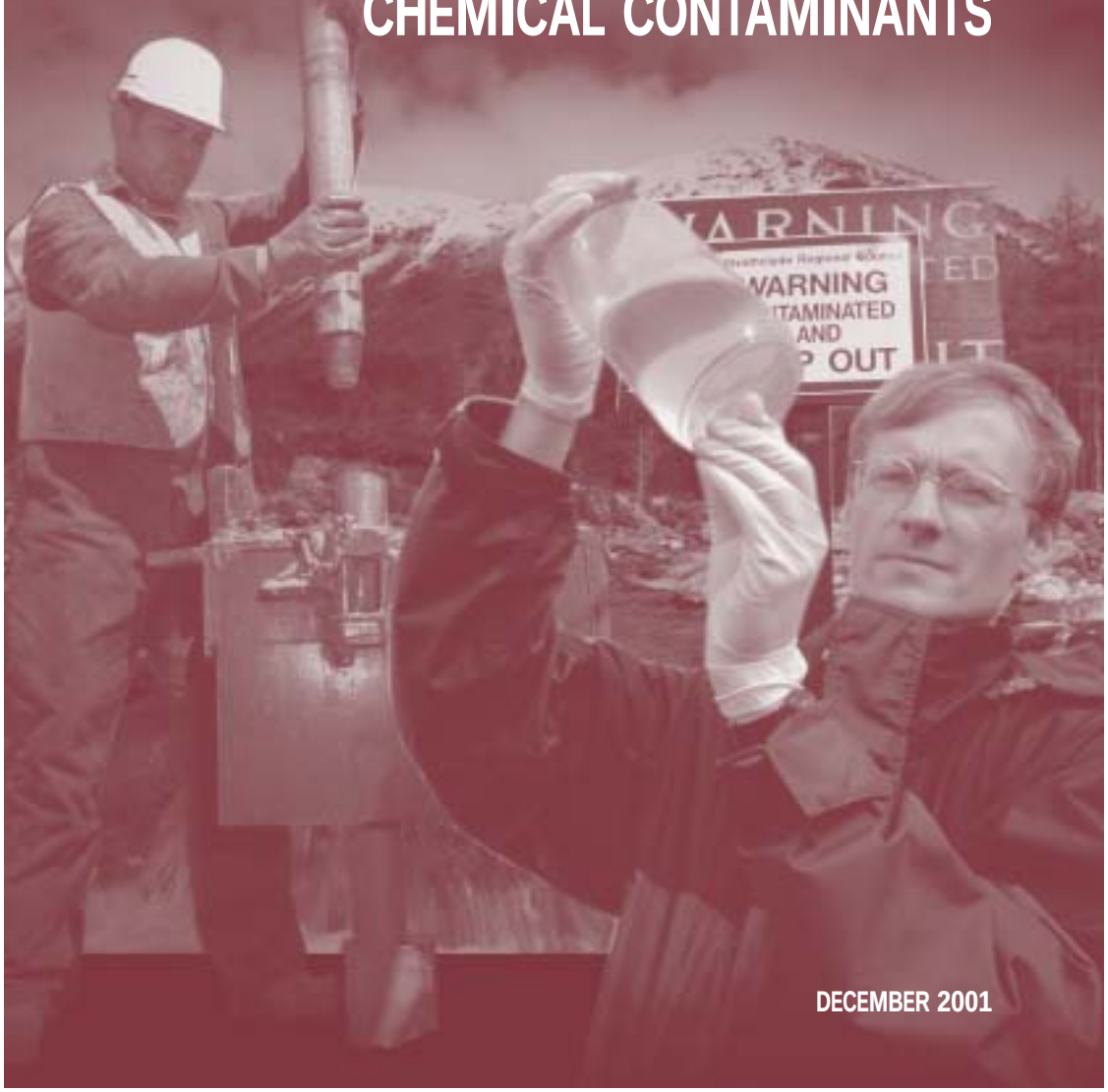
SEPA
Scottish Environment Protection Agency

WATER POLLUTION

ARISING FROM LAND CONTAINING

CHEMICAL CONTAMINANTS



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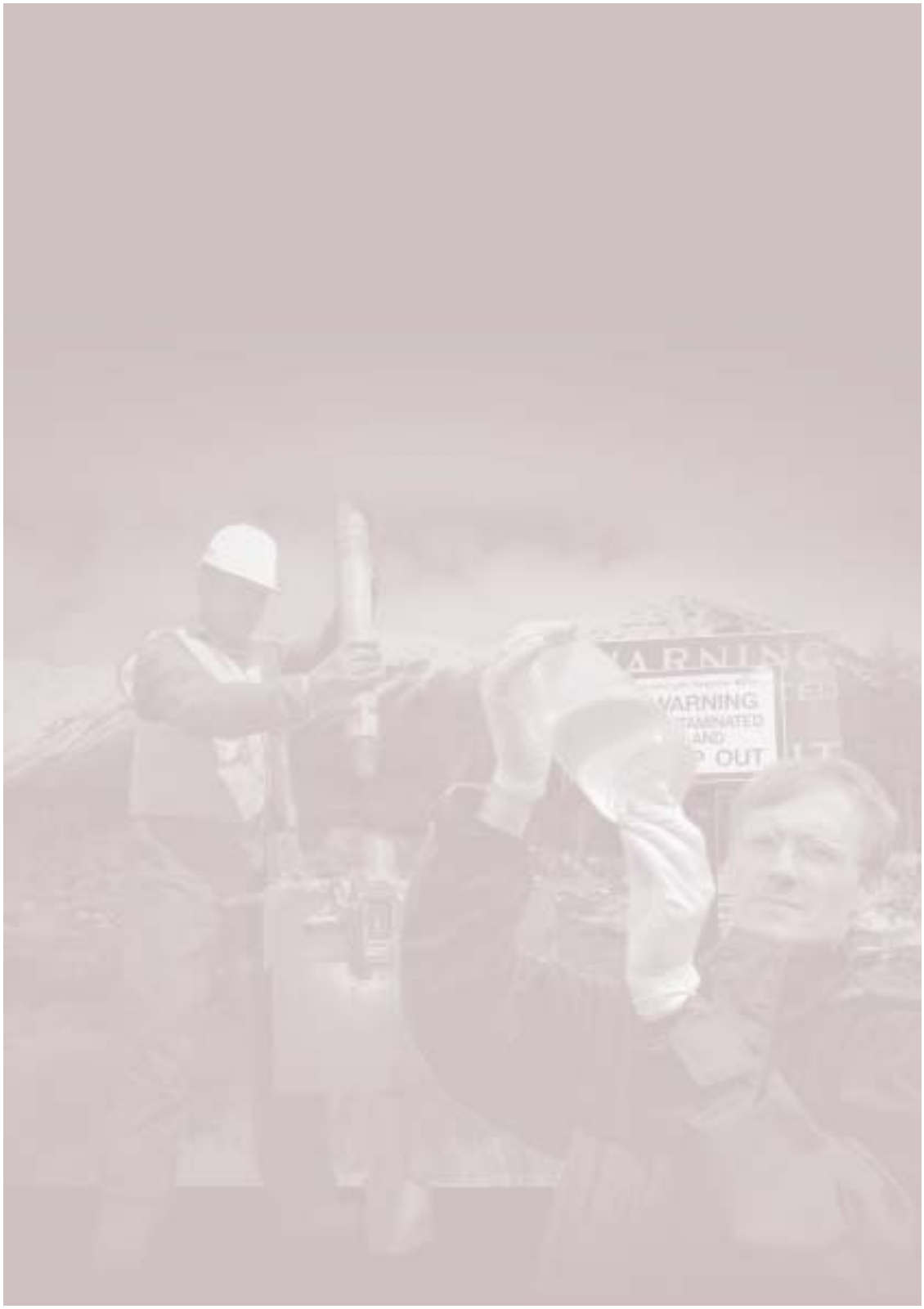

VARNING

1. Introduction

1.1 Purpose and Scope

This booklet aims to assist those involved with assessing land which contains chemical contaminants in making their own judgement as to whether the land is causing or is likely to cause water pollution. The information contained within the booklet is general and readers should refer to other publications for detail on specific aspects. It has been issued to provide an indication of SEPA's general approach and the type of advice that SEPA is likely to provide when consulted by local authorities. It does not represent a statement of SEPA's policy and has no legal status. Third parties should always seek their own advice on matters of legal, as well as technical interpretation, and tailor any contaminated land assessment to the site under consideration.

This booklet is specifically aimed at land which is being assessed or dealt with under Part IIA of the Environmental Protection Act 1990. However, it may also be useful in other contexts, in particular when considering any risks associated with land subject to planning controls. The information in this booklet is only applicable to Scotland.

1.2 Legislative Context

The concept of water pollution is important as it is one of the two reasons for land being identified as contaminated by a local authority. Section 78A of Part IIA indicates that:

"contaminated land is any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that -

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be caused."

The decision as to whether or not such pollution is occurring rests with local authorities, who are obliged by paragraph B.43 of the statutory guidance contained in Scottish Executive Circular 1/2000 (the Statutory Guidance), to adopt an approach consistent with that adopted by SEPA and to consult with SEPA when making a determination regarding pollution of controlled waters. Whilst pollution may trigger the identification of contaminated land, remediation can only be required under Part IIA where it is reasonable.

Although all linkages may be relevant in planning and other contexts, Part IIA only considers those which are 'significant'. A pollutant linkage is significant if it results in pollution of controlled waters or is likely to result in such pollution (A.20, Statutory Guidance).

Paragraphs A.38 - A.42, B.50 and B.51 of the Statutory Guidance provide guidance to local authorities on the determination of pollution of controlled waters. Pollution of controlled waters is defined in section 78A(9) of Part IIA as "the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter". Controlled waters are as defined in section 30A of the Control of Pollution Act 1974 (as amended) (COPA) and in general include (COPA should be referred to for the exact definition):

- relevant territorial waters, i.e. waters extending seaward for three nautical miles from the baselines from which the breadth of the territorial sea adjacent to Scotland is measured.
- coastal waters, including waters extending from the baselines above as far as the limit of the highest tide or as far as the freshwater limit of any relevant river or water-course.
- inland waters, i.e. the waters of any relevant loch or pond and relevant rivers and other watercourses above the freshwater limit.
- ground waters, i.e. waters contained in underground strata, including water in wells, boreholes and excavations into underground strata.

Where land is being developed for a new use, it is important that pollution of controlled waters by any contaminants associated with the land is considered. Paragraphs 10(b) and 45-50 of Annex 1 to the Scottish Executive Circular detail the interaction between the planning and contaminated land regimes. Planning Advice Note (PAN) 33 indicates that land remediation will be required before the new use commences where there are unacceptable risks to human health and the environment (paragraph 19 (ii)). Furthermore, PAN 33 indicates that it is in a developer's interest to avoid the scenario where land is identified as Part IIA contaminated land after development (paragraphs 74 and 75).

Other legislation is concerned with preventing pollution from ongoing activities, such as waste disposal and point source discharges from industrial and other processes. Whilst COPA makes it an offence to cause or knowingly permit any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters, SEPA does not yet have the powers to require the offender to address the pollution arising from the offence. Whilst this will change when the provisions of sections 46A to 46D come into force (Works Notices), the Scottish Executive have indicated that it is likely that the use of Works Notices will be

restricted to situations where Part IIA does not apply. Part IIA enables all problems resulting from contamination to be handled as part of the same process. It therefore provides the most appropriate legal mechanism for addressing water pollution, as well as harm, associated with land which is identified as being statutorily contaminated.

1.3 Roles and responsibilities

Scottish local authorities are the lead regulator under Part IIA. They are responsible for assessing and identifying land as contaminated and will therefore make the determination that pollution of controlled waters is occurring, consulting with SEPA as required. Further information on the liaison between local authorities and SEPA under Part IIA can be found in the framework for liaison which is available on SEPA's website.

Local authorities are the enforcing authority for contaminated land and are responsible for ensuring that such land is remediated. SEPA has similar responsibilities for land which is designated a special site by virtue of matching one of the descriptions in the Contaminated Land (Scotland) Regulations 2000 (the Regulations). Regulation 3 specifies those descriptions of contaminated land which relate to pollution of controlled waters, namely land where:

a) *"controlled waters which are, or are intended to be, used for the supply of drinking water for human consumption are being affected by* the land and as a result, require a treatment process or a change in such a process to be applied to those waters before use, so as to be regarded as wholesome within the meaning of Part VIA of the Water (Scotland) Act 1980.*

b) *controlled waters are being affected by* the land, and as a result, those waters do not meet or are not likely to meet the criterion for classification applying to the relevant description of waters specified in regulations made under section 30B of the Control of Pollution Act 1974. or*

c) *controlled waters are being affected by* the land and:*

(i) *any of the substances by reason of which the pollution of the waters is being or is likely to be caused falls within any of the families or groups of substances listed in Schedule 1 to these Regulations; and*

(ii) *the waters, or any part of the waters, are contained within underground strata which comprise wholly or partly Devonian Sandstones or Permo-Triassic Sandstones."*

* Section 78A(8) indicates that controlled waters are affected by contaminated land if (and only if) it appears to the enforcing authority that the contaminated land in question is, for the purposes of section 78A(2), in such a condition, by reason of substances in, on or under the land that pollution of those waters is being, or is likely to be caused.

Local authorities are also planning authorities in Scotland and are responsible for ensuring that developments take place without unacceptable impact on human health, the immediate or surrounding environment. Planning authorities and environmental protection bodies (SEPA, SNH, SEERAD) have different powers and functions that can overlap. Issues of pollution of controlled waters associated with a development are considered by the planning authority, which consults with SEPA as required.

2. Assessment of Water Pollution

There are two key stages to any assessment to establish whether water is being, or could be, polluted. Each stage will be considered in turn.

Stage 1: establishing likely pollutant linkages i.e. considering if there are pathways by which substances can enter water,

Stage 2: establishing if the linkage is resulting in, or could result in, water pollution.

Information about the site is gathered by means of a desk study and potential linkages are identified and shown as diagrams or site models, before further information to characterise the linkage is identified and obtained through more detailed enquiries and/or a site investigation. This process is repeated until it is possible to make a judgement based on the balance of probabilities.

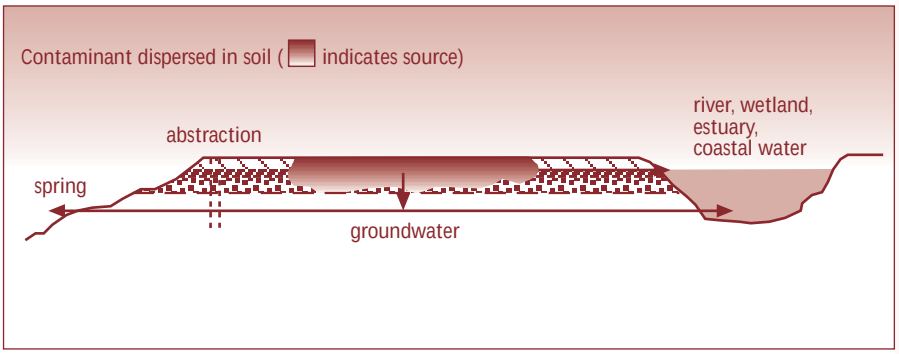
2.1 Identification of Possible Pollutant Linkages

A pollutant linkage comprises three components: a contaminant (source) which has a mechanism (pathway) by which it can cause an adverse impact on a target (receptor). In identifying possible pollutant linkages, it is important that all sources, pathways and receptors are considered. General considerations which apply to linkages where water is the receptor are detailed in this section.

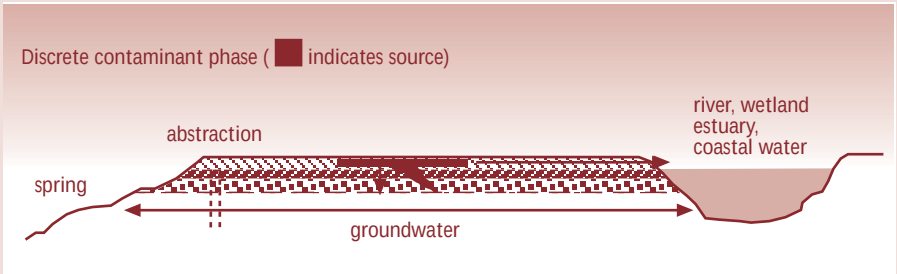
Water can be both pathway and receptor. Controlled waters should always be viewed as a receptor, as indicated in paragraph A.14 (b) of the Statutory Guidance. In the past, groundwater has not always been considered by risk assessors to be a receptor, particularly where it is not used or does not support surface water or terrestrial ecosystems. However, groundwater is a controlled water and is therefore a receptor under Part IIA. Groundwater does have an ecological component, which is important in terms of the maintenance of good groundwater quality, and it is therefore appropriate that groundwater be treated as a receptor in its own right, irrespective of its potential for use or its existing quality.

When considering groundwater as a pathway, the receptors depend on its use. Some of these receptors may be other controlled waters: groundwater in the saturated zone (both perched and main aquifers) supplies base flow to many inland waters and is often linked hydraulically to coastal waters and wetland habitats. Other receptors may arise out of use of water for drinking water supply, industrial use (including food manufacture and processing), agricultural use (irrigation, livestock watering), for recreation and in connection with fishing rights.

It is important that potential linkages are shown as diagrams. Typical linkages are highlighted in the following conceptual models (pathways are depicted by arrows and water receptors as text).



Contaminants can be dispersed in soil as the result of leaks, spillages, deposition from the atmosphere and from waste disposal activities. Contaminants can leach from the soil, through the unsaturated zone and enter groundwater. The contaminants may move through groundwater into inland and coastal water bodies which are hydraulically connected, break out at ground surface or be abstracted for use. Surface water run-off may also result in either contaminants (dissolved or adsorbed onto soil particles) entering inland and/or coastal waters, through lateral movement along a drain, fissure or diffuse entry through the unsaturated zone.



Non-aqueous phase liquids (NAPLs) such as coal tar or petrol may sometimes be present as a discrete phase of separate material, rather than being dispersed in soil. This situation is described by a separate conceptual model, since depending on site conditions, the contaminant source may itself move along a drain, fissure or through the unsaturated zone into inland or coastal waters. Furthermore, the contaminant source may migrate through the unsaturated zone to directly contact groundwater, leading to the dissolution of contaminants from the material into groundwater. Contaminants can also be released from the contaminant source into soil pore water, adsorb onto soil particles and leach from soil to enter groundwater, as in the previous model. Once in groundwater, the contaminants may migrate into inland and/or coastal water bodies which are hydraulically connected with it, break out at the ground surface or be abstracted from wells or boreholes.

The conceptual model should initially be based on available desk study information and will inform the decision to collect further information (typically by means of a site investigation and more detailed enquiries) to refine the conceptual model until all linkages are characterised and their significance can be assessed. In order to refine the conceptual model, consideration should be given to each component of the linkage. Key items to consider in both desk studies and site investigations are highlighted in Annex 1. It is important that the problem is formulated and all possible links are established before assessing the linkages.

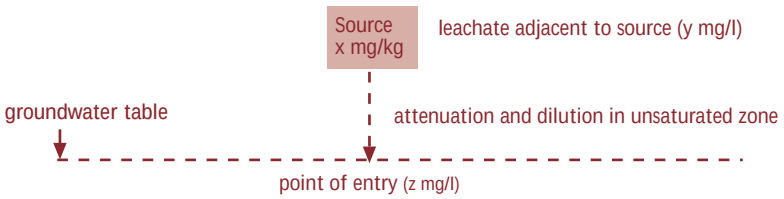
2.2 Contaminant Concentrations Entering Water

Estimating the concentration of a contaminant entering or likely to enter water is central to establishing if pollution is occurring, or is likely to occur. It involves considering the concentration that will be released from the contaminant source and the concentration that will enter the receiving water. This can be achieved through modelling and/or monitoring.

In considering the release of a contaminant from a source into water, it is important to distinguish between contaminants dispersed in soil and contaminants present in discrete phases. Viscous non aqueous phase liquids (NAPLs), such as solvents and petrol, may move through the unsaturated zone or along preferential flowpaths such as drains, to have a direct impact on water. Furthermore, the release of the contaminant (partitioning) from a discrete contaminant phase to water may differ from the release of a contaminant dispersed in soil.

For contaminants dispersed in soil, the concentration of contaminant released to the soil pore water should be considered rather than the total concentration of the contaminant in the soil. The pore water concentration can be determined by sampling and analysing pore water, conducting soil leaching tests or calculation based on soil-water partitioning equations. Any leach test, for example NRA note 301, should be appropriate to the site under consideration.

There are a variety of methods for determining the quantity and concentration of substances released from a contaminant source that may enter water. Many adopt a tiered approach, as outlined in the following diagram. At the first tier, the concentration entering water is assumed to be that adjacent to the source. Subsequent tiers account for dilution and attenuation (dispersion, retardation and degradation). Any method that incorporates degradation must consider attenuation must consider the actual rates of degradation at the site under consideration.



The Environment Agency has promoted the development of a computer software package, ConSim, to help assess risks to water quality from land contamination and has published a methodology (Environment Agency, 1999) which is useful in assessing risks as well as in deriving remedial targets. ConSim calculates contaminant concentrations along the flow path of a contaminant released from soil and therefore provides a useful tool for determining determining concentrations that will enter the receiving water.

2.3 Establishing Pollution

It is a matter for legal interpretation as to what constitutes pollution. In SEPA's reasoned opinion, pollution represents the entry of a substance into a controlled water such that the resultant concentration in the receiving water may impair the actual or potential ecological status, amenity, use or quality of the waters. This opinion incorporates the following concepts:

- a contaminant can enter, or be likely to enter controlled waters, without amounting to 'pollution of controlled waters' (paragraph 2.9, Annex 2, Scottish Executive Circular 1/2000).
- the water itself should be considered, as harm to other receptors is addressed by limb (a) of the contaminated land definition.
- there is no requirement for a demonstrable harmful effect on water
- there can be pollution of an already polluted water

In some circumstances, it may be possible to establish pollution without specifically considering contaminant concentrations. Such an approach would consider the actual impact on a water body by observation or direct measurement of biological impact or toxicity i.e. biological assessment.

In terms of a chemical assessment, the decision as to whether entry (on-going or likely) of a contaminant into a controlled water constitutes pollution depends on:

- the contaminant concentration at the point of assessment in the receiving water arising from entry or likely entry; and
- the criteria against which this concentration is assessed.

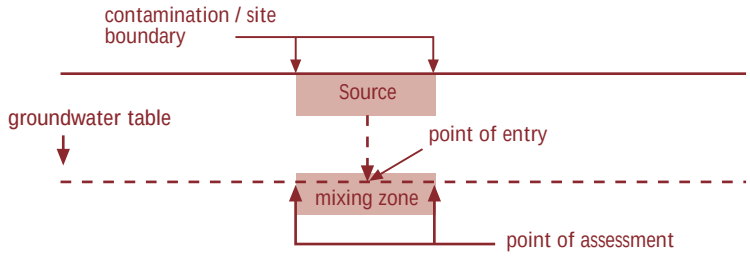
2.3.1 Point of Assessment

The assessment should normally be made just outside a mixing zone, such that it is the resultant concentration in the receiving water rather than the concentration entering the water that is being assessed. Full justification should always be provided for any mixing zone used.

For surface waters, an assessment should be made after allowing for dilution and mixing at the point of entry into the water body. Mixing zones should be established with reference to SEPA policy and there should not normally be acute toxicity or ecological damage within the zone.

For groundwater, it is anticipated that the mixing zone should not extent beyond the boundary of the contamination or site, whichever is the lesser. Providing for mixing in

groundwater underlying the contamination allows for some dilution and mixing after entry, but not to an extent that the quality of groundwater beyond the boundary is allowed to be impaired.



In practice, there are two ways in which the concentration of a substance at the point of assessment in groundwater may be established:

1) Predicting the contribution from substances associated with the land, which are entering and/or are likely to enter, through modelling both on-going and future contributions. The prediction should ideally be undertaken using measured leachable concentrations rather than theoretical concentrations.

2) Monitoring concentrations of substances at the edge of the mixing zone. Up- gradient monitoring will be required to separate out the contribution from the contaminated land from background quality, where there are detectable concentrations of the substances flowing into groundwater beneath the land.

2.3.2 Assessment Criteria

An assessment of what constitutes pollution is typically made through comparison of the contaminant concentration at the point of assessment with chemical and/or biological criteria which reflect the potential for the ecological status, amenity, quality or use of the water to be impaired. There are a variety of water classification schemes and water quality standards established by SEPA or under Regulations, which provide indicators of concentrations of substances above which there may be impairment. These classification schemes and standards are based on rigorous scientific assessment and are therefore very

useful in assessing pollution, as well as the degree of pollution. There are no such standards for groundwater. Until groundwater standards are derived, it should be assumed that the most sensitive standards designed to protect surface water (Environmental Quality Standards) and drinking water supply (Drinking Water Standards) will be protective of groundwater.

Where there is no standard for a substance, then a working standard should be derived using an appropriate method (e.g. WRc 1996 for surface waters or converting tolerable daily intake into a concentration in water by assuming that the average 60kg adult consumes 2 litres of water per day for drinking water supply).

Typically, assessment criteria relate to establishing pollution through considering contaminant concentrations in water. However, some assessors may consider contaminant concentrations in soil when establishing the potential for water pollution. Where soil guideline values derived in the UK or in other countries are applied, it should always be considered whether they are appropriate to the assessment of risk to water and the specific site under assessment. It is far more appropriate to develop site specific soil assessment criteria by relating concentrations in soil to those in water. The general approach to the derivation of soil assessment criteria is:

1. Establish the contaminant concentration in the water body against which pollution is to be assessed.
2. Establish the contaminant concentration in the soil pore water adjacent to the source which would ensure that the concentration derived in (1) would not be exceeded, accounting for attenuation and/or dilution as appropriate.
3. Establish the contaminant concentration in the soil or source material which would ensure that the concentration derived in (2) would not be exceeded, accounting for leaching as appropriate.
4. If the actual contaminant concentration in the soil or source material exceeds the concentration derived in (3), then there is a risk of water pollution.

While ConSim and the Environment Agency R&D Report 20 (Environment Agency, 1999) are commonly used to predict contaminant concentrations entering water, they can also be used to derive soil assessment criteria. Both methods adopt a tiered approach. At the first level, the criteria is that which ensures the concentration in water close to the source does not exceed a specified water concentration (i.e. stages 1, 3 and 4). Subsequent levels account for dilution in the receiving groundwater and attenuation and dilution in the saturated zone. With successive tiers, the data requirements and the sophistication of the

analysis increase, but more realistic criteria are derived.

3. Addressing Pollution

Local authorities have a duty to cause to be remediated land identified as contaminated and SEPA has similar duties for special sites. Any remedial work should ensure that pollution is no longer occurring or that it is not likely to occur. The work may target contaminants in the soil and/or groundwater and should ensure that either the release of contaminants is reduced or the pathway broken. The standard of remediation will be dictated by site-specific circumstances. The standard of remediation that can be required under Part IIA of the Environmental Protection Act 1990 depends on what can be regarded as reasonable, having regard to the cost likely to be involved, the benefit that would result, the seriousness of the pollution and the best practicable techniques.

Paragraph C.41 of the Statutory Guidance indicates that the following considerations are important when considering whether pollution is serious:

" (a) whether the pollution of controlled waters is already being caused;

(b) the likelihood of the pollution of controlled waters being caused;

(c) the nature of the pollution of controlled waters involved with respect, in particular to:
  (i) the nature and importance of the controlled waters which might be affected;
  (ii) the extent of the effects of the actual or likely pollution on those controlled waters; and
  (iii) whether such effects would be irreversible; and

(d) the context in which the effects might occur, in particular:
  (i) whether the waters have already been polluted by other means and, if so, whether further effects resulting from the water pollution would materially affect their condition; and
  (ii) the relative risk associated with the water pollution in the context of wider environmental risks."

Pollution is likely to be serious if it leads to a deterioration in status, for example a move from Class B (fair) to C (poor) for a river. In some situations it may be unreasonable to require water to be cleaned up to the same standard as that used to assess pollution. Use of the water and the significance of it as a water resource will be essential to any decision on reasonableness.

Where it is not reasonable under Part IIA to require remediation for all or some significant pollutant linkages, or just part of a particular linkage, a remediation declaration will be issued by the enforcing authority. Enforcing authorities are required to place remediation declaration particulars on their public register.

Chapter C of the Statutory Guidance should be referred to for further information regarding the remediation requirements of Part IIA. PAN 33 should also be referred to where remediation is being undertaken for development purposes.

4. References

Environment Act 1995. Available from The Stationery Office.

Environment Agency, 1999. Methodology for the derivation of remedial targets for soil and groundwater to protect water resources. Available from Environment Agency R&D Publications, WRc Swindon.

Environment Agency and Golders Associates, 1999. ConSim: contamination impacts on groundwater - simulation by Monte-Carlo method. Available from Golders Associates (UK) Ltd, Nottingham.

Framework for local authority - SEPA liaison and under Part IIA of the Environmental Protection Act (www.sepa.org.uk/contaminated-land/partii/la.pdf)

SEPA Policy 28: Initial dilution and mixing zones for discharges from coastal and estuarine outfalls. Available on www.sepa.org.uk/policies.

SNIFFER 1996. Ecological risk assessment manual for chemicals in the aquatic environment (report SR 3846/1). Available from Foundation for Water Research, Marlow.

The Scottish Executive Rural Affairs Department, Circular 1/2000. Environmental Protection Act 1990: Part IIA Contaminated Land. Available from The Scottish Executive (www.scotland.gov.uk).

The Scottish Executive Development Department, Planning Advice Note 33: development of Contaminated land. Available from The Scottish Executive (www.scotland.gov.uk).

The Contaminated Land (Scotland) Regulations 2000. SSI 2000 No.178. Available from The Stationery Office.

ANNEX 1: Information Gathering

Comprehensive, good quality information is vital when assessing whether pollution of controlled waters is occurring or is likely to occur. The following sections highlight key information requirements for conducting desk based studies and site investigations, along with potential information sources. The list of items is not exhaustive, and additional items should be considered as necessary.

Desk Studies

Linkage Component	Information Requirement	Information Source
SOURCE (contaminants)	The key contaminants and their likely locations on site (at surface and at depth).	DoE Trade Industry Profiles. Records, archives, maps, photographs and plans.
	Contaminant nature, mobility, persistence and potential for release from the source, including movement of non-aqueous phase liquids (NAPLs).	Physical and chemical properties of all contaminant species/ forms and the nature of the material/soil which contain them.
PATHWAY (migration)	The key sub-surface pathways, including nature, length and depth to groundwater.	British Geological Survey (BGS) maps and borehole records.
	Nature of made ground, soil, drift and solid geology.	Macaulay Land Use Research Institute soil maps, Scottish Agricultural College. BGS solid and drift geology maps.
	Nature of saturated zone, including links to inland and coastal water bodies.	BGS reports, hydrogeology and groundwater vulnerability maps.
	Presence of natural and man made fissures.	Service plans from utilities and site owner.
	Potential for contaminant degradation, sorption and dilution.	Physical chemical properties of contaminants, likely organic matter content of soils and strata, infiltration/ degradation rate.
	Topography.	Site visit, maps.

Linkage Component	Information Requirement	Information Source
RECEPTOR (impact)	The key water receptors, including location and nature.	Site visit, Ordnance Survey maps, SEPA.
	The key non-water receptors.	Abstractions for private and public water supplies (BGS, water authorities, local authorities).
	Hazard posed by contaminant to receptor.	Toxic effects - material safety data sheets.
	Water quality standards.	EQUALS database published by WRc, Statutory Instruments, NSCA pollution handbook.

Site Investigations

An intrusive site investigation provides a means of collecting information to further refine the conceptual site model. Traditionally, site investigations have focused on source characterisation by soil sampling and laboratory analysis. However, site investigations can also provide valuable information on pathways and receptors. As such, the site investigation design should always be informed by the conceptual site model and it is therefore essential that a conceptual model is developed prior to any investigation being designed. Every sample taken should have a purpose.

The aim of this section is to highlight some of the information requirements when designing a site investigation to assess pollution of controlled waters and when refining the conceptual site model. It should be noted that the list below is not exhaustive and reference should be made to the wealth of existing and emerging technical guidance on site investigation.

Linkage Component	Information Requirement	Information Source
SOURCE (contaminants)	Concentration of contaminants in the source material and soils (at target locations, both at surface and at depth).	Analysis of statistically representative, appropriately collected and stored samples for the key contaminant species/form using methods that give the required performance in terms of limits of detection, accuracy, precision and quality assurance.
	Concentration of the contaminants in pore water or leachate.	Leach testing of samples and/or prediction of pore water concentrations.
PATHWAY (migration)	Verify nature (thickness, porosity, organic matter content) of made ground, soil, geological strata and depth to groundwater.	Establish nature of sub-surface and groundwater levels through intrusive investigations.
	Where groundwater is a pathway, establish flow, gradient, and level.	Install groundwater monitoring boreholes.
	Consider concentration to reach receptor and duration of release.	Monitor water and/or predict concentration taking into account rate infiltration, attenuation and dilution as appropriate (assess degradation potential where degradation is allowed for).
RECEPTOR (impact)	Establish assessment criteria and compare to water/soil concentrations.	For water assessment criteria use or derive water quality standards. For soil assessment criteria use methods such as ConSim or Environment Agency Publication R&D 20.

Further Reading

BS 10175 (2001): Code of Practice for the investigation of potentially contaminated sites. British Standards Institution.

Department of the Environment 1995/1996. Industry profiles. Available from DETR publications, Rotherham (www.defra.gov.uk).

Department of the Environment, 1994. Framework for assessing the impact of contaminated land on groundwater and surface water (CLR No 1). Available from DETR publications, Rotherham (www.defra.gov.uk).

Department of the Environment, 1994. Guidance on preliminary site inspection of contaminated land (CLR No 2). Available from DETR publications, Rotherham (www.defra.gov.uk).

Department of the Environment, 1994. Documentary research on industrial sites (CLR No.3). Available from DETR publications, Rotherham (www.defra.gov.uk).

Environment Agency, 2000. Guidance on the assessment and monitoring of natural attenuation of contaminants in groundwater. R&D Publication 95 Environment Agency R&D Publications, WRc Swindon.

Environment Agency, 2001. Secondary model procedure for the development of appropriate soil sampling strategies for land contamination. Environment Agency R&D Technical Report P5-066/TR. Environment Agency R&D Publications, WRc Swindon.

Environment Agency 2001. Technical aspects of site investigation (2 volumes). Environment Agency R&D Technical Report P5-065/TR. Environment Agency R&D Publications, WRc Swindon.

Environment Agency 2001. Guide to good practice for the development of conceptual models and the selection and application of mathematical models of contaminant transport processes in the subsurface. Environment Agency National Groundwater & Contaminated Land Centre report NC/99/38/2, Solihull (in preparation).

National Rivers Authority 1994. Leaching tests for the assessment of contaminated land. NRA R&D note 301, available from Environment Agency R&D Publications, WRc Swindon.

NERC 1998. Groundwater, our hidden asset. Compiled on behalf of the UK Groundwater Forum. Published by and available from the British Geological Survey, Nottingham.

Scottish Enterprise 1998. How to investigate contaminated land.

Scottish Enterprise 1998. How to approach contaminated land.

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Perth Office
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Shetland Office
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Stirling Office
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Thurso Office
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Western Isles Office
2 James Square, James Street, Stornoway,
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