WAT-PS-10 Assigning Groundwater Assessment Criteria for Pollutant Inputs – Draft for Consultation

Annex 1 Background to the standards

A1.1 What is groundwater?

Groundwater is defined by legislation as 'water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil'. This definition has no size limit or depth limit so even small volumes of water in the subsurface or at depth are considered as groundwater if the ground or subsoil[1] are saturated. Groundwater is present in all parts of Scotland and to considerable depth.

Legally controlled activities taking place in groundwater within the landward limits of coastal waters (up to 3 miles from limit of the highest tide) are subject to control under CAR or equivalent legislation.

However, groundwater at significant depth and under coastal and transitional waters is typically saline, naturally unsuitable for use and its flow is not significant for associated surface water or wetland ecosystems. Such groundwater does not require protecting as a receptor provided it can be demonstrated that there is no significant pathway for contaminants to reach surface ecosystems.

A1.2 What is future groundwater resource potential?

SEPA consider that future groundwater resource potential is groundwater within all aquifers capable of supplying 10 m^3/day or 50 people (on a continuous basis), that are less than 400 m below ground level, and located inland of the mean high water springs tidal limit. This is in line with the UK TAG criteria for defining groundwater bodies[2]. Note that aquifers that are not currently used for potable supply may still have future groundwater resource potential.

[1] Subsoil is considered here to include both natural soils and anthropogenic soils ('made ground').

[2] UKTAG, 2012, *Defining & Reporting on Groundwater Bodies*

SEPA considers that the following groundwater have future resource potential:

- Groundwater within all bedrock aquifers[3] to a depth of 400 m below ground level in mainland Scotland plus those islands mapped by SEPA as groundwater bodies[4].
- Groundwater in sand and gravel aquifers mapped by SEPA as groundwater bodies. Selected extensive sand and gravel aquifers are mapped as groundwater bodies[5].
- Groundwater in superficial deposits that are not mapped as groundwater bodies unless it has been demonstrated using the methodology in Annex 4 that the groundwater does not have resource potential.

Where groundwater is not classed as having future resource potential, it still requires consideration as a pathway to other receptors, such as other groundwater that does have future resource potential, surface waters, abstractions or wetlands.

A1.3 What is a hazardous substance?

Hazardous substances are "*substances or groups of substances that are toxic, persistent and liable to bioaccumulate, and other substances or groups of substances which give rise to an equivalent level of concern*[6]".

The Water Environment (Controlled Activities) (Scotland) Regulations 2011 require SEPA to publish a list of the Groundwater Hazardous Substances that are applicable in Scotland on the basis of their intrinsic properties. This list is based on the recommendations of the Joint Agency Groundwater Directive Advisory Group (JAGDAG).

[3] Including weathered bedrock

[4] Note that a groundwater body is a management unit for Scotland's groundwater. All of mainland Scotland and the majority of inhabited islands are split into groundwater bodies. Each groundwater body includes the bedrock and/or overlying superficial deposits

[5] Ó Dochartaigh et al, 2015, *Scotland's aquifers and groundwater bodies*

[6] As defined in GWD – note that other regulatory regimes may use alternative definitions for 'Hazardous'.

Radioactive material and radioactive waste[7] are considered hazardous pollutants in groundwater.

Any substances that are not designated as hazardous by SEPA are considered to be non-hazardous. Non-hazardous substances also include pathogens and heat.

A1.4 What is an input and a discharge?

An input of a pollutant is direct or indirect introduction of pollutants into groundwater as a result of human activity.

Inputs to groundwater may be divided into three categories:

- Active inputs - those resulting from an ongoing activity, even where the activity is a series of separated events, for example, inputs arising from septic tank drainage fields, or disposal of waste sheep dip to land.
- Passive inputs - those resulting from some previous activity that has now ceased, for example, an input from land contamination.
- Accidental inputs - those arising as a result of an unintended activity that initially gives rise to an active input, but which eventually produces a passive input.

A direct discharge is an active input directly into groundwater i.e. it bypasses the unsaturated zone during at least part of the year. Direct discharges of pollutants to groundwater[8] are prohibited except in certain exceptional circumstances – see Section 5.

The deliberate placement of materials, where leaching exceeds the standard, below the water table without an appropriately engineered barrier will be considered to be a direct discharge. Discharge of effluents below the water table containing substances in concentrations above the standard will be considered to be a direct discharge.

[7] As defined in The Environmental Authorisations (Scotland) Regulations 2018 and associated guidance.

[8] Direct discharges of pollutants to groundwater can be permitted to groundwater below 400m below ground level or below mean high water springs if there is no pathway for contaminants to reach surface ecosystems.

An indirect discharge is an active input into groundwater via the unsaturated zone. The source is located wholly within the unsaturated zone, even during seasonal fluctuations of the water table.

Historical land contamination sources, including those that are in contact with or extend below the water table, are considered by SEPA to be inputs but not discharges.

Diffuse inputs, such as use of fertilisers in agriculture, are considered by SEPA to be inputs but not discharges.

In summary, all discharges are inputs but not all inputs are discharges.

A1.5 What is an assessment point and how does it differ from compliance?

An “assessment point” may be defined as ‘the point at which the standard should be met’ i.e the point used to assess if there has been or will be an impact. It may be real or theoretical; that is, it may represent a real borehole from which groundwater samples can be obtained, or a virtual borehole at a real location where the concentration of the polluting substance may be deduced from information on the fate and transport process. It can be derived from the spatial assessment rules.

A “compliance point” is defined as a physical sampling point used to demonstrate that the activity is likely to have achieved the agreed objectives and the input is acceptable. It need not be in the same location as the assessment point because:

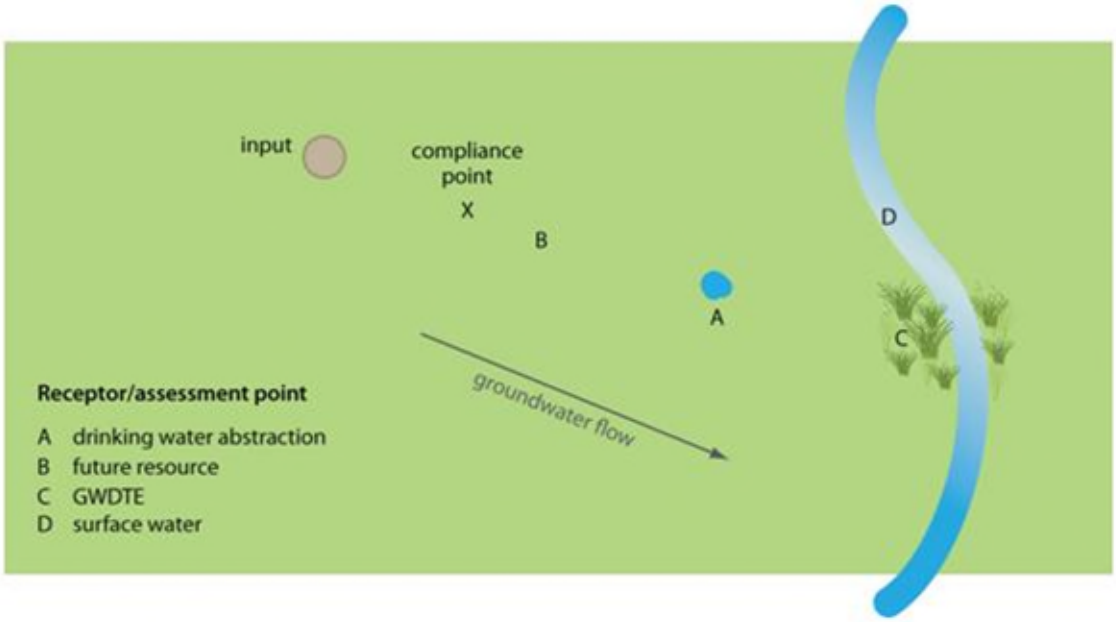
- It may not be practical to install monitoring points at the assessment point e.g. the base of the unsaturated zone or due to land use or access constraints.
- A compliance point may be required to provide an early warning to receptors e.g. by being located between the source and a water supply.

It is important that the compliance point is located within the plume or potential pathway of the plume, including monitoring at an appropriate depth and in appropriate strata.

More than one assessment point may be required to protect all receptors as is shown in Figure 3.

The compliance concentration measured at the compliance point may also differ from the concentration at the assessment point because:

- it may need to be adjusted to take account of attenuation and dilution between the assessment point and compliance point - see Figure 4.



- the agreed action e.g. a remedial target, may not be to achieve the assessment criteria

Figure 1 - Receptors, assessment and compliance points

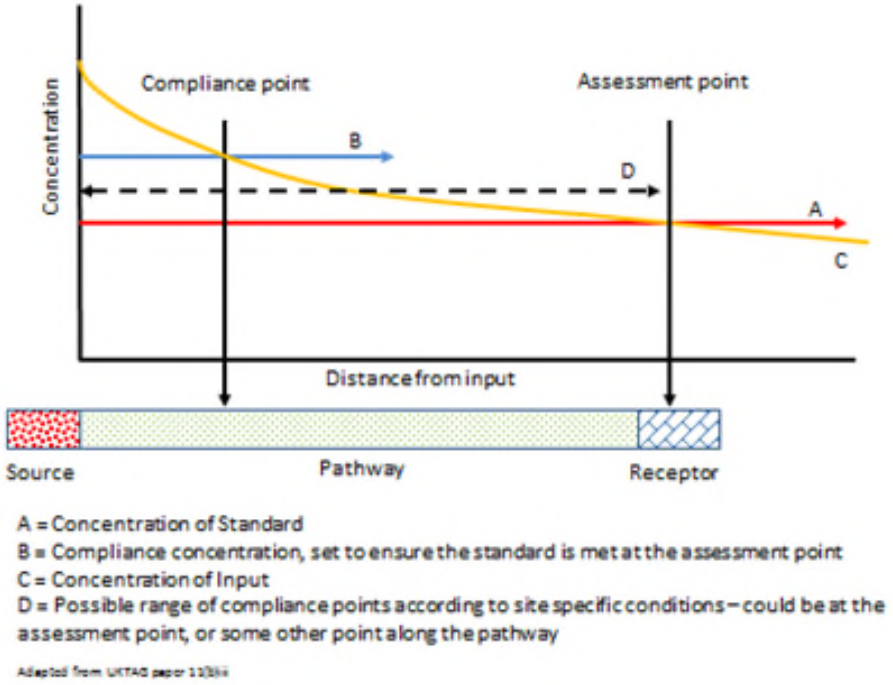


Figure 2 - Assessment and compliance points

A1.6 What is the basis for the hazardous substance input standard?

Entry of hazardous substances into groundwater must be controlled to ensure there is no risk of deterioration. In order to achieve this SEPA applies a Hazardous Substance Input Standard.

For locations more than 50 m from surface waters, the Hazardous Substance Input Standard is set at 50% of the relevant potable standard[9] assessed as an annual mean concentration. This ensures that, even if there were no dilution in groundwater and irrespective of the size of the source, the Threshold Value (as referred to in A1.8) should not be breached.

In close proximity (<50 m) to surface water features, the Hazardous Substance Input Value is either 0.5 x potable standard OR 2 x Environmental Quality Standard (whichever value is lower). The latter is based on an assumption of dilution within the surface water feature; the 95th percentile baseflow index for Scottish rivers is <0.5. While baseflow does vary both spatially and temporally, SEPA have chosen to assume a single baseflow index value to aid consistency in decision making.

In reality, there is likely to be dilution on entry to groundwater in most scenarios. Thus, SEPA consider that there is no risk of deterioration if compliance with the Hazardous Substance Input Standard is achieved.

A1.7 What is the basis for the threshold value?

Threshold values are values set at 75% of the relevant potable standard and assessed as an annual mean concentration. This is approach has been adopted to help ensure that the potable standard (assessed as a maximum concentration) is unlikely to be breached whilst allowing for a small margin of error to address minor temporal fluctuations in water quality. This approach is consistent with the approach

[9] See Annex 2 for further details.

recommended by UK TAG[10] for general chemical assessment during groundwater body classification.

The decision on which potable value to use has been based on the following hierarchy: Groundwater Directive pesticide standard (if applicable) > UK drinking water standard > World Health Organisation (WHO) drinking water guideline value> other international drinking water value (that has been derived in a reliable and relevant way and that has undergone peer review). For cases where such values are not available, a valid and reliable Health Criteria Value (HCV) for the substance has been used to derive a value following WHO guidance. Taste and odour thresholds are used where these are lower than (eco)toxicologically based values. This is because having a bad taste or odour would affect the future use of the water resource. Only where none of these values are available has a value been based on laboratory detection limits.

A1.8 What is the basis for the groundwater pollution standards?

Pollution in relation to the water environment means the direct or indirect introduction, as a result of human activity, of substances or heat into the water environment, or any part of it, which may give rise to any harm.

The groundwater pollution standard considers both existing groundwater uses, by humans, surface water ecosystems or groundwater-dependent terrestrial ecosystems (GWDTE), and potential future groundwater use. The groundwater pollution standard applies to all future groundwater resource as well as groundwater supporting surface waters, GWDTEs or abstractors.

The groundwater pollution standard for future groundwater resources is set at >1 ha of groundwater exceeding the Threshold Value assessed as an annual mean. The 1 ha area is equivalent to the area required to support 10 m^3/day of groundwater supply assuming a typical Scottish recharge rate of 1 mm/day. Whilst recharge does vary both spatially and temporally, SEPA have chosen to assume a single recharge

[10] UK TAG Paper 11b(i) 'Groundwater Chemical Classification for the Purposes of the Water Framework Directive and the Groundwater Directive', 2019.

value to aid consistency in decision making. The flow threshold of 10 m^3/day is aligned with the determination of whether a hydrogeological unit has future resource potential (see A1.2).

For hazardous substances, the groundwater pollution standards only apply to contaminants that have already entered groundwater. New or ongoing entry above the Hazardous Substance Input Value is not permitted (see Sections 5 and 7).

A1.9 What is the basis for the groundwater status standards?

Status standards in relation to the water environment reflect a serious impact on nationally or regionally important receptors.

The groundwater status standards consider both existing groundwater uses, by humans, surface water ecosystems or GWDTEs, and potential future groundwater use. Note that here groundwater status is used in relation to chemical status, as opposed to quantitative status.

The groundwater status standard in relation to surface water receptors is based on the actual or potential impact on the status of the relevant surface water body, taking into account the spatial rules used to determine surface water body status.

The groundwater status standard for GWDTEs is based on the potential impact on designated sites (i.e. sites that have been designated as Natura 2000 sites or as Sites of Special Scientific Interest (SSSI)). SEPA consider that impact or potential impact on a designated GWDTE is sufficient to also impact or potentially impact on groundwater body status.

The groundwater status standard for existing abstractions is based on potential anthropogenic impact on abstractions supplying water for human consumption. The standard also includes assessment of whether there is an upward trend in concentrations.

The groundwater status standard for future groundwater resources is set at >20 ha of groundwater exceeding the Threshold Value assessed as an annual mean. The 20 ha area is equivalent to the area required to support 200 m^3/day of groundwater supply assuming a typical Scottish recharge rate of 1 mm/day. The 20 ha area is based on an area that is 20% of the area of the smallest potential groundwater body,

which is assumed to be 1 km^2. This is aligned with current guidance[11], which provides that an acceptable extent of exceedance for each substance would not exceed 20% of the total groundwater body. Whilst groundwater bodies vary in size, a single areal value for point source status assessment is used to aid consistency in decision making and to account for scenarios where a source and/or plume may straddle groundwater body boundaries. Hazardous substances are prioritised when assessing status in relation to future groundwater resources.

For hazardous substances, the groundwater status standards only apply to contaminants that have already entered groundwater. New or ongoing entry above the Hazardous Substance Input Value is not permitted (see Sections 5 and 7).

A1.10 What is significant pollution?

Part IIA of the Environment Protection Act 1990[12] uses the concept of significant pollution of the water environment, or significant possibility of significant pollution.

SEPA consider the following to represent significant pollution of groundwater:

- Breach of the groundwater pollution standard for existing abstractions, for surface waters and for GWDTEs
- Breach of the groundwater status standard for future groundwater resources.
- What can constitute significant pollution is discussed further in SEPA Guidance, Land Contamination and Impacts on the Water Environment, the so-called Brown Booklet.

[11] Common Implementation Strategy for the Water Framework Directive – Guidance Document No. 18 – Guidance on Groundwater Status and Trend Assessment.

[12] This regime is also subject to The Contaminated Land (Scotland) Regulations 2000 (SSI 2000 No. 178) as amended and the Scottish Government's Statutory Guidance: Edition 2.