Your topic: Human risk assessment and remediation of contaminated land sites

Your topic's description: To present an overview to public professionals of the background information on processes for dealing with remediation of contaminated land sites: Legislative background (remedial options and remedial treatment for contaminated land). Risk assessment procedures and, Mitigation of potential health concern. Health risk based derivation of remediation target concentration of contaminated lands. To raise awareness of the roles of different organisations and guidance available when dealing with potential contaminated land sites.

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Human health risk assessment and remediation of contaminated land sites

The main objective of this research document is to overview the different aspects of human risk assessment and remediation of contaminated land sites.

Declaration:

The author confirms that this research is her own piece of work and has not been submitted to any institute or university.
Abstract

Human activities often give rise to environmental consequences especially observable on
the ground, as this is often the first point of contact for leaking liquid substances from
accidents that can be particularly toxic. While soil is itself not an important means in the
spread of contaminants, it has a major impact on how extensive the penetration of
contaminants can reach in soils and in combination with water is a major factor in the
levels of contamination present at various stratigraphic changes in the ground profile. In
recent years specialist techniques have developed in engineering for the classification of
ground risks and in their remediation. Such scientific advances have developed the need
for the development of techniques and technologies for the recovery of contaminants
introduced to sites by human activity. This final year research project focuses on providing
a detailed analysis of what factors are important when addressing the human health risk
assessment aspects of contaminated sites and also the technical and practical techniques
available to carry out remediation to acceptable standards to mitigate the perceived human
health risks. Specific mention of a case study is used to illustrate how human health risk
assessment needs to evolve as legislator demands change and as innovative techniques
of remediation pave the way for even greater opportunities for land regeneration without
entailing excessive costs. The pragmatic approach to land regeneration is a key feature in
the legislative controls that have been introduced in England & Wales since enactment of
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# List of Abbreviations

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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>UNIDO</td>
<td>United Nations Industrial Developed Organisation</td>
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<tr>
<td>ICS</td>
<td>International Centre for Science and High technology</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>ATSDR</td>
<td>Agency for Toxic Substances and Disease Registry</td>
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<tr>
<td>TIO</td>
<td>Technology Innovation Office</td>
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<tr>
<td>OSWER's</td>
<td>Office of Solid Waste and Emergency Response's</td>
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<tr>
<td>PE</td>
<td>The Preliminary Evaluation</td>
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<td>SI</td>
<td>Site Inspection</td>
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<td>MRL 's</td>
<td>Minimal Risk Levels</td>
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<tr>
<td>CEPIS</td>
<td>Specialised centre for Environmental Technology of</td>
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<td>PAHO</td>
<td>Pan America Health Organisation</td>
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<td>GTZ</td>
<td>German Agency for Technical Cooperation</td>
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<td>NPL</td>
<td>National Priorities List</td>
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<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
</tr>
<tr>
<td>ATSDR</td>
<td>Agency for Toxic Substances and Disease Registry</td>
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</table>
Glossary of Symbols

\[ \Sigma \]  
Sum of

\[ \text{Ra} \]  
Rank of group 'A'

\[ \leq \]  
Equal to or less than

\[ \geq \]  
Equal to or greater than

\[ \% \]  
Per cent

\[ A \]  
Total estimated exposure dose for an adult

\[ B \]  
Power Factor

\[ C \]  
during which time the ation Pobl it was exposed to the carcinogen

\[ D \]  
Calculation of individual risk

\[ \text{PC} \]  
body weight

\[ \text{TI} \]  
daily ingestion rate of water

**The NOAEL**  
maximum dose at which no observed adverse effect.

**The LOAEL**  
lowest level in which already some kind of adverse effect was observed.
Chapter One: Introduction

1.1. Background

The remediation, the action of remedying something, in particular of reversing or stopping environmental damage, of contaminated sites is a procedure that is applied to mitigate or eliminate problems resulting from improper storage or disposal of hazardous materials or waste, or accident during generation or handling. The importance of control is that the substitutes of hazardous waste or materials can dissolve in water to penetrate the soil and reach groundwater; drain on watersheds and pollute surface waters. It can also move through the air and thus transferred along the food chain affecting all routes of exposure to these animals, plants and man himself. The world has more than 100,000 substances and only for a small number of them have information about its danger and its proper management requirements. Moreover industrialised countries currently are facing a serious problem due to the generation of large volumes of hazardous waste. Although there is no inventory of this generation, it is estimated that in the world annually between 350,000 and 400,000 tonnes are produced per mill. A large part of them comes from industrial activities relevant to the economy of developing societies, the most important being the mining and petrochemical industry, metallurgical, chemical and oil (Suter II, 2006).

In the case of UK there is no information regarding the inventory of contaminated sites and much less complete and detailed information of the origin and destination of the same. In Latin America, in 1999, the second version "Methodology for the identification and assessment of health risks at contaminated sites "as a result of the second stage of the Pan American Network for Environmental Waste Management. REPAMAR was published
which was one regional initiative to promote waste minimisation and sustainable economic
development, implemented by PAHO / CEPIS, with support from the Government of
Germany through GTZ. Another initiative on this topic gave the Ministry of Environment of
Colombia who together with UNIDO (United Nations Industrial Developed Organisation)
and ICS (International Centre for Science and High technology), organised a workshop on
"Environmental Pollution and Applicability of Remediation Technology Latin American
Countries (Mueller, Chapman & Pritchard, 1989)."

1.2. Aim

The aim of this paper is to provide guidelines to start the remediation of contaminated sites
in UK, through a study of management techniques used for this evaluation and Exposure
Assessment in these sites as well as their respective Remediation preferably using
Innovative Technologies.

1.3. Specific Objectives

The objects of this paper include:

- To review available methods of carrying out a human health risk
  assessment in the UK
- To provide a detailed assessment of the theoretical development of a
  conceptual site model for a given site scenario, highlighting the specific
  source-pathway-receptors
• To critique the methods of obtaining samples from site to use in the evaluation of specific human health risks and to determine whether there is a significant possibility of significant harm at a given site by reference to published DEFRA and Government / LA Guidance
• To explore the opportunities for adopting engineering and innovative remediation techniques to reduce, eliminate or mitigate against specific human health risks by way of detailed remediation strategies and incorporation of compliance monitoring testing strategies to ensure that human health risk is assured on completion of remediation

1.4. Methodology Used

The remediation of contaminated sites is one of the most complex issues. Usually this occurs by chemical pollution mixtures (various pollutants), comes in different ecosystems and affects several communities. That is, the complexity of the contamination at these sites requires a specific methodology to study pair. However, the design of this methodology, as well as considering their characteristics of contaminated sites, you should take into account the reality of country. United States is the country that has led the way in designing programs for studying contaminated sites. Two and developed and implemented by the Environmental Protection Agency (EPA): Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund and Resource Conservation and Recovery Act (RCRA) (Jensen et al 2006).
The work of PAHO / WHO also mentions another methodology designed by the Agency for Toxic Substances and Disease Registry (ATSDR) of the Department of Public Health in the United States. The first version was developed by Dr Fernando Diaz Barriga, from the Autonomous University of San Luis Potosi, Mexico, and was revised by the ATSDR to Dr. Juan Reyes. Subsequently, a committee of searchers research gathered by the Pan American Health Organisation (PAHO) analysed the second version. ATSDR’s collaboration and research committee members enriched the document dump their expertise there. During review meetings at all time the spirit of this methodology was a valuable instrument remained.

Both EPA and ATSDR estimate the risk in environmental data based on site and in the case of the ATSDR assesses health risk, based on environmental data and health history recorded in the area of influence Site. On the other hand PAHO / WHO in one phase of its methodology additional steps not covered in the original method of ATSDR, such as: nutritional biomarkers and total microbiological evaluation. The methodology used to start an initial GASC has as that used by the OPS (with the consent and approval of the OPS to use the second version - 1999) and EPA (CERCLA) used basis. Information on using innovative technologies Re mediation was provided by the Technology Innovation Office (TIO), part of the Office of Solid Waste and Emergency Response’s (OSWER's), also from EPA (Semple, Doick, Jones, Burauel, Craven & Harms, 2004).

1.5. Estimating ecological risk

Although this paper uses risk assessment on human health as a determinant to initiate the remediation of a contaminated site factor, it would also be important that some
researchers estimate the ecological risk logician describe it so quickly. The identification of a large number of contaminated industrialised emphasised the need for Ecological Risk Estimation (Ecological Risk Assessment - ERA), resulting in the inclusion of ERA in risk assessments of contaminated sites.

1.6. Basis of ERA

The foundations of ERA are conceptually similar to the estimation of risk to human health, but emphasise the following 3 areas (Sheppard et al 1992):

- ERA may consider effects beyond is a single species, i.e. may be considered for evaluation of populations, communities or ecosystems.
- It is not only the value of the logician ecological resource which must be protected but also other values that are selected from several possibilities based on scientific and political considerations.
- It must relate to ecosystem health and land use.

The great challenge of ERA is to implement the concepts and measures comprising the ecological well-being at a level of the whole system. It is generally recognised that no eco-toxicity test is sufficient to evaluate the contaminating of an entire ecosystem. As stated above, the biggest barrier to the further development of ERA is the lack of a "proper theory" of the ecosystem that serves as a framework to interpret laboratory data and field. As the estimation of health risk, ERA can be used for priority scenarios as use and land
management, standard is to outline and guide for specific decisions and risk management (Komnitsas, Kontopoulos, Lazar & Cambridge, 1998).

1.7. Estimation of health risk assessment and ecological risk

1.7.1. Estimation of health risk

As in IS stage in the stage wills ESCS using mathematical calculations to estimate the exposure. The difference is that in this phase estimation for each of the identified paths is performed. At the end of the two is exposure for each route are summed to obtain the total dose of exposure, the dose will be used in the risk characterisation. Here are some additional details exhibited only.

i. Identification of the contaminant

In the phase of IS required to answer some questions. At the stage of ESCS responses to such questions will be used to summarise, since the information would present a compilation of the exposed in the section on analysis of the routes of exposure.

ii. Dose-response analysis

The assessor should obtain information from the data bank, and may also obtain information from MRL database ATSDR. Numerical information is generally accompanied by studies that led to the reference dose or dose of minimal risk. I.e., by the value of the
dose may be information on the effect selected for calculation. After having it with these
data, the evaluator should seek the NOAEL (the highest dose at which no observed
adverse effect for the selected condition) and LOAEL (lowest dose at which and any
adverse effects were observed). All three doses (RfD, NOAEL and LOAEL) must be for the
same route (oral, dermal or inhalation) and to the same effect or condition. In addition to
this, it is important to retrieve information on the NOAEL and/or LOAEL of other
conditions. Remember that at this stage the risk characterisation shall Come Alive in the
total dose of exposure, not just oral or inhaled dose.

iii. Exposure estimation

As the title suggests, this section seeks to know about the dose of contaminant that is
being absorbed by the exposed individual. The estimate is derived through formulas that
are explained in detail on page 18. To estimate exposure during her EESC few simple
rules are followed:

A. Taking into account only the critical pollutants.
B. Consider all routes of exposure.
C. Get the exposure dose for each route (for infant and adult), for which the average
values are used and the highest concentration found for each pollutant (follow the
directions outlined on page 18).
D. Calculate the total dose of average exposure and maximum exposure, for which the
estimated dose for each route added.

1.8. Risk Characterisation

For the evaluation of the exposure is the maximum risk possible. This would imply that once absorbed contaminants have toxicity, regardless of the route of exposure. I.e. characterisation is estimated based on the total dose and not on the specific dosage route. For example, if the data obtained from the literature RfD is for oral exposure, this RfD is compared against the total exposure dose, but this dose exposure include inhalation. The only exception is when only count with inhalation RfD tinnitus and registered in the respiratory tract (in this case a direct action of the pollutant is respiratory tissue, a fact that could not easily occur via oral exposure) (Komnitsas, Kontopoulos, Lazar & Cambridge, 1998).

It is known that the strategy proposed in the previous paragraph may result in an overestimation of risk for some diseases. However, as toxicological information is so poor for most of the pollutants, due to the uncertainty is the likelihood had preferred to overestimate the risk to ensure protection of the exposed community. The characterisation risk is calculated for carcinogenic and non-carcinogenic, on the basis of the average total dose and the highest dose. Characterisation of cancer risk, at this stage only factor is Power: Carcinogen (FPC) will be used and the importance of calculating dose use only for the adult population was reiterated. One other important point is to consider the fraction of time during which the population was exposed to the carcinogen (Jury, Spencer & Farmer,
A. Total estimated exposure dose for an adult = 3 x 10^{-3} mg / kg / day Carcinogen

B. Power Factor = 2 mg / kg / day -1 population

C. during which time the population was exposed to the carcinogen = 2 years

D. Calculation of individual risk = (3 x 10^{-3} mg / kg / day) (2 mg / kg / day -1) (2/70) = 1.7 x 10^{-4}

Note that in this example the factor of exhibition of 2/70 is taken into account because the exposure was recorded only for two years in a lifetime (for chronic effects are considered 70 years). No carcinogenic risk characterisation. In this case the risk to children and adults will be characterised. You should consider the conditions may not be the same (for example, in terms of overexposures to lead, this toxic effect on the nervous system is different in children and adults). Risk characterisation provides genuine carcinogen and no information in three points:

A. Severity of effect on health. For this point or condition considered by the evaluator as the most important will be highlighted.

B. Relationship between estimated dose / RFD (or MRL). As estimated total dose exposure dose will be used.

C. Population exposed.
Chapter Two: Literature Review

An environmental problem has recently been added by developed countries is to legislate, inventory and discover the right treatment to historical environmental liabilities existing in their respective states. In developing countries this concept occupies only a very poor country theoretical framework as the most important now is to reduce pollution and minimise the impact from the sources to the surrounding medium. The little research in this area has environmental importance due to the causes of lack of legislation for hazardous waste management, lack of techniques to make the Initial Assessment and Exposure Assessment in Site Contamination swim by this waste, irresponsibility "polluters " and perhaps the cause is more important and the high economic cost Remediate soil means a body of water and / or groundwater flow. Industrial development, the widespread use of agrochemicals in agricultural activities, urban growth and political and social problems in Latin America encourage increased production of hazardous waste, which have been, are and probably will remain polluters of many places and henceforth called "Brownfields" (Markus & McBratney, 2001).

The term hazardous waste involves the concept of waste, all materials that are generated in the process of extraction, beneficiation, Transformation, production, consumption, use, control or treatment which can no longer be reused. While the term dangerousness according to PAHO encompasses substances by their physical, chemical or infectious characteristics may (I) cause an increase in mortality or arising reversible or irreversible or serious disabling diseases or contribute significantly to, or (II) pose a substantial actual or potential risk to human health or the environment when treated, stored, transported, disposed of or handled improperly (Rügner, Finkel, Kaschl&Bittens, 2006).
Initial Evaluation, Assessment and Remediation Exposition of contaminated sites have become one of the most important environmental challenges before recent years. Soil formation originates from the interaction of the "parent material" (deposits or bedrock material transported by gravity, wind, water or ice) to climate, topography, organisms and time. It is the combined influence of these factors that determines the properties specific to the soil and the emergence of particular kinds thereof. Solid phases (mineral and organic) constitute about 50% of the volume of the soil, while the occluded water and air are the other 50%. The main physical-chemical properties of the soil are: porosity, temperature, acidity, redox, colloids, surface interactions, ion exchange capacity, texture, structure, etc., properties to consider when planning the execution of a remediation of contaminated soils. Human activities often give rise to environmental consequences especially observable on the ground, as this is the first point of contact of accidental leak liquid or solid substances which may be toxic. While soil is not an important means in the dispersion of pollutants, in combination with water and to a lesser extent with the air becomes a dispersing agent of the contamination present. The most common accidental contamination of soils in countries is verified hydrocarbons from fixed installations such as distilleries oil tank sunder ground stations, etc., or produced by accidents on routes to spill petroleum (Hough et al 2004).

Through the centuries, the residues were present in the human environment and are likely to continue to affect future imaginable. Although waste is essentially a by-product of a lifestyle, have been completely equated the problems they created, in particular in order to optimise the health of all the elements involved in the social and individual behaviours that make these styles Life (Carlon, Critto, Marcomini & Nathanail, 2001).
It is widely recognised as an ideal situation from the perspective of primary prevention would be a drastic reduction in waste production. As always, at least in the immediate inability to solve all this way, it is essential to invest in other forms of prevention, treatment of the problem of waste generation, and accumulated to cumulative environmental consequences. Therefore, choosing a set of effective procedures for the reuse, recycling and recovery of different types of waste to minimize the effects of so-called hazardous waste in different ecosystems (Carlon, Pizzol, Critto & Marcomini, 2008).

Hazardous waste is a relatively small fraction of the total waste, which is characterised by the determination of actual or potential threats to public health and in general, the environment. Internationally, still the actual amount of hazardous waste generated is unknown, suggesting an amount of 400 million tonnes per year (Gay & Korre, 2006), but it is assumed that this amount is increasing. The OECD estimates that, on average, a shipment of hazardous waste every 5 minutes through the borders of the nations that make up the organisation, representing the movement of more than 2 million tons per year between European countries OECD (Gay & Korre, 2006).

Each year, develops and markets thousands of new chemicals and only a small fraction of these substances are actually tests to assess their toxicity, adding difficulties to risk management. The magnitude of the problems created by toxic substances, it is recognised that there is huge and global, ignoring much of its impact (Nathanail & Earl, 2001).

The management of the characterisation, evaluation and risk are essential for general or local, to quantify the problems of health and the environment. Risk assessment is a formal
characterisation and estimation of the magnitude of potential harm that results from exposure to hazardous substances in the environment, either from the perspective of human health (environmental risk) and ecosystems (ecological risk). This includes assessment of target populations, and intends to answer the following question (Nathanail & Earl, 2001):

What the resulting increase in risk to humans or ecosystem exposure to a quantity or concentration of substances for a period of time

With the risk assessment is expected to provide objective, scientific, able to inform policy decisions. In risk management takes into account the human and economic values and determines the extent to which risk assessments are needed and how to use them.

This conflict resulted in the operative notion of acceptable risk, ie what level of exposure that does not cause damage or allow you to offer a socially acceptable level, because it is assumed voluntarily, there is no alternative, is associated with benefits or not anybody benefits particularly in contrast experienced by some danger.

This is a non-biomedical social decision. For cancer, it has become customary to assume a non-tolerable exposure increases the rate of cancer mortality by more than 6.10. For example, assuming that 20% of people die from cancer, one in one million, that is, an
increase of 6.10, this means that instead of 200 000 200 001 deaths occur per million. This increased risk, in practice is not provable and therefore occupational exposure tolerates higher risk, 10.4 (De Sousa, 2003).

Finally, to characterise the risk, joins his evaluation with the evaluation of the exposure, divided into three steps: hazard identification, analysis of the dose-response relationship and the measurement of the exposure in question, using epidemiological data and experimental toxicology.

The exposure assessment combining information from multiple sources - analytical chemistry, biomarkers, studies and mathematical modelling of behaviour in order to estimate individual dose received. Exposure pathways related to air, soil, water or contaminated food reaching the body through the respiratory and digestive systems, skin, alone or in combination, which requires recognition and actually contact the human body, and absorbed into the blood path and finally reaches as target organs (Weber et al 2008).

By the same dopant, there may be different pathways. For example particularly organic mercury is taken through the marine food, but usually inorganic mercury is absorbed by inhalation. Knowledge of these facts is essential for the proper recognition of the risks in each particular case.

If the risk assessment (e.g., to determine the carcinogenicity of dioxins in particular (TCDD) property results generic and call it universal, the characterisation may include the risk has particular characteristics (e.g., a particular location exposure is mainly generated
by direct ingestion of soil, a practice that is expected of them children) that result in the management of flood risks to lead to the decision to consider the situation tolerable (e.g., maintain population in their place of residence) or not (Hester & Harrison, 2001).

Therefore, in evaluating problems that may result from those immediately affected by possible exposure to toxic substances, as is naturally the case of people working or living near industrial platform storage, handling or treatment of hazardous industrial waste, the questions that have to meet in a public health perspective are (Stokes, Paton & Semple, 2005):

You can expect a significant increase in average and maximum, the concentration of substances in the environment whose characteristics imply a recognised increased risk of cancer, nervous system disorders, respiratory diseases, development or reproduction.

This increase exceeds values compatible with the notion of acceptable risk. The answer to these questions is relatively simple, based on current knowledge about the technical processes involved in the different stages of the management of hazardous industrial waste and accumulated knowledge of toxicology, which inform us about the nature and magnitude of exposures and personal and environmental risks.
Ensure optimal operating conditions, including a monitoring program operations and the health of populations, the answer is unequivocally no (Swartjes, 1999).

This implies the negative recognition, first, as is increasingly evident, accidents are not due to chance or random joints can and should be avoided. On the other hand, if the exposures resulting from routine operations in that sense the best of current knowledge, not fear unexpected effects and professional health monitoring populations for alterations in stages early enough to reverse the problems.

However, it is possible in the light of current knowledge and respect of procedures that minimize costs, ensure the conditions of risk is also evident and essential to ensure free communication in time and reasoned that whenever new emerging information and can modify the tolerance limits. Plus establish an effective monitoring system can anticipate problems a strict knowledge of the local health situation (Tiller et al 2003).

It is well known that multiple residues, the variability of their origin and composition make it difficult, in general, an accurate assessment of its health effects. However, a large body of evidence confirms the severity of the potentially harmful nature of the health of populations. The routes of exposure are inhalation, skin contact and ingestion. From one point of view it’s especially important observable consequences the onset of asthma, respiratory hypersensitivity, pulmonary dysfunction, degenerative neurological diseases, problems and neurobehavioral development, congenital malformations, disorders of the male and female reproduction, and immune disorders and endocrine disorders such as diabetes and cancer (Linkov, Varghese, Jamil, Seager, Kiker& Bridges, 2005).
Chapter Three: Methodology

3.1. Outline of the methodology

For an approach to Environmental Management of Contaminated Sites (GASC), the author of this work has seen fit to propose the following three steps:

- The Initial Site Assessment
- The Exposure Assessment at Contaminated Sites and
- Site Remediation.

3.2. Initial Evaluation of Site (IES)

The objective of this step is to collect information on the site conditions, existing discharges, potential discharges, and saw as exposure. Researchers use this information to determine if it requires or a weekend on the site or to identify critical areas with extensive studies. The information collected during this stage and is the basis for determining whether the next step is necessary. The Preliminary Evaluation (PE) and Site Inspection (SI): 2 phases are distinguished (Ferguson, 1999).

3.3. Preliminary Assessment (PA)

The PA quickly wearable device collects information from a site, generating a List of
Hazardous Sites (LSP) which can then include and a National Priorities List (NPL). The PA is designed to recognise (based on limited data) sites that have little or no threat to human health and the environment, as well as sites that may be a threat and require extensive research. The PA also identifies sites requiring assessment for possible emergency response actions. If the PA recommends extensive research, then the site inspection (SI) will be performed.

3.4. Generating a List of Hazardous Sites (LSP)

Below is presented a system for an LSP. The lack of information is the main limiting because it creates ignorance in the system. Such ignorance is exceeded as they are completing the environmental studies intends to make in the next phases of the methodology. Consequently, ignorance should not be a barrier to obtaining a listing. Moreover, the listing requires area studies; awareness motivates decision makers and facilitates prevention plans. With this background, it should be clear that the list was prim contains information of potentially dangerous sites and only the actual degree of danger of each of the sites listed, after having obtained the analytical data would be set. Defined as potentially dangerous place to any area that is contaminated with hazardous substances potential entity. The substances can be solid, gaseous or liquid and its origin can be anthropogenic or natural. This methodology is applied principally for the study and treatment of contaminated soil and groundwater (Wcisło, Ioven, Kucharski&Szdzuj, 2002).
3.5. Responsible group

To generate a LSP, first what is proposed is the formation of a group of individuals whose responsibility will be to obtain the first state list. This group will consist of members of the central, local government and the private sector will additionally be considered some researchers representing different entities of civil society groups and members of non-governmental organisations interested in the subject.

To join the group, you must have several requirements, for example, have experience in environmental issues (Environmental Engineers - chemical - Geographers - Agricultural - Forestry - Agricultural -Industrial -Civil, biologists, architects, etc.), known region and have constructive mind-set to work with people from different disciplines and with different interests. Regardless of your ability, all members should receive group training course in the prioritisation method, to establish criteria understanding or technical definitions necessary for the exercise. The group should appoint a coordinator to establish standards meetings (Gupta, Vollmer & Krebs, 1996).

3.6. Categories for the preparation of the list

After developing the first list, the research proceeds to the uniformity of criteria under which hazardous sites are listed. Among the most important to establish before starting the exercise criteria, would be the definition of categories for identifying such sites. For example, what sites could be identified considering only those that are located in a particular region (municipal, regional, national, etc.), they had one polluted environmental
(groundwater, soil, surface water, air, etc.) that were impacted by polluting sources like’s (might be listed only the mining areas, oil, etc.). Contaminating they shared similar characteristics (such contaminated with pesticides or me, would be listed sites etc.). Finally could be listed based on general characteristics (Comes Alive taking all environmental media, all polluting sources and all types of contaminants in a predefined geographical region) sites (Pollard, Brookes, Earl, Lowe, Kearney & Nathaainl, 2004).

Once the scope of the list defined, gathering information needed to be begin, which can come from several sources including:

(a) The information obtained from the experience of the members of the group responsible,

(b) Data inventory of industrial emissions or pollution sources that may exist in the regions, and (c) the information collected from the GIS or statistical sources. In order to facilitate the listing of hazardous sites, we can start with the inclusion of sites in seven broad categories. These categories are defined as the base of the main sources of hazardous waste in Latin America.

### 3.6.1. Metals

The mines, smelters or metals as electrolyte, should be considered dangerous sites until proven otherwise. The miner waste can contaminate soil and especially water sources. Smelters, refineries and electrolyte can contaminate neighbouring sites to them, for the generation of metal powders and in some cases by the emission of toxic gases.
3.6.2. Agricultural Regions

Agricultural areas where pesticides are applied gas should be considered potentially dangerous because of the possibility of contamination on of soil and drinking water sources. Due to the large area which can end up having agricultural area, the definition of hazardous site in a region of this nature, you may be limited to those points where human contact with pesticides, e.g. rivers is allowed farming communities etc.

3.6.3. Macro industries

Given the lack of mechanisms for the proper management of industrial waste, backyard industries tend to have stored large quantities of hazardous waste, and in some cases, near industrial areas become vacant real uncontrolled deposits of this type residue. In the areas of influence of an industrial area should be monitored for contamination in all environmental media.

3.6.4. Oil industry (including extraction)

Industrial activity that revolves around the pet RP is highly polluting and hazardous waste generator and contains especially organic compounds.

3.6.5. Micro industry

In most countries, a large percentage of industrial activity is generated in the micro-industries. In view of the difficulty of environmental monitoring in these businesses, they
often become important sources of pollution. Within micro industrial twists that often cause problems are the brick, leather tanneries, battery recycling, small foundries, etc.

### 3.6.6. Uncontrolled Deposits

As solid waste should be considered a health threat (to discriminate is necessary to initiate the study of cities with a population over 100,000), illegal dumping and landfills for industrial waste Trials unregulated. The liquid waste should be analysed as it reaches areas where sewage industries and / or city are located (over 100,000).

### 3.6.7. Other

This section is left for sites that cannot categorise in any of the above classifications. Such is the case for contaminated sites Swim natural activity (volcanoes, hot springs, etc.), or those contaminated by chemical accidents (spills, road accidents, etc.) With radioactive impacted cavity, areas contaminated hospital waste areas, etc.

Importantly, at this stage, it’s all sites will be considered as potentially contaminated. Therefore, it should not be removed without any proof that there is no risk. It is certain that by the end of this phase count on a long list of sites to which there are large gaps. Therefore, we propose that all the sites listed will be subject to a more detailed study, which would be the Site Inspection (SI). However, as the next phase of environmental analysis required by the cost and time is important to first evaluate the sites that could be
the most at risk. In this context, a preview of the sites listed prioritisation is needed. It is reiterated that this prioritisation is not intended to eliminate sites but sort based on information obtained. The goal is to have the first sequence to study the most dangerous. It is necessary to emphasise this point, as to the accuracy of information a site that could be considered as non-hazardous (and therefore located in the last position of the list), could actually be dangerous (Komnitsas, Kontopoulos, Lazar & Cambridge, 1998).

By prioritising the list members should keep in mind two important factors: this is an interactive process and must meet those sites social vulnerability. As for the interactive process, the coordinator of the group should generate a mechanism for the list can be edited and fed back through the process and even after the group activity is completed. With regard to the concept of social vulnerability must consider the most socially vulnerable groups would be more likely to have damage events by the presence of contaminants.

3.7. Site Inspection (IS)

The SI is the phase that follows the production of a list of hazardous sites. Listings usually include a large number of sites, so it is necessary that inspection is a simple and inexpensive phase. In addition, the inspection must have sufficient quality to conclude with certainty whether or not a site is contaminated with chemicals and / or pathogens. The IS phase comprises five activities: site visit, monitoring of environmental pollution, selection of critical pollutants, preliminary analysis of exposure pathways and preliminary risk
estimation. The sites are rated inspected to determine if they require further analysis (Hough et al 2004).

3.8. Description of the site

The report should describe the generalities on the site location, demographics (size and distance from the nearest populations), the environmental issue (brief history and general background) and the main complaints from the public about the problem. The site description should be brief but complete.

3.8.1. Types of pollutants

Clearly, without previous chemical analysis, it is difficult to accurately determine the contaminants present at the site. However, during the visit itself can be defined with sufficient clarity the types of pollutants, i.e., tracks to an inorganic, organic or microbial agent compound. To reach such a definition of the site seen, you need to set the highest possible accuracy, the source of contamination. Interviews with local authorities and the population are of utmost importance for this purpose.

3.8.2. Exposure Points

Exposure points are places where people come into contact with contaminants, such as faucet for drinking water source, soil in areas of child recreation, food, etc. A good
selection of points of exposure is very important as environmental sampling should be performed precisely on them. The relevance of the exposure points is determined by the following factors:

(1) Apparent level of contamination (Contaminated areas vs points away from the source of contamination),

(2) Number of people affected at each point, for example for a rural town with one water faucet where the entire community is served,

(3) Type of people affected (children, adults, the elderly, women of reproductive age, etc...).

During the site visit, the assessor responsible for the study should also identify areas where no evidence existed of pollution, because in them taking basal samples (used to establish the natural level of pollutants in the area shall be study).

3.9. Environmental Pollution Monitoring

This section aims are total sampling and determination of pollutants by chemical analysis in the laboratory.

3.9.1. Environmental Sampling

Sampling should be performed at the point of ex position for which should cover at least the most important points. It is important that sampling occurs more low quality rules.
Accordingly, the reader is invited to consult the professional manual sampling, as published by the Agency for Toxic Substances and Disease Registry (ATSDR). In the second stage of this manual describe in more detail what the requirements for a good sample in each of the different media environment. The selection of environmental media is to be sampled at the stage of IS at the discretion of each evaluator.
Chapter Four: Result Analysis and Discussion

4.1. Environmental Analysis

For discussion of this point, you should be clear about the concept of IS. That is, one must understand the need to investigate a large number of sites in the shortest time possible and without using tools involving an outlay. At the same time quality and accuracy is required. How to achieve this balance in sites for casual lacks sufficient information? Everywhere you will find three possible after contamination: by inorganic compounds, organic compounds and biological contaminates (microorganisms).

Referring to inorganic compounds, should focus primarily on metals and non-metallic minerals. Under our experience, would suffice to identify the most common toxic elements, such as chromium, mercury, manganese, nickel, lead, arsenic and fluoride. However, in some places it could present contamination by elements not included in this list, such as copper, cobalt to, barium, etc. This uncertainty is terminated if one of the samples is analysed by the emission of plasma, with the purpose of obtaining a "sweep" of all metals. Endo met the most abundant metals; the remaining samples can be analysed through cheaper methods such as atomic absorption spectrophotometer. Many sites will not be quantified all metals, but only the most important concentration and toxicity by gas. Alternative analytical methods may be colorimetric. This alternative is valid, provided that the laboratory performing these methods counts on quality control parameters, including the possible analytical interferences due to the presence of other substances.
The analysis of organic compounds is more complicated since these compounds comprise at least three groups: volatile and polar compounds semi volatile. For this, a lab that is at least chromatographs gas is required (with accessories such as purge and trap, "headspace" mass detector, electron capture detector, etc.) and liquid chromatographs with its own detectors (fluorescent, UV, etc.). Furthermore, quantitative analysis is extremely expensive, the price of inputs that are required not only for the analysis itself (columns, gases, etc.) but also for sample preparation (extraction elements). That is, it requires a laboratory equipped with significant financial support. It could be that these points are not met in a phase of IS, especially regarding the financial support. By cons alternatives must be sought. One would only quantitative analysis of the most important compounds for the study site.

Regarding microbiological contaminants, analysis of water and food is accessible, as there are numerous methods for both bacteria and parasites. The point is complicated in soil analysis. For this environmental medium is limited information on the methodological analysis of pathogenic microorganisms from Maria e. Another key point in terms of microbiological studies is the detection of the virus. Assays for such biological agents are generally expensive. Again, it is up to the laboratories define whether at the stage of IS, it is essential to study soil and / or viral elements to dangerous sites. In all cases, the information must completed microbiological data collected in the health centre nearest to study. It is important to remember that in the final report, the information obtained must be presented in text and graphics (figures, tables, etc.). The information shall include at least the following: design and representativeness of sampling, analysed through the atmosphere, sampling date, location of the sampling points and consent rations found in the analysed media.
4.2. Selection of critical pollutants

The importance of the contaminant levels may be determined is found by comparing its concentration against reference values. The evaluator may use domestic securities, such as the rules used in the country or international benchmarks, such as the World Health Organisation, EPA, European Economic Community, etc. However, it should be noted that it is very difficult to obtain a reference value of some contaminants in some media. Therefore, to estimate the importance of pollutants, their concentration is compared against a reference value called Environmental Assessment Guide for Media. EMEG these values have been proposed by ATSDR.

It is important to note that EMEG is not an environmental standard. Its only function is to serve as a reference for defining critical pollutants site. The use of EMEG is based on the fact that their calculation takes into account the dose at which the contaminant causes no damage (ATSDR MRL or RfD EPA). Thus, EMEG becomes maximum environmental safety guide. Therefore, a contaminant concentration in the environment which exceeds the EMEG in any means must be subject of a toxicological analysis. A pollutant that does not exceed the EMEG in any of the media analysed could be discarded.

The calculation of the EMEG dose is obtained by multiplying the minimum risk of ATSDR (MRL) or reference dose of EPA (RfD) for corporal weight and dividing the product by the daily rate of ingestion of water, soil or dust.
MRL or RfD = Information on the RfD of each substance can be obtained from IRIS data Bank TOXNET system, the MRL may be obtained from the literature published by ATSDR.

PC = body weight = 10 kg / infant, 14 kg / child (3-6 years) or 70 kg / adult.

TI = daily ingestion rate of water = 1 litre / 2 litre child / adult.

Daily ingestion rate of soil = 350 mg / child and 50 mg / adult.

Daily intake rate of powder = 35 mg / 5 mg and child / adult.

(Since there is no reliable value in the literature, for calculating dust intake uncertainty factor of 10 was used with the floor intake factor)

Note that for the calculation of the EMEG used have no exposure factors such as the rate of bioavailability. Therefore EMEG is a conservative factor as it seeks to prevent the maximum risk. However, for this reason EMEG should not be used as an environmental standard. RFD (Reference Dose) is the reference dose that EPA has available in a database for inhalation exposure and ingestion of toxic elements (on this dose is NOT harmful substance).
MRL (Minimal Risk Levels) is an estimate of daily human exposure to a hazardous substance (under doses this substance is NOT harmful). Available online (Fig. 3) at the following Web page: http://www.atsdr.cdc.gov/mrls.html It seems important also indicate in the following list if the top 20 hazardous substances defined by ATSDR the game 275 priority substances for 1999 can be accessed on the web indicated above:

Top 20 Substances

1. Arsenic
2. Lead
3. Mercury
4. Vinyl Chloride
5. Benzene
6. Polychlorinated Biphenyls (PCBs)
7. Cadmium
8. Benzo(a)pyrene
9. Polycyclic Aromatic Hydrocarbons
10. Benzo (b) fluoranthene
11. Chloroform
12. DDT, P’P’-
13. Aroclor 1260
14. Aroclor 1254
15. Trichloroethylene
16. Chromium (+6)
17. Dibenz[a,h]anthracene
4.3. Preliminary analysis of exposure pathways

After selecting the critical pollutants, the evaluator should assess the possibility that in the future these pollutants are in other environmental media. To make this theoretical exercise, you should consider the physicochemical principle of each substance. With them may determine the transmission capacity of the substances through the media and, therefore, may define its destination ambient al. The evaluation of transport mechanisms is very important to determine the possibility of potential beyond the sampled areas and the need for additional studies of environmental sampling contamination. Overall, the environmental transport involves the movement of gases, liquids and solid particles within a given medium in and through air, water, sediment, soil, plants and animals. When a substance is emitted to the environment one or more of the following events may occur:

- Movement (In water, suspended sediment, etc.).
- Physical Transformation (Volutility, rain, etc...)
- Transformation ¾ Chemistry (photolysis, hydrolysis, oxidation / reduction, etc.)
  Biological Transformation ¾ (Biodegradation, etc...) And / or ; accumulation in one or more media (including the originally contaminated environment )
Usually the mechanisms of transport and fate of contaminants can be simplified into four basic categories:

**Issue:** Escape or discharge of contaminated material from the source.

**Advection:** Contaminant migration in the direction of motion of the medium (e.g., migration in the direction of the current in the direction of prevailing winds, by the washing of soils by surface currents, etc.).

**Dispersion:** Distribution of contaminants in a liquid, gas or solid, due to the collision of the contaminant present in phase material.

**Attention:** Decrease the amount of the pollutant in the environment by degradation phenomena or adsorbing elements of the medium itself.

An evaluator should seek answers to the following questions:

- How fast are the pollutants entering the environment? (emission)
- Where contaminants are heading and how fast are you moving? (advection)
- What is the degree of degradation of pollutants while migrating? (attention)
- Are the contaminants migrated to other media? (Modal media).
4.4. Chemical factors affecting the fate and transport of contaminants

The evaluator should consider the chemical nature factors that could influence contaminant transport. Some of them are discussed in the following paragraphs.

Solubility in water: Highly water soluble compounds with a low affinity adsorb soils. Therefore, they are rapidly transported from the contaminated to the surface water bodies and/or deep soil. The solubility ESI affects volatility from water. For example, highly water soluble compounds tend to be less volatile and highly biodegradable.

Constant Henry’s Law (H):

When the vapour pressure is high relative to its solubility in water, the constant of Henry’s law is also high and the compound preferentially evaporates into the air. Partition coefficient of organic carbon (Koc): A "Koc" high indicates that the organic compound is fixed firmly to the organic matter in the soil, so little of the compound to surface water or groundwater leaves. A low "Koc" suggests the possibility that the compound may go to water bodies.

Octanol / water partition coefficient (Kow)

Chemical compounds with high values of "Kow" tend to accumulate in lipid portions in agencies and focus on soils and sediments (compounds with a "LogKow" > 3 to > 1000).
In addition, this class of compounds can be transferred to humans through the food chain. Conversely, compounds with low "Kow" tend to be distributed in the water or air.

**Bio-concentration factor (BCF)**

This factor is determined by dividing the equilibrium concentration of a chemical in an organism or tissue (such as a fish) between the concentration of the compound in an external form (such as water where fish inhabiting). In general, compounds having a high value of "Kow" have high FBC. However, some compounds such as aromatic hydrocarbons, hydro-carbons do not accumulate in fish and vertebrates despite their high "Kow". This is because fish have the ability to quickly metabolize these compounds. In addition, bio magnification is a term used when an organism in a tropic level superior is able to accumulate greater amount of pollutant that a body of the same chain located in lower tropic level.

**Speed of processing and degradation:**

This factor takes into account the physical, chemical and biological changes of a pollutant over time. The transformation is influenced by hydrolysis, oxidation, photolysis and degradation. As biodegradation is the breakdown of organic compounds for biological activity, often by microbial activity. It is difficult to calculate with precision speeds chemical transformation and degradation. Its application is also difficult to, since all depends on specific physical and biological variables of the study site.
4.5. Site Factors influencing study the fate and transport of contaminants

When identifying possible transport route, the evaluator should also consider factors specific to the study site that could influence the transport of pollutants. Each site is unique and must be evaluated to determine the features that may increase or reduce migration of contaminants of importance. Many of the factors that affect the transport depend on climatic conditions and physical characteristics of the site. Some of these factors are discussed in the following paragraphs. Index of annual rainfall: This information can be very useful in determining the amount of drag by surface soil, average aquifer recharge and / or moisture content in soils. A high annual rainfall at a contaminated site with a very important cause a water-soluble compound and migration. Further rainfall is a phenomenon of attenuation for air as particles and vapours present in the atmosphere.

i. Temperature conditions:

Affect the rate of volatile contaminants. Furthermore the Earth’s temperature treatment also affects the movement of contaminants, for example, a frozen area slows the movement. Speed and direction of winds: Influence the rate of generation of fugitive dust. During periods of atmospheric stability, gravitational settling again acts to deposit suspended particles or droplets.

ii. Geo-morphological features:

These characteristics may play an important role in the speed of water currents as well as the volume and the rate of removal of soil by surface phenomena. The land on limestone can increase the hydrologic connections between surface water bodies and aquifers.
iii. **Hydro-geological characteristics:**

The types and location of aquifers are important in determining the risk that the site represents for sources of drinking water.

iv. **Surface water channels:**

Flood channel and near the site may also affect the extent of migration of the contaminants.

v. **Soil characteristics:**

It should consider the following parameters: architecture, composition, porosity, permeability, exchange capacity and mulch. These parameters influence rates per collation, recharge, contaminant leaching and transport. To delineate the contaminated area, you need to have the information of the basal levels of metals, organic compounds and pH in soils of the area.

vi. **Flora and fauna:**

The man may use the flora and fauna as a food source thus facilitate human exposure. Public works sewers or drainage channels can facilitate the movement of contaminants. Similarly, a poorly constructed well can cause contamination between aquifers.
vii. Preliminary estimate of risk in Human Health

The method for the preliminary estimate of risk set forth below is based on the risk estimation methodology developed in the United States. In its original formulation, the methodology consists of four phases, to which he has included a fifth stage to emphasise aspects that could modify risk in health:

- contaminant
- Dose-Response Analysis
- Exposure estimation
- Risk Characterisation
- Factors associated with risk (including microbiological).

4.5. dose-response analysis

Through different investigations, EPA has defined a set of reference dose RfD for different chemicals. From manner defined ATSDR minimal risk doses MRL. Both ratings imp dose that these chemical substances are not harmful levels, i.e. a contaminated a similar dose RfD or MRL should not pose a risk for the vast majority of individuals. The RfD and MRL are theoretical doses that have been generated through dose-response curves. Both the RfD as the MRL were obtained dose exposure in the first adverse effect occurs. If a substance will cause several adverse effects, only the lowest dose that is presented is
considered for calculating the RfD or MRL. It is important to remember that because of limited scientific studies, for some substances have not calculated the RfD or MRL. The assessor should obtain information from RfD IRIS data bank (bank information EPA) and from MRL database ATSDR. Numerical information generally to studies that led to the reference dose or minimal risk is associated. i.e., by the value of the two is you can obtain information on the effect selected for calculation. In the end, the evaluator will have three types of doses in mg / kg / day, which should always be considered for the same route (oral, dermal or inhalation) and to the same effect or condition:

The RfD and / or MRL = Dose security which should not have any effect

The NOAEL = maximum dose at which no observed adverse effect.

The LOAEL = lowest level in which already some kind of adverse effect was observed.

Image 2: Panoramic View of the Bay of (old mine tailings deposit)

4.6. Estimation of exposure
As the title suggests, this section seeks to know about the dose of contaminant that is being absorbed by the exposed individual. The estimate is derived through formulas listed below. It is important to remember that for the IS phase, it was decided not to carry out analytical studies in air, by the time it takes a good sampling. Therefore, the estimated exposures to airborne contaminants are made only when count on reliable data from other sources. Otherwise, one of the recommendations arising from the study of inspection could be of an air monitoring study. To estimate exposure some simple rules are followed:

- Consider only environmental media for which are no reliable analytical data.

- Record the minimum concentration, maximum and average critical pollutant for selected environmental.

- Analyse the route of exposure for the critical path (for soil ingestion, dust, food and water, air inhalation, dermal Organic, etc.)

### 4.7. Factors associated with risk

Everywhere there are factors such as populations, geographical, climatic, etc which can alter contaminant exposure or toxicity of this. Such factors should be noted in this section with a discussion of its meaning. In the case of developing countries, a factor that should be considered in all situations: the nutritional factor. Malnutrition weakens natural defences. Furthermore, May described absorption of some metals in individuals with diets low in iron, calcium or protein. Another factor to consider is always to microbial diseases.
4.8. Final Analysis

In the end, the evaluator must have three sources: obtained from the risk characterisation, the source obtained by evaluation of associated risk factors and bibliographic records concerning toxicity and behaviour of pollutants. With all this information it will proceed to generate a scheme for risk. It is very important that in one or two paragraphs the evaluator can provide a comprehensive overview of the problem. For example, experimental toxicity data, which have not yet been corroborated in humans, could be useful from the use of the precautionary principle. It is reiterated that the assessor should take into account all the information as a whole and not based solely on duty to a line of research.
Chapter Five: Conclusion

It is recognised now that every aspect of the environment potentially affects health for better or worse. This applies not only to specific agents (microorganisms or other biological, chemical or physical agents), but also the elements of urban and rural environments: home, workplaces, leisure facilities, infrastructure and components. The natural environment such as air, soil, water and other parts of the biosphere. Until recently when it comes to health is understood as only human health. We now recognise that the environment sick man is also affected. Therefore, it is more logical and efficient to seek to develop procedures to relate health effects of man to dependence associated factors, and economic factors and the environment, or that we will study together the effects on human health and ecosystems (Environmental Health).

In our daily activities, each of us comes into contact with pollutants, breathing, drinking water, eating food, playing solos and dust. This contact between people and pollution, called “exposure” requires simultaneous occurrence of two events: the presence of a contaminant in a complex environment (eg, water, air, soil and food) and contact between a person and one or more of these compartments. The logic of industrial development and technological innovations in the chemical industry has fostered a growing risk a much higher rate than the capacity of scientific and institutional review and manage them.
References


