apart (dam failures). More than 30 dams and weirs are known in the central region, from which 8 of them are considerably large structures.
   These potentially dangerous situations are only envisaged in those cases in which flood surge could exceed the 500th year flood.

   Due to the location of some of those dams, namely the dam of Castelo de Bode, in the case of accident, the extent of impacts would clearly exceed the regional level, affecting the region of Lisbon and Vale do Tejo.

C. Dike "break down" – this is another potentially risky situation that took place during the winter of 2000/01 when flood waves in Mondego River exceeded by far flow capacities of the existing dikes which fall apart overflowing the village of Montemor o Velho and several others villages from Baixo Mondego.

Table 1: Natural and Technological hazards in the planning of Centre Region

Natural and technological hazards	**spatial relevance** in the planning region: + = high, o = low, - = none
Natural hazards	
Floods	+
Landslides/ avalanches Rock collapses Landslides	 0 0
Earthquakes	0
Droughts	+
Forest fires spatially in Pinhal Interior Nut III (Inland region)	+
Storms wind storms	 +
Extreme precipitation (heavy rainfall and hail)	+
Extreme temperatures (heat waves)	0
Technological Hazards	
Hazards from nuclear power plants	0
Hazards from hazardous -storage of nuclear waste Old uranium mine with ground water contact near Mangualde e Urgeiriça	 +
dam failure	+
Hazards from other sources	0

1.3.3 Elements of available planning documents with relation to hazards and risks

Protection Civil plans

As mentioned in the first interim report, the national council for emergencies and civil protection (CNPCE) is the responsible official board for the coordination of all civil protection services.

1st Level – Institution: National Centre of Emergencies and Civil Protection (CNPCE)
Scope of Action: National Territory

Accountable body/ Figureheads:

- ***Planning body*** - NCECP depends directly on the Prime Minister of Portugal;
- ***Operation level*** – NCECP guides the activities of the National Services of Fire Brigades (SNB) and the National Service of Civil Protection (SNPC)
- ***Strategic Document*:** National Plan for Emergencies and Civil Protection

Within CNPCE, there are sectoral committees, which depend directly upon government even if in operational terms depends upon the president of CNPCE.
Those committees are accountable for the elaboration of emergency plans that should be put in place in case of accidents, having also, the possibility of preventing them since they have at their disposal an advanced risk forecast simulation system.

CNPCE is a full member of senior civil emergency planning committee.

2nd Level – Institution: District Centre for operations of Emergency and Civil Protection
Scope of Action: District Area

Accountable body/ Figureheads:

- ***Responsible –*** *Governador Civil (Mayor of County Council)*
- ***Operation level*** - District Services of Fire Brigades and District Service of Civil Protection, which are being merged.
- ***Strategic Document:*** District Plan for Emergencies and Civil Protection, plus special emergencies plans for flooding, fire forest and seismic activity, etc. These strategic documents have a full physical description of the basin, where the different levels of alerts are laid out, - The different procedures in case of risks are established,- and finally, a contact list of human and material resources,- needed in case of accident,- are listed.

3rd Level – Institution: Municipal Centres of Emergencies and Civil Protection
Scope of Action: Municipal area

Accountable body/ Figureheads:

- ***Responsible –*** City's Mayor
- ***Operation level*** – town councillor for Civil Protection, the chief of Fire Brigades, the chief of GNR (police operating in rural areas), director of City council Infra- structures, director of EDP (Portugal Electricity Enterprise), director of the Red Cross, director of hydric resources of INAG, director of *Misericórdias* (Charity health and social care Institution)
- **Strategic Document:** Municipal Plan for Emergencies and Civil Protection. This plan holds information on:
  - Mission statement
  - Responsibilities of each civil protection agent in case of accidents
  - List of contacts of each one of those entities
  - List of material and human resources within the municipal area (this includes private bodies as well)
  - General characterizations of the main risks and the levels in which they have to mobilize the right agents according to the level of risk (green, yellow, orange and red).

  In case of an accident, the 3rd level is the first one that is responsible for mobilizing all necessary civil protection agents, and if proves to be insufficient due to the dimension of the phenomenon or due to the scarceness of human or material resources. They will be accountable for mobilizing the 2nd and, if necessary, the 1st level of this chain.

1.3.4 References

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ANNEXES OF 2 CENTRAL REGION OF PORTUGAL

Annex I What will be text be?

Annex II Preliminary maps of selected hazards, vulnerability and risk of the Central Region of Portugal

Annex III Development of new indicators

Annex I What will be text be?

TERRITORY, SETTLEMENT AND POPULATION

Territory	Centro
Total area	23 666,4 km²
Weight of total area in the country	25,7 %
Number of NUTE III	10
Number of Boroughs	78
Number of Wards	1 109
Área média dos concelhos	303,4 Km²
Área média das freguesias	21,3 km²
Occupation of the territory:	
Agricultural area	27,4 %
Forestry area	43,6 %
Urban area	10,8 %
Other uses	18,2 %

Settlement	
Population density (2001)	75,3 hab/km²
Structure of the settlement (% of population by places, 1991):	
Places up to 1,999 inhabitants	72,1 %
Places with 2,000 to 4,999 inhabitants	7,9 %
Places with 5,000 to 9,999 inhabitants	1,4 %
Places with 10,000 to 19,999 inhabitants	3,1 %
Places with 20,000 or more inhabitants	15,5 %
Population in the major urban centres (2001)	727 980 hab.
Weight in the total population of the Centre Region	40,8 %

Population	
Resident population (2001)	1 782 254 hab.
Weight in the resident population in the country (2001)	17,2 %
Population present (2001)	1 749 168 hab.
Families (2001)	640 741
Average size of families (2001)	2,8 pess/fam.
Variation in resident population 1991/2001	3,5 %
Age structure of the population (2001):	
0 a 14 years old	266 915
15 a 24 years old	245 904
25 a 64 years old	919 305
65 years old and over	350 130
Male/Female ratio	0,93
Fertility rate (2000)	41,8 %
Birth rate (2000)	10,1 ‰
Mortality rate (2000)	11,6 ‰
Ageing index (2000)	131,0 %

ECONOMIC BASE

Overall indicators	
Regional GDP (1998)	13 550 M€
Weight of the regional GDP in the country	13,4 %
GDP per capita (1998)	7 922 €
GDP per capita (PPC) – EU = 100 (1998)	65
Ratio in national productivity (1999)	82 %
Regional employment (1998)	778 000
Unemployment rate (2001)	2,5 %
Activity rate (2001)	57,1 %
Female activity rate (2001)	52,1 %
Gross forming of fixed capital (1997)	2 915 M€
GAV (1998)	11 677 M€
Structure of the GAV by sectors (1998):	
Agriculture, arboriculture and fishing	5,3 %
Industry, construction, electricity, gas and water	36,4 %
Services	58,3 %
Population employed by sectors of activity (1998):	
Agriculture, arboriculture and fishing	18,5 %
Industry, construction, electricity, gas and water	33,1 %
Services	48,4 %
Number of companies with head offices in the region (2000)	195 611
Sales volume of companies in the region (2000)	22 521 M€
Imports (2000)	3 723 M€
Exports (2000)	3 652 M€

Agriculture	Centro
Agricultural area (1999)	935 173 ha
Agricultural Area in Use (1999)	588 755 ha
AAU by unit (1999)	4,62 ha
Number of agricultural units (1999)	128 119
Blocks of agricultural exploration (1999)	6,4
Weight of agriculture in the regional GAV (1998)	4,8 %
Weight of agriculture in regional employment (1998)	18,1 %
Number of permanent workers per unit (1999)	2,5
Idade média da mão-de-obra agrícola (1999)	51,2 anos
Wine production (1999)	1 407 508 hl
Olive oil production (1999)	157 155 hl
Cattle stock (1999)	1 613 968 heads

Fishing (2000)	
Total fish landed	16 551 ton.
Value of fish landed	20 M€

ECONOMIC BASE

Industry (1998)	
Number of manufacturing companies	12 528
Staff working in manufacturing industry	166 615
GAVpm in manufacturing industry	2 712 M€
Food and drink	9,2 %
Textiles, clothing and footwear	12,7 %
Wood, paper and graphic arts	16,1 %
Chemicals. Rubber and plastics	8,7 %
Non-metallic minerals	20,3 %
Base metals	1,7 %
Metallic products	10,0 %
Machines, equipment and devices	13,1 %
Transportation materials	4,3 %
Others	3,9 %
Weight of manufacturing industry in the regional GAV	25,8 %
Weight of manufacturing industry in regional employment	21,4 %
Number of mining companies	367
Staff working in mining industry	2 942
GAVpm in mining industry	78,2 M€

Trade and services (1998)	
Weight of trade in the regional GAV	12,8 %
Weight of trade in regional employment	14,4 %
Weight of real estate activities and services to business in the regional GAV	9,8 %
Weight of real estate activities and services to business in regional employment	2,7 %
Weight of education in the regional GAV	8,7 %
Weight of education in regional employment	6,5 %

Tourism	
Number of hotel establishments (1999)	538
Number of restaurants (1999)	2 643
Staff working in hotels and restauration (1999)	26 466
Lodging capacity of hotel establishments (2000)	20 161 beds
Nights spent in hotel establishments (2000)	2 000 134
Rate of occupation of hotel establishments (2000)	28,2 %
Average stay per guest in hotel establishments	1,9 nights
GAVpm (1998)	176,5 M€

HABITATION AND CONSTRUCTION

Total buildings (2001)	757 476
Total dwellings (2001)	949 796
Licences granted for construction of buildings (2000)	13 800

EQUIPMENTS AND SERVICES

Teaching	
Number of students enrolled (2000/2001)	387 280
Pre-school	11,3 %
Primary School	50,6 %
Secondary School	16,8 %
Professional Schools	1,8 %
Higher Education	19,5 %
Number of teaching establishments (2000/2001)	4 912
Pre-school	31,4 %
Primary School	63,7 %
Secondary School	2,7 %
Professional Schools	1,0 %
Higher Education	1,2 %

Health	
Number of hospitals (1998)	41
Hospital beds per 1,000 inhabitants (1998)	4,5
Doctors per 1,000 inhabitants (2000)	3,1
Pharmacies per 10,000 inhabitants (2000)	2,8

Telecommunications e Energy	
Telephones (PT) per capita (1999)	0,4
Domestic consumption of electricity per consumer (2000)	1,9 kW/h

Banks (2000)	
Banks, building societies and mutual agricultural credit institutions (establishment)	923
Deposits	15,8 M€
Credit granted	12,6 M€

Buying Power	
Buying Power index (2000) (Portugal=100)	77,5 %

Figure 2: Statistical data of the Central Region of Portugal

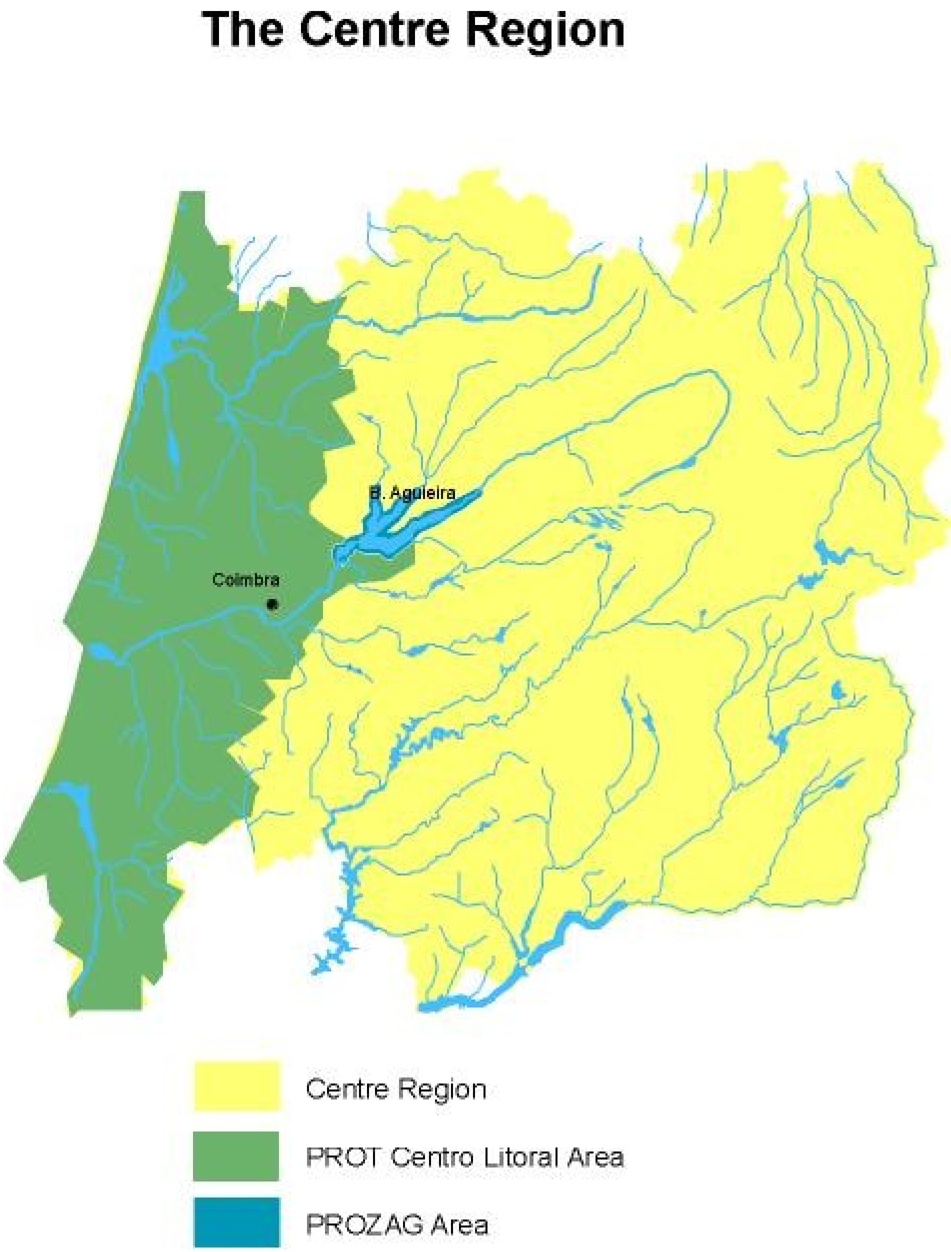

Figure 3: The Centre Region

Annex II Preliminary maps of selected hazards, vulnerability and risk of the Central Region of Portugal

Note: This chapter intends to be in relation to the spatial typologies developed in project 1.

Preliminary maps of selected hazards, vulnerability and risk

Note: The list/map of highly sensitive areas will be one of the main outputs of the project (also in this case we suggest to use the term (high) risk areas). At this stage the focus of our work should be on maps of the risk components such as maps about hazards (depending on the availability of data), damage potential etc. Concerning the term "sensitivity": We have not explicitly defined "sensitivity"; this should be added to our glossary; a common understanding and a consideration of this term is of high importance as the type of sensitivity (of a region) also determines the type of response/coping capacity that will be needed. Another determinant for the needed coping capacity is the political system in general and as a part of this especially the planning system. Together, sensitivity and response capacity can serve as criteria for the selection of the case studies.

Preliminary maps of selected hazards

The relevance of forest fire hazard specially to the southern Europe and the fact that this risk maps were made available in the internet by Portuguese government authorities were the reason to decide to introduce that information in this report. Although ESPON Portuguese consortium did not gather sufficient information at this moment this hazard will be studied at the Central Portugal Region level. The request made to the ESPON 1.3.1 Project to study the hazards like earthquakes, droughts, floods, mining radioactivity contamination and nuclear power plants is the reason for these hazards being present in this second interim report, although some of them are not sufficiently studied at Portuguese Central Region scale. Nuclear power plant contamination is not significantly due to Almaraz Nuclear Power Plant situated some 200 Km upstream in Spanish territory in this region of Portugal. The affected regions are mainly in Tejo basin and the affluent rivers that belong to Central region are not affected by nuclear power plant area of influence.
The central region of Portugal occupies an area of 23,666 km2 (25.7% of the Portuguese land area) and includes 78 counties. The population is almost 1.8 million inhabitants (17.2% of the national total), of which 65% is made up of active population The region contains 10 NUTs III level areas. It is marked out by being crossed through the main mountain chain in Portugal, which culminates in mountain Serra da Estrela (1991m). It includes the hydrographical basins of some of the most important Iberian Rivers (Mondego, Vouga, Dão, Lis) and part of Douro (through Côa) and Tagus (through Zêzere) and several water reserves, including thermal and mineral waters, of the greatest strategic importance for the region and for the country (Fig. 1).
will be presented several GIS derived maps tha will be used in Risk analysis.

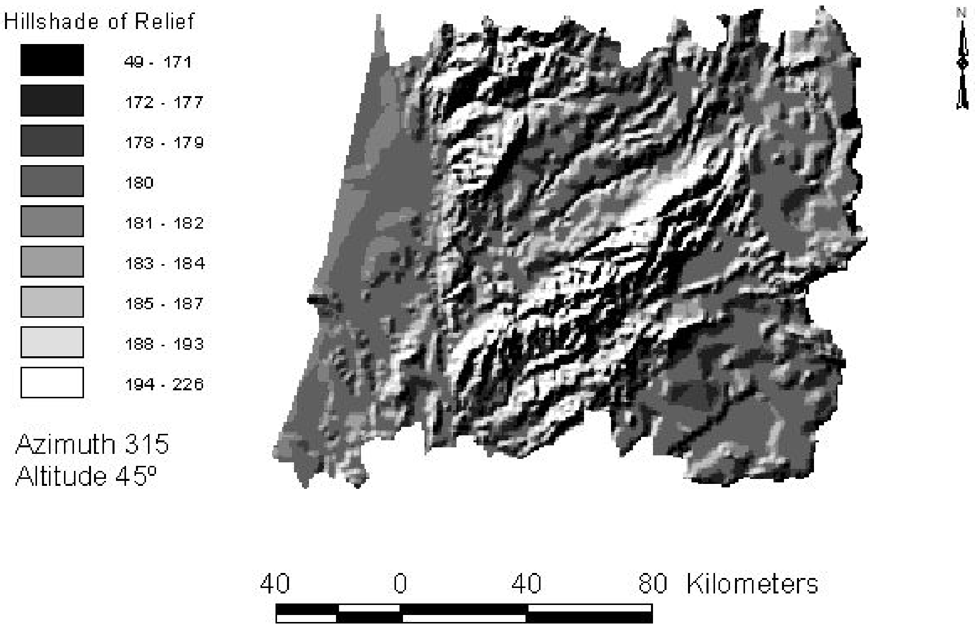

Figure 4: Elevation aspect of Central Region of Portugal

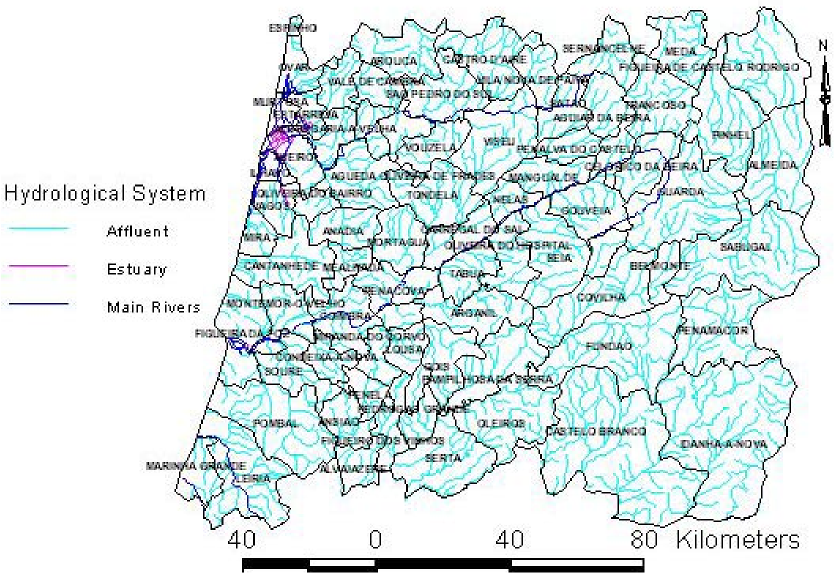

Figure 5: Hydrological System of Central Region

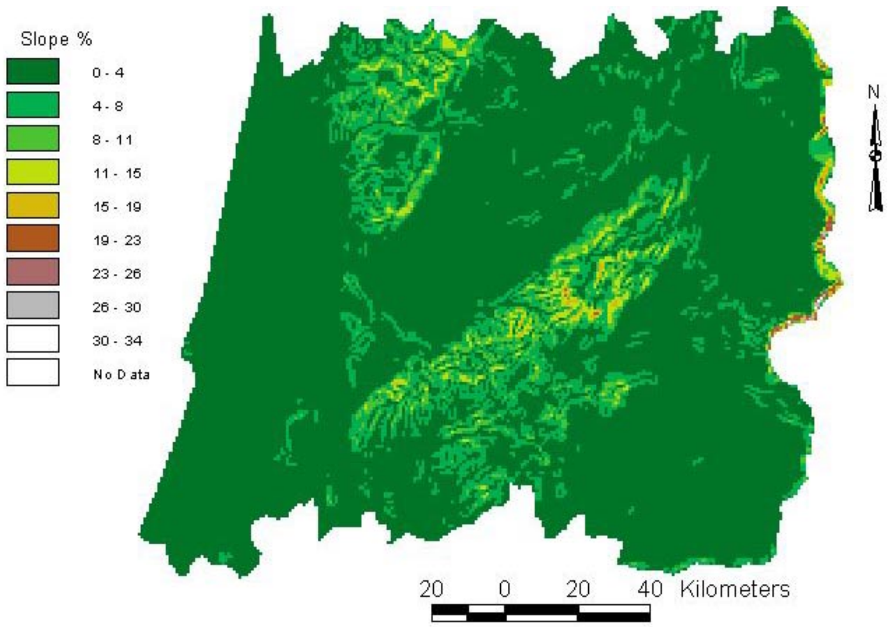

Figure 6: Slope map (%) of Central Region of Portugal

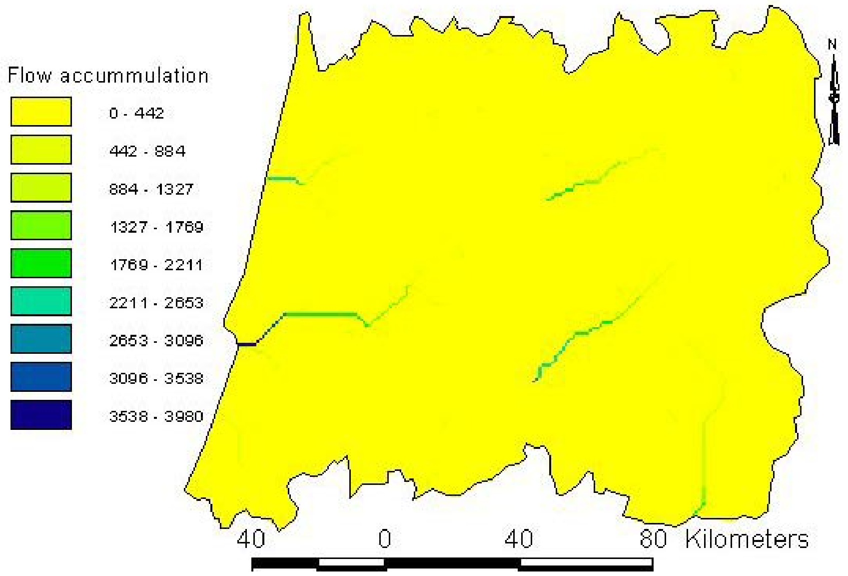

Figure 7: Flow accumulation from Central Region of Portugal

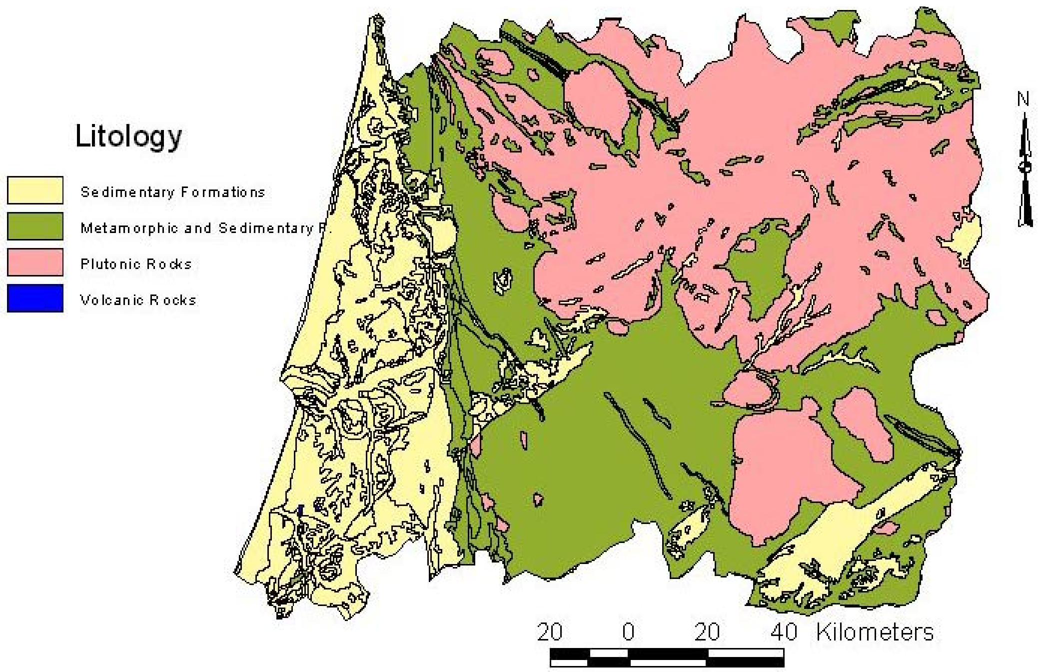

Figure 8: Main lithologies of Central Region of Portugal

Earthquake hazard map

According to the UNESCO definition in 1980, the seismic risk is related to the expected losses or damages for a certain element exposed to risk, during a certain length of time.

As described in chapter 4.4 of the First Interim Report, for the hazard seismicity & earthquakes, in the case study area of Central Portugal, the pressure indicators available are active faults, instrumental and historical seismically and the response indicator seismic zoning for constructions.

A short description of the mentioned pressure indicators will be given below. For the indicator active faults it is considered that a fault is active if it suffered a displacement in the present tectonic regime (usually considered for the Portuguese territory as the last 2 My) having, therefore, capability to produce new displacements in the future. In a pure geological sense, the activity of faults is measured by its slip-rate and is express in cm/yr or mm/yr. However, the data available classifies active faults in function of geological and geophysical criteria. It is not available yet a specific map with the active faults of the Central Portuguese region thus it will be derived from the 1:1 000 000 Neotectonic Map (Figure 9)

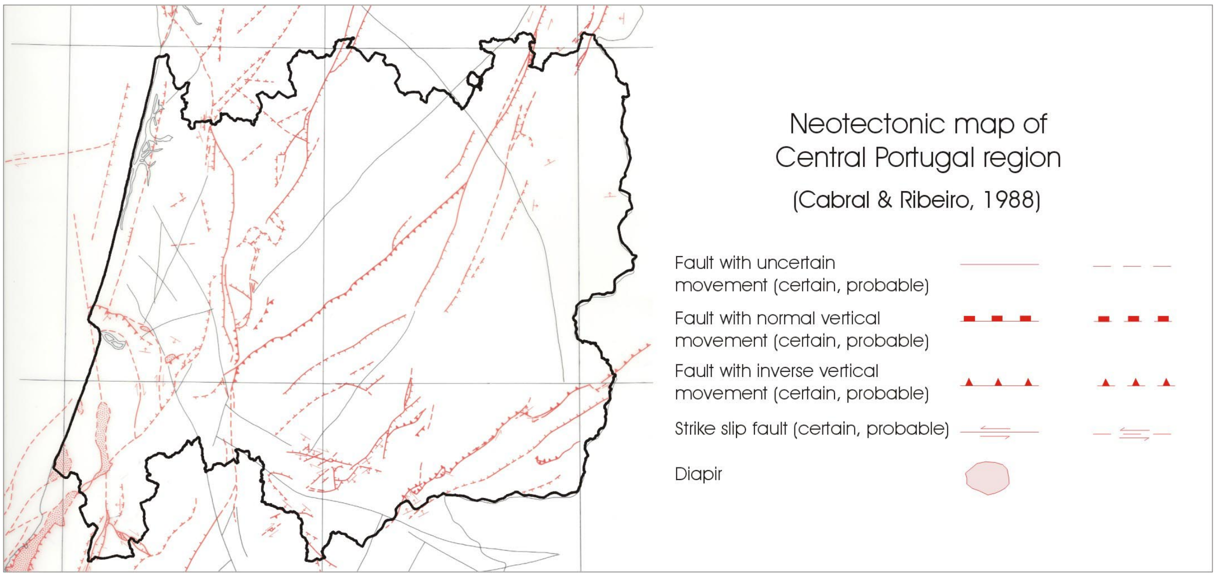

Figure 9: Neotectonic Map of Central Portugal (Cabral & Ribeiro, 1988)

The instrumental and historical seismicity is other pressure indicator. The seismicity detected for the seismographs and that which have historical descriptions of the damages give us information about the zones that are more vulnerable to the earthquakes. The seismic data are collected by a seismograph network and are published by the Instituto de Metereologia in monthly and annual bulletins. This institute has databases with the information about the historical seismicity.

The response indicator available is the seismic zoning for constructions. This indicator is included in the “Portuguese code for security and actions in buildings and bridges structures” (Regulamento de segurança e acções para estruturas de edifícios e pontes, decreto-lei nº235/83 do D.R. nº125, Iª série), where the seismic zones are defined for the Portuguese territory. This map (see next figure) is, so far, the best approach of a seismic hazard map for construction.
The quantification of the action that a earthquake may cause on the constructions is made in terms of the seismic coefficient α and then calculating the effect on the constructions through methods of dynamic analysis integrating the seismic data, the ground nature (that is classified in type I - hard and coherent soils and rock; II - hard, coherent and medium hard soils, incoherent and compact soils and III - coherent and soft and very soft soils and incoherent non compact soils) and the construction features.
This map (Figure 10) is currently used by the insurance companies, construction companies and for the environmental impact studies to quantify the seismic action for the constructions.

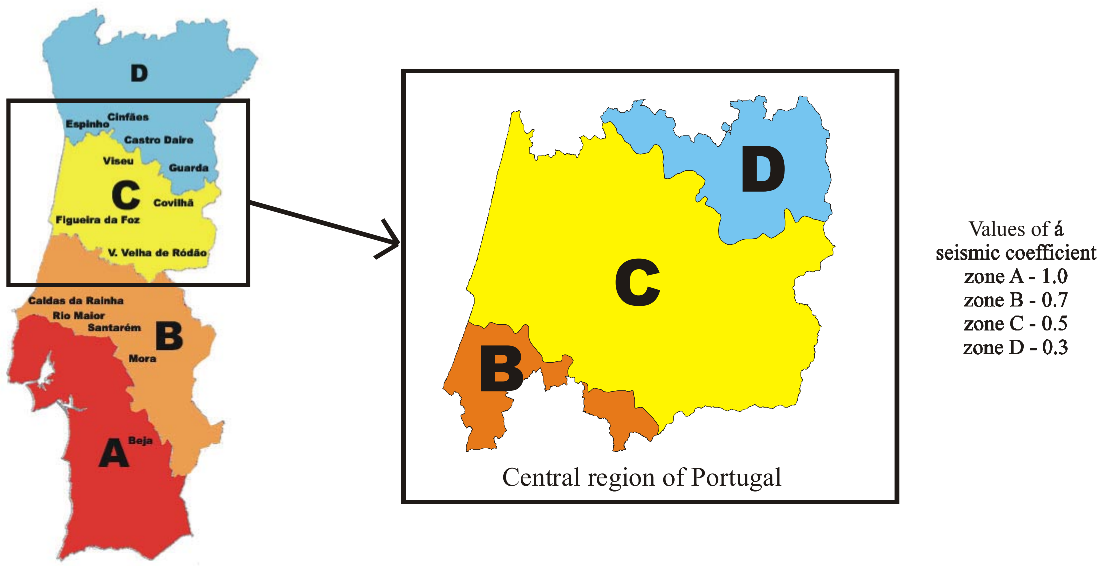

Figure 10: Seismic zoning from the Code for security and actions in buildings and bridges structures

The seismic zoning made for the portuguese territory reflects the conjugation of the inter plate seismicity resulting from the activity in the tectonic plate boundary Eurasia/Africa situated south-southwest of the territory (Azores-Gibraltar Fault) , and the intra plate seismicity, like the one resulting from the activity of the Vale Inferior do Tejo fault, situated near Lisbon. The resulting map shows a seismic zoning which is more important at the southwest of the territory, decreasing in northeast direction.

Floods hazard map

Flood period in Central Portugal goes from the autumn until spring. Flood affects the most important rivers but cause damage in several parts of Central Region of Portugal due to lack of appropriate land planning. Nowadays response capacity to water flow raising is higher in most of the rivers. In the Mondego River a system to regulate water flow to prevent flooding was implemented several years ago, nevertheless in 2000 a serious flood occurred in the city of Coimbra (Proença Cunha, 2002).

In Portugal a Flood Surveillance System was developed that joins several institutions to monitor and prevent flood. This system operates in dam control of water flow to avoid high water flow in short periods without recovery time[6].

The scheme of the surveillance is represented in Figure 11.

[6] The institutions involved are Instituto de Meteorologia (Weather Institute), INAG (Water Institute), Regional Authorities of Environment, Dam Management Entities, Serviço Nacional de Protecção Civil (SNPC) (Emergency and Protection National Service) and regional delegations of this institution. (http://snirh.inag.pt/snirh/download/relatorios/net_Livro_REDES_svarh_9.pdf)(*in Portuguese*)

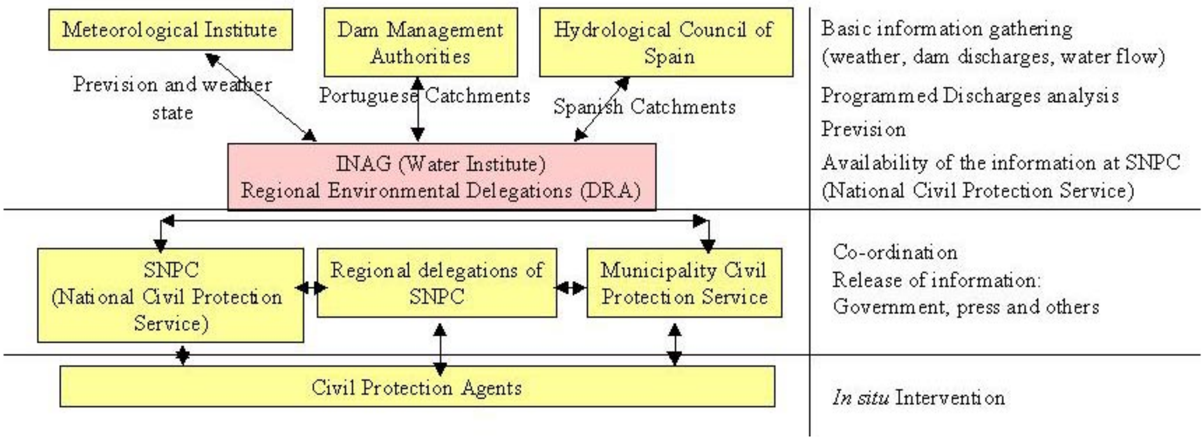

Figure 11: National Surveillance Plan

Flood Vulnerability areas

Vouga River, the stuarine conditions of the terminal part (half-delta) are susceptible to inibit water flow specially when sea waves are high and river water flow is dificult to enter in the sea. **Águeda river**, also register several floods that affects Águeda city.

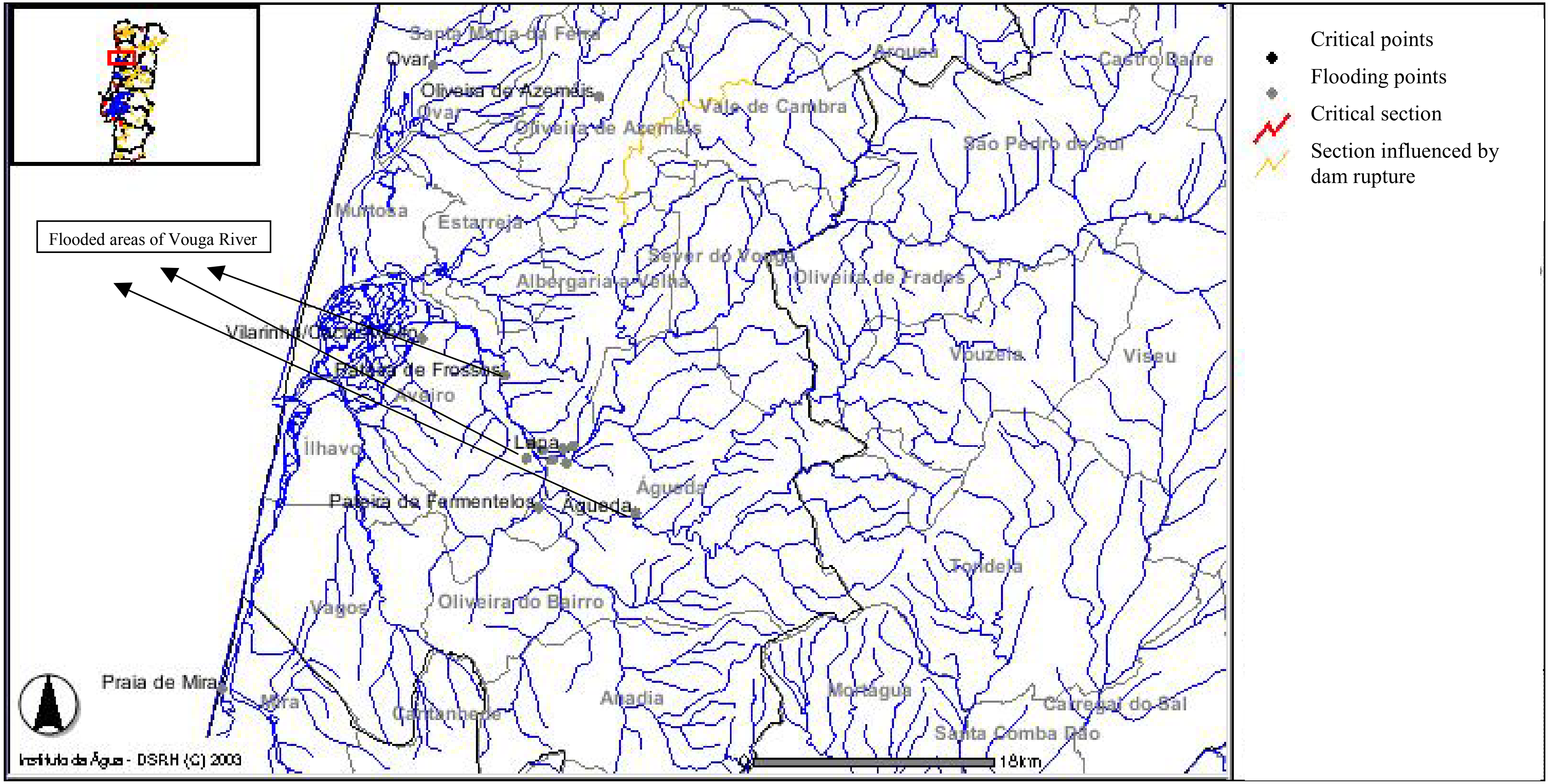

Figure 12: Vouga basin vulnerability map with registered flooded areas

Mondego River problems are caused by agriculture practices downstream from Coimbra city added to the fact that the main affluents of Mondego like, Alva, Ceira, Arunca, Ega also contributes with high water flow in some periods of the year (Figure 13).

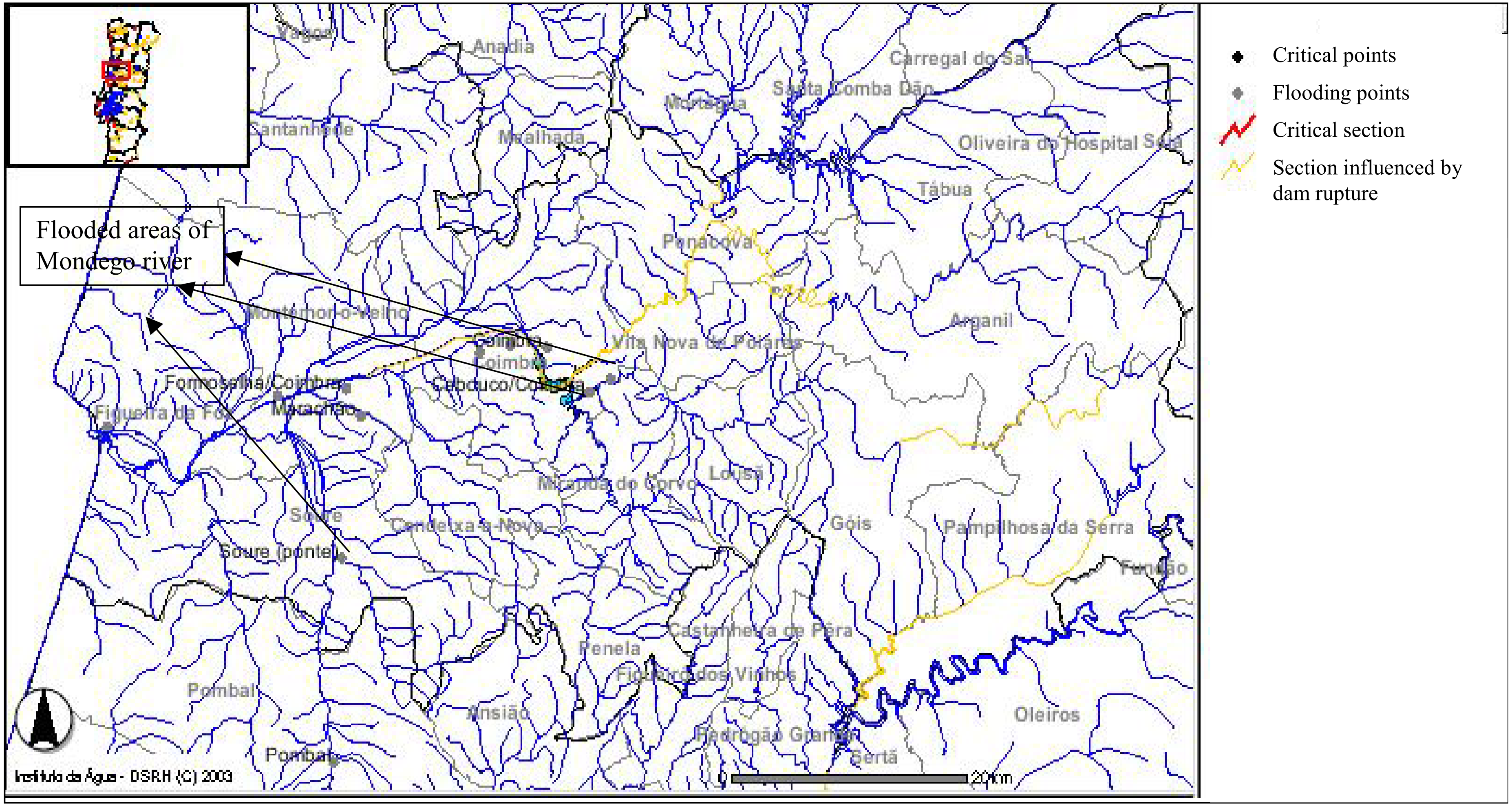

Figure 13: Mondego basin vulnerability map with registered flooded areas

Zezere River high vulnerability to flood areas are located in Fundão, Covilhã e Belmonte (Figure 14).

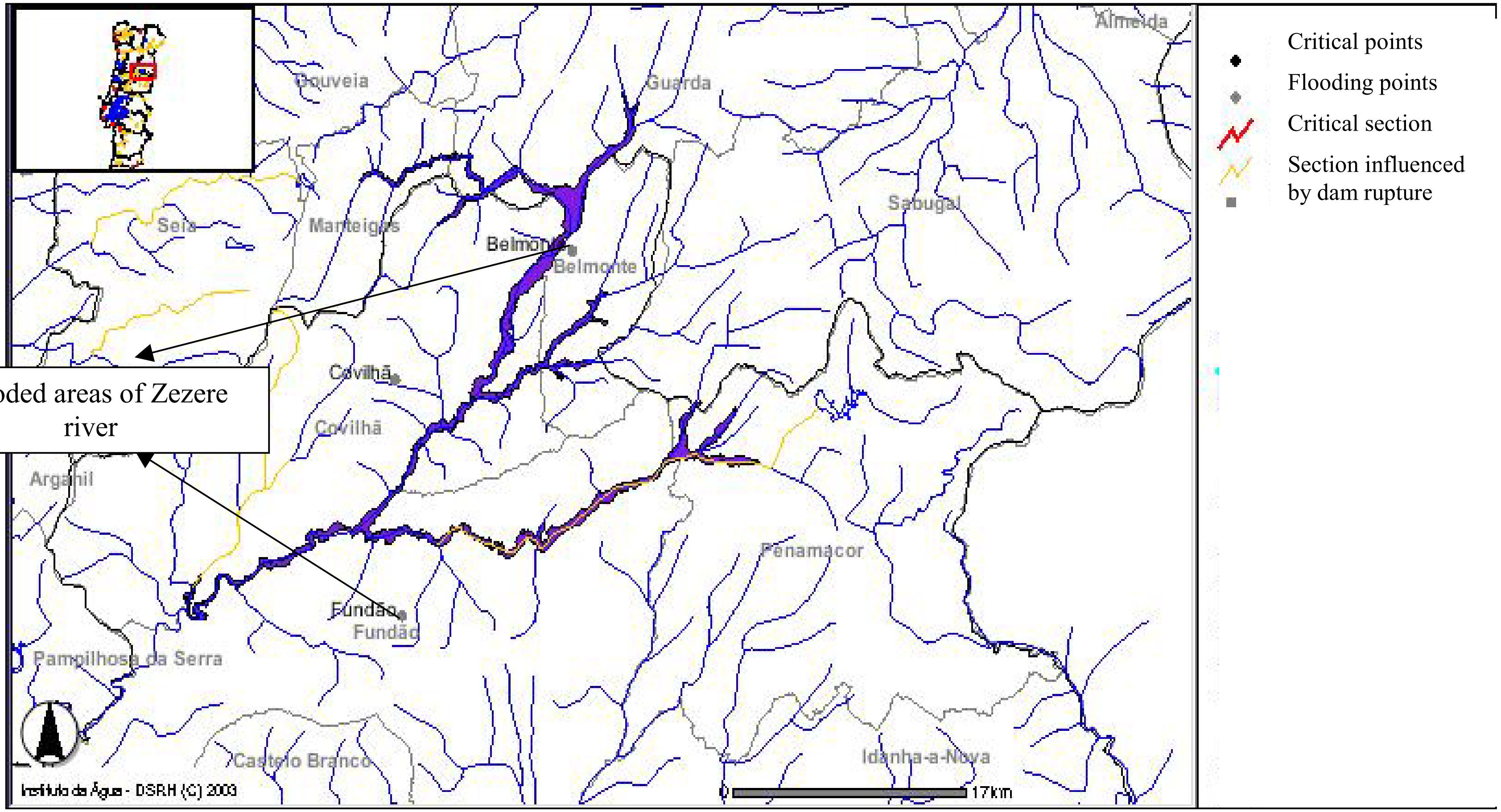

Figure 14: Zezere basin vulnerability map with registered flooded areas

Lis river considered by INAG the critical area affects the city of Leiria (Figure 15).

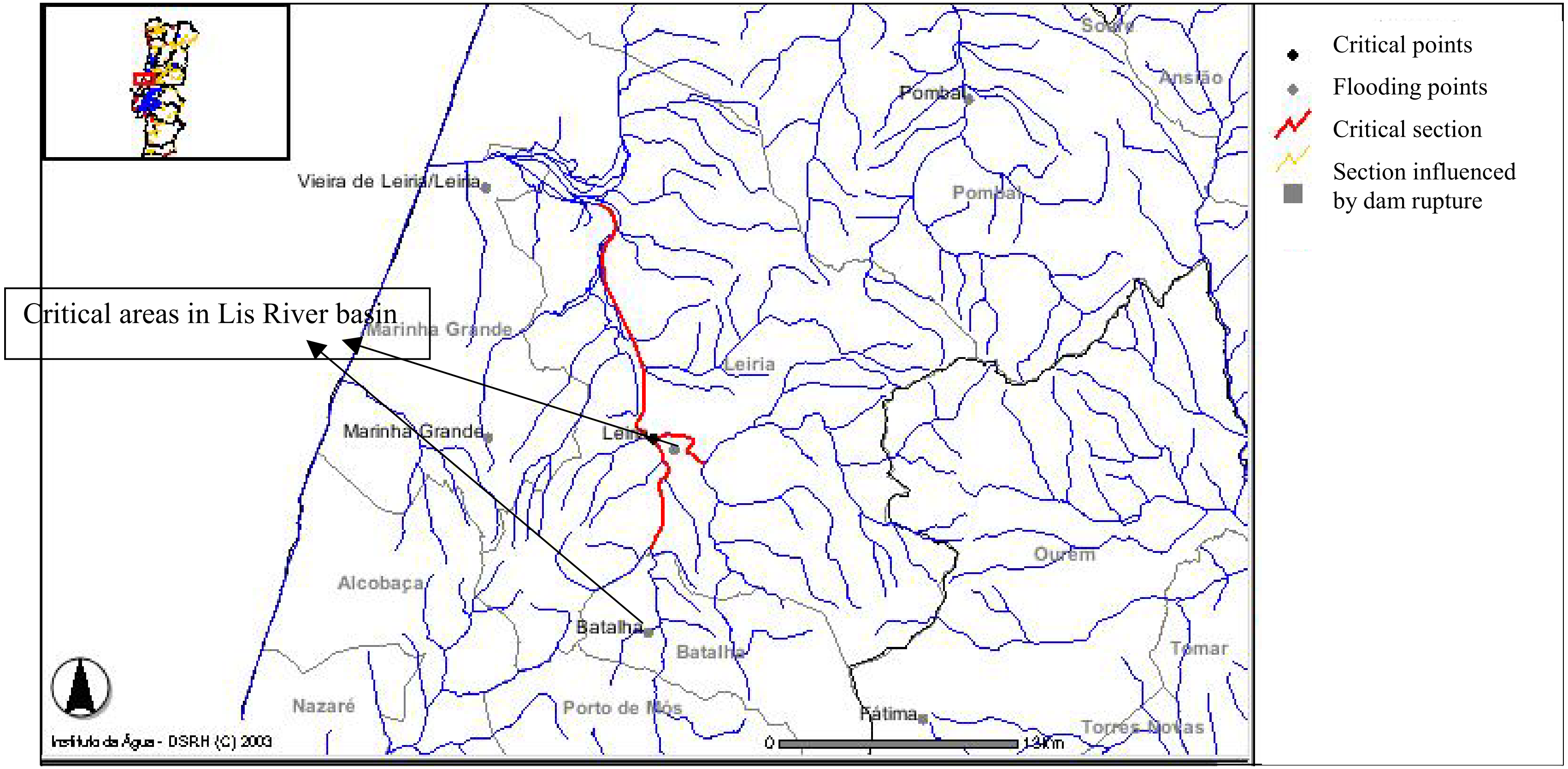

Figure 15: Lis basin vulnerability map with registered critical areas

Big dams are considered higher than 15 m and storage of 1 000 000 m^3 of water. In Portuguese legislation responsible entities for dam management are forced to define flooding vulnerability areas caused by rupture of a dam, with risk analysis based in hydrodinamic models, with emergency plans.

Portuguese legislation contains three documents:

- The **Regulamento de Segurança de Barragens** (**RSB**) establishes protection to people in case of the acident occurs and calculates the effect of the flooding wave and the risk map (article 42º). In 44º Article, o RSB establishes the Emergency Plan, in 45º article is included the warning and alert system.
- The **Normas de Projecto de Barragens** (**NPB**) include hydrological studies with evaluation of period of flooded areas and the efect of rupture of the dam with hydrodinamic models (Article 6º) and the study of warning signal in real time.
- The **Normas de Observação e Inspecção de Barragens** (**NOIB**), consists of definition of a observation plan included in Article 12º, in Article 17º, is established a comunication scheme in case of anomalous situation.

Droughts hazard map

Droughts are a natural phenomenon that occur cyclically in many regions of the World but unfortunately raised their frequency in the last years due to the necessity of water caused by the raise of population and the demands of modern society and also due to global climatic change.
The drought situations have been reported in Portugal for several periods. Between 1940/41 and 1994/95 relevant droughts was registered in 1943/44-1944/45 with a return period of 50 years.
In Portugal droughts are being studied by (Santos,1981; Cunha, 1982; Santos *et al.*, 1983; Correia *et al.,*1988; Rodrigues *et al.*, 1993; Vaz, 1993; Santos, 1996, 1998; Pimenta & Cristo, 1998 *in* Plano Nacional da Água (National Water Plan)).

Coastal areas of Central Region of Portugal are not usually affected by insuficient domestic water distribution in case of drought, but concerning water distribution in Castelo Branco and Guarda located in the interior Central region crops and cattle are much affected. This indicator need to be developed in Central region.

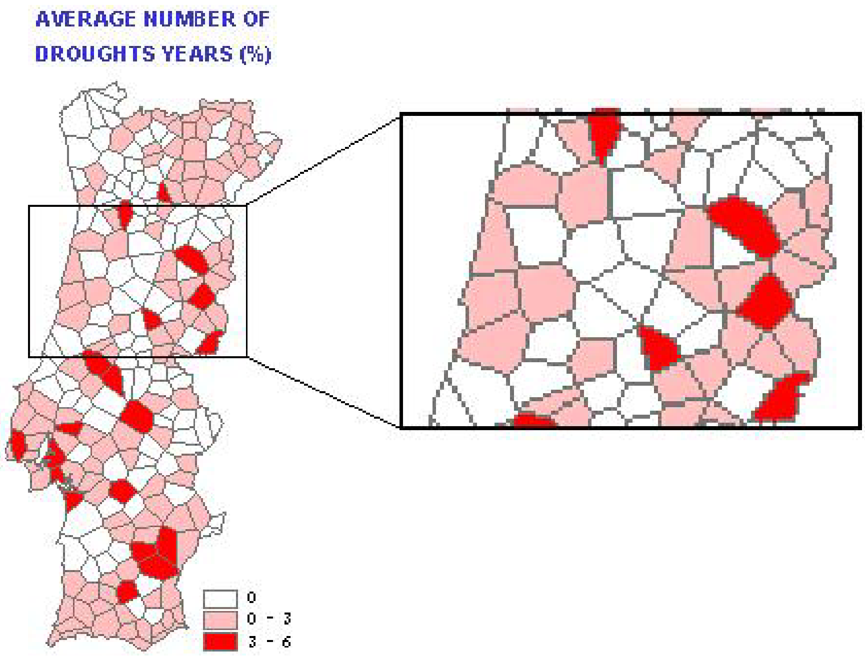

Figure 16: Average Number of droughts year (%) in Central Portugal

Source information: Plano Nacional da Água (National Water Plan)

The highly affected areas, meaning the areas with more average droughts per year are Guarda, Penamacor and Idanha-a-Nova (Figure 16).

Nuclear power plants hazard map

This hazard is not relevant in the Central Region of Portugal context.

Forest fires hazard map

Forest fires are one of the most important natural hazards affecting Portugal. This is considered a natural hazard not because is naturally occurred but because depends mostly in natural conditions to develop. Weather conditions, vegetation cover, elevation and accessibility, fireman intervention delay, are the most important contributions for fire development. The most important occurrencies are from July to September and the annual fire occurrency average from 1980-1996 were 12.500. The annual burned area is 87.000 hectares from wich 50.000 are from forest cover. Centre and North Portugal are the most afected regions for forest fires.
Law-Decree n.º 334/90 of 29 October prevents situations like controlled fires, waste burning, smoking, make fire, pic-nic, apiculture, electric lines, railways at short distance to the forest. Some of this activities are not permited only in the „season fire period" wich is regulated every year (Regulamentary decret n.º 55/81 of 18 December and n.º 36/88 of 17 October).

As it was explained before National Emergency Protection Agency is responsible for hazards prevention and answering to the emergency occurrence and risk assessment. This institution uses the Canadian Index on forest fire vulnerability already described in previous reports but due to the fact that data are not available another information was obtained.

In a easy access mapping, another methodology was performed to map risk and vulnerability areas from Direcção Geral de Florestas from 1994 in a project named CRIF (Cartografia de Risco de Incêndio Florestal) risk of forest fire mapping that will be presented at this stage of ESPON-HAZARD project because it is already available in internet (http://snig.igeo.pt/Portugues/Igd/html/frametemas.html).

Methodology

The used fire risk index was based in Chuvieco et Congalton (1989) (in CRIF, 1994). This model uses a raster bases (IDRISI) to organise the information. Risk maps are produced with the help of several layers of information resumed in this table with the coefficients to enter in the risk analysis.

Table 2: Fire risk index

Variable	*Maximum value of the variable*	*Variable coeficient of the model*	*Reclassification of the variable*	*Subclass reclassification of the variable*	*Subclass value*
Slope	*210*	*21%*	*0--10*	*3,81%*	*8*
			10--20	*11,43%*	*24*
			20--30	*22,38%*	*47*
			30--40	*66,67%*	*140*
			>40	*100%*	*210*
Sun Exposition	*47*	*4,7%*	*315-45*	*6,38%*	*3*
			45-135	*21,28%*	*10*
			135-225	*100%*	*47*
			225-315	*57,45%*	*27*
Population distribution	*38*	*3,8%*	*0--250*	*100%*	*38*
by Km²			*250--1500*	*21,05%*	*8*
			>1500	*100%*	*38*
Class of	*399*	*39,9%*	*Class 1*	*100%*	*399*
landuse			*Class 2*	*73,343%*	*293*
			Class 3	*47,4736%*	*189*
			Class 4	*24,06%*	*96*
			Class 5	*15,03%*	*60*
			Class 6	*4,51%*	*18*
			Class 7	*1,5%*	*6*
Traffic net	*136*	*13,6%*	*<25*	*100%*	*136*
			25--50	*46,32%*	*63*
			50--100	*20,58%*	*28*
			100--150	*9,55%*	*13*
			4 dense	*50%*	*68*
			3 dense	*23,52%*	*32*
			2 dense	*10,29%*	*14*
			1 dense	*5,14%*	*7*
Hidro-	*59*	*5,9%*	*0--30*	*0*	*0*
graphynet			*>30*	*100%*	*59*
Surveillance station vision	*111*	*11,1%*	hidden	*100%*	*111*
basin			*1 vision site*	*11,71%*	*13*
			>=2 vision site	*6,31%*	*7*
TOTAL	*1000*	*100%*	#	#	#

Example of Lousã region (Figure 17) will be presented below, although several other regions also have available risk maps in internet. Map methodology applied and how the maps were achieved is also presented.

Clime characterisation: Maximum and minimum temperatures; precipitation, fog, wet, wind and than classification according to Thornthwaite. Soil type is obtained from soil characteristics.

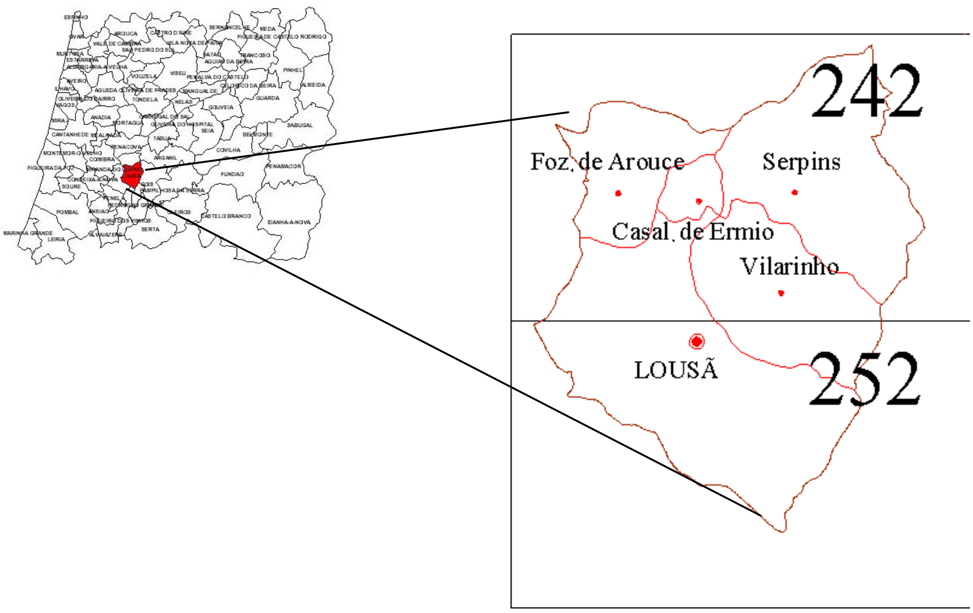

Figure 17: Region description (NUTS IV)

Demography situation like population density

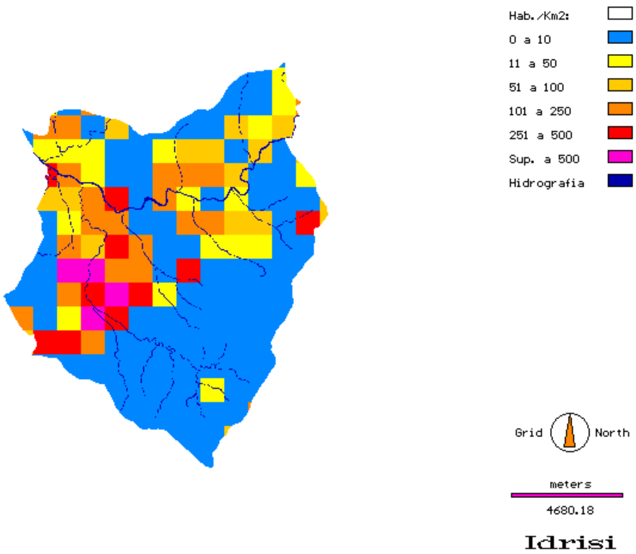

Figure 18: Population density

Physical characterisation of the region

Elevation map

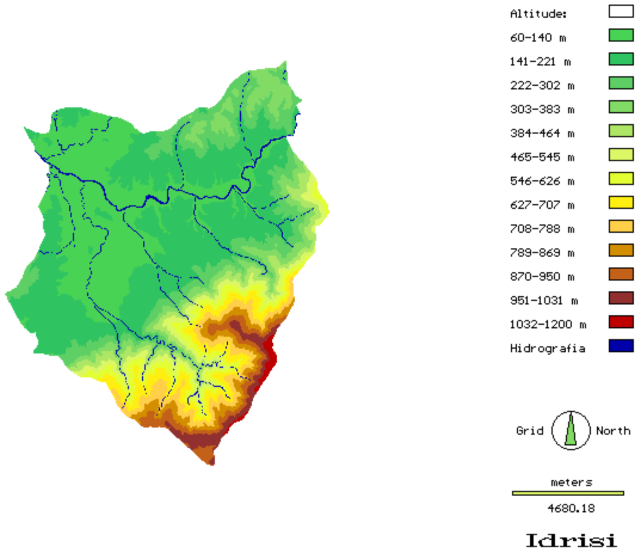

Figure 19: Elevation map

Sun exposure map

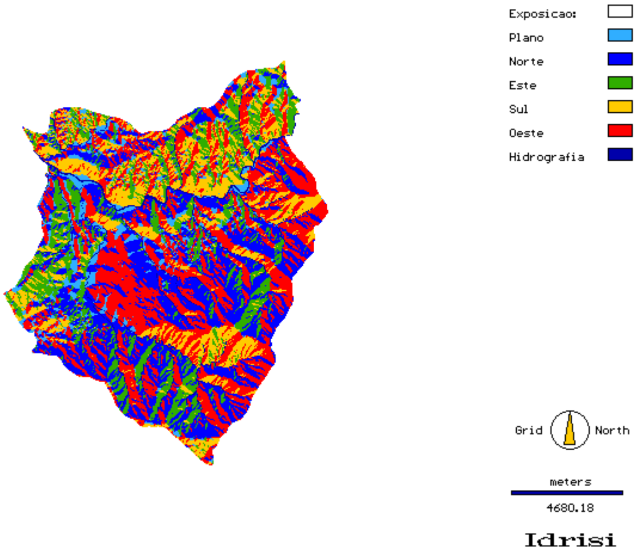

Figure 20: Sun exposure map

Slope map

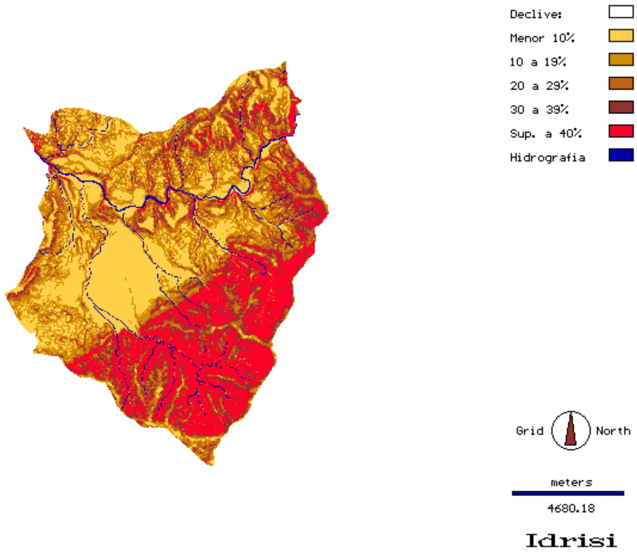

Figure 21: Slope map (%)

Landuse map

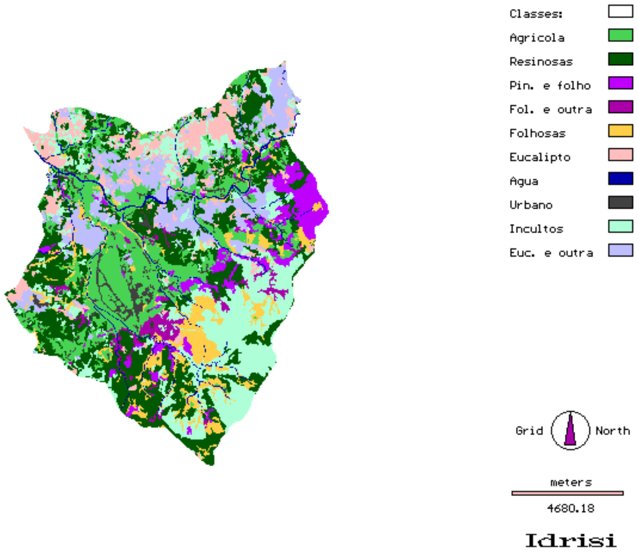

Figure 22: Land use map

Track locations by forest area map

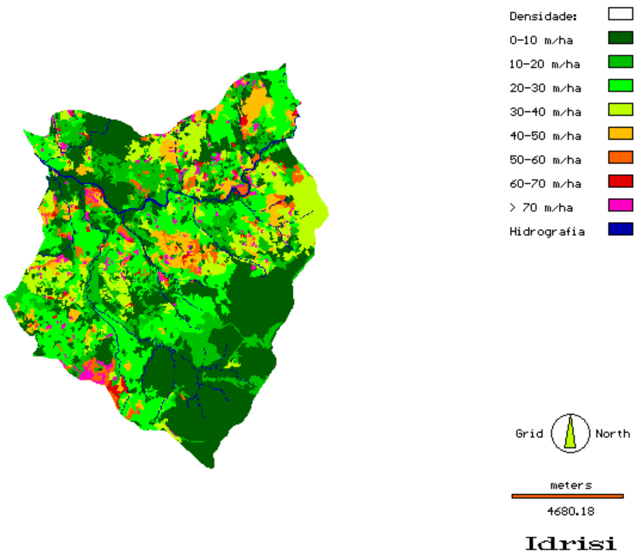

Figure 23: Track locations by forest area map

Map of visibility to surveillance station

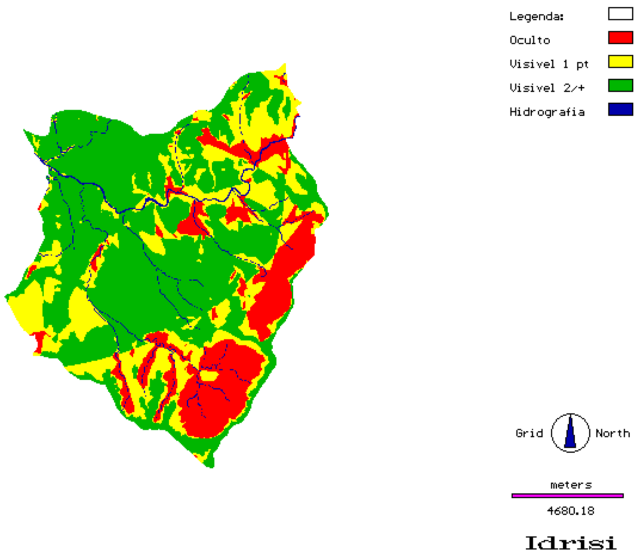

Figure 24: Visibility to Surveillance Station Map

Distance map to water bodies

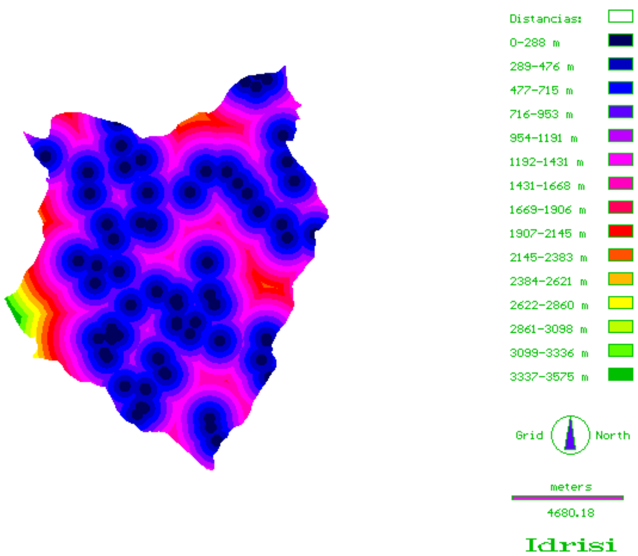

Figure 25: Distance from the water bodies

<u>Uranium mine contamination hazard</u>

Central Region of Portugal as a high quantity of abandoned uranium mines exploited since 1907 located mainly in granitic rocks and also in shales near the contact to granites (PARRA&FILIPE, 2003).

Information used to calculate the indicators of this hazard to obtain the risk map:
Instituto Geológico e Mineiro (IGM) Mining Information System (SIORMINP) for uranium mine locations and characteristics.
Instituto Geológico e Mineiro (IGM) Geochemical Database, in this particular case of uranium stream sediment results, data were obtained from Regional Portuguese Mapping of Stream Sediments in Aveiro University (FERREIRA, 2000), available in IGM.
Instituto do Ambiente (IA) Environmental Atlas (available in the internet), ArcView shapefile layers of contour elevation, lithology map, region urban centre map. Alfanumeric information in database like “number of people using a region water system”, “number of systems per region”.
Direcção Geral de Florestas-National Forest Inventory, the land use map.

When ESPON methodology is applied at the scale of Europe only few of the previously proposed indicators will be possible to use. The number of uranium mines per NUTS 3 as a pressure indicator and the number of water distribution systems per NUTS 3 as a pressure indicator. The reason of this restriction concerns the nature of information obtained to use at NUTS 3 level. Table 14 resumes the information used determine the hazard map.

Table 3: Determination system for hazard maps

NUTS3	Nºwater_systm/NUTS3	class_NºSist/NUTS3	Nºminas/NUTS3	class_minas/NUTS3	Sum	Hazard
BEIRA INTERIOR NORTE	176	IV	209	V	9	V
PINHAL LITORAL	30	II	0	I	3	II
PINHAL INTERIOR SUL	185	IV	0	I	5	III
BEIRA INTERIOR SUL	57	II	2	I	3	II
COVA DA BEIRA	63	III	24	IV	7	IV
SERRA DA ESTRELA	57	II	36	IV	6	III
DÃO LAFÕES	190	IV	76	V	9	V
PINHAL INTERIOR NORTE	225	V	27	IV	9	V
BAIXO MONDEGO	36	II	2	I	3	II
BAIXO VOUGA	59	II	1	I	3	II

The hazard map obtained is shown in Figure 26. The Degree 0 never appears in this map not because in some NUTS3 uranium mines do exist, but because the use of both indicators with the same weight leads to this classification. This hazard will probably include other indicators in the next report.

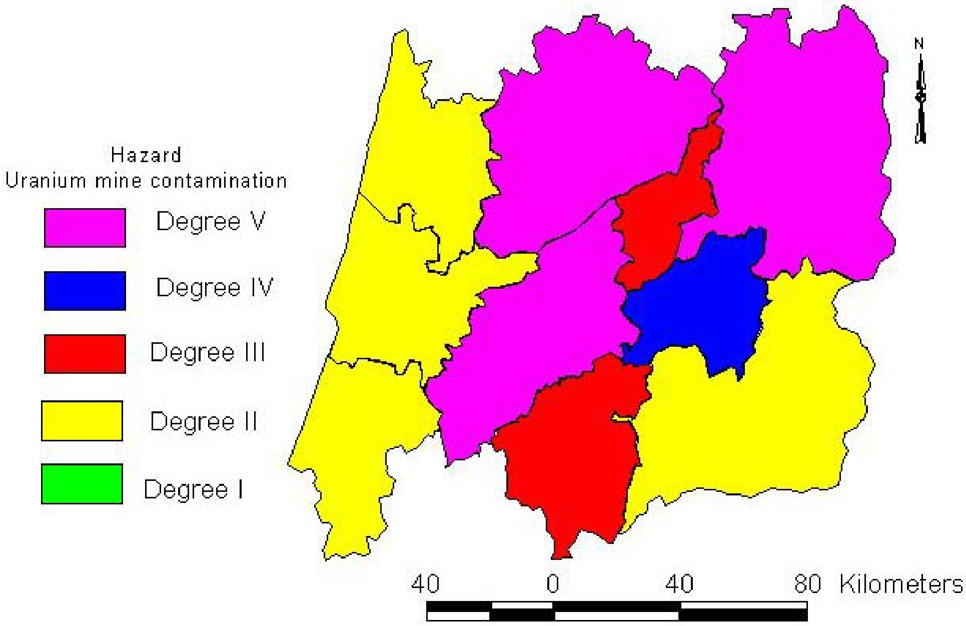

Figure 26: Map of vulnerability

Considering the only hazard studied for Central Region of Portugal at this moment "uranium mines contamination" the vulnerability maps determined according to GDP per capita (NUTS 3) and population density (NUTS 3).

The maps corresponds to the methodology proposed in Chapter 6 of First Interim Report where the division from I to V gives the Degree of vulnerability.

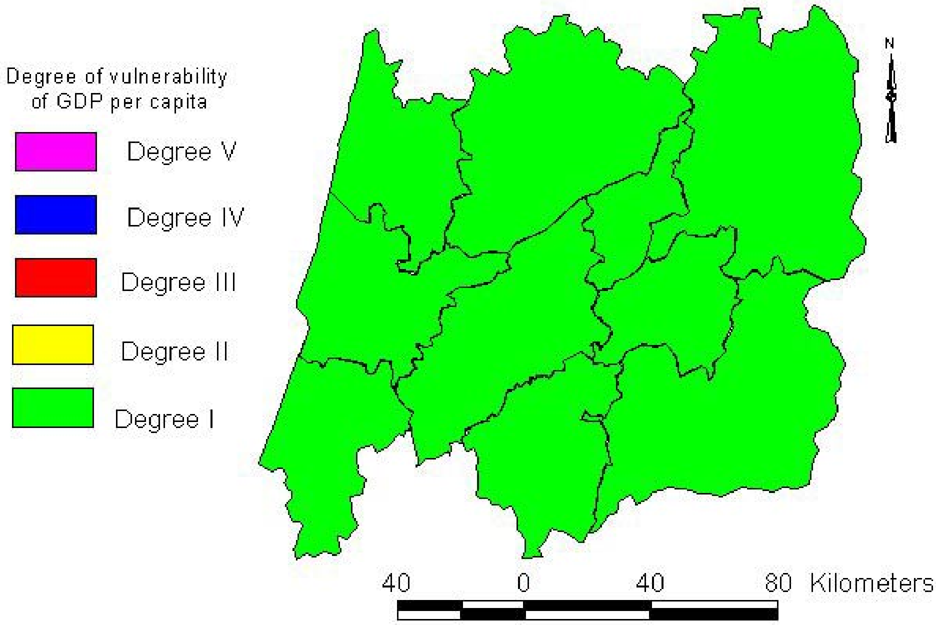

Figure 27: Degree of vulnerability due to GDP per capita

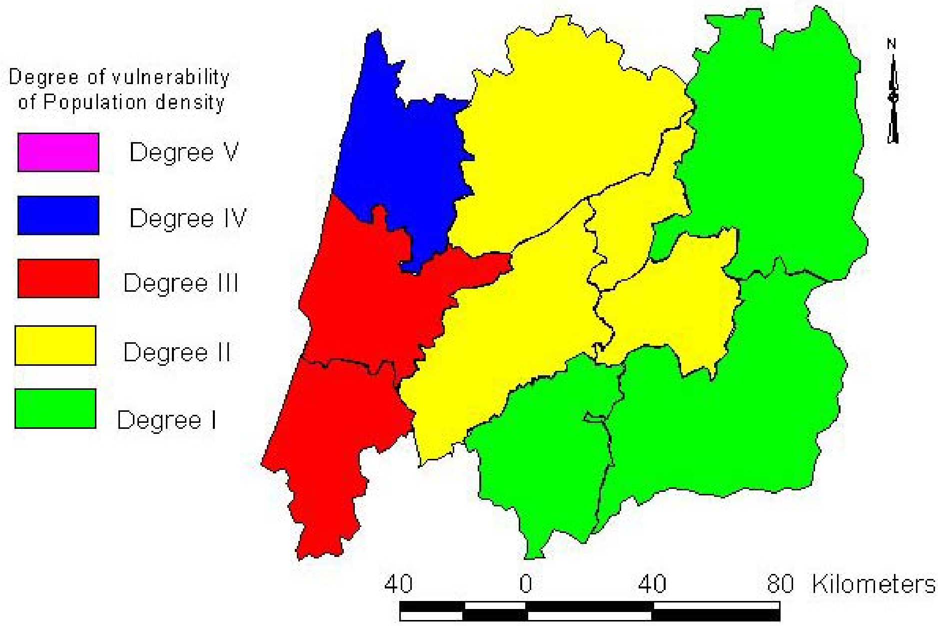

Figure 28: Degree of vulnerability due to Population Density

Uranium mines contamination risk map

Following the methodology proposed in ESPON project for NUTS 3 of Central Portugal the risk map obtained according to the Table 15.

Table 4: Uranium mining vulnerability map

Intensity of hazard Uranium mines contamination	Degree of vulnerability				
	I	II	III	IV	V
I					
II	Beira Interior Sul	Pinhal Litoral Baixo Mondego	Baixo Vouga		
III	Pinhal Interior Sul	Serra da Estrela			
IV		Cova da Beira			
V	Beira Interior Norte	Dão Lafões Pinhal Interior Norte			

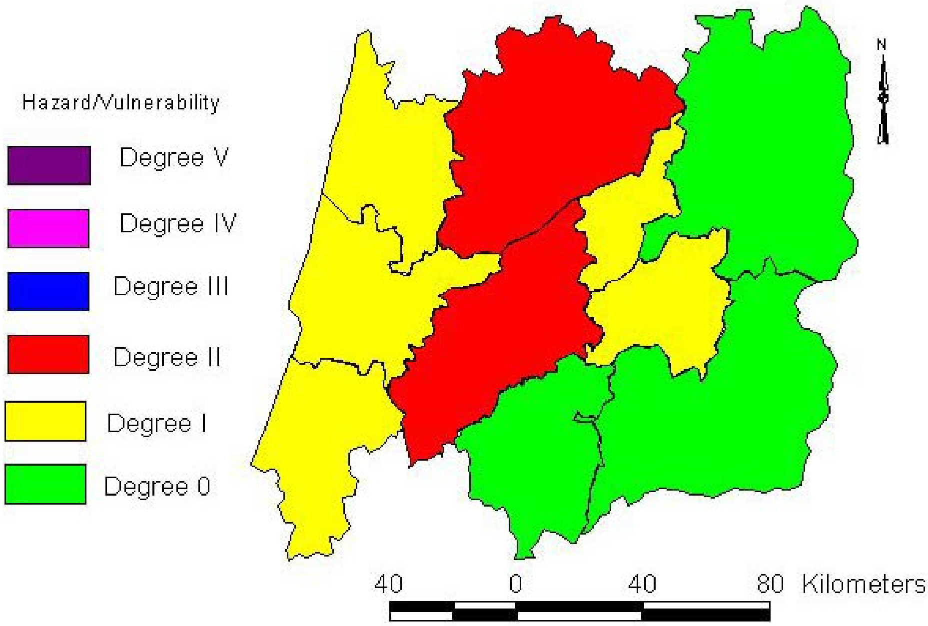

Figure 29: Uranium mines contamination risk map

The risk map will be for the NUTS3 of Central Region of Portugal

Towards an overall risk map and the identification of most sensitive regions

Note: This map will be one of the final results of the project. At this stage it is not yet possible to create this map, because we need the risk maps for all the other hazards, too.

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FÖRSTNER, U.; AHLF, W.; CALMANO W.; KERSTEN, M. (1990) - “ Sediment Criteria Environment – Contributions from Environmental Geochemistry to Water Quality Management” *In:* “Sediments and Environmental Geochemistry-Selected Aspects and Case Histories” *Springer-Verlag, pp. 312-338.*

PARRA, A.; FILIPE, A. (2003) Ocorrências Portuguesas de Urânio. (unpublished).

Geoaccumulation index indicator map (MÜLLER, 1979 *in* FERREIRA *et al*., 2001; FÖRSTNER *et al*., 1990) defined as:

$I_{geo} = \log_2 [C_n / 1,5 \times B_n]$

Where: C_n= chemical element concentration n in fine grain sediments of the present sediments results.

B_n= geochemical background from clay fraction sediments (average value in clays); the 1,5 factor was calculated by the authours to prevent lithologic changes in the background values.

This results were classified in 7 degrees represented in table 16.

Table 5: Geoaccumulation index

Igeo(class)	Geoacumulation Index	Pollution degree
6	>5	Very Strong Pollution
5	>4-5	Strond to Very Strong Pollution
4	>3-4	Strong Pollution
3	>2-3	Moderated to Strong Pollution
2	>1-2	Moderate Pollution
1	>0-1	Weak to Moderate Pollution
0	<0	Absent to Weak Pollution

The results obtained for Central Region of Portugal were from 0, 1, 2 and 5 Igeo classes and the 0 and 1 class were combined in one class that served the study porpuses (Figure 30).

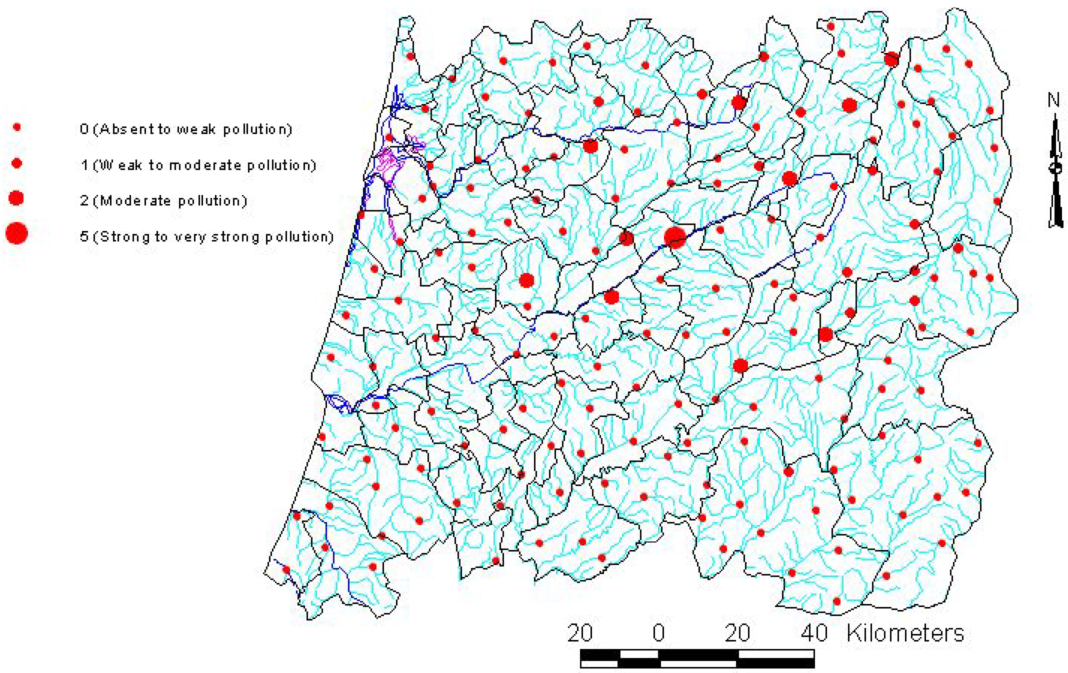


Figure 30: Geoaccumulation Index mapping for uranium

Lithology indicator map
The relevance of this indicator comes from the knowledge that high concetrations of uranium are mainly due to geostrutural belt (Zona Centro Ibérica ZCI) granitic rocks and shales near the contact to the granitic intrusions. Three classes were obtained one of low influence includes limestones, sandstones, slits, clays, the medium influend class includes shales and quartzites and the high influence class includes granitic rocks (Figure 8).

Inhabitants per water system distribution per region indicator map
This indicator was considered important due to the fact that water for human consumption is the highest risk for radioactivity contamination. This information was obtained only for the groups of systems per region. In the future should be developed with more detailed information (Figure 31).

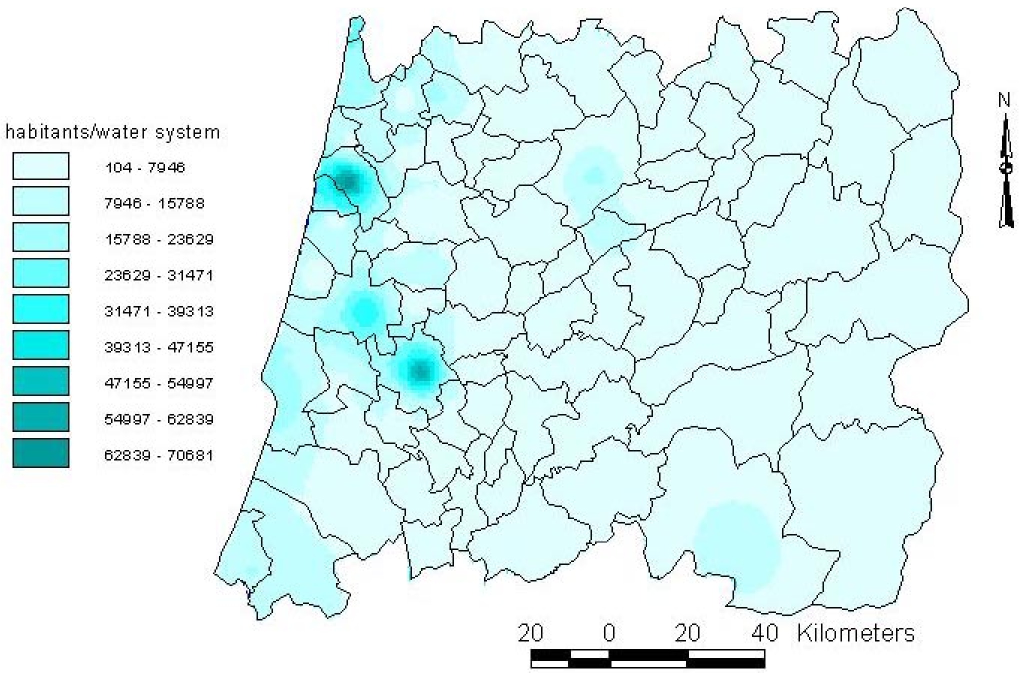


Figure 31: People per water system distribution per region indicator map

This was divided in three classes from few people per system to a lot of people per water system. First class with low influence from 104 people to 5145 people; second class from 5145 to 30351; third class from 30351 to 70681 people. Which shows that near the coast is where one water system is distributed to more people.

Number of water systems per region indicator map
This indicator was considered relevant because more systems per region implies more vulnerability. Small systems for small villages are more vulnerable to this kind of contamination because they are often uncontrolled (Figure 32).

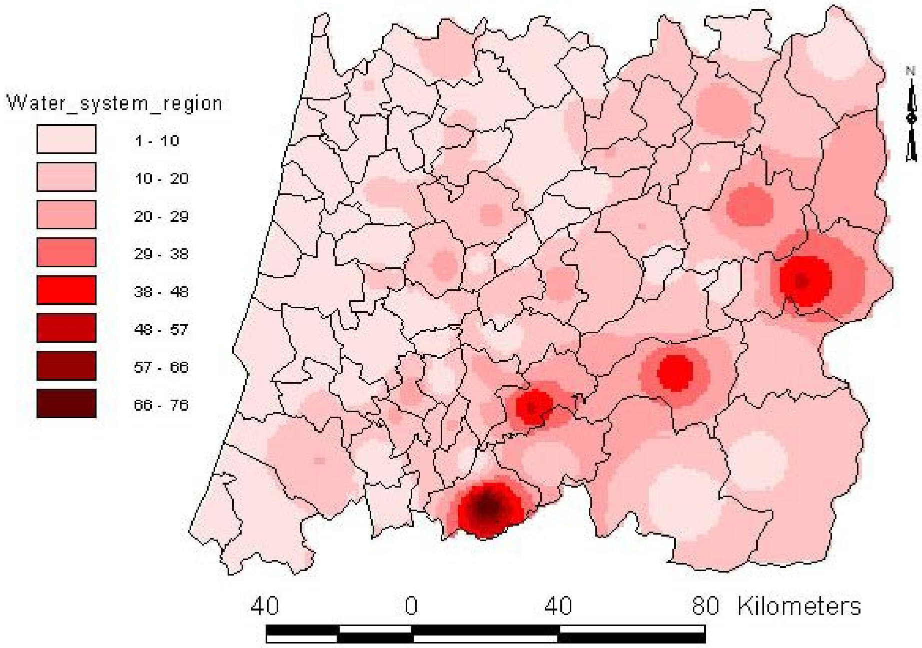
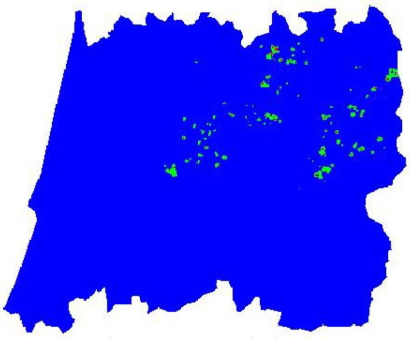
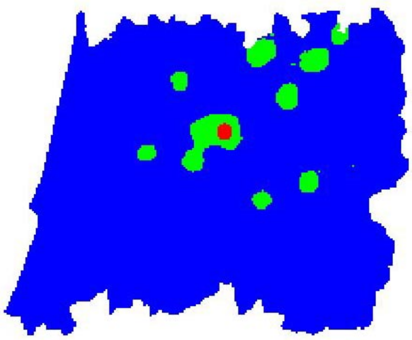


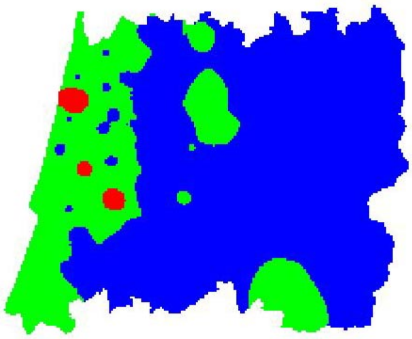
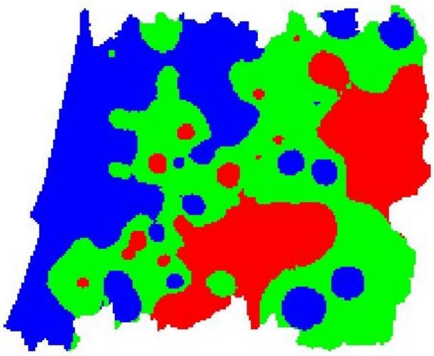
Figure 32: Water system per region

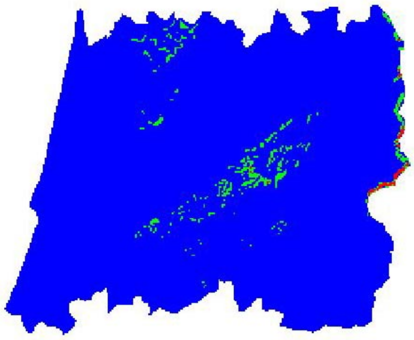
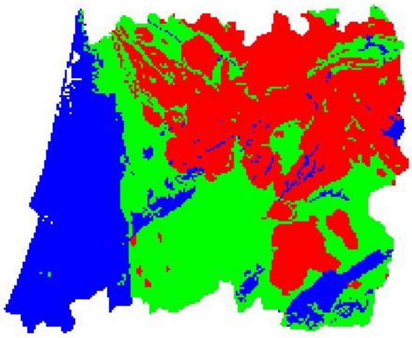
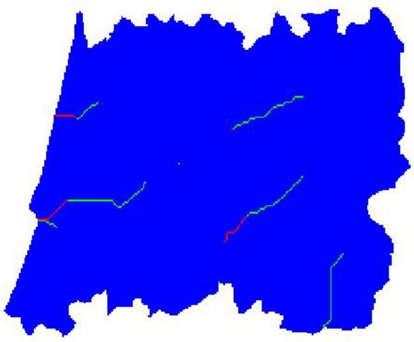
This indicator was also divided in three classes from 1-10 low influence class; 10-20 medium influence class; 20-76 high influence class.

The **hazard maps** calculated with three classes and the respective multiplication factors are presented in table 17.

Table 6: Hazard maps

Hazard Map	Calculation	Class	PF
Distance from uranium mines to landuse categories  (Land use categories X 10000)/Distance to uranium mines	0 - 20 20 – 40 40 - 60	1 2 3	Multiplication factor of 3
Geoaccumulation Index 	0-1 2 5	1 2 3	Multiplication factor of 3

Hazard Map	Calculation	Class	PF
People per water system per region 	104-5145 5145-30351 30351-70681	1 2 3	Multiplication factor of 2
Water system per region 	1-10 10-20 20-76	1 2 3	Multiplication factor of 2

Hazard Map	Calculation	Class	PF
Slope 	0-11% 11%-19% 19%-34%	1 2 3	Multiplication factor of 1
Lithology 	limestones, sandstones shales and quartzites granitic rocks	1 2 3	Multiplication factor of 1
Flow Accumulation 	0-884 884-2211 2211-3980	1 2 3	Multiplication factor of 1

Landslide hazard map

This hazard, though it is not extreme in continental Portugal, could become problematic in case of high values of rainfall in areas with severe relief and . In Portugal this hazard is still studied only at an academic level, not having a systematic gathering of data throughout the country.
Concerning the state indicator mentioned on the First Interim Report, the occurred landslides on Central Portugal, which is the main information for the compilation of that hazard map, it wasn't possible so far to collect all the information needed.
The Operational Commands of Emergency of the 6 districts that constitute de Central Portugal region were all contacted, in order to supply information about the occurred landslides. Due to unexpected circumstances that prevented this entity to supply the team project on time with the required data we are still receiving the information, not having yet sufficient data to produce the hazard map.
The other pressure indicators used for the construction of this map, such as the rainfall (Figure 33), the slope map (Figure 6) and the lithology map of Central Portugal region are already available (Figure 8). The maps of these 3 pressure indicators are shown at the next figures. The intersection between these 3 maps and the occurred landslides map will produce the landslides hazard map that we intend to produce at the next phase of the project.

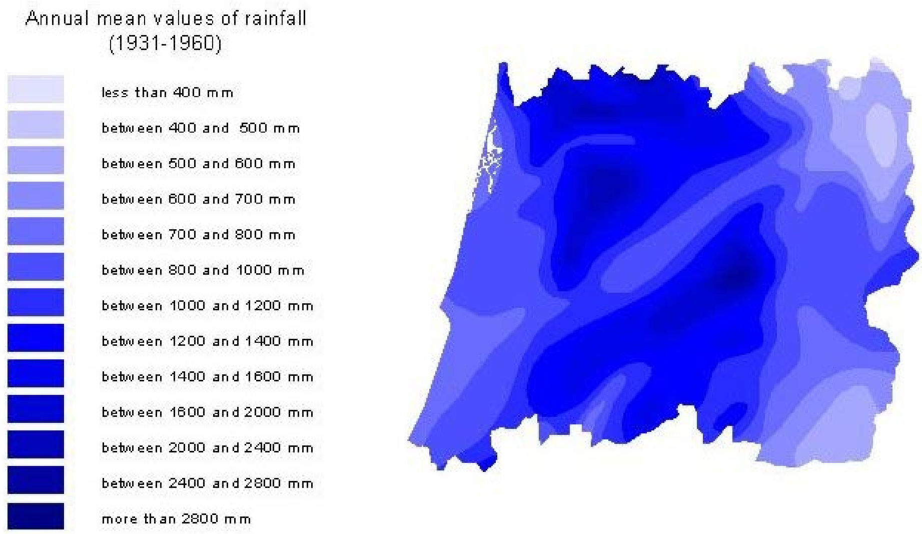


Figure 33: Annual mean values of rainfall from 1931 to 1960 (Atlas do Ambiente, IA).

Map of vulnerability

Not yet available

Preliminary maps of risks

Note: These maps will be the result of the combination of the single hazard maps with the vulnerability map.

Earthquake risk map

Note: Explanation of data used, possible problems and finally of the result.

Floods risk map

Mapping flood vulnerability areas was made by National Water Institute INAG and is available in the internet (http://mapas.inag.pt/Website/inundaHTML/viewer.htm) (Figure 28).

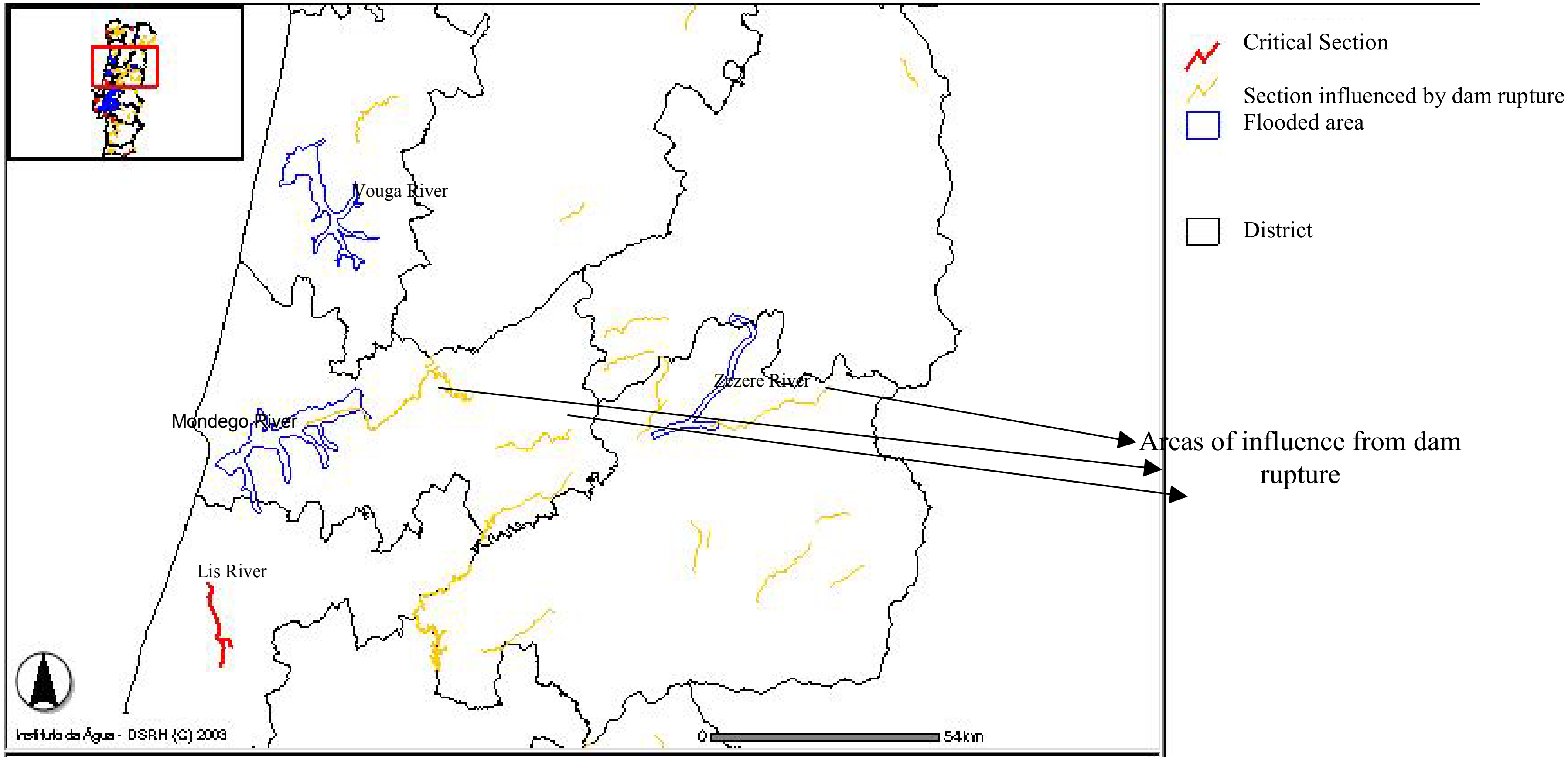


Figure 34: Flooding Risk Map for Portuguese Central Region

Droughts risk map

Not yet available.

Nuclear power plants risk map

Not yet available

Forest fires risk map

Lousã was considered according to the methodology applied a high to median-high fire risk. The high-risk areas are located in higher slope regions with low accessibility of top of Lousã Hills (Figure 29).

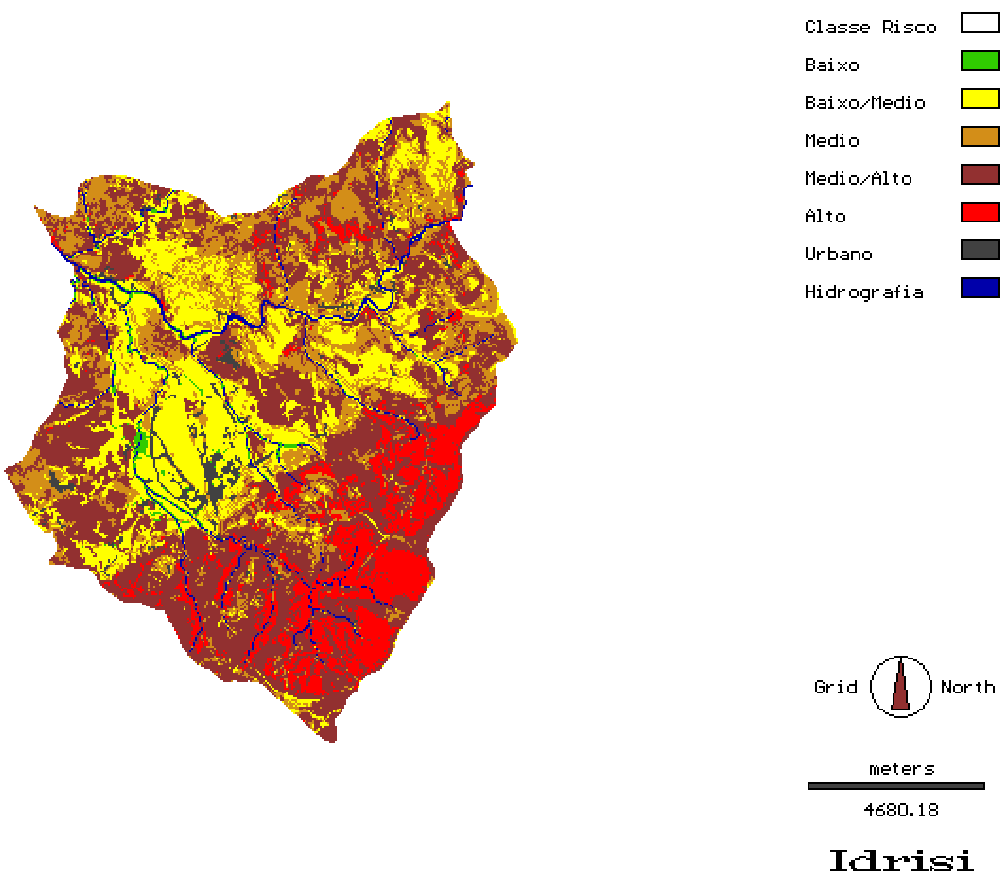


Figure 35: Forest Fire Risk map

Risk classification goes from zero (minimum risk) to 1000 (maximum risk).

This risk maps are completed to several Central Region NUTS areas (Figure 30).

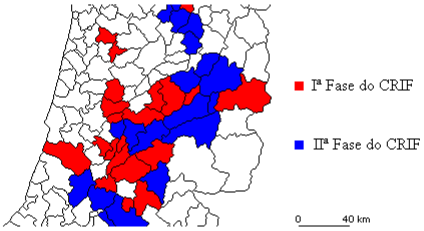


Figure 36 - Portuguese Central Region Risk map cover

The risk maps of Arganil, Figueiró dos Vinhos, Ferreira do Zêzere, Castanheira de Pera, Mação, Manteigas, Mortágua, Oleiros, Oliveira de Frades, Oliveira do Hospital, Pedrógão Grande, Penacova, Penela, Vila Nova de Poiares, Pombal, Sabugal, Seia, Sertã, Aguiar da Beira, Belmonte, Celorico da Beira, Covilhã, Fundão, Gouveia, Guarda, Lousã, Moimenta da Beira, Pampilhosa, Proença-a-Nova and Sernacelhe will be present in appendice.

Uranium mines contamination risk map

This map was obtained after risk analysis, considering different multiplication factors available that contributed in different ways to map Figure 44.

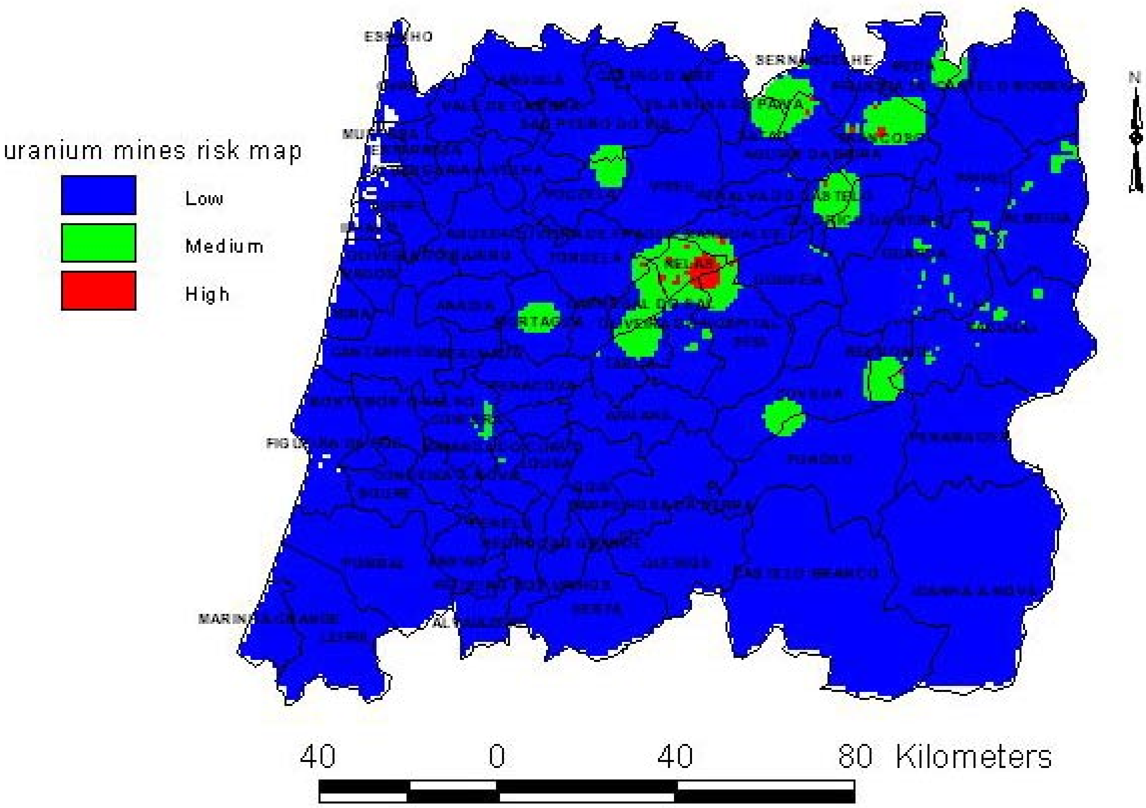


Figure 37 - Uranium mines contamination risk map

The Nelas region is the most vulnerable region to uranium mine contamination.
Due to the methodology used in this risk analysis *Response Indicators* for Central Region should consider:

-Water distribution prevention and control measures in the red and green zones

- Agriculture prevention to contamination measures in the red and green zones.

Towards an overall risk map and the identification of most sensitive regions

Note: This map will be one of the final results of the project. At this stage it is not yet possible to create this map, because we need the risk maps for all the other hazards, too.

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Annex III Development of new indicators

Most of the hazards presented in second interim report were not sufficiently studied because metadata related with these indicators was not yet available. Earthquakes, landslides and droughts are among those that will possibly be studied in a next stage as long as the required data will be available.

New indicators to be developed are presented after 5.1.3.

- Groundwater vulnerability
- Coastal erosion
- Coastal pollution

Earthquakes

Metadata needed to develop this hazard and risk analysis are:

- Active faults (neotectonic) mapping
- Detailed lithology mapping
- Historical and instrumental seismicity

The seismic zoning for constructions is, so far, the best approach of a seismic hazard map for construction in Portuguese territory. This mapping is used by the insurance companies, construction companies and for the environmental impact studies to quantify the seismic action for the constructions.

Landslides

Metadata needed to develop this hazard and risk analysis is:

- Occurred landslides
- Detailed lithology
- Rainfall
- Slopes (DTM)

The intersection between these indicators will produce the landslides hazard map at the next phase of the project.

Drought

Several indicators will be used according to the following information:

Drought natural causes

- Changes in weather conditions with:
  - Change in subtropical anti-ciclonic nuclei from its normal position

Drought unnatural causes

- Bad land planning
- Insufficient water storage infrastructures
- Over-exploitation of groundwater
- Deforestation especially due to forest fires

Drought direct effects:

- Deficient water distribution
- Damage in agriculture, industry and hydroelectric energy production
- Restriction to fishing in lakes and rivers

Drought indirect effects:

- Conditions favour to forest fire occurrence
- Sanitary problems
- Degradation of water quality
- Conditions favour favourable to erosion

Vulnerability areas can be calculated with:

- Quality and capacity of water supply
- Distance to water storage infrastructures
- Water quality in long term storage
- Accessibility to alternative water supply

Predition Methods to Droughts

In Portugal drought occurrence analysis is done in March by emergency protection entity Protecção Civil, to plan the response to this hazard in the dry period of the year that normally ends in September. Prediction models are used:

- Statistic- interaction ocean-atmosfere. Relation between atmosferic variability and ocean temperature variability.
- Dinamic – Global atmosfere circulation models. Relation between climatic standards in large areas.

Source information: http://www.meteo.pt/DMM-2003/web_secas_pag2.htm

Needed indicators to study drought hazards are dependent of the applied methodology. Several methodologies can be used based in climatic variables and in duration of drought or cumulative effects of droughts.

One example of classification of drought based in climatic indices of draughtiness relates registered quantity of precipitation in climatic stations and the area of influence of that precipitation. Classification can be:

Year	Quantity of registered precipitation
-Extremely dry	>90% of the total years in analysis
-Very dry	>80% of the years in analysis
-Dry	>70% of the years in analysis
-Normal	between 40 and 70% of the years in analysis

This classification measures total quantity of precipitation in a period of several years. If total quantity is very low, meaning that more than 90% of the years are dry the classification of that region is “Extremely dry” and so on.

Classification can also be based in percentage of affected area:

Drought	Affected area
-Local	<10%
-Extended	until 20%
-Very extended	20 to 30%
-Very much extended	30 to 50%
-Generalised	> 50%

Other climatic variables that may be considered to this hazard study:

- Total precipitation
- Duration of precipitation
- Water in soil
- Evapotranspiration
- Temperature (Nº days above a certain temperature)

Groundwater vulnerability

The aquifers vulnerability representation is a complex task. Effectively it is not possible to represent in a single map, specially in a small scale, all geologic, hydrogeologic and hydrochemic aspects that are determinative to foresee the behavior of the diverse contaminant substances. The propagation of these substances is affected by several factors such as the aquifers lithology, the depth of water table, the type and thickness of soil, characteristics (lithology and fissuration) of the unsaturated zone, recharge rate, topography, etc.

In the elaboration of Portugal Central Region aquifers vulnerability map, will be applied an expedite methodology based in the lithology and, probably in the confinement of aquifers of the undifferentiated hydrogeologic formations. This simple methodology shows advantages relatively to the application of quantitative indices of vulnerability. The main objections to the use of these indices are: 1) the parameters estimation is made from scarce or null hydrogeologic information, generating high levels of uncertainty; 2) the estimation of some parameters is based on speculative considerations; 3) the calculations are generally redundant because there are variables related between itself that are considered as independent; 4) the balance of parameters is somehow arbitrary; 5) the vulnerability maps are not representative for all types of pollutants.

With this perspective, in the next stage, the vulnerability classes will be defined according lithologies and types of aquifers (phreatic or confined) whose hydraulic conductivities reflect the greater or minor capacity to attenuate the propagation of any contamination.

The Portugal Central Region aquifers vulnerability map will be generated from raster analysis in GIS environment (ArcGis 8.2 - ESRI) from the Carta Geológica de Portugal (Geologic Map of Portugal, Figure 1), scale 1:500 000 (Serviços Geológicos de Portugal, 1992) Figure 2 represents the main aquifer systems with summary characterization for Portugal Central Region.

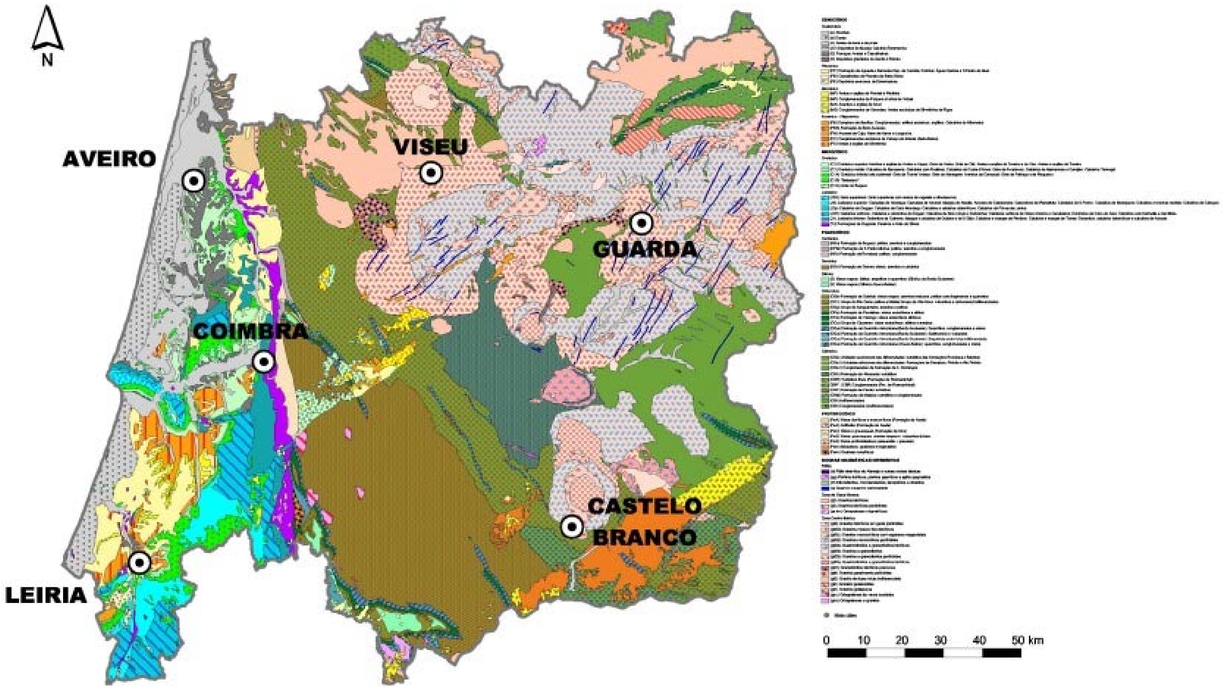

Figure 38: Portugal Central Region Geological Map – extracted from the Carta Geológica de Portugal (Geologic Map of Portugal), scale 1:500 000 (Serviços Geológicos de Portugal, 1992)

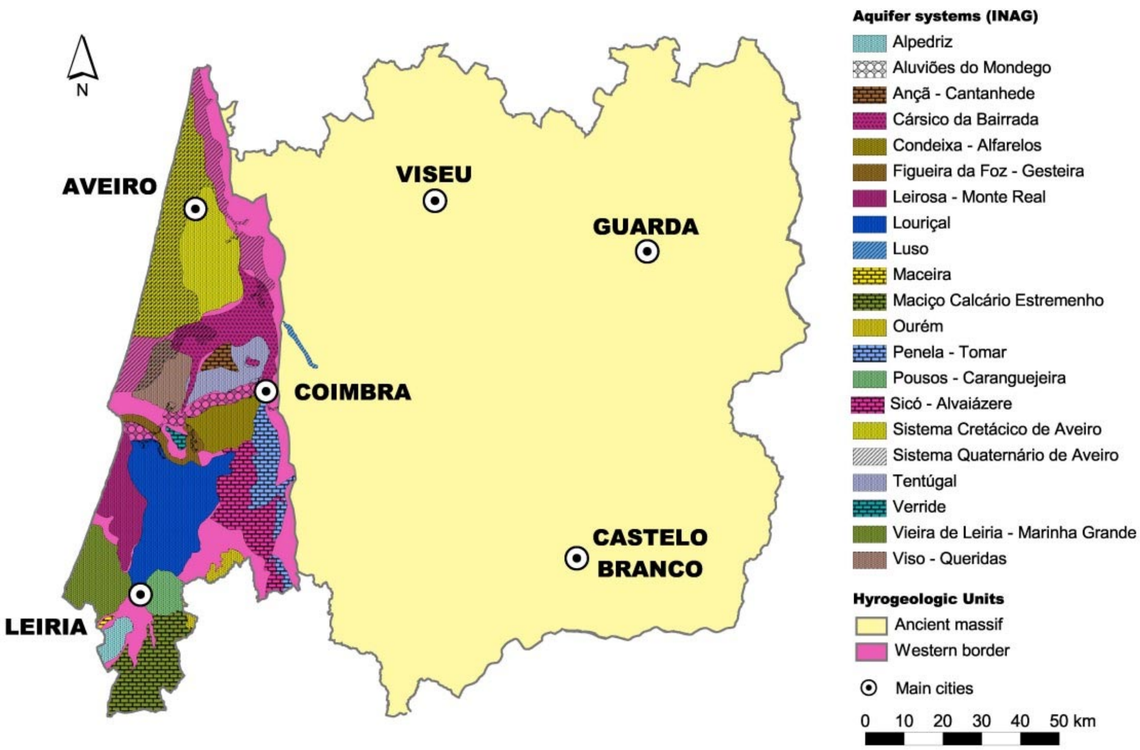

Figure 39: Portugal Central Region Aquifers Systems Map (INAG, 2000).

Coastal erosion

The importance of coastal zones to Central Portuguese Region is the motivation to develop this indicator. Several Work groups are or have been studying the coastal erosion phenomena like RIMAR evolving several institutions (universities, sea institutes, meteorological institute). Water institute has a control system called Sistema Nacional de Informação dos Recursos do Litoral (SNIRL) this system controls coastal activities and the monitoring maps cam be observed as follows. The information is available in the internet http://mapas.inag.pt/Website/SnirLitHTML/viewer.htm.

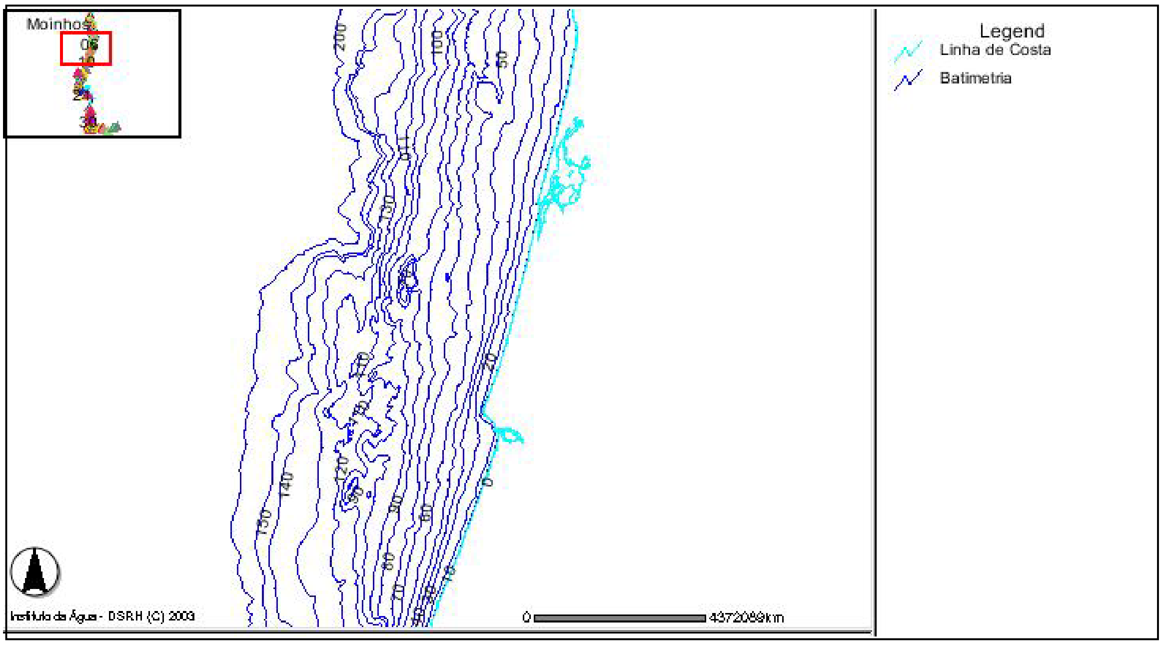

Figure 40: Batimetric mapping (Instituto da Água, SNIRL)

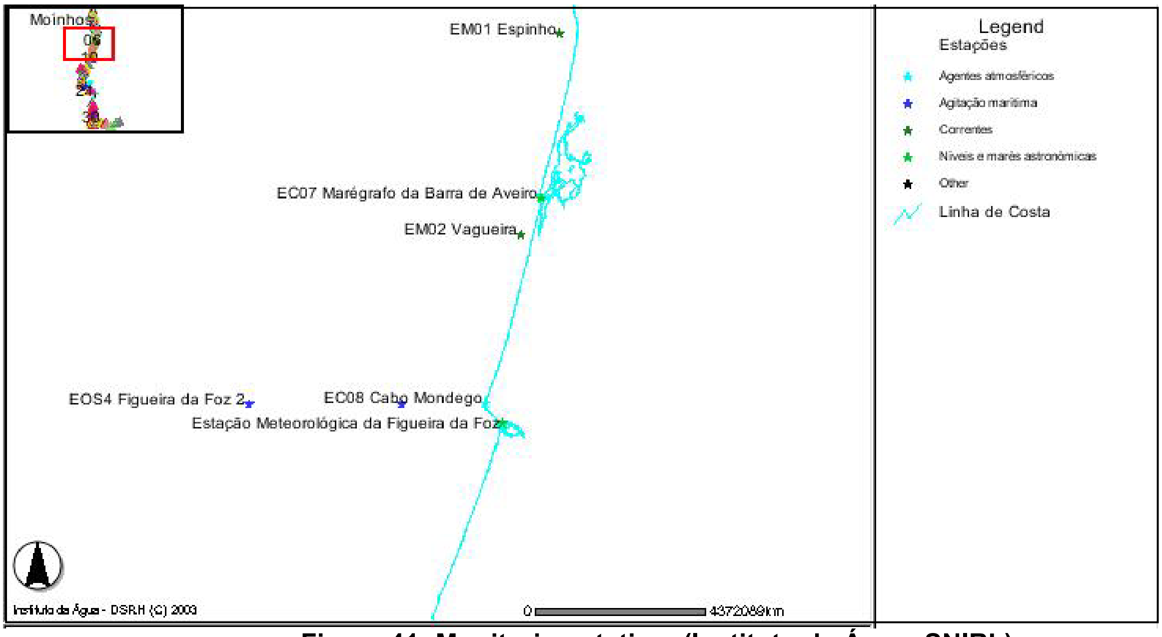

Figure 41: Monitoring stations(Instituto da Água, SNIRL)

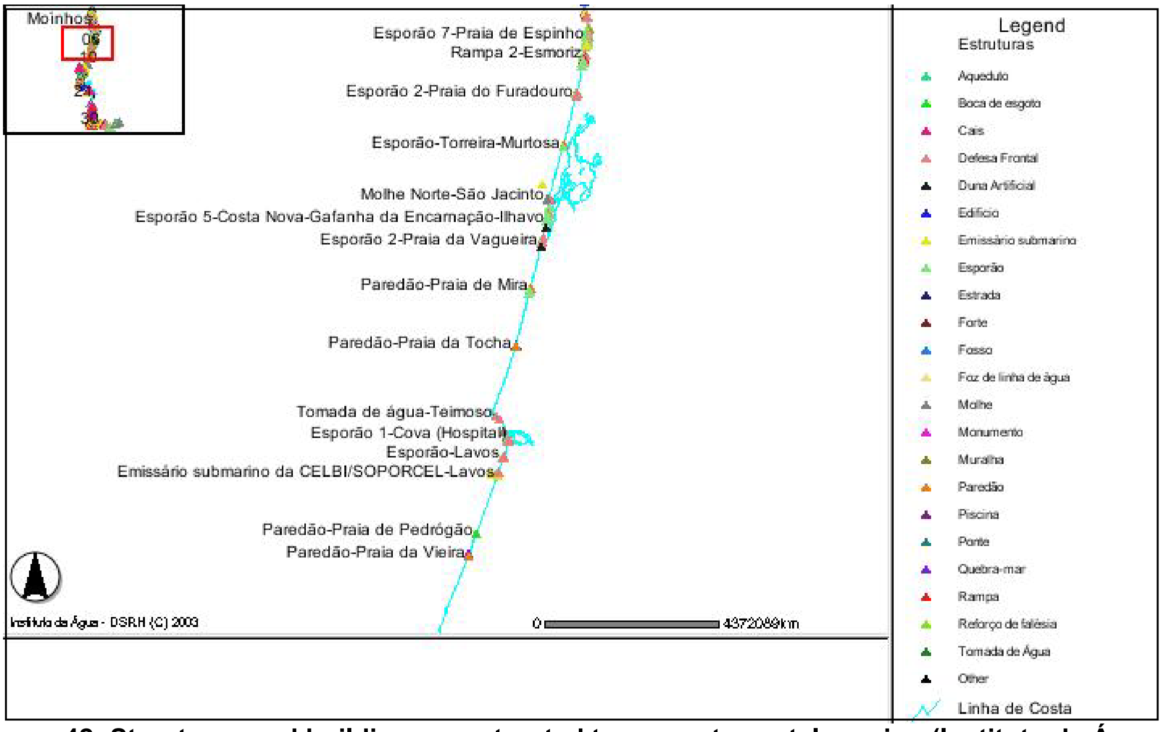

Figure 42: Structures and buildings constructed to prevent coastal erosion (Instituto da Água, SNRIL)

This building information is given on line by the institution. Risk and response indicator are being controlled by Water Institute.

A draft of the possible future study to be carried out by ESPON Portuguese team in case data is available for the project is presented below.

High density of population near the coast implies construction development that increases vulnerability and overexploitation of natural resources.

Hazard/Risk Type	Coastal erosion
Indicator	Population density
DPSIR model	Pressure indicator

The process of erosion is potencially acelerated in coastal unconsolidated terrains.

Hazard/Risk Type	Coastal erosion
Indicator	Lithology of coastal zones
DPSIR model	Pressure indicator

Several studies shows that regions where relevant tectonic events were registered are more vulnerable to coastal erosion.

Hazard/Risk Type	Coastal erosion
Indicator	Tectonic mapping
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Ocean corrents regime
DPSIR model	Pressure indicator

Coastal pollution

Several entities act in order to maintain surveillance in marine coast and are usually partners in projects to prevent model and diagnose marine pollution. These institutions are:
CILPAN – Centro Internacional de Luta Contra a Poluição do Atlântico Nordeste
Brigada Fiscal da Guarda Nacional Republicana
Instituto Marítimo-Portuário
Força Aérea Portuguesa
Estado Maior da Armada
Direcção Geral da Autoridade Marítima
Instituto Hidrográfico
Minstério da Defesa Nacional –Direcção de Infrastruturas
Laboratório de Apoio às actividades Aerospaciais do INETI
Instituto da Água
Instituto da Conservação da Natureza

These institutions detect and diagnose pressure and state indicators and develop response indicators in coastal pollution.

In case information is available coastal pollution will be also studied for Central Region of Portugal. Several pressure indicators can be used to diagnose this hazard.

Hazard/Risk Type	Coastal pollution
Indicator	Population density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Main rivers mouth
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Chemical Industry density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Animal raise infrastructure density
DPSIR model	Pressure indicator

Hazard/Risk Type	Coastal erosion
Indicator	Stream sedimens contamination
DPSIR model	State indicator

Hazard/Risk Type	Coastal erosion
Indicator	Platform sediments contamination
DPSIR model	State indicator