A SYSTEM FOR THE PRIORITISATION OF POINT SOURCES

A summary of the site prioritisation methodology used in the GeoEnviron Contaminated Land Module

GeoEnviron

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TERMINOLOGY

The following gives short definitions of the meaning of certain terms as they are used in the report and in this document.

*Contact Risk**:*** refers to the possibility that humans will come into contact with polluted soil or gases. The possibility of humans coming into contact with polluted water is not considered in this definition.

Degradation: refers to breakdown of potentially hazardous contaminants to their harmless derivatives in the natural environment.

Hazard: a substance, property or situation that in particular circumstances could lead to harm. The hazardous nature of a contaminant is valued according to its mobility, toxicity, degradability and volatility.

Mobility: the mobility of a contaminant in soil is defined relative to groundwater velocity and is a function of dispersion, sorption, ion exchange, solubility etc.

Pathway: the mechanism by which the receptor and source can come into contact.

Receptor: the entity that is vulnerable to the adverse effects of the hazardous substance or material.

Risk: a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

Risk characterisation: a preliminary evaluation of risks on a site. Risk characterisation differs from risk assessment in that the level of information required to carry out a characterisation can be a fraction of that required to carry out a risk assessment.

Risk Screening: identification of all major hazards and receptors

Source: the hazardous site, substance or material

Source strength: refers to the gas generation capability of a waste disposal site at any given moment.

Toxicity: refers to the relative ability of a particular chemical substance to cause harm to a living organism. The toxicity of the chemical is dependent on the environmental receptor being considered.

Volatility: This is defined as the propensity of a chemical to vapourise and is measured using Henry's Constant.

1. INTRODUCTION

For most Local Authorities, the implementation of their contaminated land strategies will begin with a desk top study. The information acquired from this exercise will then be used to set priorities for further investigation and remediation. Setting priorities is important for decision-making as it helps to promote transparency by ensuring an explicit and justifiable basis for decisions (DETR, 2000).

The USEPA and the UK Environment Agency advocate the use of the "*source-pathway-receptor*" concept as the basis for risk assessment. A *tiered approach* where risk management questions are answered at each stage is recommended.

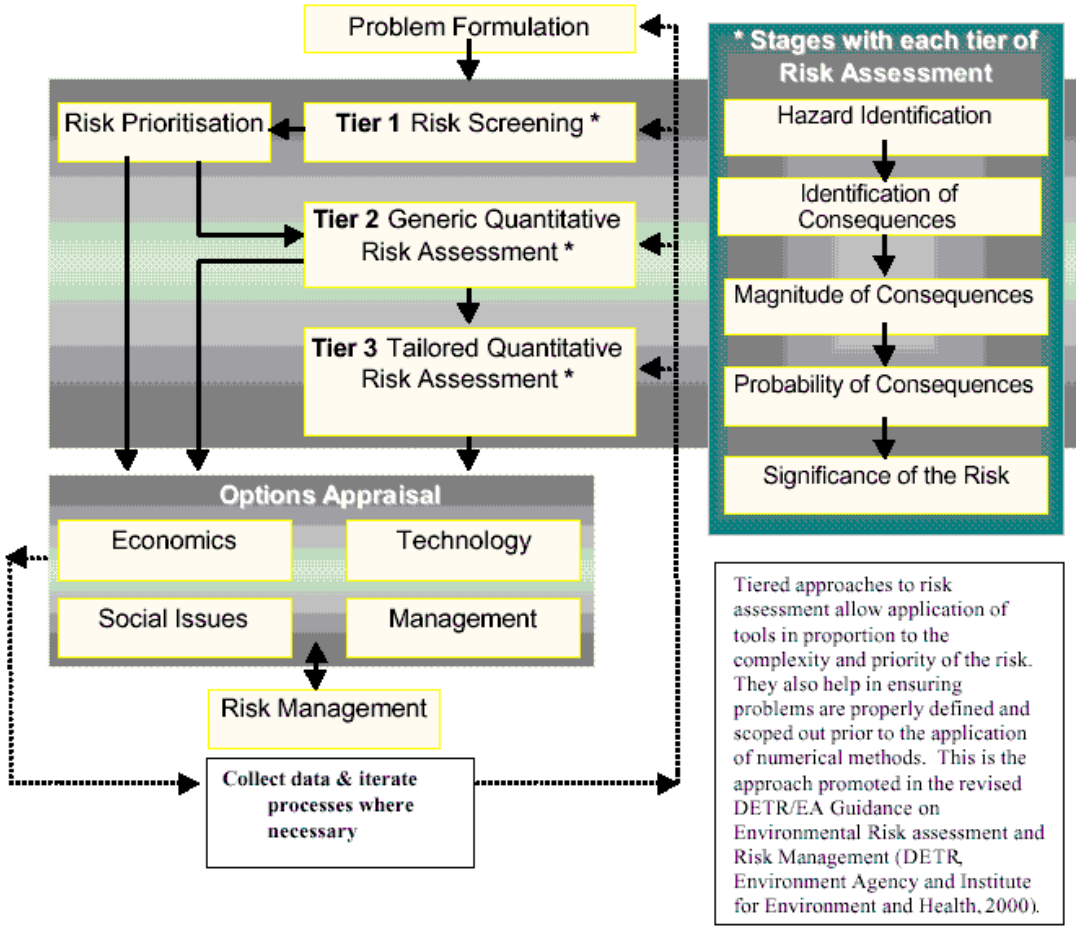

Figure 1 - A tiered approach to risk assessment
(Source: DETR, Environment Agency and Institute for Environment and Health).

As can be seen from the figure above, the first tier of the risk assessment process involves hazard identification, risk screening and prioritisation. This process is used to determine which hazards or risks should be investigated in more detail. The process helps to minimise unnecessary effort and reduces the chance of potentially important risks being overlooked. In addition, it provides an auditable trail to support or explain the omission of certain risks from further consideration. It also helps to identify risks where action, as

opposed to further investigation, may be preferable (DETR, 1999). Ultimately prioritisation provides a mechanism for targeting resources towards those sites that present the greatest risks.

There are various prioritisation methods available. One simple and effective method is to rank hazards based on screening scores, thereby providing a priority list for further action.

Geokon have produced a computer based environmental information management system known as GeoEnviron, which among other things, includes a module dedicated to managing information related to the identification, risk assessment and remediation of contaminated land. The module has built within it, a site prioritisation system for use in *tier 1* of the risk management process.

The prioritisation system uses the Source-Pathway-Receptor concept to assess risks. It is split into two stages. The Stage I assessment involves hazard ranking sites based on their historical industrial uses and the receptor's sensitivity. The Stage II procedure involves refining the assessment from Stage I by carrying out an exposure assessment.

The stage I assessment can be carried out very rapidly, providing that source and receptor information is available. The assessment produces a priority listing of sites for each type of receptor considered.

The Stage II assessment involves refining the priority listing obtained from stage I, by carrying out a pathway or exposure assessment to determine whether or not a potential pollutant linkage exists. The priority listing arrived at after Stage II can be used to inform decisions as to which sites should be investigated further under the Part IIA regime. In many instances the information yielded after a stage II assessment will be sufficient to enable a decision to be taken as to whether a site should be determined 'contaminated'.

The GeoEnviron Site Prioritisation methodology is similar to that proposed in Contaminated Land Research Report No. 6 (CLR6) in that it is not designed to produce a single site risk score that encompasses all the different receptors types. Instead it requires that policy decisions are taken with respect to the relative priority that is assigned to each of the receptor groups. These decisions should be made after taking local circumstances into account.

The main part of this document details the Stage I and II of the GeoEnviron site prioritisation methodology. The Appendix, which contains screen shots of the GeoEnviron system's risk assessment tab folders, describes how both the Stage I and II site prioritisation methods have been implemented practically within the GeoEnviron system.

2. BACKGROUND

The prioritisation system has been developed to fulfill the needs of local authorities to identify, register and deal with contaminated sites.

Overall Aim: To establish a prioritisation system for contaminated sites about which little is known.

Requirements:

- The system should prioritise sites based on their potential risk to humans and the environment;
- The system should be simple and transparent;
- Site characterisation should be based as much as possible, on existing data;
- Site prioritisation should be based on a uniform method;
- The system should be objective and verifiable (i.e. others performing the exercise should be able to arrive at the same score);
- The system should be capable of being used at both local and regional levels;
- The time used to prioritise sites should be minimal.

The prioritisation system caters for:

a) regional prioritisation of sites in terms of their requirement for detailed site investigations;
b) regional prioritisation of sites in terms of their requirement for remedial works;
c) national prioritisation of sites.

The system characterises sites according to their impact on three receptors:

a) *Groundwater* - considered mainly with regard to its value as a drinking water resource;
b) *Land Use related receptors* – the term land use related receptors encompasses the use of land by humans, wildlife, plants and buildings.
c) *Surface water* – considered mainly with regard to the desired quality objective of the water body.

The characterisation of each site results in a *Risk Score* for each receptor, which can then be used to prioritise the sites in terms of the need for detailed site investigation and/or remediation.

3. DATA REQUIREMENTS

In an ideal situation, data on geography, hydrogeology, contaminant properties, current and historical site uses as well as information on animal use and behavior patterns would be available for a risk assessment. In acknowledgement of the fact that this is rarely the case, this method has been designed such that it has very minimal data requirements.

Where the data required is not available, implementation of the method can be based on assumptions. In such cases, the user is advised to assume a worst case scenario for each situation. Further information should then be collected in order to verify assumptions made and further refine the priority listing.

Information on former and historical land uses can in most instances be obtained fairly readily these days. It can be accessed from archive libraries or purchased from the increasing number of commercial organisations offering historical land use information for sale. One of the methods most important data requirements is information on contaminants likely to be present on the site. Information on typical contaminants associated with industries can be obtained from a variety of sources including the DOE industry profiles, which are included as part of the GeoEnviron system. Site specific information necessary for the exposure assessment can be obtained from land coverage's in a GIS, aerial photos, from documentation held by the local authorities or alternatively by carrying out site walkovers.

4. STAGE I SITE PRIORITISATION

Before arriving at the stage of site prioritisation you should have compiled a list of potentially contaminated sites. This can be done using sources and receptor information which will usually be available in a GIS. A simple spatial query can then be performed in the GIS, to find out for example, areas where sources and receptors overlap. A buffer zone can be incorporated within the spatial query, in cases where the source contamination is considered to have the potential to migrate. The areas identified via the spatial query are considered to be the potentially contaminated sites. The list of potential sites obtained from the GIS is then imported into the GeoEnviron Contaminated Land Module.

The different classes of receptors in the area along with a sensitivity score for each receptor is also entered in the base tables of the database. Receptors are divided into 3 broad categories - land use, groundwater and surface water. Land use receptors are further sub-divided into humans and protection zones (i.e. nature conservation reserves, SSI's, RAMSAR sites, listed buildings, etc). Following this, a list of receptors that each site may potentially impact is captured from GIS and imported into the database.

The first stage of the site prioritisation is based solely on the types of industrial uses the site has been subjected to and the sensitivity of the potential receptors. The issue of pathways is considered in Stage II. The GeoEnviron system contains as standard detailed information on all the DOE industry profiles. An objective methodology (which is not detailed here) has been used to derive hazard scores for each of the profiles in relation to land use, ground and surface water receptors. The hazard scores have been derived by considering the contaminants likely to be present on the site. Information on potential contaminants of concern is available from CLR8 "Potential Contaminants for the Assessment of Land". A spreadsheet is available with the GeoEnviron system to enable the same objective methodology to be used to rate industries that do not fall within the scope of the DOE industry profiles.

An example of risk categorisation and hazard ranking for a selection of the industry profiles is shown in the tables below.

Note: All the scores used in the GeoEnviron risk ranking are user configurable. The numbers presented below are only examples.

Table 1: Example of Stage I Prioritisation Risk Categories

Risk Category	CODE	Score
Very High	VH	6
High	H	5
Medium High	MH	4
Medium	H	3
Medium Low	ML	2
Low	L	1

Table 2: Example of Industry Profile Hazard Ranking

INDUSTRY PROFILE	LAND USE	GROUNDWATER	SURFACE WATER
Airports	M	MH	MH
Animal and animal products processing	M	L	L
Asbestos manufacturing works	VH	MH	MH
Ceramics, cement and asphalt manufacturing works	LM	L	L
Charcoal works	MH	MH	MH
Chemical works : Coatings (paints and printing inks)	MH	M	M
Chemical Works : Mastics, sealants, adhesives & roofing felt	M	M	M
Chemical works: Cosmetics and toiletries manufacturing works	L	M	M

As mentioned above, the different classes of receptors are rated in terms of their sensitivity. For human receptors, the sensitivity rating is carried out by assessing the current land use. For the groundwater receptor, the rating is carried out by considering the groundwater class. For surface water receptors, the rating is carried out by considering the water body's quality objective. An example is given below.

Table 3: Example of Land Use Sensitivity Rating

Land Use	Sensitivity	Score
Residential Houses with gardens	H	5
Residential without gardens	M	3
Commercial with soft cover	M	3
Commercial (no soft cover)	L	1
School with play grounds	H	5
Nursery	VH	6
Allotments	VH	6
Park	H	5
Nature Conservation Area	H	6
SSI or RAMSAR site	H	6

Table 4 : Example of Groundwater Sensitivity Classes

Groundwater Class	Sensitivity	Score
Major Aquifer	H	5
Intermediate Aquifer	M	3
Minor Aquifer	L	1

Table 5: Surface Water Sensitivity Classes

Surface Water Quality Objective	**Sensitivity**	**Score**
Major Aquifer	H	5
Intermediate Aquifer	M	3
Minor Aquifer	L	1

4.1. Calculation of Stage I Site Risk Score

The stage I site risk scores for each individual potentially contaminative industrial site use for each receptor is then automatically calculated using the following simple algorithm:

SRS= IRS x RSS

Where:

SRS = Site Risk Score
IRS = Industrial Risk Score
RSS = Receptor Sensitivity Score

When using the default scores, the maximum site risk score for land use related receptors is 30. The maximum for ground and surface water receptors is 25.

Using these site risk scores, one can rapidly obtain a site by use by priority listing.