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COMMON IMPLEMENTATION STRATEGY FOR THE WATER FRAMEWORK DIRECTIVE (2000/60/EC)

Guidance Document No. 17

Guidance on preventing or limiting direct and indirect inputs in the context of the Groundwater directive 2006/118/EC

EUROPEAN COMMISSION

environment

COMMON IMPLEMENTATION STRATEGY
FOR THE WATER FRAMEWORK DIRECTIVE (2000/60/EC)

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GUIDANCE ON PREVENTING OR LIMITING DIRECT AND INDIRECT INPUTS IN THE CONTEXT OF THE GROUNDWATER DIRECTIVE 2006/118/EC

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FOREWORD

The Water Directors of the European Union (EU), Acceding Countries, Candidate Countries and EFTA Countries have jointly developed a common strategy for supporting the implementation of the Directive 2000/60/EC, "establishing a framework for Community action in the field of water policy" (the Water Framework Directive). The main aim of this strategy is to allow a coherent and harmonious implementation of the Directive. Focus is on methodological questions related to a common understanding of the technical and scientific implications of the Water Framework Directive.

In particular, one of the objectives of the strategy is the development of non-legally binding and practical Guidance Documents on various technical issues of the Directive. These Guidance Documents are targeted to those experts who are directly or indirectly implementing the Water Framework Directive in river basins. The structure, presentation and terminology is therefore adapted to the needs of these experts and formal, legalistic language is avoided wherever possible.

In the context of the above-mentioned strategy, a guidance document "Analysis of Pressures and Impacts" has been developed and endorsed by the Water Directors in November 2002 (CIS Guidance Document Nr. 3). This document provides Member States with Guidance on analysing pressures and impacts within the characterisation of water bodies in the broad context of the development of integrated river basin management plans as required by the WFD.

As a follow-up, and in the context of the development of the new Groundwater Directive under Article 17 of the Water Framework Directive, Member States have expressed the need to clarify issues of risk assessment and measures related to 'direct and indirect inputs of pollutants' to groundwater. A project to develop a guidance document complementing the CIS Guidance Document Nr. 3 has, therefore, been designed in 2004, and an informal drafting group has been established under the umbrella of the CIS Working Group on Groundwater (WG C). This drafting group has been coordinated by Industry stakeholders and the Netherlands, and involved a range of experts from other Member States and from stakeholder organisations.

The present Guidance Document is the outcome of this drafting group. It contains the synthesis of the output of discussions that have taken place since December 2004. It builds on the input and feedback from a wide range of experts and stakeholders that have been involved throughout the procedure of Guidance development through meetings, workshops, conferences and electronic media, without binding them in any way to this content.

"*We, the water directors of the European Union, Norway, Switzerland and the countries applying for accession to the European Union, have examined and endorsed this Guidance during our informal meeting under the German Presidency in Dresden (18-19 June 2007). We would like to thank the participants of the Working Group C and, in particular, the leaders of the inputs drafting group for preparing this high quality document.*

We strongly believe that this and other Guidance Documents developed under the Common Implementation Strategy will play a key role in the process of implementing the Water Framework Directive and the newly adopted Groundwater Directive.

This Guidance Document is a living document that will need continuous input and improvements as application and experience build up in all countries of the European Union and beyond. We agree, however, that this document will be made publicly available in its current form in order to present it to a wider public as a basis for carrying forward ongoing implementation work.

We also commit ourselves to assess and decide upon the necessity for reviewing this document in the light of scientific and technical progress and experiences gained in implementing the Water Framework Directive and new Groundwater Directive".

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1.1 Introduction

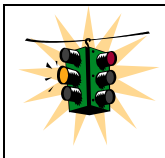
Groundwater is an important resource, which once damaged could be difficult and expensive to restore. In the interest of sustainability it therefore makes sense on environmental and economic grounds to have in place a framework for its effective protection aligned with the precautionary and polluter-pays principle. Much of this framework is established by the Water Framework Directive (WFD, 2000/60/EC), which builds on but is much wider in scope than the existing Groundwater Directive (80/68/EEC) to be repealed in 2013, which is now strengthened and relayed by the daughter directive on groundwater protection (GWD) adopted on 12 December 2006 (2006/118/EC). This framework also complements other European legislation that contains groundwater protection measures, such as the Nitrates and Plant Protection Products Directives.

1.2 Purpose

This document provides guidance on the implementation of the WFD with respect to those obligations for preventing or limiting entry of pollutants into groundwater, as further developed in the GWD. The guidance explains the relationship between the objectives for prevent or limit and other WFD objectives and, in particular, it clarifies the requirements regarding direct and indirect inputs.

This guidance should be read in conjunction with the companion guidance from Working Group C – Groundwater (WG C) of the Common Implementation Strategy for the Water Framework Directive (CIS), in particular the guidance on groundwater monitoring[1].

The WFD gives Member States the flexibility to take into account local circumstances when setting criteria for good chemical status and fulfilling the other requirements of the directive, including the objectives for preventing or limiting inputs of pollutants into groundwater set by the WFD. Such local circumstances can include differences in approach to regulation and environmental protection between Member States. This guidance document therefore will not attempt to recommend specific measures that can be taken to prevent or limit inputs of pollutants to groundwater. It will concentrate firstly on explaining the definitions and requirements of the WFD such that Member States all have the same understanding of what is required of them, and secondly provide examples of how the requirements could be fulfilled. In this guidance some diagrams are introduced that cover the relevant procedures, criteria, decisions, etc, as precisely and completely as possible. However, one should realise that it is not possible to include all specific situations and detailed instructions in such schematic presentations. Nevertheless these schemes are included to give a quick visual insight into the headlines of the WFD and the GWD on these subjects.



Look out! The methodology from this Guidance Document must be adapted to regional and national circumstances

The Guidance Document proposes an overall pragmatic approach. Because of the diversity of circumstances within the European Union, Member States may apply guidance in a flexible way in answer to problems that will vary from one river basin, sub-basin or groundwater body to the next. This guidance will therefore need to be tailored to specific circumstances.

[1] CIS Guidance No. 15 on Groundwater Monitoring, December 2006.

1.3 Scope

This guidance document is part of a series of documents clarifying requirements of the WFD and the GWD, each one is focussed on a different groundwater issue, namely Groundwater Monitoring[1], Groundwater in Drinking Water Protected Areas[2], Preventing or Limiting Direct and Indirect Inputs in the context of the Directive 2006/118/EC (the present guidance), status compliance and trends, and common methodology for the establishment of groundwater threshold values.

In practice these different requirements strongly interact with each other and overlap in some cases. Each guidance document will be most useful in relation to a specific directive requirement which is often only relevant in a particular part of the groundwater system. Figure 1 highlights the parts of the groundwater system that each guidance document relates to. In the figure, three main 'areas' (called GWI, GWII and GWIII) are distinguished to show the primary field of attention of each guidance document. However, the areas overlap, depending on local circumstances and specific points of attention. (e.g. in a protected area, Inputs can be present on/in the unsaturated zone or as historical pollutants in the saturated zone.)

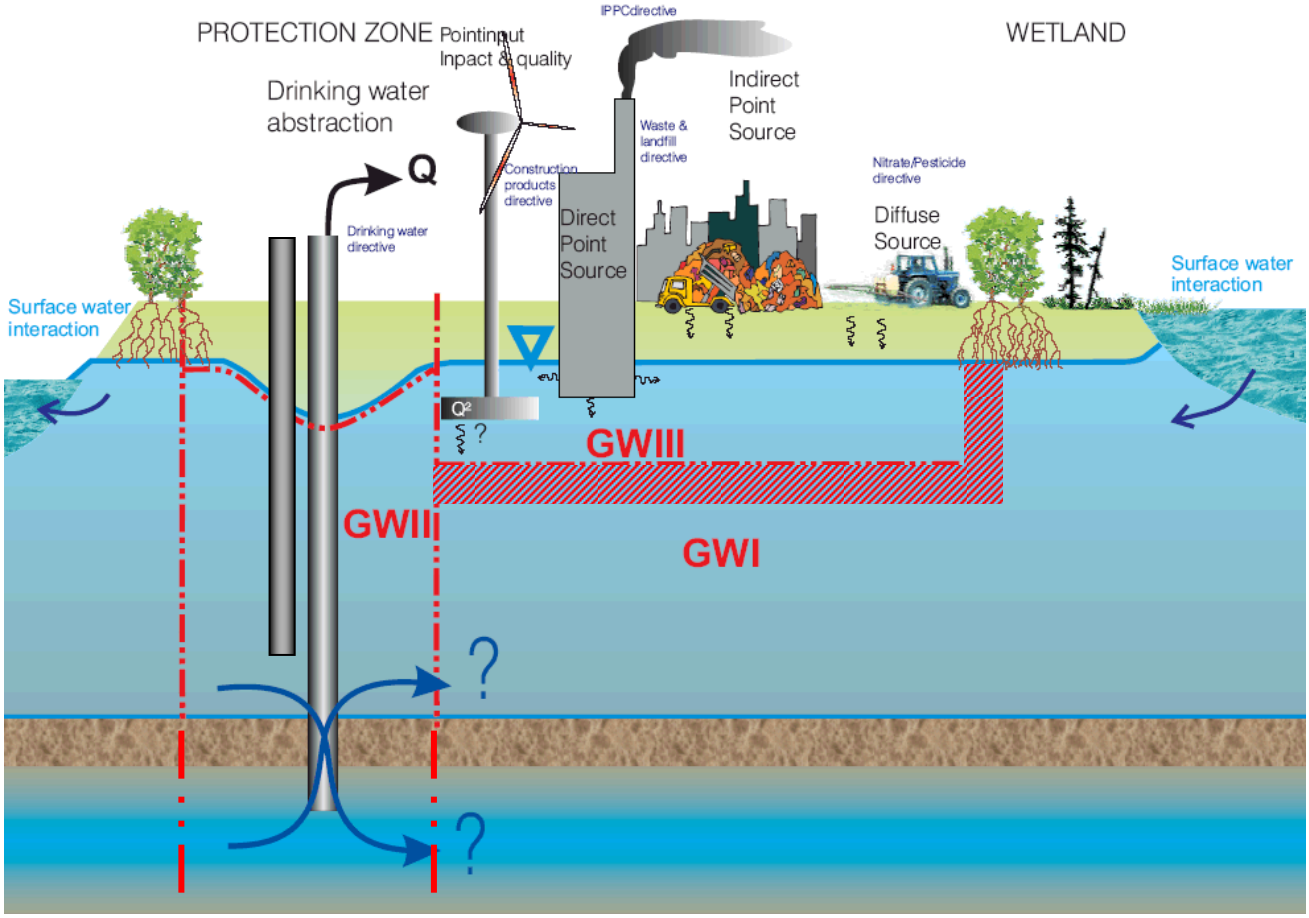
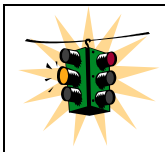


Figure 1: Delineation of the focus of the different guidance documents within the groundwater system (GWI-GWIII). Zones and points of attention may overlap. GWI primarily relates to 'Monitoring', 'Status and Trends' and 'Threshold Values'; GWII primarily relates to 'Protected Areas' (e.g. Drinking Water Protected Areas); while GWIII primarily relates to 'Direct and Indirect Inputs'

The present document provides guidance on direct and indirect inputs into groundwater. Inputs can originate from different sources and take different forms. For example, diffuse inputs may originate from urban areas or agriculture, point source inputs from industrial activities.

[2] CIS Guidance No. 16 on Groundwater in Drinking Water Protected Areas, July 2007.



Look out! The scope of the guidance documents may overlap

In some cases more than one guidance document may be relevant for a given situation, (e.g. where an input from a direct point source influences a drinking water abstraction or a wetland, the guidance on status and trends, protected areas, and this guidance may all be relevant).

2 Background

2.1 The Groundwater Directive (80/68/EEC)

The existing Groundwater Directive 80/68/EEC requires that Member States take the necessary measures, including a special authorisation system, to *prevent* "List I" substances from entering groundwater, and to *limit* the entry of "List II" substances so as to prevent pollution of the groundwater. The lists I and II, presented in an annex to the directive, each consist of a number of groups of substances. List I comprises anthropogenic substances as well as naturally occurring substances of which the additional direct or indirect introduction into groundwater due to anthropogenic activities presents relatively high risks to the environment, while the introduction of List II substances presents relatively moderate risks to the environment. The meaning of 'prevent' and 'limit' and also of 'direct' and 'indirect' will be discussed later on in this guidance document.

2.2 The Water Framework Directive (2000/60/EC)

The WFD extends controls to the inputs of all pollutants to groundwater and sets additional environmental objectives for groundwater. For the purposes of this guidance document, the most significant provisions are:

- Article 4(1)(b)(i), which requires Member States to implement measures necessary to prevent or limit the input of pollutants into groundwater. This objective of preventing or limiting inputs of pollutants into groundwater was introduced into the WFD to ensure continuity in the groundwater protection regime established by Directive 80/68/EEC after its repeal in 2013;
- Article 4(1)(b)(ii), requiring the protection, enhancement and restoration of all bodies of groundwater, with the aim of achieving good groundwater status, as defined in WFD Annex V;
- Article 4(1)(b)(iii), requiring the reversal of any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity; and
- Article 11(3)(j), which introduces a prohibition of ALL *direct* discharges of pollutants into groundwater, subject to certain exemptions. A direct discharge is defined in Article 2(32) as a discharge of pollutants into groundwater without percolation through the soil or subsoil. See also section 3.3 of this guidance document.

2.3 The Groundwater Daughter Directive (2006/118/EC)

The new Groundwater Directive (GWD) includes criteria for assessing good groundwater chemical status and for identifying significant and sustained upward trends and starting points for trend reversals. One element that is also included is a framework for making the WFD's'prevent or limit' objective operational. This clarifies which substances shall be prevented from entering and which shall be limited in groundwater. It also clarifies the exemptions from this prevent or limit objective.

Pursuant to WFD Article 22(2), Directive 80/68/EEC will be repealed in December 2013, but the level of protection established by 80/68/EEC should be continued and strengthened under the WFD and GWD.

2.4 The links between the prevent or limit objective and threshold values

The "prevent or limit" objective in the WFD/GWD protects all groundwater from unacceptable inputs of pollutants. It protects a wide range of receptors and protects groundwater from pollution at a local scale.

This contrasts with the requirements for good chemical status, as the assessment of good chemical status is carried out over the whole of a groundwater body. In most cases, this will be a large area. The assessment is carried out once every river basin plan period, and provides a six yearly review of the condition of groundwater bodies. This assessment tells us whether that groundwater body can meet the definition of good chemical status specified in the WFD/GWD. This definition is limited to only a few receptors and specific circumstances, and does not necessarily protect groundwater quality at a local scale.

To affect a receptor, an input of a pollutant must physically move through the groundwater system. This movement varies according to the physical and chemical characteristics of the geological strata. Most importantly, the pollutant may be subject to dilution and attenuation along the flow path to a receptor. For this reason, many inputs only have localised effects. These inputs may still result in localised pollution, but may have little or no impact on the receptors noted in the definition of good chemical status of groundwater. Under the WFD/GWD it is quite possible to have localised pollution within a groundwater body that is at good chemical status. However, the more widespread the pollution becomes, the more likely it is that the groundwater body will be at poor status. Localised pollution should be investigated (and remedied if necessary) via prevent or limit measures.

In principle, prevent or limit measures are our first line of defence in preventing unacceptable inputs of pollutants to all groundwater (and thereby avoiding pollution). The effective implementation of the prevent or limit objective via routine regulation should ensure that groundwater quality is protected. This day to day regulation can consist of permits, general binding rules or codes of practice to control specific activities on the land surface. Permit conditions and/or "Limit Values" may be used to ensure that no unacceptable input of pollutants into groundwater occurs. Notwithstanding the time that is required to enable the historical legacy of prior releases to be degraded or dispersed, if all prevent or limit requirements were met everywhere within a groundwater body, the body would be at good chemical status. The prevent or limit objective and the status requirements are therefore complementary, and used together provide an effective framework for groundwater protection across the EU.

Whilst the threshold values that have to be established pursuant to Article 3 of the GWD will help to assess good chemical status, these values (and the associated compliance regime) will often not be appropriate to meet the more stringent requirements of the prevent or limit objective.

It is useful to summarise here the different purposes and roles of Limit Values and Threshold Values in the protection of groundwater:

1. Scale of application.

   Threshold values derived to meet the requirements of Articles 3 and 4 of the GWD do not necessarily apply at the same points of compliance (POC) as Limit Values (described in this guidance document). Assessment of status is carried out at monitoring points on the strategic/operational monitoring network, which are distributed across the groundwater body. Inputs are assessed locally to the source of the input at prevent and limit monitoring points, which may be real or virtual. This gives more immediate and comprehensive protection for "groundwater itself". It should be noted that in some cases, the prevent and limit monitoring point used to assess the acceptability of the input may also be an operational monitoring point where status is assessed, in which case the threshold value is an appropriate limit value;

2. Location of application.

The same threshold value has to be applied across the whole groundwater body, but many different "limit values" can be applied at different POC. Threshold values also only apply to groundwater bodies, whereas "limit values" set to support the "prevent or limit" objectives apply to all groundwater. For example, water within discontinuous river terrace gravel deposits or perched water in a peat deposit above a boulder clay are both groundwater, and inputs of pollutants have to be prevented or limited to ensure that pollution of any receptors does not occur. However, neither of these geological deposits are management units and are therefore not groundwater bodies. They therefore do not have to be classified into good or poor status, and will not have threshold values set for them.

2.5 Other relevant European Legislation

Other European legislation indirectly provides some level of protection for groundwater or provides relevant reference information for the protection of groundwater. The most relevant are listed below:

- Nitrates Directive (91/676/EEC) – contains provisions for the designation of vulnerable zones and Member State action where the amount of nitrate contained in groundwater is exceeding, or is likely to exceed 50 mg/l;
- Habitats Directive (92/43/EEC) - indirectly protects groundwater, in particular quantity. The requirement to maintain groundwater fed habitats implies safeguarding groundwater flow in these areas;
- Plant Protection Products Directive (91/414/EEC) - regulates the authorisation of the placing of plant products on the market based on comprehensive risk assessments for humans and the environment. Concerning groundwater, authorisations would not be granted if the uses to be authorised (might) lead to exceeding maximum permissible concentrations for the active substances and relevant metabolites, degradation or reaction products as laid down in the drinking water directive 80/778/EEC, superseded by 98/83/EC.
- Biocides Directive (Directive 98/8/EEC) - concerns the authorisation and the placing on the market for use of biocidal products similar to Directive 91/414/EEC,
- Urban Wastewater Treatment Directive (91/271/EEC) - aims to protect the environment from the adverse effects of discharges of urban waste water and waste water from certain industrial sectors. This directive is indirectly relevant to groundwater (protection of receiving groundwaters from possibly contaminated waste waters originating from freshwater sources).
- Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC) – sets out controls in a site permit, designed to prevent or reduce emissions in the air, water and land from a range of activities listed in the Annex I of the directive.
- Landfill Directive (99/31/EEC) – concerns the landfill of waste. It aims to provide measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, including groundwater.
- Sewage Sludge Directive (86/278/EEC) - seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals and man.
- Construction Product Directive - focuses on conformity aspects of construction products, taking into account possible risk to water environments, in particular release of dangerous substances to water.
- Management of Waste from Extractive Industries Directive (2006/21/EC) - a stand-alone legal instrument requiring minimisation of impacts to groundwater from mine waste facilities
- EU-Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency and amending Directive 1999/45/EC. - This Regulation provides a structure for evaluation substances being brought on the EU-market and providing adequate information for users, authorities and others. This Regulation is based on the principle that it is up to manufacturers, importers and downstream

users to ensure that they manufacture, place on the market or use such substances that do not adversely affect human health or the environment. Its provisions are underpinned by the precautionary principles. Protection of groundwater is included in the evaluation of substances by manufacturers and other relevant organisations. REACH leaves all room for the WFD/GWD and for the relevant authorities to evaluate substances (as such or in products) with regard to protection of water in general or in specific situations.

- Environmental Liability Directive (2004/35/EC) - provides a driver to prevent and remediate pollution in groundwater;
- Drinking Water Directive (80/778/EEC, superseded by 98/83/EC): The objective of this directive is to protect human health from the adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean.
- Soil directive: the draft soil directive (negotiated in 2007) is focussing on the protection of soil (without groundwater); processes as for example erosion, sealing will have to be monitored, action plans will have to be written and, if necessary, measures will have to be taken. Also soil contamination (including the prevention, the detection of contamination and the remediation) is included. The introduction into soil of dangerous substances should be limited (Article9).

Half of the above mentioned legislation is listed in Part A of Annex VI of the WFD as being part of its "basic measures" which Member States have to implement to achieve the objectives of the WFD. These directives are therefore complementary to the WFD, and their requirements must still be carried out. If the requirements within these existing directives are not on their own sufficient to achieve the objectives of the WFD, then Member States must carry out supplementary measures.

2.6 Timescales for meeting WFD Objectives

Unlike the achievement of good chemical status, there are no specific deadlines within the WFD for complying with the Article 4 prevent or limit objectives (supplemented by Article 6 of the GWD). However, Article 11 of the WFD specifies that, by December 2009, Member States shall establish for each river basin a programme of measures for achieving the WFD Objectives. These programmes of measures shall include measures to control point source discharges liable to cause pollution, measures to prevent or control the input of pollutants from diffuse sources liable to cause pollution, and a prohibition of direct discharges of pollutants into groundwater (subject to certain exemptions). Deciding on the necessary measures requires an understanding of pressures (pollution inputs into groundwater), their impact, ways to prevent/limit and the cost of preventing/limiting measures.

These programmes of measures shall be included in the River Basin Management Plans, which also need to be produced by December 2009.

2.7 National regulations

The WFD, the GWD and other EU directives require Member States to identify appropriate competent authorities to fulfil the specified tasks and obligations. Competent authorities will have to develop definitions of good water and groundwater quality, methods to assess status of water bodies, threshold values, river basin management plans, licensing and other measures that may affect inputs.

This approach of mandating national authorities and other competent authorities means that it is not possible to simply describe general measures to be taken on activities and products that may cause inputs to groundwater. One of the main tasks of competent authorities is to take into account local conditions when specifying criteria or even bans on activities or products that may harm surface water and groundwater.

3 General Principles

This chapter deals with the main principles regarding 'inputs'. What is 'pollution', what are (direct and indirect) 'inputs', what is meant by 'prevent' and 'limit', and how can inputs be approached. The subdivision on 'direct inputs' and 'indirect inputs' is mainly based upon some important different approaches for 'hazardous substances' (primarily linked to 'prevent') and 'non-hazardous substances' (primarily linked to 'limit'.)

3.1 What is Pollution?

The goal of the 'prevent or limit' objectives set out in the WFD and GWD is to prevent pollution. Member State Competent Authorities therefore need to have a clear understanding of the basis for judging 'pollution'. For pollution to occur, there needs to be some actual or likely harmful effect of human activity on a given receptor.

Under the existing Groundwater Directive (80/68/EEC) pollution is defined as "…*the discharge by man, directly or indirectly, of substances or energy into groundwater, the results of which are such as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with other legitimate uses of water*".

Under the Water Framework Directive (WFD), and thus the GWD, pollution is defined more broadly as: "*...the direct or indirect introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment*" (Article WFD 2(33)). The WFD therefore extends controls to cover all pollutants (all substances liable to cause pollution, including radioactive substances as well as carbon dioxide or heated water from cooling) and is not restricted to the groundwater environment. The WFD does not mention microbiological agents.

Hazardous substances are defined in the WFD as "*substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern*" (Article 2(29)). The GWD requires that these substances should not be introduced into groundwater (Article 6(1)(a)). Harm is deemed to have occurred when hazardous substances are present in the discharge in amounts that are discernible over and above the naturally occurring background concentrations in the receiving groundwater. Article 6.3, however provides exemptions about inputs of pollutants in certain circumstances. For new discharges (e.g. from a landfill or to a soakaway) it is not acceptable to take into account the dilution of these substances by the groundwater flow, nor is it acceptable to say that such substances can enter groundwater because it has previously been polluted. At sites where the land is historically contaminated and hazardous substances have already entered the groundwater, pollution will already be considered to have occurred.

Substances which are considered 'non hazardous' may still have the capacity to cause pollution and related harmful effects, depending on their concentration in groundwater. For these substances the mere entry into, or slight deterioration in quality of groundwater is not to be considered as pollution. Pollution will only result where the entry or deterioration is linked to a harmful effect at a receptor. In this respect, all receptors at the point of entry and 'downstream' along the groundwater flow have to be considered. The term 'receptor' must be taken in its widest context to include not only the existing uses of groundwater but all plausible future uses and functions to which the groundwater might be put, as well as groundwater itself. 'Uses' includes both the active abstraction of groundwater by pumping and passive recipients of groundwater such as springs, rivers or wetlands.

3.2 What are Inputs?

The term "Input" is not defined within the WFD, and is used in the context of preventing or limiting the inputs of pollutants into groundwater (Article 4 1(b)(i)). "Input of pollutant into groundwater" is defined in the GWD as "*the direct or indirect introduction of pollutants into groundwater as a result of human activity*".

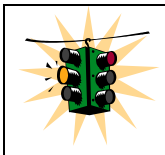
The term input is distinctly different from discharge (used in the 80/68/EEC Directive) in that it covers all pollutants that enter groundwater, and is not restricted to deliberate disposals. This means that the term input covers a broader range of scenarios/situations where substances are entering the subsurface than is covered by 80/68/EEC.

Inputs can be either point source from one single discharge/emission/installation, or diffuse sources resulting from many losses or emissions. The distinction between the two is the number of inputs and the scale over which they occur.

Some examples of activities from which inputs can occur are:

- Industry: accidents, spills, leaks, storage, waste disposal and land filling
- Waste management activities
- Traffic: through exhaust gasses; oil and gasoline losses; rubber abrasion from tyres; accidents with loss of oil, gasoline or load; other particles
- Others: Construction products used on or in the soil (concrete, paints,); private and commercial storage and fuelling facilities (tanks, gasoline stations); shooting ranges; waste water systems; storage of carbon dioxide; input of cooling water (geothermic plants);

Diffuse inputs are mainly related to agricultural land uses, inputs from soil containing pollutants from atmospheric deposition (due to emissions to air from industry, traffic, fires, etc.), and inputs coming from large 'developed' regions such as large urban areas



Look out! Therefore an input is:

any entry of a substance into groundwater from an activity, whether accidental or deliberate, point source or a diffuse source, that causes a release of a pollutant into groundwater.

Control of inputs to groundwater is required because they can:

1. cause pollution;
2. lead to or maintain poor chemical **status** of the groundwater body;
3. result in significant and sustained upward **trends**.

This is why the WFD contains the objective to prevent or limit the input of pollutants into groundwater (see chapter 3.4) and that the GWD has introduced supplementary provisions through its article 6.

3.3 Direct and indirect inputs

Direct inputs can be identified by one of the following properties:

- They bypass the unsaturated zone;
- The pollution source is in the saturated zone (or discharges directly in the saturated zone);
- Seasonal fluctuations in the water table mean that the pollution source will be in direct contact with groundwater, from time to time.

These three conditions are represented in the following figure (figure 2).

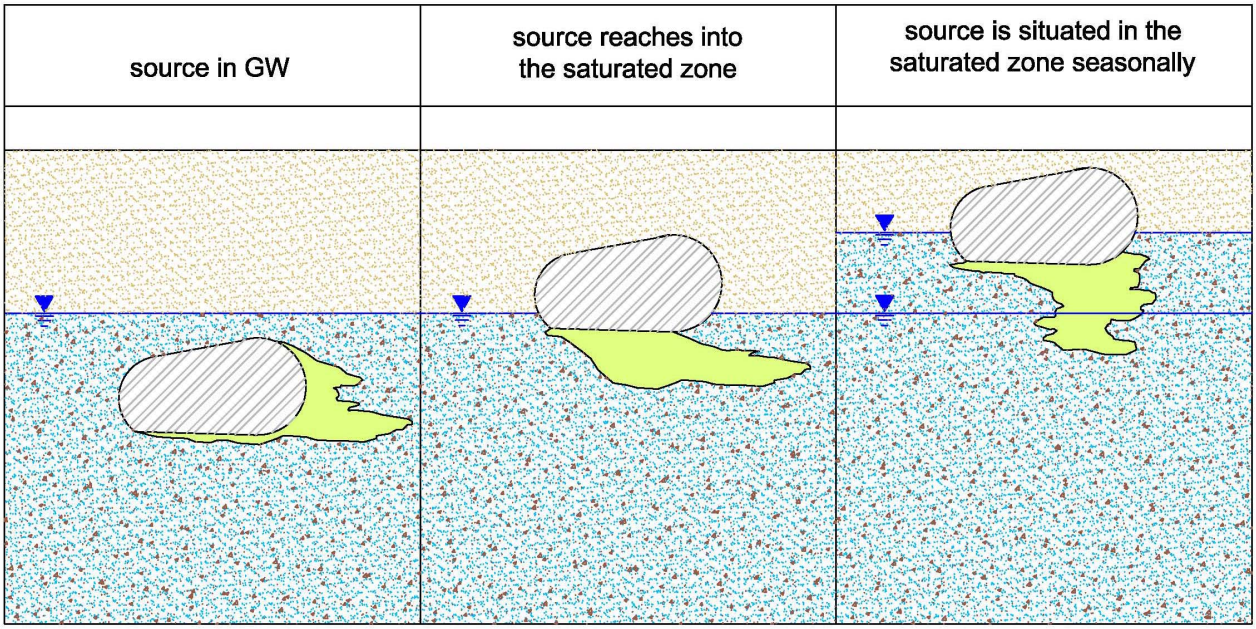


Figure 2: direct inputs. (The blue shaded oval block, representing an input, may be permanently (totally or partly) in the saturated zone, or may be in the saturated zone periodically when the groundwater table rises to the oval block)

Indirect inputs are characterised by the discharge into groundwater after percolation through the soil or subsoil, as represented in the following figure (figure 3).

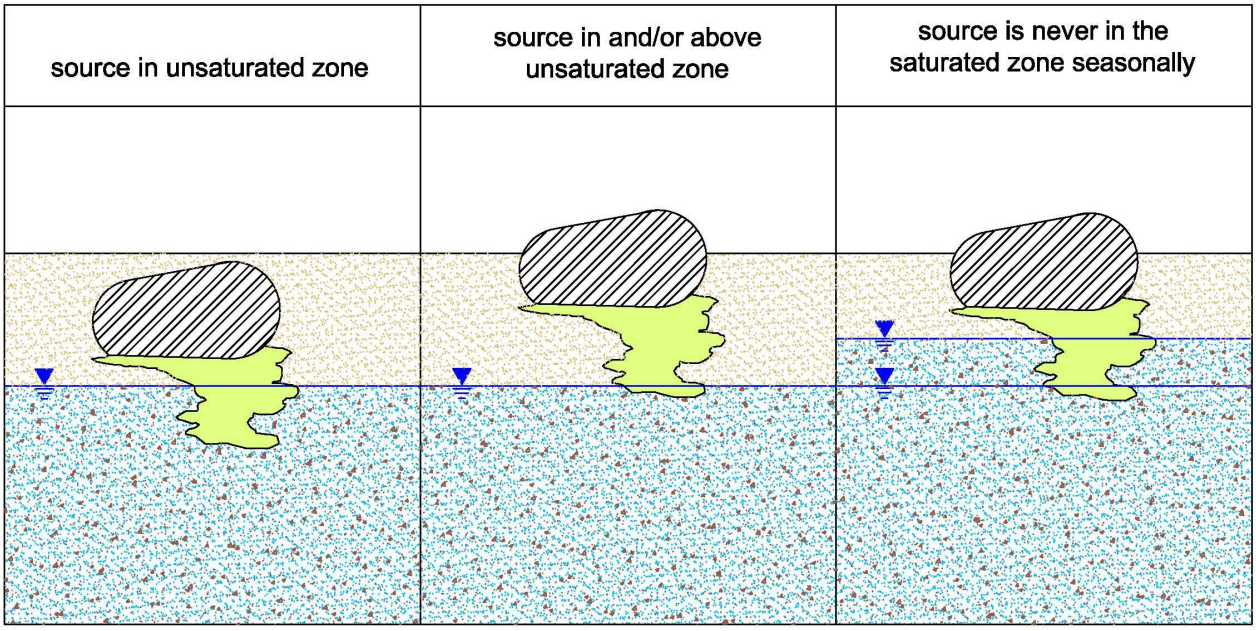


Figure 3: indirect inputs. (The blue shaded oval block, representing an input, is permanently totally above the saturated zone, even in periods with a high groundwater table.)

Some examples of types of direct and indirect inputs are presented in annex 1.

3.4 What is prevent and limit?

According to the GWD, substances to be *prevented* from entering groundwater are substances identified by Member States as being *hazardous* (Article 6(1)(a)). In identifying such substances, Member States shall in particular take account of hazardous substances belonging to the families or groups of pollutants referred to in points 1 to 6 of Annex VIII to Directive 2000/60/EC, as well as of substances belonging to the families or groups of pollutants referred to in points 7 to 9 of that Annex, where these are considered to be hazardous. Substances to be *limited* in groundwater such that pollution does not occur are all other pollutants.

As mentioned earlier in this document, 'hazardous substances' in the WFD context means substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. Criteria for designating a substance as toxic, persistent, and liable to bio-accumulate are not given by the WFD. Criteria for defining “hazardous” are given, for example, in the Technical Guidance Documents (TGD) [3] adopted to support the risk assessment of substances in the EU. These criteria, or any other appropriate Member State assessment procedures could be used. Not all substances referred to in points 1 to 9 of WFD Annex VIII would thus classify as 'hazardous'. Note that linking the prevent clause to hazardous substances and the limit clause to all other pollutants as done in the GWD, is a move away from the List I and List II approach of the 80/68/EEC Directive. Indeed, according to this directive, Member States should take the necessary measures to prevent List I substances from entering the groundwater, while the entry of List II substances should be limited so as to avoid pollution.

The broadening of controls on pollutants by the WFD noted above, is now balanced by a series of exemptions introduced by the GWD (Article 6.3). It is indeed not technically feasible to stop all inputs of hazardous substances, and some small inputs are environmentally insignificant and therefore do not present a risk to groundwater. Without these exemptions, the "prevent" requirement would imply an onerous and sometimes unfeasible task. Each exemption applies to both the ‘prevent' and the 'limit’ objective (both hazardous and non-hazardous substances) but must not override other more stringent requirements in other EC legislation. These exemptions are detailed in section 5.3.

To "prevent" an input into groundwater means: taking all measures deemed necessary and reasonable to avoid the entry of hazardous substances into groundwater and to avoid any significant increase in concentration in the groundwater, even at a local scale. "Reasonable" means technically feasible without involving disproportionate costs. How to define "disproportionate costs" depends on the local circumstances.

Questions to be answered may be at what horizontal and vertical distances from the (potential) pollution source concentration increases should be assessed, and the extent to which conceptual models, calculations, or measurements are needed to make the assessment.

It is therefore helpful to employ additional criteria to assess whether this objective has been met in practice. An unacceptable input of hazardous substances to groundwater would be one that:

- Could result in pollution; or
- Is of a magnitude and persistence that it could result in a sustained increase in concentration in groundwater.

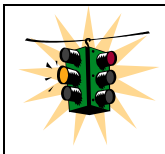
Compliance should be assessed in the immediate vicinity of the input by, for example:

[3] Technical Guidance Document in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances and Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. (http://ecb.jrc.it/home.php?CONTENU=/Technical-Guidance-Document/sommaire.php). See also http://ecb.jrc.it.

- Calculation of the concentration that will be present in the unsaturated zone immediately before entry into groundwater and in the saturated zone on entry into groundwater.
- Measurement of the concentration of the substance in groundwater as near to the point of entry as is practically possible.

When considering the need for measures to prevent an *indirect* input of a hazardous substance into groundwater, one can take into account the attenuation (fixation, degradation) of the substance in the *unsaturated* zone. To this end, all the geological, hydro-geochemical and biological processes should be taken into account, including changes in the water table at a particular site. Processes in the *saturated* zone are not relevant for assessing inputs of hazardous substances, since these substances should be prevented from entering the saturated zone, as described above. Only if hazardous substances are already present in the saturated zone (e.g. from historical pollution) are processes in the saturated zone relevant. These processes can be used to determine the measures needed (remediation, isolation, etc.) to prevent the spreading of the contamination through the groundwater (this is linked to the provision of Article 5.5 of the GWD, requiring to assess the impact of existing plumes of pollution and to take appropriate measures).

Substances already present in the environment (air, surface water, soil, and constructions) in many cases cannot be prevented completely from entering the groundwater. However, pollution of the environment by hazardous substances could be subject to a more absolute prevention, through a total ban or phasing out of certain applications in accordance with the WFD. Before a decision on banning or phasing out can be taken, one has to check if reasonable measures to prevent entry into groundwater are possible.



Look out! To prevent an input into groundwater means:

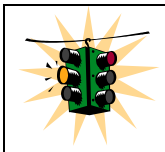
There should be no significant increase in concentration of pollutants in the groundwater, even at a local scale. All measures deemed necessary and reasonable to avoid the entry of hazardous substances into groundwater, should be taken. Member states can, under certain conditions, exempt inputs from these measures, as specified in GWD Article 6(3) (see section 5.3).

Limit applies to all non-hazardous pollutants. Article 6.1 of the GWD states that Member States should take all measures necessary to limit inputs into groundwater so as to ensure that such inputs do not cause deterioration [in status] or significant and sustained upward trends in the concentration of pollutants in groundwater.

Note: Although deterioration is not specifically linked in Article 6.1 with status, this is clearly specified in Article 1 of the GWD and has been confirmed by the European Commission as the correct interpretation.

Though not explicit in Article 6.1 of the GWD, it is clear from the rest of the directive that the "limit" requirement should be implemented so that *pollution* does not occur. This is necessary to maintain the existing level of groundwater protection afforded by Directive 80/68/EEC, when it is repealed in December 2013

The GWD defines a "significant and sustained upward trend" as any statistically and environmentally significant increase of concentration of a pollutant, group of pollutants, or indicator of pollution in groundwater, which presents an environmental risk for which trend reversal is identified as being necessary in accordance with Article 5. The GWD requirements (that inputs do not result in significant upward trends and/or deterioration of status) ensures that pristine and relatively unpolluted groundwater remains protected.



Look out! To limit an input into groundwater means:

To take all measures necessary to prevent pollution, which will ensure that:

1. *there is no deterioration in status;*
2. *there is no significant and sustained upward trend in the concentrations of pollutants in groundwater.*

Limiting inputs to prevent pollution will ensure that the concentration of the substance remains below a level such that harm to a receptor does not occur, or that local maximum allowable concentrations and/or relevant groundwater quality standards are not exceeded.

Member states can, under certain conditions, exempt inputs from these measures, as specified in GWD Article6(3).

When considering which measures would be necessary to limit an input (see chapter 5 for explanation on measures), one can also take into account processes that will result in attenuation in the unsaturated as well as in the *saturated* zone. Such processes include fixation to soil particles, degradation, or dilution, such that no threat to receptors occurs and there is no significant and sustained upward trend in concentration. In addition, the potential for the substance to transform into a hazardous substance should be taken into account. If this were to occur, then the substance should be *prevented* from entering groundwater.

3.5 Receptor based vs. compartment based approach

Some Member States differ in their approaches to protecting groundwater, whilst still complying with the requirements of community legislation. One such approach is "receptor based", where all uses of groundwater (both active e.g. abstractions, and passive e.g. spring discharges to rivers and wetlands), are the receptors that are taken into account when assessing whether an input could cause pollution. This approach is applicable for those substances that have to be limited in groundwater. For hazardous substances, which have to be prevented from entering groundwater, the groundwater itself becomes the receptor.

The alternative approach is "compartment based", where the groundwater compartment as a whole is the receptor, irrespective of its use, and is the object of protection. This approach is applied equally, irrespective of the substances involved. Groundwater itself should be protected from contamination.

3.6 Conceptual hydrogeological model

In order to assess whether pollution has occurred or will occur, it is necessary to develop a conceptual model and an understanding of all the relationships between sources, pathways and receptors within their wider hydrogeological setting. The key considerations are:

1. the physical and chemical nature of the discharge or source of contamination (installation or contaminated part of the subsurface);
2. the physical and chemical characteristics of the aquifer;
3. the subsurface processes, e.g. dilution and degradation, that act on the pollutant as it moves down towards the water table or moves within the groundwater flow;

4. the location of all the receptors and their relationships to groundwater flow; and
5. the environmental standards (for water quality) that apply to the receptors and by which harm can be measured, as well as criteria for groundwater ecosystem.

A conceptual hydrogeological model (CHM) is therefore the schematisation of the key hydraulic, hydro-chemical and biological processes active in a groundwater body. This characterisation is essential for an understanding of the basic physical, chemical and biological processes influencing groundwater quality. As pollutants often travel through the unsaturated zone to reach groundwater, the processes acting on pollutants in the unsaturated zone should also be included where appropriate.

The system schematisation and process quantification is a necessary part of the conceptual understanding of the groundwater system. It defines background quality and any variations within it, and provides the reliable basis for future decisions. The conceptual model allows a basic assessment of attenuation mechanisms relevant to input behaviour and groundwater quality to be easily undertaken.

Guidelines for conceptual hydrogeological models (CHM) set up are available in English[4] and German[5].

4 How to Assess Inputs

4.1 Compliance Points

To help determining whether a contaminated discharge is acceptable or to decide how far you should clean up a site to address historical pollution you need to set compliance values (see box) at one or more compliance points.

There are two types of compliance point:

1) a theoretical point within a model for calculating an acceptable discharge concentration or the required level of clean up at a contaminated site;
2) a physical monitoring point (e.g. an observation borehole) for the purpose of measuring compliance with a permit or a clean-up regime.

A compliance point may either be at the receptor itself or at a point between the receptor and the source of contamination - for practical reasons, the latter may be necessary or more desirable. Where the compliance point is set between the receptor and the source in question, compliance values are based on the predicted effects of dilution and attenuation/degradation downstream at the receptor.

For the purpose of this guidance document, four different points of compliance (POC) are identified:

- POC 0: this POC is located at the base of the source in the unsaturated zone (for point sources as well as for diffuse sources). It could therefore be situated just below the ground surface. The purpose of POC 0 is to assess if a pollutant release takes place, what the pollutants are, and whether the groundwater could be affected;
- POC 1: this POC is located at the point of input into the groundwater.; For a direct input, POC 0 is the same as POC 1, however the function is different. At POC 1 the actual concentration in the groundwater itself is primarily taken into account, whereas at POC 0 one primarily looks at the properties of the source itself as explained above;
- POC 2: this POC is located hydraulically down gradient from the input in between POC 1 and a receptor. The purpose of this compliance point is to provide an early warning that the

[4] UK Environment Agency, 2001

[5] FH, DGG, 2002a, 2002b

receptor might be impacted. It is also used during the risk assessment process for predicting the potential impact of the input. POC 2 can be located in the horizontal as well as in the vertical spreading direction.

- POC 3: This POC is used to assess whether the desired groundwater quality is reached and to monitor the impact at the receptor. If a risk assessment shows that the pollutant will exceed the compliance value at this POC, then pollution is likely to occur as a result of the input. Measures/controls will need to be put in place to remove this impact, or the activity should not be permitted.

Specifications at POC 0, POC 1 and/or POC 2 should be defined such that they prevent compliance values at POC3 from being exceeded.

Compliance Values and Limit Values.

A **"Compliance Value**" for a substance is the concentration and associated compliance regime that, when not exceeded at the compliance point, will prevent pollution. This is **measured at the "prevent/limit" monitoring point (POC 1, 2, or 3).**

A compliance value thus prevents an environmental standard being exceeded at a receptor. Compliance values typically relate to protecting water uses such as drinking supplies or surface water environments. However, values from other legislative regimes (Drinking Water Standards or Environmental Quality Standards (EQS)) should not be used automatically without further consideration of their relevance, particularly where the compliance regime is different. Misuse of such standards can lead to over or under protection of the groundwater resource.

Compliance values differ to "Limit Values" in terms of where they are set and applied.

A **"Limit Value"** for a substance is the concentration and associated compliance regime that, when not exceeded at the source, will prevent an unacceptable release to groundwater. This is **measured at the source**, i.e. the point of release (POC 0).

Limit values can be expressed as a concentration or acceptable loading. They can be included in a permit as a condition, or specified as a remedial target for soils on contaminated land sites.

Examples:

1. Use or reuse of construction materials.

Strict limit values can be defined for the emission of pollutants from the material at POC 0. This value could be specified by the competent authority (appropriate approval process for the construction material if one exists, or in General Binding Rules). If modelling and experience confirms that such leachate will never lead to a relevant standard being exceeded, e.g. in a drinking water protected area, usually it will not be necessary to install specific monitoring points. Otherwise, compliance values may be defined at virtual points POC 1, POC 2 and/or POC 3 to further monitor the input and prevent pollution.

2. Use of manure.

For farmers it may be most practical to check the effects of using manure by assessing the potential input at a depth of e.g. 1 metre below the water table (POC 2). If the groundwater discharges directly to surface water (e.g. ditches) next to the farmlands, a POC 3 may be defined at the point of discharge to the surface water. Compliance values may be set at either of these POCs.

For historical inputs (e.g. contaminated land or accidents/spills/losses) where pollutants, including hazardous substances, have already entered the groundwater, the assessment of the inputs should determine the need for and scope of remediation that is appropriate for the situation. The compliance point locations remain the same.

These POCs are illustrated in the next figure (figure 4)

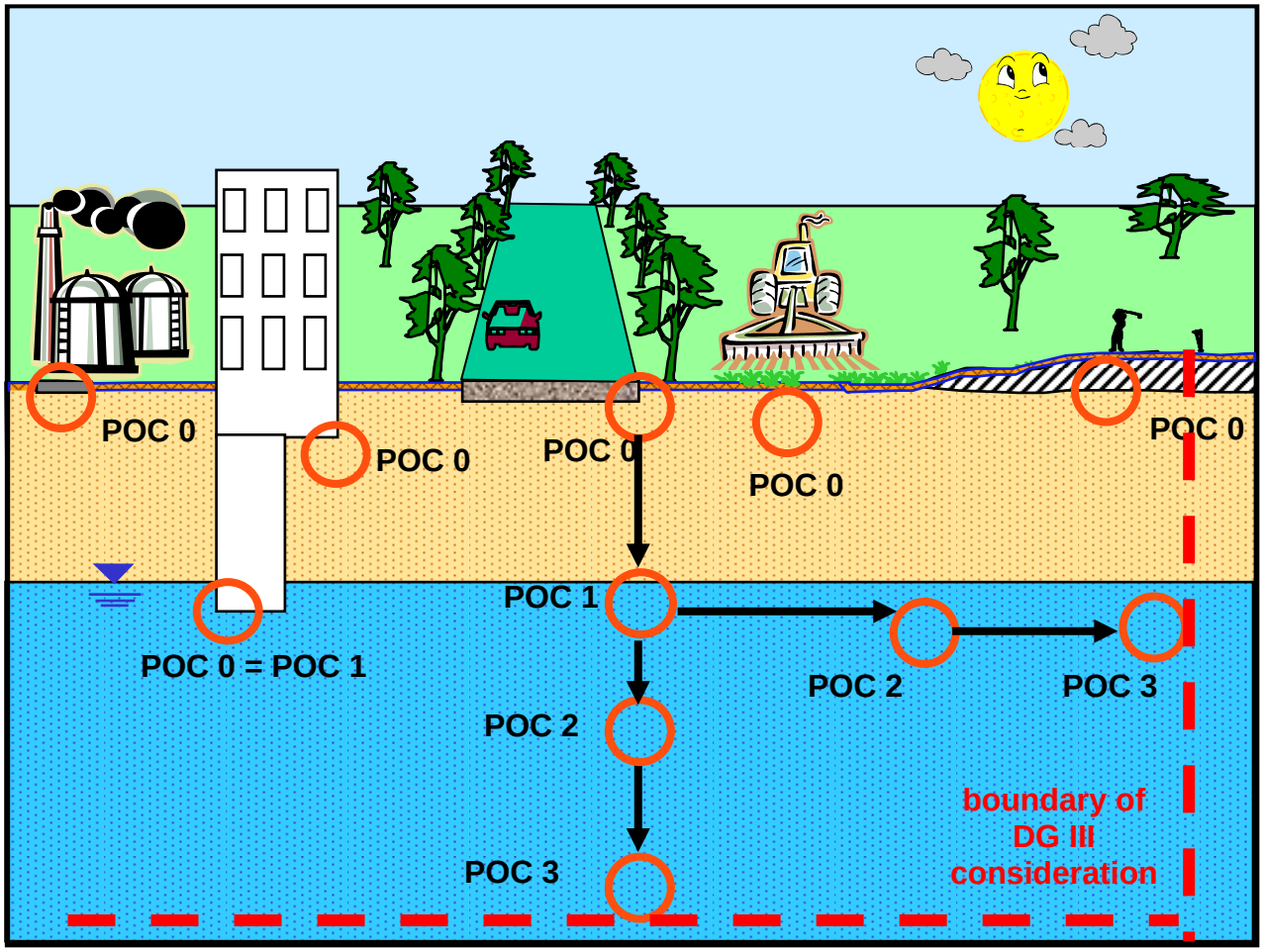


Figure 4: points of compliance (POCs)

The following outlines the potential data requirements to undertake an adequate assessment of the inputs at POC 0 using the examples in Figure 4. The first POC 0 on the left is situated under a factory. The type of data that might be needed include:

- an inventory of substances that are present on the site ground, and which may reach the ground by leakages, spills, accidents or planned discharges. This might be substances in drums, in tanks, in trucks or in a network of pipes;
- substance properties (e.g. hazardousness, physico-chemical behaviours (liability to degradation, evaporation, etc.));
- the total mix of substances and how they react together, e.g. determining influence of the pH of the soil, the transport by DOC, the competition between sorption and transport of different substances, etc.: and
- the likelihood of them entering into the soil (sealed surfaces? drainage?).

If the foundation of a building reaches groundwater, the assessment at POC 0 will need an inventory of the substances present in the foundation material, their properties, and their potential to migrate out of the material into the groundwater. Where construction materials are situated in the unsaturated zone, the POC 0 assessments will similarly concern the migration of substances out of the material, but will not include the entry into groundwater, since the migration through the unsaturated zone is a step assessed at POC 1.

For landfills, deposited contaminated soil and mining rock, etc., POC 0 should be situated at the interface between the engineered barrier if present, and the subsoil.

In the case of agricultural application of substances in the field (pesticides, fertilizers, manure) some penetration of the substances involved into the soil will almost certainly occur due to factors such as the open structure of the soil. POC 0 should therefore be situated just below the ground surface, e.g. 1 m, where the potential for the substances of concern to migrate towards the water table can be assessed.

The type of input and the hydrological, physical and chemical characteristics of the relevant soil and subsoil will determine what pollutants, including the breakdown products, might be present.

Other diagrams, representing the position of the POC's in different kinds of aquifers and in different situations, are represented in annex 2.

4.2 Guidelines for choosing receptors and compliance points

Inputs from newly planned activities, and inputs that are occurring or have already occurred from historical contaminated land or spills/accidents/losses etc, should be handled in different ways. Guidance on this is given in the following sections.

4.2.1 Planned new activities.

As stated before, discharges, emissions and losses involving hazardous substances must not result in the introduction of these substances into groundwater. The receptor is groundwater itself, and therefore all proposals involving hazardous substances should be assessed at POC 1 (at the Water Table).

For planned activities involving non-hazardous substances, the assessment needs to ensure that the substances will not exceed acceptable concentrations in groundwater so that pollution (or a significant and sustained upward trend) does not occur. Compliance should be assessed at POC 3 depending on the receptor; compliance values at POC 2 should be derived with reference to the characteristics of the aquifer, the contaminants, the processes in the soil and the groundwater, thereby ensuring compliance at POC 3.

4.2.2 Discharges from historically contaminated sites.

Site clean up should be directed towards preventing any hazardous substances from entering groundwater (POCs 0 & 1) unless it can be demonstrated by risk assessment and cost benefit analysis that this is infeasible, or one of the exemptions described in article 6(3)(a-f) applies.

Where pollution of groundwater has already occurred, the need for and amount of remediation for non hazardous substances will be determined by the receptors that could be, or are being harmed. The primary aim of the remediation strategy will be to prevent pollution from occurring or reduce the risk of further pollution by the expansion of the plume (Article 5.5). This should be assessed at POCs 2 and 3.

Once the appropriate remediation has been undertaken, this will in many cases result in a stable end-point where there are no further inputs to groundwater. A plume of contamination may still remain however, as it is often too costly or not technically feasible to completely clean up groundwater back to pristine conditions. Under these circumstances, it would not be reasonable to expect Member States to undertake further measures for clean up of all pollution, and this is allowed for under the exemptions to prevent or limit in Article 6 (3) of the GWD (see section 5.3). This action will require justification to the satisfaction of competent authorities. Additional trend assessment of the remaining plume should be carried out.

New activities planned on the site of historical contamination (e.g. a new oil storage facility on soil contaminated in the past with oil spills from leaking pipes and leaking industrial facilities) should be designed and maintained in such a way that no additional contamination occurs, taking into account all requirements of prevent and limit in the Directive. Any new permitted input should not impede any future improvement of groundwater quality.

4.2.3 Physical Constraints on setting compliance points.

Factors such as existing and future land uses, land ownership, topography or constraints on the future development of groundwater may influence decisions on whether a receptor may be justifiably located further along the groundwater pathway than described above. Scale is clearly a factor. The lifetime of the effects of a small point discharge may be considerably less than that from a landfill or an extensive industrial site, which may have an impact over many decades. Inevitably, greater caution is required in making assumptions about issues like land ownership for major, long-term impacts.

4.3 Assessing New Activities

When assessing whether new activities that may result in inputs are acceptable, i.e. whether they meet the requirements of the WFD, several questions need to be answered for every substance of concern, namely:

- Does the activity fall under an existing exemption of GWD Article 6 or is an exemption planned, e.g. is the input so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater?
- Is the input direct or indirect?
- Is the substance hazardous or non-hazardous?
- Can sufficient controls be put in place to prevent or limit the substance from entering groundwater?

The following flowchart (figure 5) is a decision tree for this assessment.

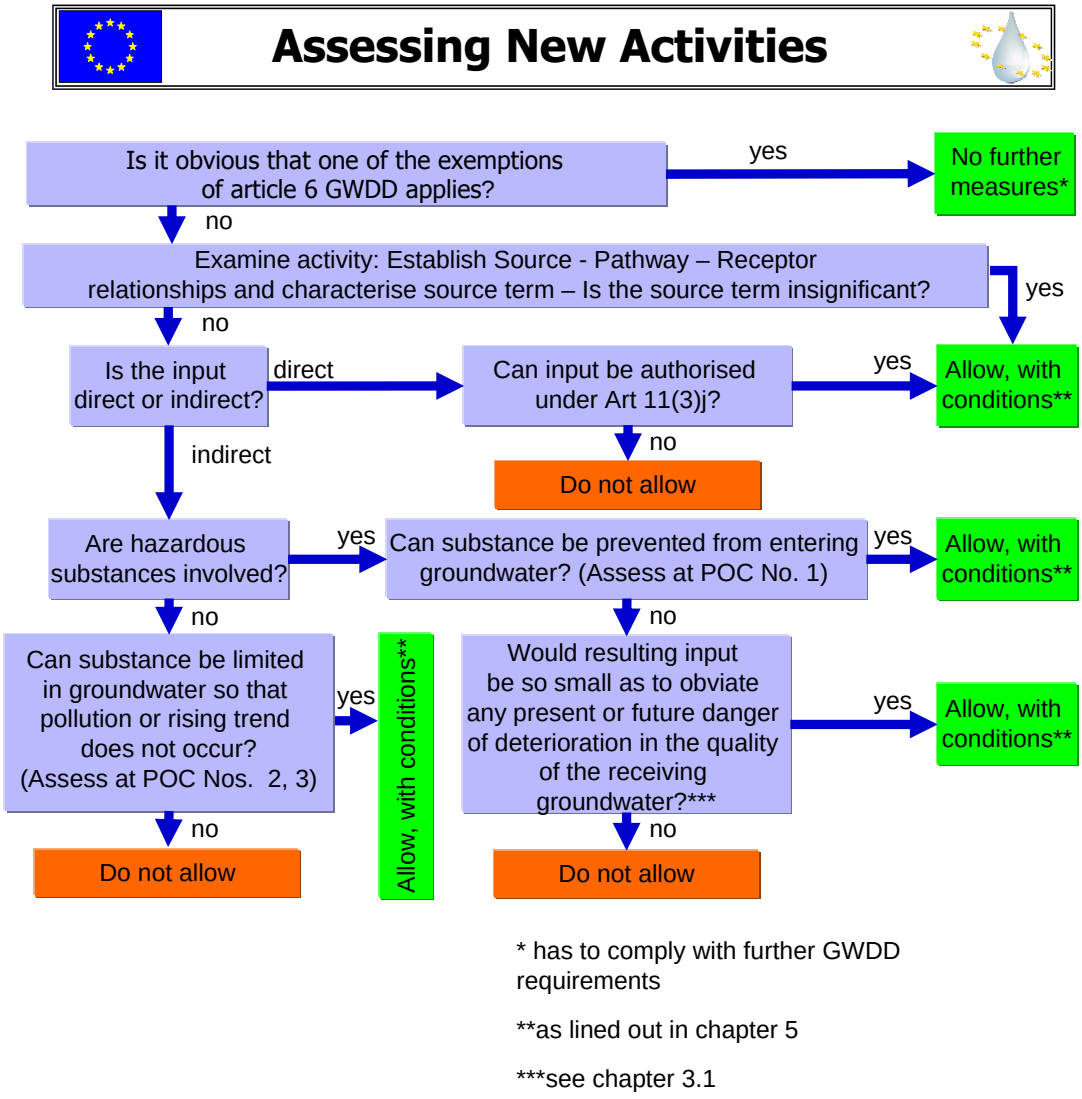


Figure 5: Assessing new activities.

4.4 Assessing Existing Sources of Contamination

Where the activity which led to the input has stopped, and there is an existing groundwater contamination, or soil contamination which could result in groundwater contamination, the question of whether the input is direct or indirect is no longer relevant. The assessment should consider whether the contamination has already entered groundwater, and what level of clean up is justified.

The assessment process is outlined in Figure 6.

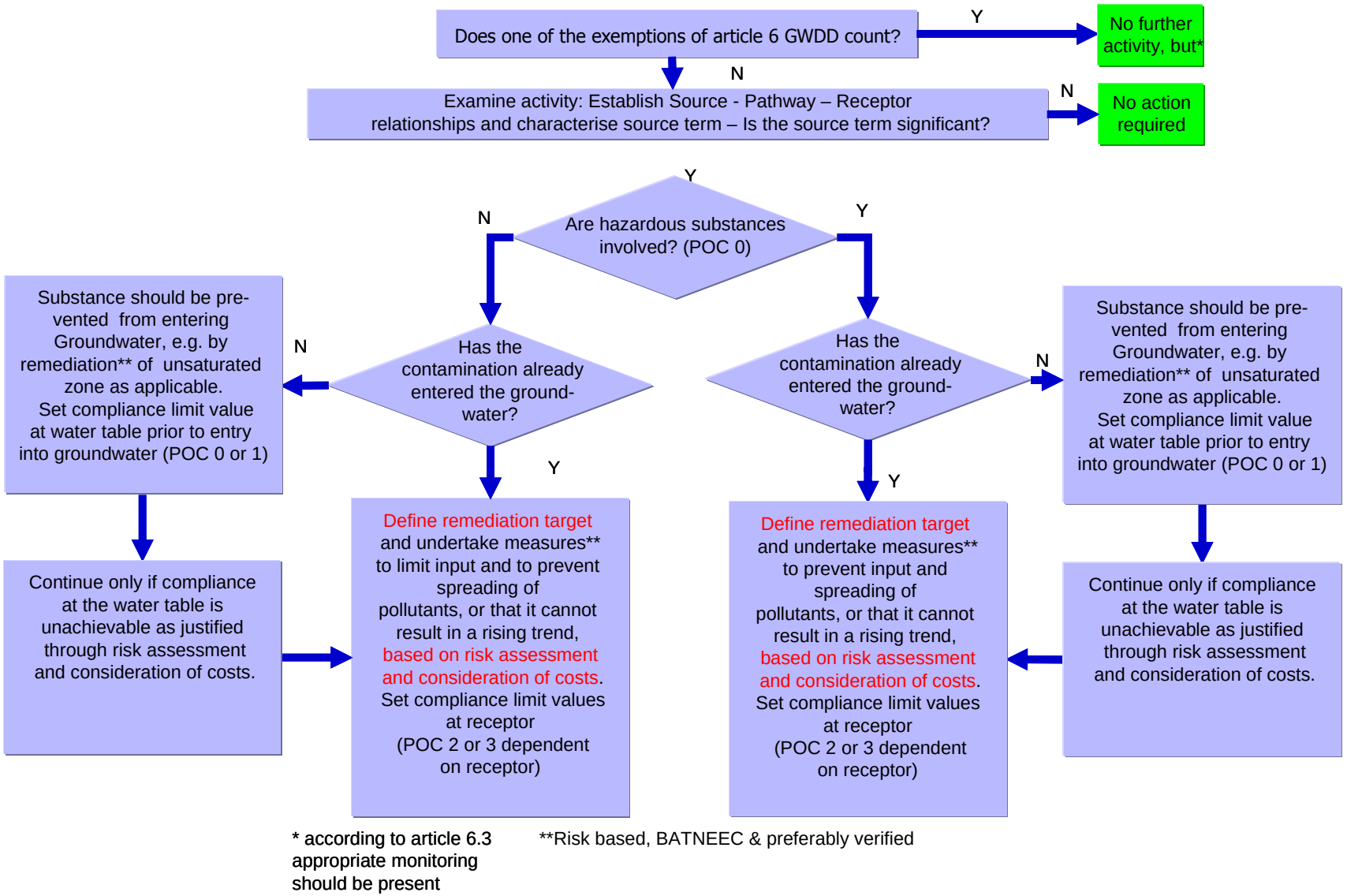


Figure 6: Assessing existing sources of contamination

4.5 Monitoring of inputs

The monitoring discussed in this guidance document is complementary to the monitoring described in the guidance document of Working Group C Drafting Group 1 - Groundwater Monitoring. This document provides guidance on establishing groundwater monitoring programmes as required by the WFD. It mainly focuses on surveillance and operational monitoring[6], i.e. the surveillance and operational monitoring that is required to characterise groundwater bodies and establish the status of groundwater bodies.

Planning, running and controlling measures to prevent or limit direct or indirect inputs require a reliable conceptual model (chapter 3.6). To develop this model, a more specific monitoring strategy than the status monitoring may be required, as it has to provide detailed information on system interactions. These monitoring points can later form part of the prevent/limit monitoring.

4.5.1 Purpose of Prevent and Limit monitoring

Groundwater quality monitoring is required to assess the effectiveness of the measures introduced to prevent or limit the inputs of pollutants. This is to ensure that pollution and/or deterioration of the status of groundwater has not or will not occur as a result of the input. Although surveillance and operational monitoring programmes will contribute significantly to this, there may be a need for additional monitoring programmes specifically targeted at point and diffuse source pressures. This prevent and limit monitoring is distinct from the monitoring (surveillance and operational) which is focused at the groundwater body scale. See the monitoring guidance for more detail. The prevent and limit monitoring should be based on a conceptual model/understanding of the related groundwater system and how direct and indirect inputs interact with that system (see previous sections).

Prevent and limit monitoring of this type is designed primarily at ensuring compliance with site conditions and authorisations in the case of regulated activities. For contaminated sites, prevent and limit monitoring is used for characterising site specific impacts and designing and assessing remedial action programmes. It should provide enough information to assess that inputs do not have an unacceptable impact on groundwater. The acceptability of inputs is determined by the nature of the substance, the type of input, and whether pollution as defined by the WFD occurs (as described in previous sections).

4.5.2 Design of Prevent and limit Monitoring

The need for, and extent of, prevent and limit monitoring will in many cases be determined by MS national legislation on permitting and remediation of land contamination. This type of monitoring is often located within a small area of a groundwater body, unlike the large-scale surveillance and operational monitoring. Prevent and limit monitoring always requires planning on a case-by-case

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- [6]A **surveillance monitoring network** to: (a) supplement and validate the Article 5 characterisation and risk assessment procedure with respect to the risks of failing to achieve good groundwater chemical status; (b) provide information for use in the assessment of long-term trends in natural conditions and in pollutant concentrations resulting from human activity and; (c) to establish, in conjunction with the risk assessment the need for operational monitoring. (**See also Monitoring Guidance for Groundwater. chapter 2)**
- An **operational monitoring network** to: (a) establish the status of all groundwater bodies, or groups of bodies, determined as being 'at risk', and (b) establish the presence of significant and sustained upward trends in the concentration of pollutants. (**See also Monitoring Guidance for Groundwater, chapter 2)**
- **Prevent and limit monitoring:** Prevent and limit monitoring is designed primarily at ensuring compliance with site conditions and authorisations in the cases of regulated activities or for site specific investigation, i.e. compliance monitoring, or for the purposes of characterising site specific impacts and designing and assessing remedial action programmes, i.e. investigation monitoring. (**See also Monitoring Guidance for Groundwater chapter 6)**.

basis to determine parameters to be sampled, frequency of sampling and location of monitoring points.

When designing prevent and limit monitoring programmes, the following need to be considered:

- Zero monitoring (upgradient and/or background monitoring): It may be necessary to report on the unaffected/background situation in the subsurface either before a new activity is set up or up-stream of an existing source of contamination.
- The monitoring intervals (frequency) have to take into account the behaviour (e.g. travel times) of the known pollutants and their degradation products.
- Construction (technical) characteristics of the monitoring wells and the depth of monitoring within each observation well should be dependent on the nature of the input, e.g. LNAPL/DNAPL[7] and on the seasonal water level fluctuation.
- Sampling methods, sample preservation and analysis methods will be dependent on the nature of the input and its expected pollutant concentration
- The parameters monitored at each well should be indicative of the type of pollutant(s) and their expected impact. Possible indicator parameters (redox, pH, electrical conductivity, temperature, salts) could be used to reduce the monitoring effort.
- The cost-benefit of the number of wells versus the level of information that will be obtained.

Monitoring geometry will depend on the definition of the points of compliance, which in turn strongly depends on the characteristics of the groundwater body described in the conceptual hydrogeological model (chapter 3.5) and the regulatory requirements.

5 Measures and exemptions to preventing or limiting inputs to groundwater

The following section aims to explain the requirements for undertaking measures to achieve the 'prevent or limit' objectives for groundwater within the WFD and GWD. Differences between these new requirements and the regime set out in the existing groundwater directive (80/68/EEC) are described as well.

The Directive 80/68/EEC is to be repealed by the WFD in 2013, and the protection regime set out within it will be continued and strengthened under the GWD. Article 11 of the WFD states that programmes of measures shall be established by 2009, and that all measures shall be made operational by December 2012.

This means that existing permits/licences/authorisations will need to comply with WFD requirements by 22 December 2012. In order for Member States to achieve this, a period of review for existing permits is necessary to ensure that all prevent or limit measures are WFD-compliant by 22 December 2012, and therefore also compliant with the new regime established by the GWD by December 2013 when Directive 80/68/EEC is repealed.

According to GWD 80/68/EEC, Article 11, "GWD-authorisations may be granted for a limited period only and will have to be reviewed at least every four years. They may be renewed, amended or withdrawn". Therefore, from early 2009 (at least four years before the deadline), this review process for existing authorisations should take into account the new regime of the WFD and the GWD, so that the renewed authorisations are fully compliant with the new regime from 22 December 2012.

[7] LNAPL: Light non aqueous phase liquid; DNAPL: Dense non aqueous phase liquid

According to GWD Article 7, new permits/licences/authorisations pursuant Articles 4 and 5 of the Directive 80/86/EEC should take into account the requirements of the GWD, article 3, 4 and 5 from 16 January 2009.

It should be noted therefore, that as a result of the migration from the old regime to the new regime, permit conditions and/or operational management may need to change. It will therefore be necessary for MS to manage this transitional period in a practical and effective manner.

It is therefore clear that the requirements of the WFD, and the 'prevent or limit' regimes established by the GWD are to be implemented before the repeal of 80/68/EEC.

5.1 "Basic measures" required by the WFD

Article 4.1(b)(i) of the WFD states that "Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater". Article 11 of the WFD requires Member States to establish a programme of measures in order to achieve all the Article 4 objectives, including the objectives for preventing or limiting inputs to groundwater.

Measures are those processes and controls that Member States will have to put in place in order to meet the environmental goals set for water bodies, including preventing or limiting inputs of pollutants to groundwater. This section aims to describe and interpret the minimum requirements for "basic measures" set out in Article 11(3), where they relate to preventing or limiting inputs. These "basic measures" are the minimum measures that MS have to include in the Programme of Measures within the River Basin Plans. There are also "supplementary measures" which MS may choose to adopt if necessary, but these will not be discussed here.

The relevant paragraphs are:
(paragraph numbers referred to are those in Article 11(3) of the WFD)

(a) *those measures required to implement Community legislation for the protection of water, including measures required under the legislation specified in Article 10 and in part A of Annex VI*

In the WFD, the 'combined approach' is introduced in recital 40, which states: 'With regard to pollution prevention and control, Community water policy should be based on a combined approach using control of pollution at source through the setting of emission limit values and of environmental quality standards.'

Article 2(36) defines 'Combined approach' as the control of discharges and emissions into surface waters according to the approach set out in Article 10.'

Article 10 requires Member States to use existing legislation to provide a combined approach for controlling point and diffuse sources that may result in discharges to surface water. This should be achieved by putting in place emission controls using best available techniques, setting relevant emission limit values, and in the case of impacts from diffuse inputs, follow the best environmental practice set out in relevant community legislation. This includes, but is not restricted to the IPPC, Urban Waste Water and Nitrates Directives.

Article 10 does not refer directly to inputs to groundwater, but in using the existing directives to reduce and/or eliminate discharges to surface water, this may also result in the indirect control of inputs to groundwater.

Part A of Annex VI lists the directives whose requirements must be included in the programmes of measures, and which are therefore complementary to achieving the objectives of the WFD.

The directives most relevant for preventing or limiting inputs of pollutants into groundwater listed within Annex VI are:

- The Plant Protection Products Directive - this sets out an approvals system for the use of pesticides. When considering the effects on groundwater, one of the Uniform Principles for decision making (annex VI of 91/414/EEC which is 97/57/EEC) requires that the 0.1 mg/l drinking water standard (from 98/83/EC) for any individual pesticide is not expected to be exceeded in groundwater. By applying this principle when approving new pesticides groundwater is protected to some degree. However experience from across Europe has shown that approved pesticides sometimes still leach to groundwater even when applied according to best practice. Additional measures may therefore be necessary to ensure that pesticides do not enter groundwater. Such measures could be those outlined in the rest of Article 11(3), including prior authorisation of the use of the products (for the definition of product see the PPPD) (Article 11(3)(g)).
- The Nitrates Directive, which contains provisions for designation of vulnerable zones and Member State action where the amount of nitrate contained in groundwater is exceeding, or is likely to exceed 50 mg/l. These action plans only relate to controlling nitrate from agricultural activities, and therefore further measures will be needed to address inputs from non-agricultural sources.
- The Urban Waste-water Treatment Directive, which indirectly protects groundwater by requiring that agglomerations of more than 2000 households are connected to a sewerage system (instead of discharging wastewater into the soil or into surface water).

(d) *measures to meet the requirements of Article 7, including measures to safeguard water quality in order to reduce the level of purification treatment required for the production of drinking water*

The interpretation of the requirements of Article 7 can be found within the CIS WG C Guidance on Drinking Water Protected Areas. It is likely that in order to comply with Article 7, it will be most appropriate for measures to be focussed within "safeguard zones" around abstraction points for raw drinking water. Controls may include restrictions or bans on the use of certain hazardous substances within these zones or restricting the development and use of land to low risk activities, as considered appropriate by individual MS competent authorities.

(f) *controls, including a requirement for prior authorisation of artificial recharge or augmentation of groundwater bodies. The water used may be derived from any surface water or groundwater, provided that the use of the source does not compromise the achievement of the environmental objectives established for the source or the recharged or augmented body of groundwater. These controls shall be periodically reviewed and, where necessary, updated.*

This is a requirement for MS to have in place a system of authorisations or permits for aquifer storage or augmentation schemes. This is a similar control and provision to that which already exists in the Directive 80/68/EEC.

(g) *for point source discharges liable to cause pollution, a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, or for prior authorisation, or registration based on general binding rules, laying down emission controls for the pollutants concerned, including controls in accordance with Articles 10 and 16. These controls shall be periodically reviewed and, where necessary, updated.*

This is a requirement to regulate inputs from point sources. Such regulation can take the form of:

- prohibitions if the assessment of the impact of the point source shows that, for example, the risk that hazardous substances may enter groundwater cannot be adequately controlled;
- authorisations to ensure that the technical precautions are in place to comply with the 'prevent or limit' objectives; or
- creation of general binding rules to cover activities considered to be low risk to groundwater.

In Article 11(3)(g), there is no restriction on the types of activities or substances covered by this measure. This is more protective than the system of prior investigation and authorisation set out in Directive 80/68/EEC, in that the WFD extends these controls to all pollutants, as opposed to only those substances contained within List I and List II of Directive 80/68/EEC. Therefore, all existing permitting regimes are covered by this requirement, and there may be a need to develop additional systems to control the extra substances that this includes. The requirement in Directive 80/68/EEC to only grant authorisations for a limited period disappears but reviewing the effectiveness of these authorisations must still be undertaken. There is no longer a set time frame for these reviews, however. Logically, the review should take place at least once every six years as part of the review of the river basin management plans as they contain the programmes of measures.

As well as encompassing more substances, the WFD also allows for a more flexible approach than specified in Directive 80/68/EEC. It gives MS the ability to create rules and statutory Codes of Practice covering low risk industry sectors. These could then be used at the discretion of MS as an alternative to authorising individual activities.

WFD Articles 10 & 16, to which Article 11(3)(g) refers, are primarily aimed at protecting surface water.

(h) *For diffuse sources liable to cause pollution, measures to prevent or control the input of pollutants. Controls may take the form of a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, prior authorisation or registration based on general binding rules where such a requirement is not otherwise provided for under Community legislation. These controls shall be periodically reviewed and, where necessary updated.*

This is a similar requirement to sub-paragraph (g), but applying to diffuse inputs not being point sources. This particular protective measure is more specific and clearer than those required by Directive 80/68/EEC, which specifies a system of prior authorisation for "disposal, or tipping for the purposes of disposal" that are ineffective for diffuse pollution. It does not specify what the appropriate measures are that should be taken to prevent or limit indirect discharges of listed substances from other activities.

The measures implemented by MS in this case to adequately control diffuse inputs will need to apply over a wider area and on a larger scale than those for point sources. Controls such as general binding rules and statutory Codes of Practice are likely to be the most effective measures available to MS.

Article 11(3)(j) contains a specific prohibition relevant to groundwater, and exemptions from this rule. It is the subject of the next section.

5.2 Prohibition of direct discharges to groundwater

The WFD includes a specific prohibition relevant to inputs into groundwater. The basic measure contained within Article 11(3)(j) is a prohibition of all direct discharges of pollutants into

groundwater. This is different from Directive 80/60/EEC, which contains a requirement to prohibit all direct discharges of substances in list I, i.e. only the most dangerous substances.

This means that the WFD is more stringent than the existing regime as all direct discharges are now in principle included in this prohibition. The implication is that Member States will need to ensure that existing practices comply with this new requirement via a process of review.

There is no similar prohibition of "inputs" written into the GWD. As mentioned earlier in this document, the term "inputs" covers all pollutants that enter groundwater, rather than being restricted to deliberate disposals. It is therefore considered that the prohibition set in WFD Article 11(3)(j) should apply to all direct inputs to groundwater.

WFD Article 11(3)(j) also contains a number of exemptions/provisions to this prohibition which will be dealt with in the next section. The WFD does not provide any specific prohibitions concerning *indirect* inputs,. However, the GWD indirectly prohibits all direct and indirect inputs to groundwater of substances considered by the competent authorities to be hazardous, through its prevent clause Article 6(1)(a), subject to exemptions.

5.3 Exemptions

With the exception of the provisions relating to direct discharges, the WFD does not contain any explicit exemptions to the requirement to prevent or limit inputs of pollutants into groundwater. However exemptions are included within the GWD and are set out in Article 6(3).

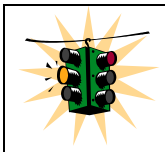
The exemptions appearing in the GWD will replace the exemptions currently set out within Directive 80/68/EEC. Table A compares the exemptions in the two directives. The GWD contains more exemptions than are contained within Directive 80/68/EEC. The only exemption from Directive 80/68/EEC that remains is the so-called *de minimis* provision ((b) in the table). It should be recognised that the exemptions set out in Directive 80/68/EEC are exemptions from the directive itself. The tabled exemptions within the GWD are exemptions only from paragraph 1 of Article 6, i.e. the 'prevent or limit' requirements, not from the directive as a whole, which has a much wider scope than Directive 80/68/EEC.

Table A: Exemptions included in the GWD (2006) and in the Directive 80/68/EEC

GWD - Article 6(3)	**Directive 80/68/EEC – Article 2**
Inputs of pollutants that are: (a) the result of direct discharges authorised in accordance with Article 11(3)(j) of Directive 2000/60/EC (b) considered by the competent authorities to be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater (c) the consequences of accidents or exceptional circumstances of natural cause that could not reasonably have been foreseen, avoided or mitigated (d) the result of artificial recharge or augmentation of bodies of groundwater authorised in accordance with Article 11(3)(f) of Directive 2000/60/EC (e) considered by the competent authorities to be not technically feasible to prevent or limit without using: (i) measures that would increase risks to human health or to the quality of the environment as a whole; or (ii) disproportionately costly measures to remove quantities of pollutants from, or otherwise control their percolation in, contaminated ground or subsoil (f) the result of interventions in surface waters for the purposes, amongst others, of mitigating the effects of floods and droughts, and for the management of waters and waterways, including at international level. Such activities, including cutting, dredging, relocation and deposition of sediments in surface water, shall be conducted in accordance with general binding rules, and, where applicable, with permits and authorisations issued on the basis of such rules, developed by the Member States for that purpose, provided that such inputs do not compromise the achievement of the environmental objectives established for the water bodies concerned in accordance with Article 4(1)(b) of Directive 2000/60/EC.	(a) discharges of domestic effluents from isolated dwellings not connected to a sewerage system and situated outside areas protected for the abstraction of water for human consumption. (b) discharges which are found by the competent authority of the Member State concerned to contain substances in lists I or II in a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater (c) discharges of matter containing radioactive substances

5.4 Examples of exemptions

Each of the exemptions is quoted below, followed by an explanation and some examples.



Look out!

The examples given below are not an exhaustive list, nor should they be understood to be the most common exemption cases.

WFD Article 11(3)(j) which comprises a general prohibition of direct discharges also contains a number of exemptions where in certain circumstances direct discharges are allowed provided they are authorised with conditions or conducted in accordance with general binding rules developed for a particular activity/industry sector. These authorisations should ensure that the achievement of the environmental objectives established for that body of groundwater are not compromised. These provisions are as follows:

1. *Member States may authorise reinjection into the same aquifer of water used for geothermal purposes.*

They may also authorise, specifying the conditions for:

2. *injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes. Such injections shall not contain substances other than those resulting from the above operations,*
3. *reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works,*
4. *injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into geological formations which for natural reasons are permanently unsuitable for other purposes,*
5. *injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into other geological formations where there is an overriding need for security of gas supply, and where the injection is such as to prevent any present or future danger of deterioration in the quality of any receiving groundwater,*
6. *construction, civil engineering and building works and similar activities on, or in the ground which come into contact with groundwater. For these purposes, Member States may determine that such activities are to be treated as having been authorised provided that they are conducted in accordance with general binding rules developed by the Member State in respect of such activities,*
7. *discharges of small quantities of substances for scientific purposes for characterisation, protection or remediation of water bodies limited to the amount strictly necessary for the purposes concerned*

Whereas most of the activities described under (1) to (7) are self-explanatory, a general description like "injection of water for technical reasons ...", see (2) above, may need explanation. A specific example of this is reinjection of brine, resulting from desalination of brackish groundwater through membrane filtration. The brine is reinjected in a deeper saline aquifer that is unsuitable for any purposes. By properly locating abstraction and reinjection points an enlargement is established of the part of a partly fresh, partly brackish groundwater body that can be sustainably used for drinking

water production. By performing the membrane filtration without auxiliary substances, the activity fulfils the condition set by provision (2): "Such injections shall not contain substances other than those resulting from the above operations".

Exemption (6) includes the prerequisite that the activities are conducted in accordance with general binding rules developed by the Member State. One of the purposes of these rules will be to prevent the use of construction and auxiliary materials or techniques causing unacceptable leaching of polluting substances into groundwater. Whereas the exemption refers to "activities", it is obvious that it also includes the remaining *presence* of approved construction materials in contact with the groundwater, once the work has been finalised.

Member States may exempt (based on GWD Article 6 (3)) inputs with certain characteristics from the 'prevent or limit' requirements, without prejudice to any more stringent requirements in other Community legislation. The exempted inputs are listed (a) to (f).

(a) inputs which are *the result of direct discharges authorised in accordance with Article 11(3)(j) of Directive 2000/60/EC;*

This explicitly provides consistency between the GWD and the exemptions provided by WFD Article 11(3)(j) described above.

(b) inputs which are *considered by the competent authorities to be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater;*

A similar *de minimis* provision was included in Directive 80/68/EEC. It recognises that small inputs exist for which prevention or limitation measures are not reasonable since the effect of the inputs on the groundwater quality would be negligible or absent if the activity was not controlled. The exemption "discharges of domestic effluents from isolated dwellings not connected to a sewerage system" in Directive 80/68/EEC is not in the GWD. However, if a discharge from an isolated house or very small settlement has a negligible effect, it may still be exempted through the *de minimis* provision.

The *de minimis* provision may also apply to residual insignificant inputs from landfills. Landfills have to meet certain requirements aimed at minimising leaching. In the course of time a small flux of contaminants into groundwater may occur, but if the impact is assessed as being insignificant (e.g. by modelling) and validated through monitoring, then the exemption applies.

In general the exemption also applies to residual insignificant inputs from construction materials which have been approved by the competent authority for certain applications. Usually it is physically impossible to completely prevent any diffusive flux from construction materials into the surrounding groundwater. Among the constituents of the material there may be substances considered hazardous. However approval of the construction material implies that the expected leaching is considered "to be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater". Allowing the use of such materials is also the purpose of exemption (6) under WFD Article 11.3 (j), which was mentioned above.

(c) inputs which are *the consequences of accidents or exceptional circumstances of natural cause that could not reasonably have been foreseen, avoided or mitigated;*

The text is not specifying whether it refers to accidents of natural cause or accidents in general (e.g. accidents with land-based transport of chemicals). However, it is reasonable that the exemption would not apply to accidents causing pollution that could be reasonably prevented, that can be removed at reasonable cost, balancing the benefit for groundwater.

Exceptional circumstances of natural cause could be floods, droughts, forest fires, earthquakes, and volcanic eruptions. Obviously natural effects that occur independently of human activity are excluded from the scope of the 'prevent and limit' requirement. However, if such circumstances can be foreseen (e.g. floods or earthquakes) preventive measures should be taken, unless effects are negligible or such measures are not feasible as covered in the exemptions (b) and (e).

Floods can lead to groundwater pollution in particular if they affect facilities, such as waste sites or sites for storage and handling of chemicals. The direct result is surface water pollution, but eventually the pollution may reach the groundwater through infiltration of surface water into the soil or deposition of contaminated soil from which pollutants subsequently leach into the groundwater. Whether exemption (c) could apply depends on a judgment of whether measures to avoid or mitigate such accidents could reasonably be taken. In principle accidents should be prevented through safe constructions, restrictions in flood prone areas, or warning systems and protocols in case of flood events. Putting such measures into place should be part of the programme of measures referred to in GWD Article 6(1) and WFD Article 11. A similar reasoning applies to the widespread accidents that can be brought about by earthquakes.

(d) inputs which are *the result of artificial recharge or augmentation of bodies of groundwater authorised in accordance with Article 11(3)(f) of Directive 2000/60/EC;*

GWD Article 6(3)(d) explicitly provides consistency between GWD Article 6 and WFD Article 11(3)(f), which is described in section 5.1.

The provision of WFD Article 11(3)(f) is rather self-explanatory. Artificial recharge or augmentation is also named "artificial infiltration".

(e) inputs which are *considered by the competent authorities to be not technically feasible to prevent or limit without using:*

(i) measures that would increase risks to human health or to the quality of the environment as a whole; or

(ii) disproportionately costly measures to remove quantities of pollutants from, or otherwise control their percolation in, contaminated ground or subsoil;

An example of "measures that would increase risks to human health or the quality of the environment as a whole" could be treatment of polluted soil by excavation that would disturb the impermeable layers in the soil, protecting the deep groundwater used for drinking water production.

In some cases contaminated soil or sediment may cause an input of pollutants into groundwater that is significant (at least at a local scale) so that exemption (b) does not apply, however (full) remediation would do more harm than good to the environment. (Full) remediation may for instance cause noise disturbing wildlife, may need disproportionate amounts of energy or other resources, etc. In some cases other solutions may be possible, providing partial remediation. Remediation of contaminated sediment settled on the bottom of surface water may in some cases not be possible without causing considerable re-suspension of contaminated material which would lead to ecological damage or be harmful to swimming water quality or to the use of surface water for drinking water production. A more careful remediation technique may be suitable, but if this were disproportionately expensive, exemption (ii) would apply. In general, remediation of polluted soil or sediment that would infer unreasonably high cost compared to the environmental benefit would be a case for exemption (ii). What is 'unreasonable' is to be determined in case by case assessments, which according to WFD Article 14 should be made with participation of all relevant parties, and be reported in a transparent way.

(f) inputs which are *the result of interventions in surface waters for the purposes, amongst others, of mitigating the effects of floods and droughts, and for the management of waters and waterways,*

including at international level. Such activities, including cutting, dredging, relocation and deposition of sediments in surface water, shall be conducted in accordance with general binding rules, and, where applicable, with permits and authorisations issued on the basis of such rules, developed by the Member States for that purpose, provided that such inputs do not compromise the achievement of the environmental objectives established for the water bodies concerned in accordance with Article 4(1)(b) of Directive 2000/60/EC.

Examples where this provision applies are the maintenance of river channel depth for shipping, and excavation of an adjacent channel in a river flood plain to increase protection against flooding. Such activities produce large amounts of sediment or soil that needs to be deposited somewhere. The material could for example be used in dike construction. Another sustainable and cost-effective solution is deposition in deep sand or gravel excavation pits within or close to the river system. These pits are filled with water but due to their significant, artificially created depth they do not provide a natural ecological habitat. Most sediments are contaminated to some extent. The concentration of widely spread sediments into the limited area of a pit is likely to reduce the overall input of contaminants into surface and groundwater as well as the exposure of the contamination to the environment. Nevertheless a local flow of pollutants into groundwater might result. This may be a case for exemption (b) (insignificance), or exemption (f) which allows for an approach by general binding rules developed by the Member State. Such rules should prevent that works such as those outlined above significantly affect the groundwater quality. Works can be exempted if they comply with general binding rules, which should imply that the potential flow of pollutants into groundwater is considered by the competent authority to be sufficiently small so as not to compromise the achievement of the environmental objectives established under the WFD for the groundwater bodies concerned. Although it could be argued that the soil or sediment deposition may be permitted pursuant to exemption (e)(ii) as well, exemption (f) refers more clearly to cases such as those described here.

5.5 Conditions for applying exemptions

GWD recital 18 says: "*In certain circumstances, Member States should be authorised to grant exemptions from measures to prevent or limit the input of pollutants into groundwater. Any exemptions should be based on transparent criteria and be detailed in the river basin management plans*". GWD Article 6(3) defines specific activities or situations to which the exemptions can be applied (subject to certain conditions). So in order to exempt an input from the prevent or limit requirement the competent authority should in the first place decide whether any of the descriptions given in Article 6(3) apply. The criteria for this decision should be transparent and relevant details should be provided in the river basin management plan. To make clear that one or more of the exemptions of Article 6(3) apply, the activity or incident causing an input that is to be exempted from measures has to be described. Obviously, for activities or incidents that have a similar character, a single general description in the river basin management plan, or a reference to another document containing this justification, may be sufficient. This applies for example to activities complying with general binding rules developed by Member States.

GWD Article 6(4) requires an inventory of the exemptions for the purpose of notification, upon request, to the Commission. Article 6(4) does not say how much detail the inventory should contain, nor does it require that the inventory itself should be part of the river basin management plan. The inventory could be an annex of the plan, either including all justification related to the exemptions, or referring to other documents containing this reasoning. Alternatively the river basin management plan could indicate where the inventory can be found. It is unreasonable to maintain an inventory with detailed description of each individual exemption, especially when it concerns frequently occurring inputs from construction works or septic tanks. Practical solutions for elaborating such inventories should be developed, e.g. if Member States use general binding rules or codes of practice

to authorise the use of construction materials to ensure that the residual input is acceptable. In this case, it would be sufficient to only include that general binding rule in the inventory.

The last sentence of GWD Article 6(3) says that the exemptions may be used only where the Member States' competent authorities have established that efficient monitoring of the bodies of groundwater concerned, in accordance with point 2.4.2 of Annex V to Directive 2000/60/EC, or other appropriate monitoring, is being carried out. The monitoring in accordance with point 2.4.2 of WFD Annex V, which is addressed in the Guidance on Groundwater Monitoring, will probably not provide for measurements with sufficient detail to determine effects of individual cases where exemptions are applied. The competent authorities should decide whether additional monitoring is needed to verify that the effects of an exempted input are acceptable, e.g. in the case of a construction material which has been approved for use in soil or groundwater despite containing a hazardous substance, the approval implies that leaching is considered to be insignificant. It is obviously not necessary to monitor groundwater quality at all sites where the material is applied. The tests of the material that led to its approval may be sufficient proof. Other types of widespread inputs for which an exemption is applied may have to be monitored at a few representative sites.

Article 6(3) starts with the condition "Without prejudice to any more stringent requirements in other Community legislation". Application of an exemption should, for example, not have adverse effects on a Natura 2000 area, or on drinking water production. If groundwater flow occurs from an exemption site towards sites where other community legislation sets more stringent objectives, it should be shown that those objectives can still be expected to be achieved. Such arguments may require expert assessment by groundwater managers and stakeholders (Stakeholders should be involved pursuant to WFD Article 14 on public participation).

5.6 How to develop measures

The development of measures (figure 7) is based on the characteristics of the input (chapter 3.2 & 3.3) and the type of activity (chapter 4.3 & 4.4). This is the basis to check if one of the exemptions of the GWD (chapter 5.3 & 5.5) applies. For both scenarios, new activities and existing sources the point of compliance approach - POC (chapter 4.1) should be used to assess the impact of these activities, and thus the action required to ensure that the prevent or limit objective of the WFD is complied with.

For new activities, figure 5 gives clear advice on how to proceed. For existing sources the POC concept leads to a stepwise development of measures necessary to prevent or limit the input of pollutants into groundwater. It starts with monitoring and sets clear action lines when more rigid, site specific measures have to be taken. The design of these measures should be based on a receptor/compartment based (chapter 3.5) risk assessment following the pathways in figure 6.

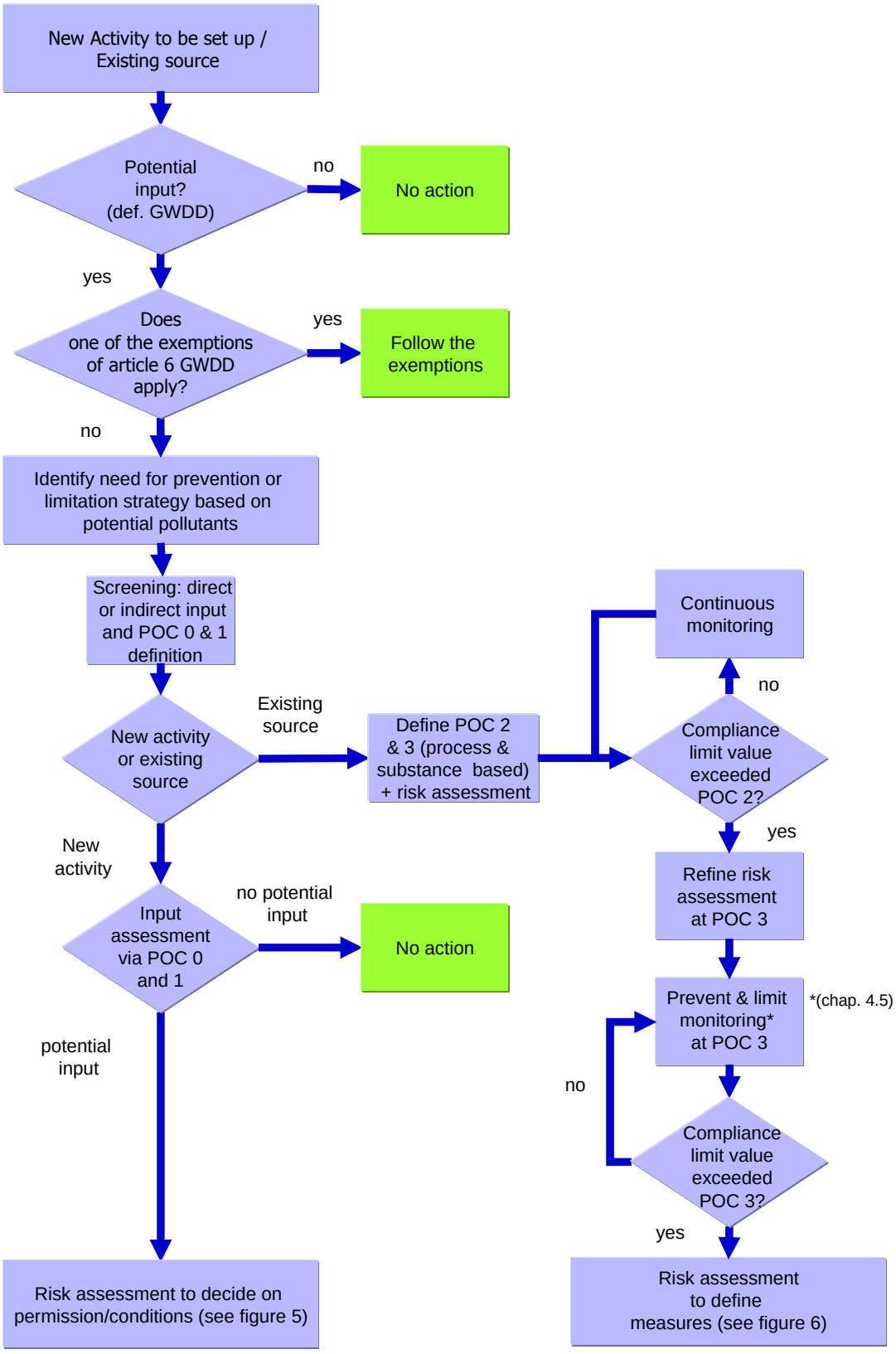


Figure 7: Overview on how to come to measures

Annexes

Annex 1 Examples of inputs

	Types of sources	Examples	Direct or indirect input (usual)	Properties regarding input	Point source or Diffuse 1)
1	Point sources; liquid discharges through pipes	- Infiltration from industrial treatment plant - Septic tank-infiltration system - Rain water infiltration from roofs, roads, etc	- indirect or direct - Indirect - Indirect	Continuous input	Point source
2	Leachate from solid materials	- Construction materials - Landfills - Preserved wood - Metal objects	All: Indirect or direct	Once-only action2); usual decrease of release in time	Point source
3	Spreading out	- Pesticides - Manure, Fertilizers, Compost - Sewage sludge - Highway de-icing	All: Indirect	Periodical repeated input	Diffuse source
4	Infiltration	- Groundwater suppletion - For drinking water supply - For energy storage - Leakage from ponds for storage of liquid waste, etc. - Injection/disposal of fluids associated with production of oil and gas	- Direct or indirect - Direct or indirect - Direct - Direct or indirect - Direct	- Continuous input - Continuous input - Continuous input - Continuous or incidental input - Continuous input	Point source
5	Atmospheric inputs	- (former) Local industries - Industrial accidents - By general air quality	All: Indirect	-Continuous input -Incidental input -Continuous input	Diffuse source
6	Existing Soil and groundwater pollution	- Polluted soil spot - Large area of polluted soil - Polluted groundwater spot - Large area of polluted groundwater	All: Direct or indirect	Once-only action; usual slow spreading to and though groundwater.	-Point source -Diffuse source -Point source -Diffuse source
7	Leakages by accidents	- Tanks, pipes, oil bore holes, - Energy storage systems	All: Direct or indirect	Once-only action 2); slow or fast spreading	Point source

Remarks

1) a number of point sources in the same area may be seen as diffuse source, when regarded as a group.

2) once only = each input is a once-only action. However, on the same spot it may be possible to repeat the action with the same or with other materials that may release substances. In such cases it may look like a continuous type of input on that spot.

Annex 2 : examples of the POC concept