

# Remediation of former military sites

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## Abstract

The European Parliament's mandate to the Commission to develop a thematic strategy for soil protection highlights the need to adopt measures that prevent, limit or reduce the impact of human activities on soil. In Spain, the Royal Decree 9/2005 of 14<sup>th</sup> January fulfils the provisions of the Wastes Law 10/1998 of 21<sup>st</sup> April, and establishes a list of potentially soil contaminating activities and criteria and standards for declaring that sites are contaminated, subject to prior consultation with the Autonomous Communities. The Royal Decree shall not apply to publicly owned sites where military installations are located. Within a period of two years from the date on which it enters into effect, the Ministry of Defence shall approve, subject to previous acceptance by the Ministry of the Environment, a decontamination plan for such sites. As the Ministry of Defence owns more than 1% of the whole National territory, the selection of a case study is the first step in the definition of a practical methodology for demonstration of the economic viability of the environmental remediation. It involves estimating a range of values for the potential profit that could be obtained when the site is disaffected from use and introduced into the market.

*Keywords: catalogue of contaminated properties, decontamination plan, defence facilities, polluting activities, soil pollution, study of economic viability.*

## 1 Introduction

The number of contaminated sites in Western Europe (Prokop et al. [1]) varies between 300,000 and 1,500,000. These figures, in themselves indicative of the seriousness of the problem, also point to the serious ecological and legal consequences that result from an absence of standardized methodologies for identifying and characterizing contaminated soils. Indeed, the extent of the difference between the two figures is due precisely to a lack of uniformity in the



criteria used in different countries for defining contaminated sites, quantifying acceptable risks and adopting instruments and characterization methodologies.

In Spain, the Wastes Law of 1998 identifies the polluter as liable (Ministry of Environment [2]). If the polluter is unknown, the landowner is responsible. The Ministry has the option to fund a remediation and later recover the costs. Costs can be recovered either directly or by the transfer of an appropriate portion of the remediated property (Lopez de Velasco [3]). Cost recovery is to take place over a 10-15 year period. The Wastes Law includes a mandate instructing the Spanish Government to approve and publish a list of potentially soil-contaminating activities, and establishes specific obligations that apply to the owners of activities and of properties where the specified activities are carried out or have been in the past

The Royal Decree 9/2005 of 14<sup>th</sup> January (Ministry of Presidency [4]) establishes a list of potentially soil contaminating activities and criteria and standards for declaring that sites are contaminated. It fulfils the provisions of the Wastes Law 10/1998 of 21<sup>st</sup> April, subject to prior consultation with the Autonomous Communities. The Royal Decree makes reference to the presence of dangerous chemical substances of human origin that are capable of altering the chemical, physical or biological characteristics of soil. They, therefore, constitute a risk that must be quantified in order to assess possible harm that may result to human health and the environment. Sites shall be declared contaminated by express decision if, in accordance with the standards set out in this Royal Decree, said risk is deemed unacceptable for human health and the environment.

The Contaminated Soils Decree shall not apply to publicly owned sites where military installations are located or where military activities are carried out. In the past, many military activities have been developed in industrial belts located in the surroundings of the cities. Such activities can be compared to industrial ones, and due to the growth of many cities, these sites have been absorbed and now are part of the reserves of land, required for the future development of the city.

Within a period of two years from the date on which this Royal Decree enters into effect, the Ministry of Defence shall approve, subject to previous acceptance by the Ministry of the Environment, a decontamination plan for such sites, which shall conform to the technical content of the Royal Decree. As a consequence, the Ministry of Defence is responsible for the design and preparation of a catalogue of contaminated properties to be remediated in the future. The Spanish Ministry of Defence is the first landowner in Spain, with an estimated 1% of the whole national territory. These figures are representative of the huge task to be accomplished.

## **2 Process for the remediation**

The environmental remediation of contaminated properties, especially former military sites, requires a study of economic viability. Methodologies addressed in such a study have been tested and demonstrated in other countries, but application in Spain has to be done prior to starting any big scale remediation



plan (Grima and García-Delgado [5]). The objective of the study is the definition of the steps for an effective environmental remediation work. The scope and performance of remediation actions shall be such as to guarantee that any remaining contamination translates into acceptable risk levels in relation to current and anticipated land uses. To illustrate the process, a property of the Defence Ministry has been chosen as a case study. The demonstration of the viability of the remediation from the economical and technical point of view is a prerequisite to initiate the process.

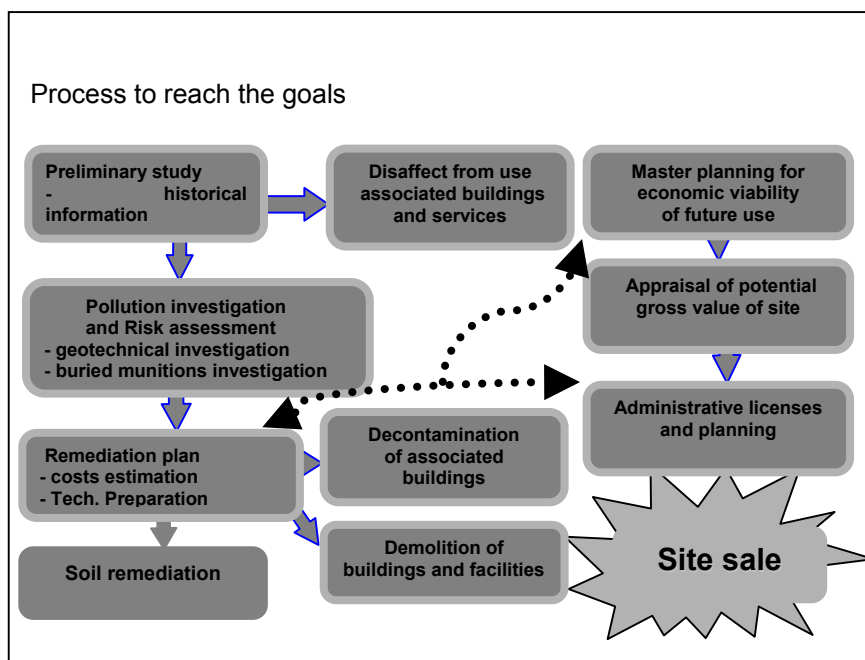


Figure 1: Main activities to be done for remediation of Defence Ministry properties.

### 3 Historical land use

At this stage, information about the historical land use of the site and its surroundings is to be collected. In addition, activities carried out, pollutants generated and accidents (e.g. spillages) that occurred during the useful life of the facilities must be investigated.

The former fire range studied is located in the municipality of Lorca, province of Murcia, approximately 45 km south of Murcia City. The property has an extension of 688,484 m<sup>2</sup>. The estimated value of the property is 353,395.12 €. Little information exists about previous land use before it was selected as a firing range by the Spanish Army, but based on this information agricultural use seems to be the traditional use of the site from centuries past.

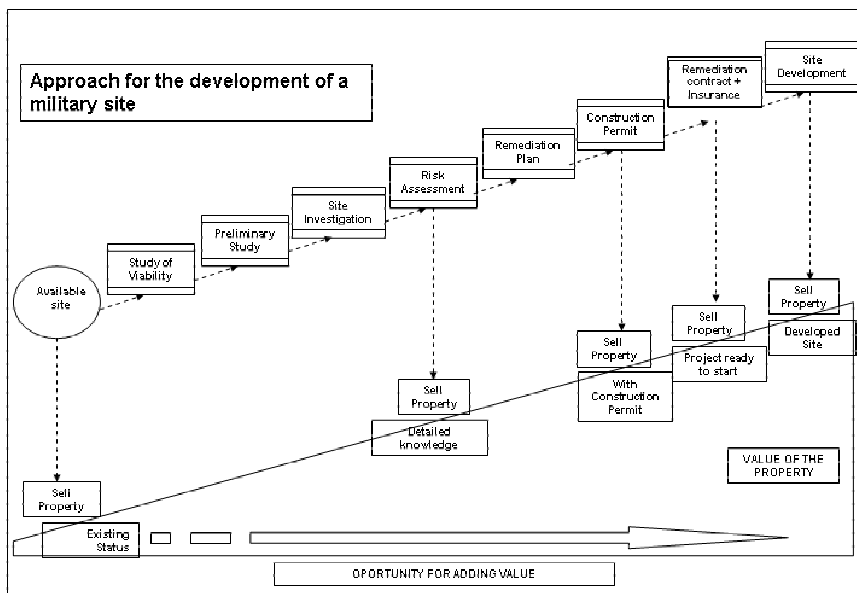


Figure 2: Steps in the development of a military site for adding economic value.

#### 4 Environmental setting

The environmental setting comprises the factors that define the characteristics of the site, and include, at least, geology, climate (average monthly temperature and precipitation), risk of flooding (flood return periods, etc.), hydrology, hydrogeology and ecology (natural factors and human influences).

Generally speaking, groundwater is the most important pathway for migration of contaminants, so special attention must be paid to the definition of the site materials. The existence of aquifers must be determined as well as directions of flow, relationships between piezometric levels and recharge and discharge areas.

Moreover, information about springs, water wells, hydraulic parameters (transmissivity, storage coefficient, etc.), surface water and relationship between groundwater and surface water must be analyzed. The Commission proposal of Groundwater Directive COM(2003)550 specifies that the "good chemical status" of Groundwater shall be based on compliance to existing Community quality standards (nitrates, plant protection products and biocides) and on threshold values (i.e. environmental quality standards) to be established by Member States at the most appropriate level (local, regional or national). These threshold values will have to be set up for all pollutants which have characterised groundwater bodies as being at risk, pursuant to the analysis of pressures and impacts carried out under the article five of the Water Framework Directive. The agenda of the

Groundwater Daughter Directive proposal, as modified in the Council Common Position, implies that threshold values for relevant groundwater pollutants should be established on the basis of a common methodology before December 2008.



Figure 3: Aerial view of a former military site.

## 5 Potential contamination sources and risk assessment

The first objective is the review and evaluation of known and suspected contamination sources. Potentially polluting activities must be analyzed and evidence of buried munitions or contamination must be searched for.

Without prejudice to any subsequent development of requirements by the Autonomous Communities, the elements that shall be included in assessment of risks associated with contaminated sites are as follows:

- A detailed description of the focal points of contamination, identifying the contaminating substance(s) and determining significant concentration values (maximum measured, p95 or another duly justified statistic).
- A characterization of the textural properties and components of the soil.
- A description of the immediate physical environment for the purpose of identifying mechanisms that may transfer contaminants from focal points to potential receptors and relevant contamination exposure pathways for such receptors, including groundwater.
- An identification of potential receptors of contamination and an assessment of the characteristics or habits that determine their level of exposure to contamination. In the absence of other information concerning such characteristics or habits, this assessment may make use of the parameters utilized to define reference levels. The existence at the site in question or in adjacent areas of relevant ecological receptors shall also be taken into account.

- Identification of foreseeable exposure pathways and quantification of the exposure dose received. However, possible pathways may be added or eliminated based on the expert opinion of the technicians responsible for carrying out the assessment, subject to previous consultation with the Autonomous Community official in charge. For the quantification of exposure dose, the expressions used to develop reference levels or similar methods deemed appropriate by the Autonomous Community officials in charge may be employed.
- A toxicity value and justification of its choice for each of the relevant contaminants identified.
- Quantification of risk. In cases where contaminants with the same action mechanism are found together at a single site, the combined risk that they pose shall be considered.
- An analysis of the uncertainties associated with the risk assessment carried out, including appropriate conclusions regarding the validity and reliability of the results of the assessment.

The degree of detail with which these points are to be covered shall be established by the competent body of the Autonomous Community in question, based on reasonable criteria and taking into account the specific circumstances that apply in each case.

## 6 Study of economic viability

The first phase to consider in a study of economic viability is the appraisal of the potential gross value of the site. Then, the different potential costs associated with the development of the site must be calculated and the ecological protection requirements must be included.

Among the potential costs, the following ones must be considered when making calculations: General communications (railway and access), protection of surface waters (and channels), general infrastructure (electricity, sewerage, water supply, etc.) and, finally, remediation costs.

Sampling will determine the degree of remediation needed but, based on similar experiences, a conservative estimation of remediation costs at Carralaca pilot site provides a figure between one hundred and twenty thousand euros (120,000 €) and one million, three hundred and fifty thousand euros (1,350,000 €). Therefore, the potential net benefit for the owner of the site varies between some five million, seven hundred thousand euros (5,777,576 €) and seven million euros (7,007,576 €), compared to the potential gross value of the site at the beginning of the process, of about three hundred and fifty thousand euros (353,395 €).

On the other hand, the Ministry of Defence has established in the last years a very efficient model of compensations (or spin-offs). The return of a certain established percentage of the military investment has proved to be a very important source of funding. The qualitative impact of spin-offs has had impact on sectors and activities of major interest from the economic, technological and defence point of view. Priority is given to sensible technologies in acquired



equipment and formation of personnel and establishment of centres of excellence for research and development from the knowledge transferred.

Figures in euros	CASE A	CASE B
<b>REVENUE</b>		
Potential Gross Value	<b>7,692,826</b>	<b>7,692,826</b>
<b>COSTS</b>		
<b>INVESTIGATION</b>		
Geophysics	38,000	38,000
Sampling	75,000	75,000
<b>REMEDICATION</b>		
Project Management	90,000	90,000
Explosives Cleaning	362,250	362,250
Structures Demolition	90,000	90,000
Contaminated Soil Removing	120,000	1,350,000
<b>SUBTOTAL</b>	<b>775,250</b>	<b>2,005,250</b>
<b>NET BENEFIT (DEFENCE)</b>	<b>6,917,576</b>	<b>5,687,576</b>
<b>Actual value</b>	<b>353,395</b>	

Figure 4: Summary of investigation and remediation costs at Carraclaca pilot site.

## 7 Conclusions and recommendations

The Wastes Law of April (1998) determines the existence of Contaminated Soil and the different responsibilities of landowners. It has implications from the legal and economic point of view.

The provisions of the law have been developed by means of the Royal Decree 9/2005 of 14<sup>th</sup> January. The manner in which a record is to be created in the Land Register and the declarations made by property owners carrying out potentially contaminating activities are defined in the Decree, giving effect to the legal provision by virtue of which a marginal note is to be recorded, its content, effects, duration and corresponding requirements for cancellation. Within a period of two years from the date on which this Royal Decree enters into effect, the Ministry of Defence shall approve, subject to previous acceptance by the Ministry of the Environment, a decontamination plan for such sites, which shall conform to the technical content of the Royal Decree.

Due to the different land uses and remediation technologies, calculation for different land use scenarios should be consider in order for better return on capital investment.



The rehabilitation of a contaminated site must be undertaken in phases, according to a sequential program. It is not feasible to make precise estimations of remediation costs before finishing site investigation, so there is a real risk of underestimating the total remediation cost in early stages of the process.

According to the study of economic viability conducted on the Carraclaca pilot site, the application of the proposed approach can optimize the benefits related to the disaffection of a military site and introduction into the market. National databases can provide very useful information on natural characteristics of investigated sites.

## References

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