UK Technical Advisory Group on the Water Framework Directive

Paper 11b(i)
Groundwater Chemical Classification for the purposes of the Water Framework Directive and the Groundwater Directive.

This Guidance Paper documents the principles to be adopted by agencies responsible for implementing the Water Framework Directive (WFD) and the Groundwater Directive in the UK.

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1 Purpose

1.1 The UKTAG Groundwater Task Team has produced two papers describing the classification process for quantitative and chemical status of groundwater bodies during the 2nd River Basin Management Planning cycle.

1.2 This paper details the procedures for translating the definitions of good groundwater chemical status into an operational classification system. The classification system is divided into 5 tests using the criteria for good chemical status as set out in the WFD and the Groundwater Directive (GWD).

1.3 Paper 11b(ii) provides the detailed procedures for the translation of the definitions of good groundwater quantitative status outlined in Annex V of the Water Framework Directive (WFD) into an operational classification system. The classification system is divided into 4 tests using the criteria for good quantitative status as set out in the WFD.

1.4 The criteria that define good groundwater status are fixed within the WFD/GWD and cannot be altered. These detailed classification papers use, and build upon, the principles outlined in EC CIS Guidance Document No. 18 (on Groundwater Status and Trend Assessments) and UKTAG Paper 11b (Outline classification under the WFD) to describe how these criteria have been taken and developed into a classification system.

1.5 Environmental standards, to be used in regulation and in the derivation of Programmes of Measures (PoM),have been developed from these detailed procedures. The links between classification and regulation are the subject of UKTAG Paper 11b(iii)[1].

2 Overview of Classification Process

2.1 Achieving 'good status' for groundwater involves meeting a series of conditions that are defined in Annex V of the WFD and applied to the groundwater body. The criteria for good groundwater chemical status are set out within Annex V 2.3.2 of the WFD and elaborated upon in Articles 3 & 4 and Annexes I – III of the GWD.

2.2 Groundwater Status was assessed in 2009 for the 1st River Basin Management Planning cycle and the results were reported in the River Basin Management Plans for each River Basin District.

2.3 Future amendments of this classification guidance may be required as better data becomes available in each planning cycle.

2.4 Groundwater status objectives set by the WFD rely in part on the protection of, or objectives for, other associated waters and dependent ecosystems. ***The objectives for these must be known before groundwater classification can be fully completed.*** These associated waters and dependent ecosystems may have different sensitivities to water level and/or

[1] UKTAG Paper 11b(iii) v2– Application of groundwater standards to regulation .

pollutants. As a result it is possible that different environmental standards[2] may apply within a single groundwater body to reflect these varying sensitivities.

2.5 In order to assess whether a groundwater body is meeting all the various criteria for achieving good status, a series of classification tests has been developed for both quantitative and chemical elements. These are outlined in Table 1 and detailed in later sections.

2.6 There are five chemical and four quantitative status tests, some elements of which are common to both.

2.7 The variety of classification elements in Table 1 and the inherent uncertainties in our understanding of groundwater flow and quality, both contribute to uncertainty in the classification process. Whilst the WFD emphasises the use of monitoring data during classification, in practice a **weight of evidence** approach, with monitoring data complemented by conceptual understanding and risk assessment data, is essential to ensure reliable classification of groundwater bodies and subsequent proper targeting of measures in the River Basin Planning process.

2.8 The worst case classification from the five chemical tests is reported as the overall chemical status of the groundwater body, and the worst case classification from the four quantitative tests is reported as the overall quantitative status. This is the one-out all-out system, as required by the WFD. If any one of the tests results in poor status, then the overall classification of the body will be poor. The confidence associated with the worst case test result is also reported.

2.9 **Note:** The Groundwater Task Team believes that the production of separate chemical and quantitative status assessments (and maps) is more useful than producing an “overall” status for each groundwater body. This is because the individual outcomes are easier to communicate and use when implementing measures. However, if the production of a single “overall” status map is a requirement for an Agency, the results of quantitative and chemical status could be combined; if either the quantitative or chemical status is poor, then the overall classification for that groundwater body is poor.

[2] For groundwater, the term “environmental standards” includes standards or conditions for water quantity, water quality standards, and the threshold values that will be discussed later in this paper.

Table 1 - Classification Elements

Classification Element	Classification Test
Common to both quantitative and chemical:	
“No saline or other intrusion” Alterations to flow direction resulting from level changes may occur temporarily, or continuously in spatially limited area, but such reversals do not cause salt water or other intrusion, and do not indicate a sustained and clearly identified anthropogenically induced trend in flow direction likely to result in such intrusions. (WFD Annex V 2.1.2) Changes in conductivity are not indicative of saline or other intrusion into the groundwater body (WFD Annex V 2.3.2)	Entry into the groundwater body of either: a) saline water of higher conductivity/salinity from connate or sea water; or b) water of different chemical composition, from other groundwater bodies or surface waters, and which is liable to cause pollution.
Surface water No “Failure to achieve the environmental objectives specified under Article 4 for associated surface waters” nor “any significant diminution in the status of such waters”	No significant diminution of surface water chemistry and ecology.
Groundwater Dependent Terrestrial Ecosystems (Wetlands) No “significant damage to terrestrial ecosystems which depend directly on the groundwater body”	No significant damage to GWDTE
Quantitative only:	
Water Balance “Available Groundwater Resource” means the long term annual average rate of overall recharge of a body of groundwater less the long term annual average rate of flow required to achieve the ecological quality for the associated surface waters specified under Article 4, to avoid any significant diminution in the ecological status of such waters and to avoid any significant damage to associated terrestrial ecosystems. (WFD Art. 2 Definitions 27)	Abstraction < (recharge-ecological needs of river bodies) and there are no significant environmental impacts on the groundwater body itself or dependent surface water system
Chemical only:	
No deterioration in quality of waters for human consumption (GWD Article 4.2 b (iii)) and paragraph 4, Annex III)	Meet the requirements of WFD Article 7(3) - Drinking Water Protected Areas
No significant impairment of human uses (GWD Article 4.2 b (iv))	General assessment of quality of the groundwater body as a whole
No significant environmental risk from pollutants across a groundwater body. (GWD Article 4.2 b (i) and paragraph 3, Annex III).	

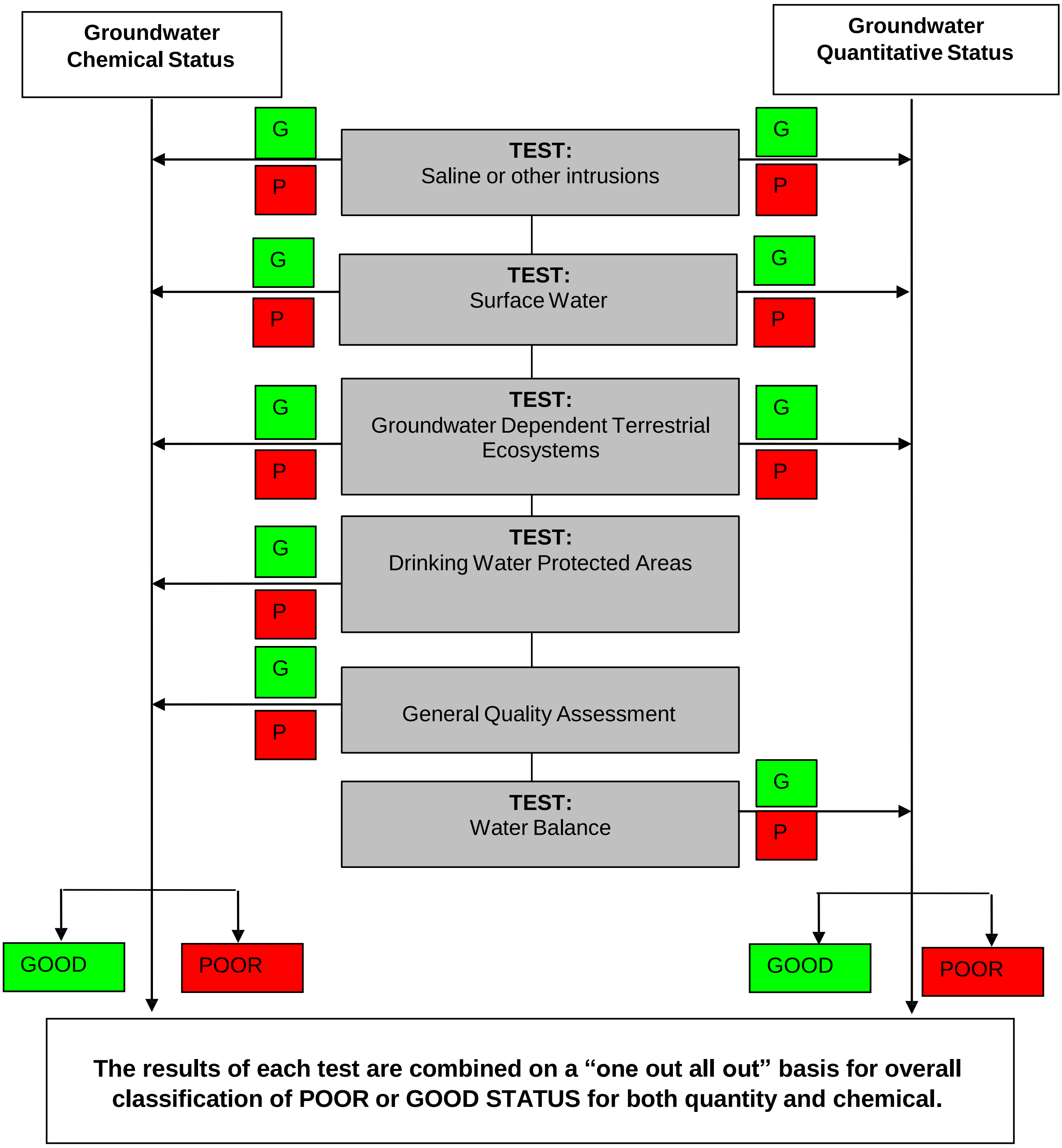

Figure 1 - Overview of the Classification Process.

3 Classification and Threshold Values

3.1 Article 3 of the GWD states that for assessing chemical status, Member States should use prescribed groundwater quality **standards** for nitrates and pesticides, and locally derived **threshold values** for other pollutants that have been identified as contributing to the characterisation of the groundwater bodies as being at risk. The GWD provides a minimum list of pollutants that Member States are asked to consider when setting threshold values.

3.2 **Note**: Where the application of the specified groundwater quality standards for nitrate and/or pesticides could result in a failure to achieve the environmental objectives for a groundwater body, more stringent threshold values should be derived and applied.

3.3 Threshold values are groundwater quality standards that are to be established by Member States and can be set nationally, or on a local groundwater body scale, for the purpose of assessing groundwater chemical status. Threshold values are triggers, such that their exceedance prompts further investigation to determine whether the conditions for good status have been met, rather than representing the boundary between good and poor status. The groundwater quality standards prescribed for nitrate and pesticides are used in the assessment process in the same way. However, if all standards and thresholds are met at all monitoring points then, under Article 4.2(b) of the GWD, the groundwater body is considered to be at good status and no further investigation is necessary.

Note: the standards and conditions that are applied to environmental permits should reflect the need to meet all WFD objectives, including good chemical status, but these are not threshold values as described in this paper. UKTAG Paper 11b(iii) describes the link between groundwater classification and the standards used in permits.

3.4 The process of setting threshold values can be complex. Threshold values have been derived for the purpose of assessing each of the tests for good chemical status. Once each test has been conducted the individual tests must then be assessed together, on a one-out all-out basis. Effectively, the most stringent relevant threshold will apply as the final (reported) threshold for a groundwater body. The thresholds will be applied at the strategic operational monitoring points in the groundwater body. Depending on the classification test, threshold values for a single substance could accordingly vary across a groundwater body, particularly for those substances where there is a highly variable natural background concentration.

3.5 The threshold value for each test relates to the receptor being considered in that test, e.g. a groundwater abstraction, an associated surface water body, or a groundwater dependent terrestrial ecosystem. The way monitoring data are compared to the threshold values during classification (whether data are aggregated across the groundwater body or used in isolation) varies between the individual classification tests. Use of the appropriate threshold value is essential to ensure a reliable assessment of status.

3.6 Threshold values should be reviewed and amended, where necessary, as more data become available and conceptual understanding improves.

3.7 In accordance with good practice for risk assessment and as an aid to rapid assessment of the potential for not meeting good chemical status, it is also proposed to use **screening values**. They will be used as part of the further characterisation process to enhance and improve the risk assessments already undertaken for Article 5 of the WFD. Typically, the values will be lower and therefore more conservative than threshold values, and will be one of the following:

I. the limit of detection (for synthetic substances);

II. the upper limit of natural background levels (NBL)[3];

III. a reference value that protects the receptor being considered from harm (e.g. EQS)

3.8 In order to compare data from each monitoring point with the screening value, the mean of the last six years data is calculated - tying the assessment to the River Basin Planning Cycle.

3.9 An **exceedance of a screening value is an indicator of a potential anthropogenic impact** and that the groundwater body is or might be at risk of failing to meet good status. It is a flag that threshold values might need to be calculated, whereas an exceedance of a threshold is a flag that good status may be compromised and detailed investigation is needed. Screening values and threshold values are defined in Annex I. They are specific to the test being assessed.

3.10 If neither screening nor standards/threshold values are exceeded, then the groundwater body will not be characterised as "at risk" and will be classed at good status for that test. This follows Article 4.2 (b) of the GWD. Further information on assessing risk and linkages with status and trend assessments are provided in the UKTAG paper on the Characterisation of Risks to Groundwaters for the 2nd River Basin Cycle.

3.11 An exceedance of a screening value should prompt an evaluation of whether this exceedance reflects naturally high concentrations in groundwater or whether it is a result of human activity.

3.12 An **exceedance of a threshold value will trigger further investigation** - an assessment of whether the pollution is of sufficient magnitude to prevent the groundwater body achieving its status objectives under the WFD (i.e. it is not just a localised impact). This will be undertaken, for example, using status assessments for surface ecosystems, assessments of loadings to surface receptors or aggregations of groundwater data.

3.13 Only if the concentration of pollutants exceeds the groundwater chemical threshold **and** any supporting evidence confirms the presence of an impact that compromises the achievement of WFD status objectives, will the groundwater body be classified as poor status.

Note: Where there are insufficient data to conduct a particular test, then in the absence of contrary information, the groundwater body should be assigned good status for that test, but with low confidence in this assessment. In addition, additional monitoring and/or investigation should be put in place so that the test can be properly conducted at the next round of classification.

3.14 The wording of the GWD implies that threshold values are needed (and therefore could be reported) for each test. For two tests (Saline or other intrusions and Drinking Water Protected Areas) thresholds are used in combination with trend assessments. Therefore in these cases threshold values should not be reported in isolation of the outcome of the trend assessment. Annex 1 summarises the application of screening and threshold values and the following sections their application in each test.

[3] Natural "Background Level" is defined in the GWD as "the concentration of a substance or the value of an indicator in a groundwater body corresponding to no, or only very minor, anthropogenic alterations to undisturbed conditions

4 No saline or other intrusions test

Key concept:
Status, and the presence of an intrusion of poor quality water into the groundwater body, is determined through an assessment of trends in Electrical Conductivity (EC) or other indicator substances. The test is designed to detect the presence of an intrusion that is induced by the pumping of groundwater.

Threshold Values:
Set at the upper limit of the natural background range for key determinands. Threshold values are only used in combination with trend assessment.

The conditions for good chemical status are not met when:
Threshold values are exceeded **and** there is either a significant and sustained rising trend in one or more key determinands at relevant monitoring points or there is an existing significant impact on a point of abstraction as a consequence of an intrusion.

4.1 This test is also used in the assessment of groundwater quantitative status as it assesses a chemical impact caused by a quantitative pressure.

4.2 An intrusion is interpreted to be intrusion of poor quality water into a groundwater body from another water body, rather than the movement of a plume of poor quality water within the body. Types of intrusions that are considered in this assessment are illustrated in Figure 2.

4.3 The test outlined in Figure 4 should be repeated for all relevant chemical determinands where initial characterisation has identified that the groundwater body is at risk of not being at good status for saline or other intrusions. The test is conducted at those monitoring points that have been identified as being representative of potential intrusion conditions. The list of chemical determinands will depend on the results of risk characterisation and should be representative of the pressure acting on the groundwater body.

4.4 As a minimum, electrical conductivity should be assessed for all groundwater bodies where abstractions occur and there is a risk of saline or other intrusion. For groundwater bodies identified as being at risk from other intrusions, additional determinands can be selected as appropriate.

4.5 The WFD indicates that the presence of an anthropogenically induced intrusion in a groundwater body will result in it being at poor status. However, measuring the extent of an anthropogenic intrusion is complex, given that the influence of seawater is a natural feature of many groundwater bodies near the coast, and some groundwater bodies have naturally elevated levels of salinity due to the geochemistry of the aquifer. For this test, due to the complex fluctuation of groundwater quality adjacent to the freshwater-saline interface, numerical threshold values would not be definitive on their own. A “lines of evidence” approach is proposed to confirm the presence of such an intrusion.

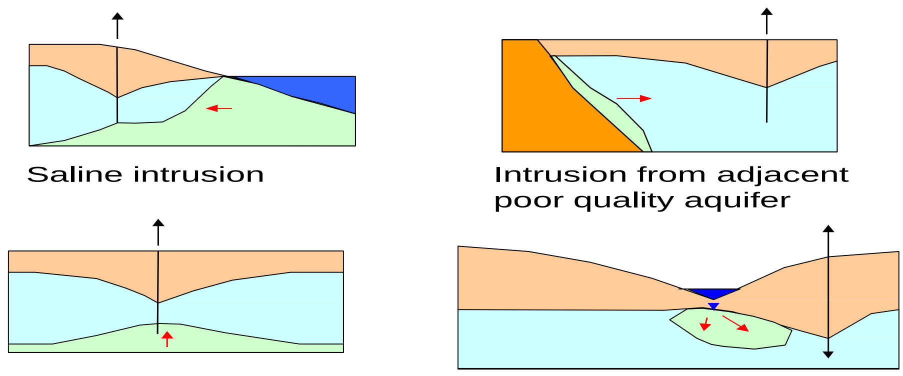

Figure 2 - Types of Intrusion

4.6 In the first instance groundwater monitoring and pressure data should be screened against:

- The upper limit of natural background range in groundwater quality in the groundwater body on the "fresh" side of the freshwater/saline water interface; and/or
- Recharge versus abstraction ratios obtained from the quantitative assessment.

This evidence can then be used, in conjunction with characterisation and pressure data to assess the risk and likelihood of an intrusion.

4.7 Exceedance of the screening values above indicates that there is a risk to the groundwater body. Threshold values shall be set as the screening values but only used in conjunction with a trend assessment. A trend assessment should be carried out for key elevated chemical substances at relevant monitoring points (see UKTAG paper on Groundwater Trend Assessments). An indication of confidence in this status assessment should be reported as indicated in Figure 3.

Status	Confidence	Criteria
Good	High	No pressure acting on the groundwater body that could give rise to saline intrusion OR Risk Characterisation indicates that the groundwater body is at risk but monitoring and **all** other lines of evidence indicate no exceedance of a relevant threshold value and/or no upward trend in pollutants concentrations
	Low	Risk Characterisation indicates that the groundwater body is at risk for this test AND There is insufficient monitoring to confirm the risk assessment but all other lines of evidence indicate that there is no impact on receptors or upwards trends
Poor	Low	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value AND Further investigation confirms that groundwater abstractions are causing the exceedance and/or are causing sustained upward trends but there is only limited evidence or disagreement between some lines of evidence
	High	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value AND All supporting lines of evidence e.g. evidence of impact on other receptors or water supplies, including groundwater monitoring, confirm significant and sustained intrusion or significant impact as a result of intrusion

Figure 3 – Assigning confidence to the status test for saline or other intrusions

4.8 If there is a statistically significant and sustained upward trend, the body should be classified as being at poor status. An investigation should be made into the cause(s) of the trend to confirm the assessment. The reported threshold values in this instance are the upper limits of natural background range for the key determinands. However, they should only be reported in combination with the trend assessment.

4.9 If no upward trend can be identified, an assessment should be undertaken to assess whether there has been previously or is currently an impact on any point of abstraction. If it can be demonstrated that there has been a significant impact (taken for these purposes to be that the abstraction is rendered unsuitable for use without additional treatment), and that natural background concentrations continue to be exceeded, the body should be classified as being at poor status.

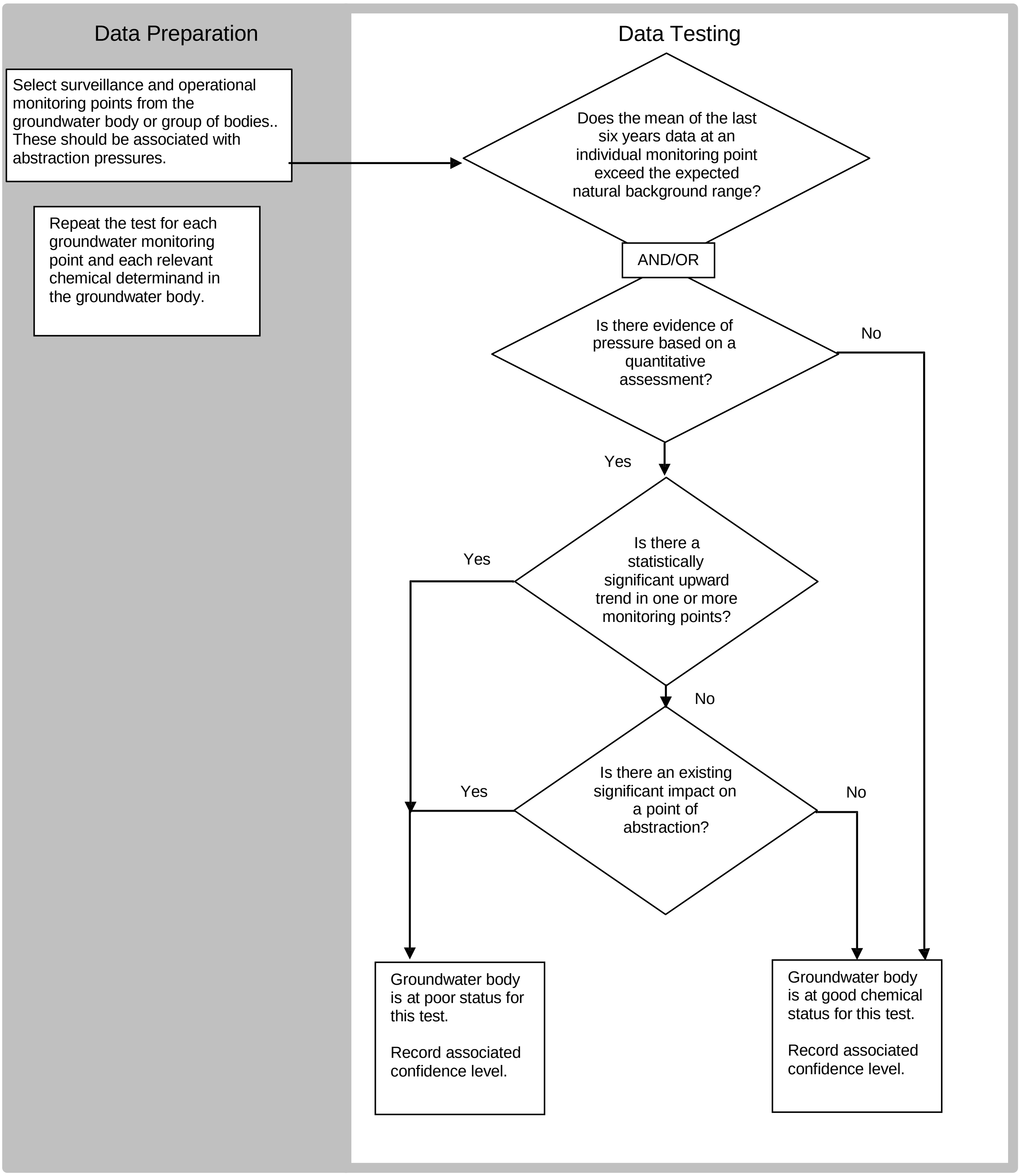

Figure 4 - Outline of procedure and data preparation for status test for saline or other intrusions

[redacted]

5 No significant diminution of surface water chemistry and ecology test

Key concept:
Status is determined through a combination of surface water classification results and an assessment of chemical inputs from groundwater bodies into surface water bodies. The surface water bodies can comprise rivers, standing waters, and transitional waters. The test is designed to determine whether the contribution from groundwater quality to surface water quality or any consequent impact on surface water ecology is sufficient to threaten the WFD objectives for these associated water bodies.

Threshold Values:
Surface water quality standards adjusted by dilution and, where appropriate, attenuation factors.

The conditions for good chemical status are not met when:
An associated surface water body does not meet its objectives, threshold values are exceeded and groundwater contributes at least 50% of the relevant surface water standard.

5.1 The test is outlined in Figure 6 and should be repeated for all relevant chemical determinands in groundwater bodies where the initial characterisation indicates that there is a risk of it failing these status objectives. The data may be aggregated across a groundwater body or bodies, or assessed at individual points depending on the nature of the pollution (see below). The list of chemical determinands will depend on the results of risk characterisation and the results of the surface water status assessments. Where a surface water body fails to achieve the relevant objectives set for it, the assessment should be carried out for the pollutants responsible for that failure.

5.2 Relevant objectives for surface water bodies will normally be good surface water status or, for artificial or heavily modified water bodies, good ecological potential or good surface water chemical status. However, where a lower objective has been set for the surface water, and this is not as a consequence of poor groundwater quality, then the groundwater body should not be classified as at Poor Status.

5.3 The groundwater quality monitoring data should be screened against the relevant surface water quality standard for each of the identified pollutants. These standards will be taken from the physico-quality elements of surface water status classification. The main determinands likely to be of relevance to groundwater are: phosphorous (primarily for diffuse pollution); ammonium (primarily for point source pollution); acidity; metals (primarily for mine water discharges); and Environmental Quality Standards for specific pollutants.

5.4 The above screening will identify where potential problems may exist. However, before proceeding to derive threshold values in detail there should also be a check that perceived impacts on surface water are not simply a reflection of natural baseline quality of the groundwater body. This should be flagged with those responsible for surface water classification.

5.5 If the impacts on surface water are due to anthropogenic pressures, threshold values can then be derived for each chemical determinand of concern. A single threshold can be derived for the catchment of the surface water body, or thresholds can be derived for subdivisions representative of variations in pressures or geological conditions. The threshold will be derived from the higher value of either:

- upper limit of natural background range; or
- a surface water quality standard, adjusted (by dilution and attenuation factors) to allow for the proportion of groundwater flow to total flow in the surface water body, and attenuation within the aquifer/stream sediments. The calculation should be performed using the most rigorous conceptual and numerical understanding available for groundwater - surface water interactions in the catchment.

5.6 Where more elaborate models are not available, dilution factors can be derived from simple indices such as baseflow index or the ratio of groundwater recharge to effective precipitation. In these instances, the following formula can be used:

$$\text{Threshold Value} = 0.5 \times \frac{\text{Surface Water Quality Standard}}{\text{Dilution factor}}$$

Where the dilution factor is normally in the range between 0.1 and 0.9

5.7 Where attenuation factors cannot be derived, thresholds for non-conservative contaminants should only apply at monitoring points that are representative of the groundwater contribution to the surface water.

5.8 For standing waters, the relevant value can be calculated from the estimated groundwater input at the surface water outlet. For transitional waters, the value can be calculated from the estimated groundwater input at the tidal limit.

5.9 For consistency, all the data measurements in this test are based on long-term averages. Thus, the monitoring data should be averaged over a six-year timescale, baseflow contribution is generally calculated on an annual average basis, and compliance against surface water standards is also carried out based on annual averages.

5.10 When undertaking this status assessment, confidence in the assessment should be reported as indicated in Figure 5.

Status	Confidence	Criteria
Good	High	The groundwater body is not at risk for this test due to (i) there being no dependent surface water bodies or (ii) all associated surface water bodies are at good chemical or ecological status OR Information is available and supporting lines of evidence agree that the groundwater body is not contributing to a surface water body being at less than good status
	Low	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of surface water bodies that are less than good status in the groundwater body AND There is insufficient monitoring available to confirm that groundwater is making a significant contribution to the surface water failure and/or there is uncertainty surrounding the contribution (load) from groundwater to the associated surface water bodies
Poor	Low	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of surface water bodies that are less than good status in the groundwater body AND At least one monitoring site exceeds an appropriate threshold value, and further investigation confirms that the pressure from the groundwater body exceeds 50% of the loading required to breach the surface water environmental quality standard (EQS). However there is a discrepancy between different supporting lines of evidence OR Expert judgement confirms that point source pressures have polluted groundwater and this has resulted in an associated surface water body failing to meet its environmental objectives
	High	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of surface water bodies that are less than good status in the groundwater body AND At least one monitoring site exceeds an appropriate threshold value AND All supporting lines of evidence, including groundwater monitoring, validate the conceptual model and confirm that the pressure from the groundwater body is providing greater than 50% of the loading required to breach the surface water EQS

Figure 5 – Assigning confidence to the status test for surface water chemistry and ecology

5.11 With reference to Figure 6, groundwater results can be compared with the relevant thresholds as follows:

5.11.1 Six-year averages from relevant groundwater monitoring points are calculated and, where appropriate (see below), aggregated across the groundwater body. Where hydrogeological conditions are relatively uniform and impacts are distributed along a surface water body (typically due to diffuse pollution), a simple aggregation across the catchment of the surface water body can be used. Results can then be compared with the thresholds identified in paragraph 5.5

5.11.2 Where significant variations in hydrogeological conditions occur, the surface water catchment should be subdivided into representative areas. Groundwater monitoring points (including suitable points from outside the catchment) can be associated with these areas. Aggregate concentrations can then be estimated in each representative area, using a 6-year average at individual monitoring points. The overall pollutant loading in the surface water due to groundwater can then be estimated from an understanding of groundwater / surface water dilution factors and attenuation rates.

5.11.3 Where more elaborate conceptual models are not available, dilution can be incorporated for each representative area using average annual groundwater recharge estimates. The pollutant loading to surface water from groundwater can be calculated as follows:

$$\text{Concentrations in SW due to GW} = \frac{(\text{GW Flow from Area}_1 \times \text{average conc in Area}_1 + \ldots \text{GW flow from Area}_n \times \text{average conc in Area}_n)}{\text{Average annual flow in surface water}}$$

In this example, the result is an estimate of concentrations in the surface water due to groundwater, taking account of dilution in the receiving water. The results can therefore be compared directly with the relevant surface water quality standard.

Where impacts from groundwater are confined to discrete reaches along the surface water body (possibly because the pollution is from a more restricted area or point source), the assessment may be restricted to a comparison of appropriate surface and groundwater monitoring points close to where they interact. Aggregations across a catchment will not be necessary. The assessment should determine whether the loading of pollutants from groundwater is of sufficient magnitude to result in exceedance of the surface water thresholds, taking into account dilution in the receiving watercourse.

5.11.4 Where groundwater inputs to surface water are more obvious (e.g. mine water resurgences), classification can be based on a comparison of surface water quality upstream and downstream of the point of impact. In these instances, groundwater monitoring data can be used as qualitative supporting information to indicate the substances to be monitored in surface water.

5.12 Once these loading calculations have been undertaken, and the predicted concentrations in the surface water body have been defined, they should then be compared directly with the relevant surface water standard. The groundwater body would be at poor status if:

- The surface water body is at less than good status; and
- The pollutant loading from groundwater results in a concentration in surface water of at least half of the relevant surface water standard. For example, if the surface water standard is 1 mg/l, then the groundwater must give rise to a concentration of at least 0.5 mg/l in the river.

It is assumed that in these circumstances both the groundwater body and the surface water body will be at less than good status.

5.13 Where mine water impacts on surface water have been identified, expert judgement can be used regarding the relationship of the mine to the groundwater body. The emission of pollutants from the mine must be associated with the groundwater body for it to have any bearing on classification of that groundwater body.

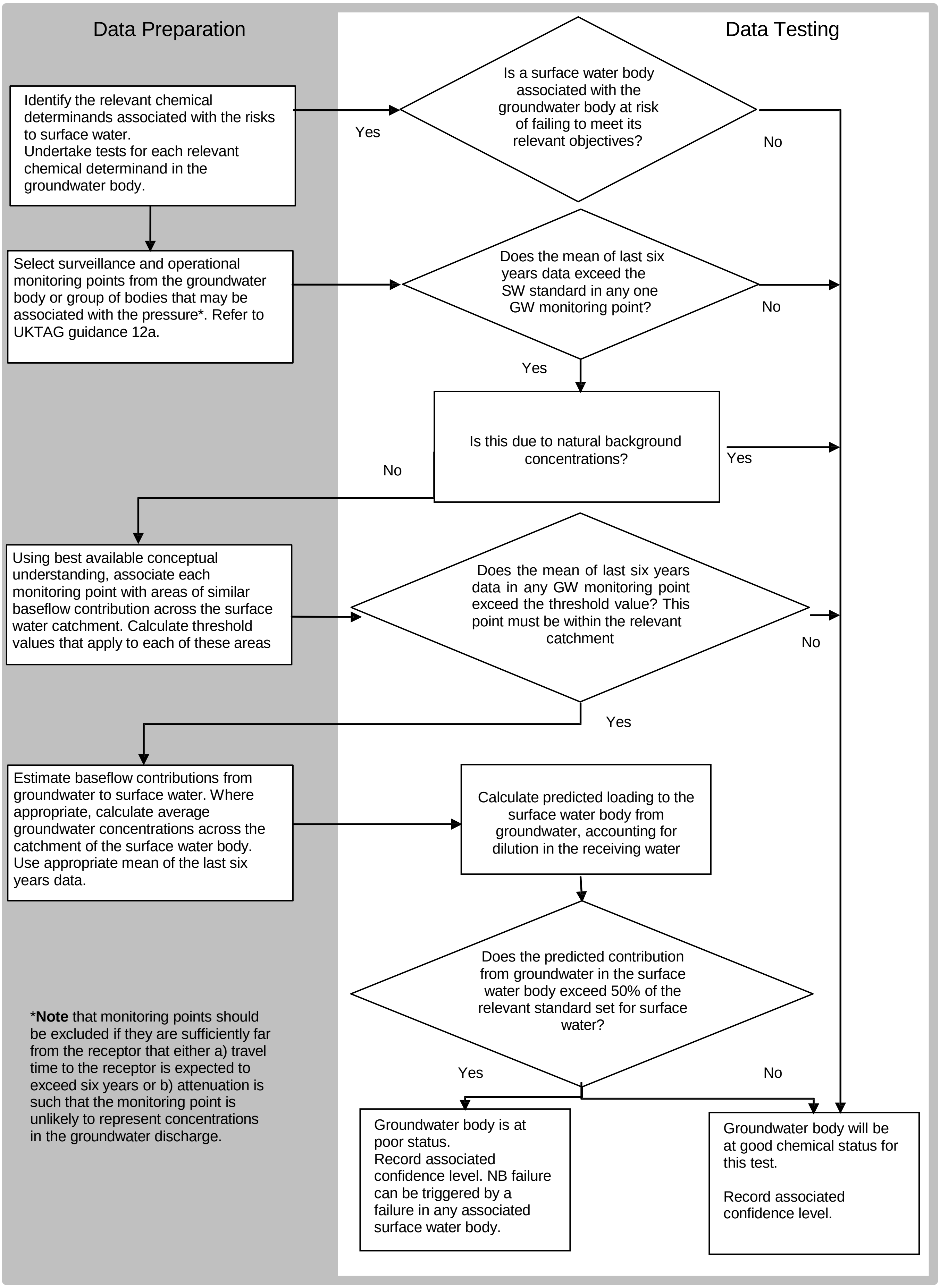

Figure 6 - Outline of procedure and data preparation for status test for significant diminution of surface water chemistry and ecology

6 Groundwater Dependent Terrestrial Ecosystem (GWDTE) test

Key concept:
Status is determined through a combination of GWDTE assessments to determine ecological damage and an assessment of chemical inputs from groundwater bodies to GWDTEs. The test is designed to determine whether the contribution from groundwater quality to GWDTEs and consequent impact on GWDTE ecology is sufficient to cause significant damage to the GWDTE ecology.

Threshold Values:
Wetland threshold values for the appropriate GWDTE type and altitude.

The conditions for good chemical status are not met when:
The ecology of an associated GWDTE is damaged due to the chemical contribution from the groundwater body, TVs are exceeded and groundwater is the significant reason for the GWDTE's failure to meet its environmental supporting conditions.

6.1 Groundwater dependent terrestrial ecosystems (GWDTE) are wetlands which critically depend on groundwater flows and/or chemical inputs to maintain them in favourable ecological condition (EU CIS Technical Report on GWDTEs, 2011). As part of the assessment of groundwater status, we are required to assess if a GWDTE has been significantly damaged and if the pressure that is causing this damage is associated with the groundwater body.

6.2 Threshold values have been developed to ascertain whether or not there is a risk to a GWDTE from pressures on a groundwater body. The process for deriving these thresholds is described in more detail in Wetland Task Team's technical paper 'Groundwater dependent terrestrial ecosystem (GWDTE) chemical threshold values (WTT UKTAG report, 2012).

6.3 The GWDTE threshold values should be compared with an average concentration for groundwater monitoring points calculated using up to the last six years of data.

6.4 For groundwater bodies with GWDTEs, the body can be classified using the process outlined in Figure 8 and steps (i) - (iv) below:

(i) *Assess relevance of ecological impact:* Assess which wetlands a) contain groundwater dependent communities and b) are significantly damaged which is likely due to a pollutant pressure that could be transmitted by groundwater. The assessment of significant damage is an ecological evaluation of the significance of the ecosystem itself and the magnitude of the damage. This is defined within UKTAG, 2005 'Draft Protocol for determining "Significant Damage" to a "Groundwater Dependent Terrestrial Ecosystem" (GWDTE). If a groundwater body does not have wetland which meets these ecological criteria, then the groundwater body is at good status for this test. Otherwise, proceed to step (ii).

(ii) Assign threshold value for the appropriate GWDTE type and altitude: Identify whether the threshold value is exceeded in groundwater using data from the most suitable operational groundwater monitoring borehole. This is a hydrogeological assessment. Suitability depends on the conceptual or quantitative understanding that a groundwater pathway exists between the monitoring point and the GWDTE. If the threshold is not exceeded, then the groundwater body is at good status for this test. Otherwise, proceed to step (iii).

(iii) *Carry out further investigation and classify:* For those sites where there is both 1) relevant ecological damage and 2) evidence that a threshold has been exceeded, further investigation is needed. This step is a site specific assessment. This investigation is to determine whether the GWDTE has been significantly damaged by pressures on the groundwater body. This investigation may require an ecological assessment to confirm the cause of damage and environmental supporting conditions, and/or a more detailed hydrogeological investigation to confirm a connection between the wetland and the groundwater body. This further investigation can include a simple walkover survey of the site, work between expert ecologists and hydrogeologists. The level of investigation required will depend on the ecological evidence and the confidence in the hydraulic linkage between the site and the groundwater body.If it is confirmed that the necessary environmental supporting conditions for the GWDTE are not being met as a result of pressures transmitted through the groundwater body, and this is the most significant reason for the failure to meet the environmental supporting conditions, then the body will be at poor status for this test.

(iv) Assign confidence: When undertaking this status assessment, confidence in the assessment should be reported as indicated in Figure 7. Knowledge of the conditions causing ecological damage in GWDTEs, and of GWDTE interactions with groundwater, remains a developing field. Assessments of confidence will always be site specific involving a subjective evaluation of overlapping hydrogeological and ecological lines of evidence. For many sites, groundwater monitoring may not be available, or it will be difficult to define supporting conditions required within the GWDTE with a high degree of confidence. Under these circumstances the classification will be assigned a low confidence and available evidence should be used to decide if sites are considered ‘at risk’.

Status	Confidence	Criteria
Good	High	Risk Characterisation indicates that the groundwater body is not at risk for this test due to no significantly damaged GWDTE in the groundwater body OR Information is available and supporting lines of evidence agree that the groundwater body is not contributing to significant damage at a GWDTE
	Low	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of a significantly damaged GWDTE in the groundwater body AND Insufficient monitoring is available to confirm the conceptual model of pressures and impacts or there is uncertainty surrounding the environmental supporting conditions for the GWDTE OR Further investigation validates the conceptual understanding and confirms that the pressure from the groundwater body is not sufficient to cause the significant damage in the GWDTE. However there is a discrepancy between available monitoring and the conceptual model of pressures and impacts
Poor	Low	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of a significantly damaged GWDTE in the groundwater body AND Further investigation validates the conceptual understanding and confirms that the pressure from the groundwater body is contributing to the significant damage in the GWDTE. However there is a discrepancy between available monitoring and the conceptual model of pressures and impacts
	High	Risk Characterisation indicates that the groundwater body is at risk for this test due to the presence of a significantly damaged GWDTE in the groundwater body AND All supporting lines of evidence, including groundwater monitoring, validate the conceptual model and the pressure from the groundwater body is significantly contributing to the significant damage in the GWDTE

Figure 7 - Assigning confidence to the status test for GWDTE

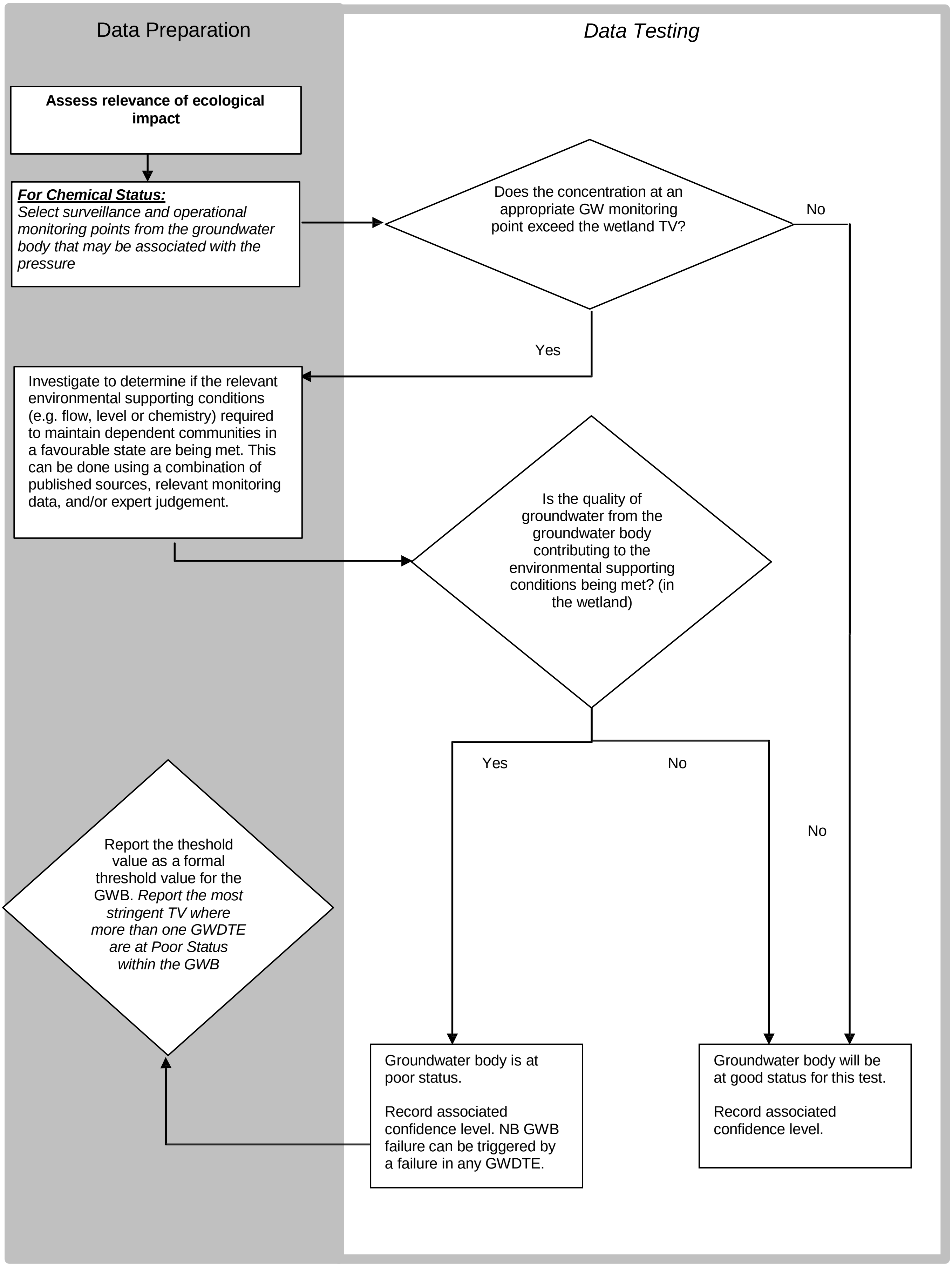

Figure 8 - Outline of procedure and data preparation for status test for significant damage to groundwater dependent terrestrial ecosystems

7 Drinking Water Protected Areas (DWPA)

Key concept:
Good chemical status requires an assessment at the point of abstraction for water intended for human consumption, of whether there is deterioration in groundwater quality due to anthropogenic influences that could lead to an increase in purification treatment. **Note**: the stated aim of the DWPA objective in the WFD is to provide the necessary protection to avoid deterioration in water quality in order to reduce the need for purification treatment. This has been interpreted as a minimum requirement to prevent deterioration in groundwater quality at the point of abstraction for drinking water supply. (**Note**: more general or widespread deterioration in groundwater chemical quality is dealt with by other WFD objectives.)

Threshold Values:
An appropriate percentage (see Annex I) of Drinking Water Standards or any other requirements to ensure that drinking water is free from contamination that could constitute a danger to human health (in accordance with the Drinking Water Directive)

The conditions for good chemical status are not met when:
There is a significant and sustained rising trend in one or more key determinands at the point of abstraction and threshold values are exceeded.

7.1 This section describes the UKTAG position in relation to groundwater bodies that contain Drinking Water Protected Areas. Further information on achieving the Drinking Water Protected Areas objectives is provided in UKTAG paper on Drinking Water Protected Areas. However, there are a few aspects of this paper that are inconsistent with the assessment of groundwater status, notably:

- For surface water there is an inherent separation of Drinking Water Protected Area assessments and status assessments which is not the case for groundwater, where the objectives are similar and therefore have been combined into one assessment.
- Statistical methods for trend assessments in surface water are proposed, but are not provided for groundwater. Statistical methods for trend assessments in groundwater are provided in the UKTAG paper on trend assessments in groundwater (UKTAG, 2012).

7.2 This test is designed to assess groundwater quality trends from the baseline and the relationship of this baseline to drinking water standards. It is not influenced by the treatment plans of water suppliers. It is not an assessment of whether groundwater is suitable for drinking water purposes. A groundwater body could be at good status but contain water that is only suitable for drinking with purification treatment.

7.3 The test is outlined in Figure 12. It comprises two basic elements, firstly an assessment of whether existing untreated water quality exceeds a threshold and secondly whether there is a deterioration (increasing trend) that could result in the need for new or additional purification treatment. The trend should be predicted forward for at least one River Basin Plan cycle and any assessment of status should take account of predictions for the current cycle.

7.4 The assessment point for this test is in the raw water at the point of abstraction of "water intended for human consumption" (as defined in the Drinking Water Directive (DWD)). Not all such abstractions need to be assessed. Representative assessment (abstraction) points should be selected, based on the conceptual model of the groundwater body, the pressures and impacts assessment and knowledge of the pattern of abstraction.

7.5 Not all changes in groundwater quality are anthropogenic or are significant for the supply of drinking water. Purification treatment (including blending between sources) may be installed to deal with both anthropogenic and natural contamination. Moreover, treatment that is already installed for one determinand can mask a significant deterioration in another determinand, which if assessed on its own, would require new or additional treatment. Figure 9 illustrates this point.

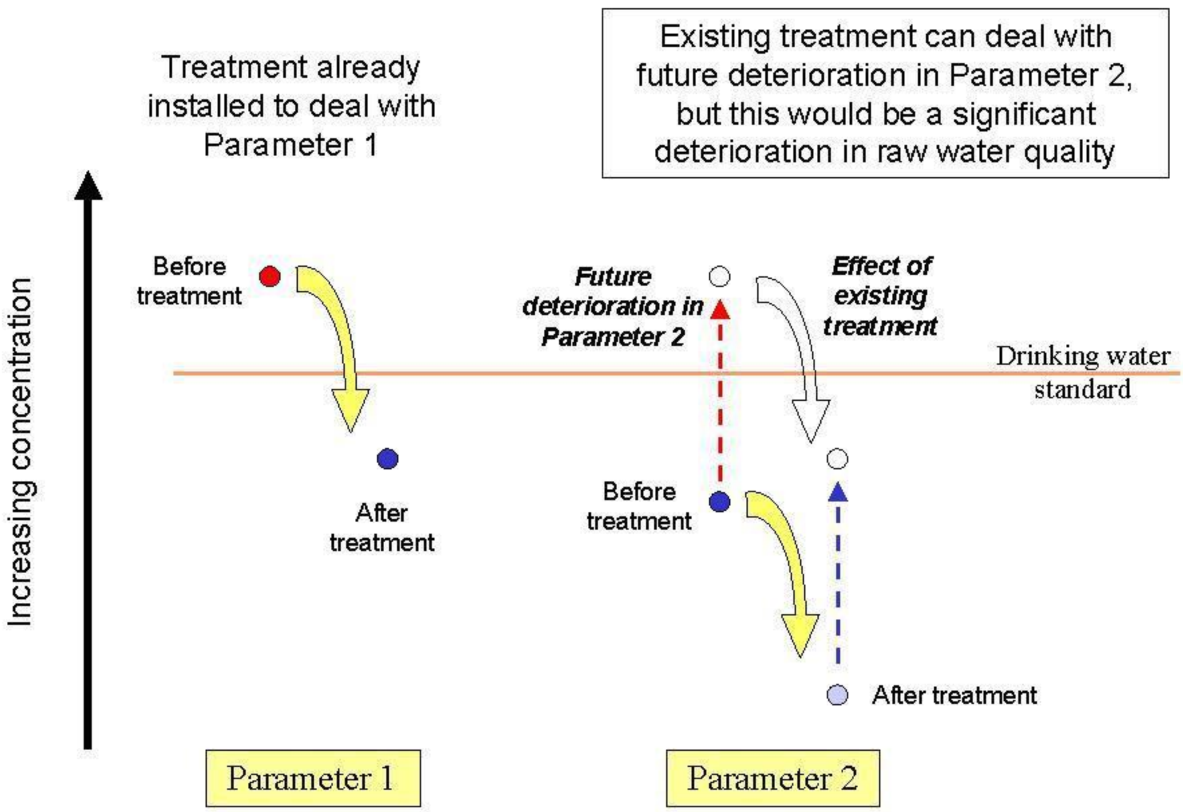

Figure 9 - Significant deterioration and treatment

7.6 Data on existing treatment systems, their purpose and effect is complex and subject to change for many reasons. As the focus is on changes in raw water quality, knowledge of treatment systems is unnecessary to conduct the basic test, and treatment data will not be used routinely in this test. However, evidence of the presence and nature of treatment may be useful supporting data in some circumstances.

7.7 **Note:** all determinands within the scope of the DWD, including chemical, microbiological and radiological determinands should be assessed; on a risk basis (this may require further characterisation to adequately define such risks). For some determinands there may not be a formal DWD drinking water standard. However, in order to meet the DWD's need to take account of "any other requirements to ensure that drinking water is free from contamination that could constitute a danger to human health", responsible bodies may have defined a value that represents no risk to human health. In this text both the formal drinking water standards and these "local" standards are referred to as <u>relevant standards</u>.

7.8 **Initial screening**: determine if mean concentrations from raw water data for the relevant individual monitoring points (as noted in 7.4) are less than the relevant threshold value (see Annex I). If so, the data pass this initial screen and the groundwater body is at good status for this test.

7.9 During the initial screening determinands should be identified where the mean concentration in groundwater quality is greater than 50% of the relevant standards and/or have been identified as contributing to the "at risk" designation of the groundwater body. This is to identify, for the purposes of conducting trend assessment, those determinands that could trigger the need for purification treatment should any deteriorating trends continue, but to **screen out** substances where there is no such risk and trend assessment is unnecessary.

7.10 For the determinands so identified the monitoring data should be compared with the natural background concentration. If any failure of the initial screen or any elevated concentration is entirely due to natural concentrations, then the body is at good status and further assessment is not required for this parameter. Natural quality could fail the relevant standards. The reported threshold value should therefore be adjusted to reflect the upper limit of the natural background range for that parameter. As a consequence some threshold values may be above the relevant standards due to natural circumstances.

7.11 **Main test**: where one or more determinands fail the initial screening and are identified as being a risk due to anthropogenic influences then the following should be undertaken:

a) Set a baseline condition for each parameter, ideally using quality assured raw groundwater quality monitoring data.

b) Determinands should be identified where the mean concentration in groundwater quality is greater than the threshold value (see Annex I)

c) Conduct a trend assessment on the raw groundwater quality data for each parameter to determine whether there is a statistically significant trend. The level of confidence in this trend should be determined.

7.12 If the data are sufficient to detect trends with confidence and no deterioration is observed, the groundwater body is at good status for this test (***Case 1 – Figure 10).***

7.13 If there is a statistically significant deterioration, further assess the data to confirm that the deterioration is due to anthropogenic influences (which will normally be the case where there is confidence in the trend).

7.14 Where the threshold values are exceeded **and** there is a statistically significant trend (with sufficient confidence) due to anthropogenic influences then the groundwater body does not meet good status ***(Case 2)***.

7.15 Where the threshold values are not exceeded but there is a statistically significant trend, the concentration should be predicted forward, from the original baseline year, to the next River Basin Plan cycle. This is to determine whether any deterioration in quality due to anthropogenic influences is significant in terms of triggering the need for purification treatment. If the trend is predicted to cause an exceedance of a threshold in the current plan cycle, before measures are due to be implemented, then the groundwater body does not meet good status

(***Case 3***). If the exceedance is predicted to take place beyond this point then the body is at good status for the present but should be flagged as being at risk of failing good status in the future (***Case 4***).

7.16 In some cases there may be insufficient data to identify statistically significant trends or there may be low confidence in the trend. However, there may be other evidence of deteriorating quality. This may be pressure data from characterisation, evidence of the installation of treatment or increased treatment at abstraction sources etc. Where there are multiple lines of evidence from pressure and impact data that all point to deteriorating quality and a need for increased treatment, then if thresholds are exceeded, the groundwater body does not meet good status (Case 2 – determined on weight of evidence). Where thresholds are not exceeded the groundwater body does meet good status but is at risk of failing good status (Case 4 – determined on weight of evidence).

7.17 The four possible outcomes (cases) are represented in Figure 10.

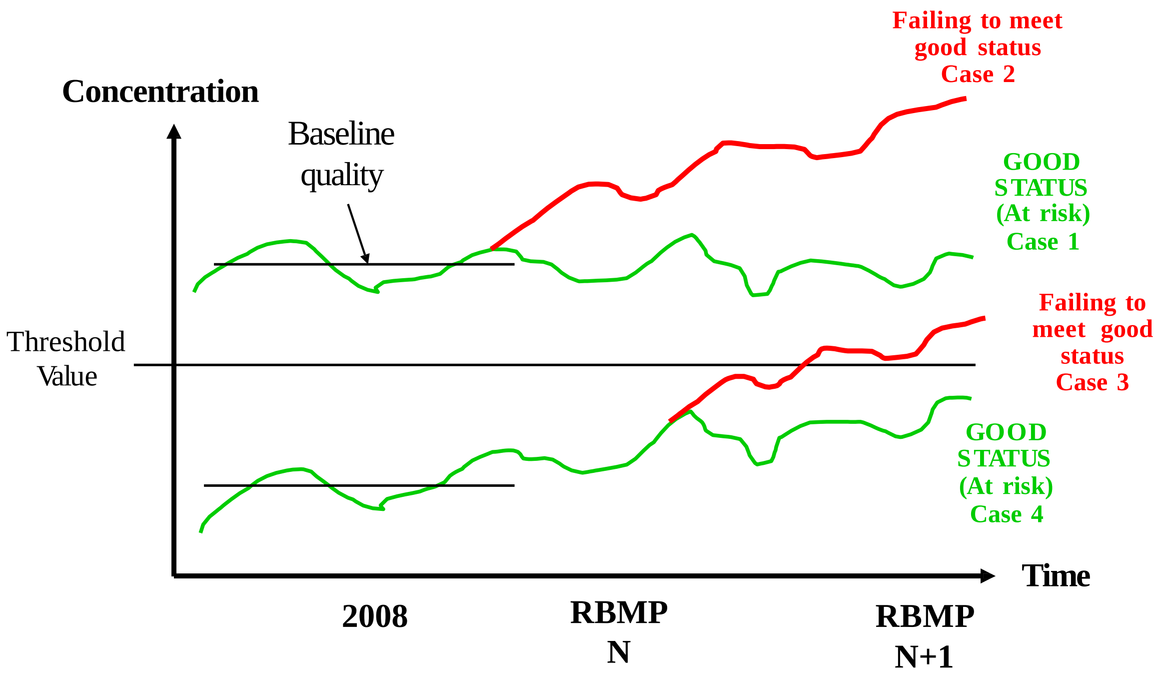

Figure 10 - Different outcomes for the DWPA test

7.18 In both of the cases noted above where the groundwater body is at risk but of good status, it would be a priority within the River Basin Planning process to consider measures to prevent any potential future deterioration in status.

7.19 This test relies on both threshold values and a trend assessment used **in combination**. The reported threshold values (which should not be used in isolation of the trend assessment) are the concentrations that are exceeded for each relevant parameter for each monitoring point.

7.20 An indication of confidence should be included in the assessment of thresholds and trends (see UKTAG paper on Groundwater Trend Assessments). Confidence in this status assessment should be reported as indicated in Figure 11.

Status	Confidence	Criteria
Good	**High**	No relevant threshold values are being exceeded at any representative drinking water abstractions in the groundwater body AND There are no statistically significant upward trends in relevant concentrations at any representative drinking water abstractions in the groundwater body
	Low	Risk Characterisation indicates that the groundwater body is at risk for this test AND Monitoring indicates that relevant threshold values are being exceeded at one or more representative drinking water abstractions in the groundwater body but there is insufficient monitoring data available to confirm the presence of statistically significant trends in determinand concentrations OR Monitoring indicates that relevant threshold values are being exceeded at one or more representative drinking water abstractions in the groundwater body, but trend assessment shows that there are no statistically significant upward trends in determinand concentrations
Poor	**Low**	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value, and trend assessment indicates statistically significant upward trends in determinand concentrations. However, there is a slight discrepancy between the data used for the trend assessment and that gathered by water operators
	High	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value and the presence of statistically significant upward trends in determinand concentrations is confirmed and all data sources are in agreement AND There is evidence of increased purification at a water supply (to meet DWD requirements) due to deterioration in groundwater quality

Figure 11 – Assigning confidence to the status test for the drinking water test

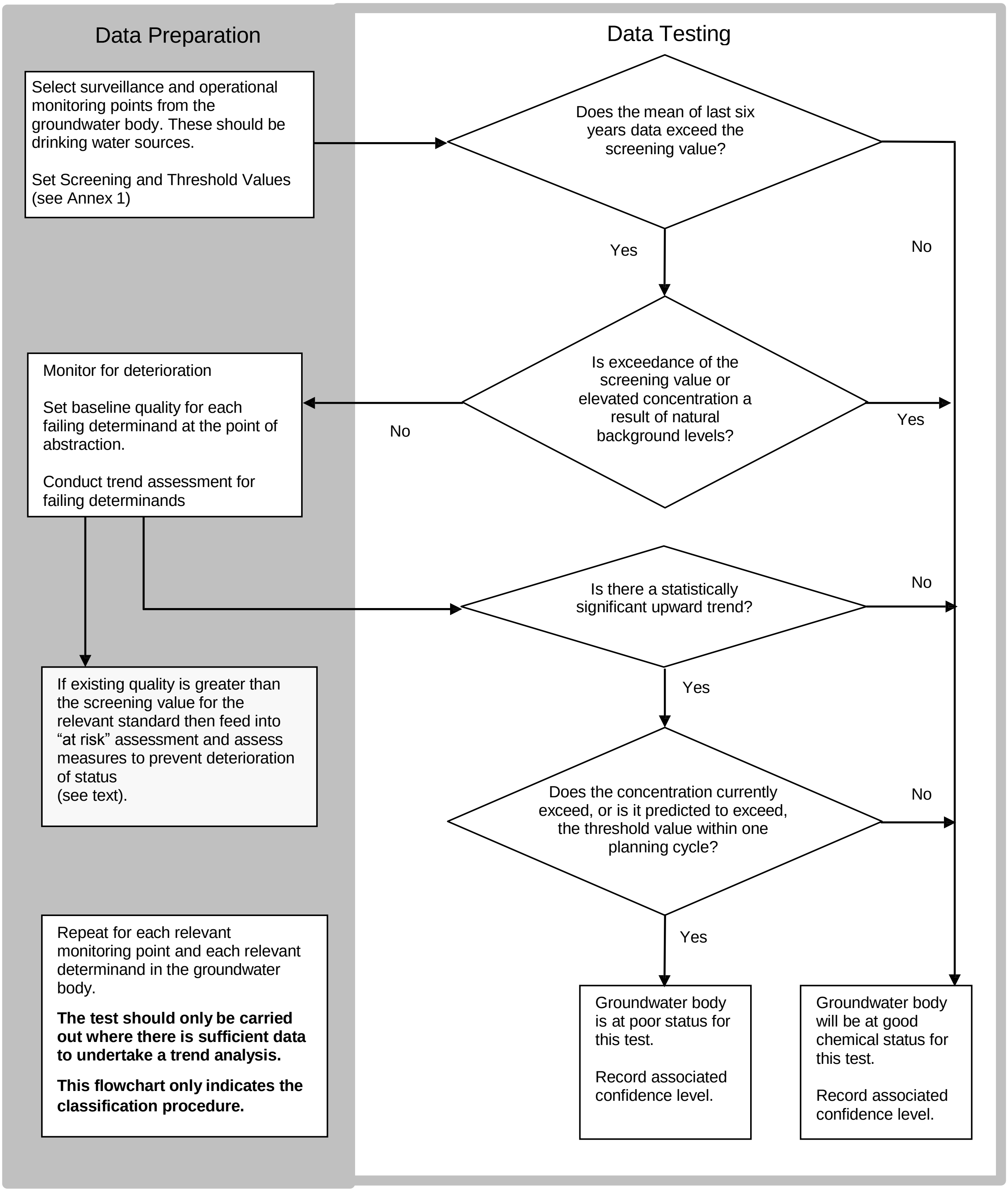

Figure 12 - Outline of procedure and data preparation for status test for drinking water protected areas.

8 General assessment of quality

Key concept:
Status is determined through an assessment of the areal extent of a groundwater body exceeding a threshold value for a pollutant. It is only conducted for determinands for which:

- an EU prescribed standard is set; or
- the risk characterisation process has indicated that pollutants may cause significant impairment of human uses of groundwater.

Threshold Values:
An appropriate percentage of the EU prescribed standards for nitrates and pesticides or a use-related standard that is appropriate for existing or planned use of the groundwater body.

The conditions for good chemical status are not met when:
Threshold values are exceeded at individual monitoring points, and a representative aggregation of the monitoring data at the groundwater body scale indicates that there is a significant environmental risk resulting in a significant widespread impact within a groundwater body or a significant impairment of human uses of the groundwater body.

8.1 The test is outlined in Figure 14. The overall aim of the test is to assess if the impact of groundwater pollution is sufficiently widespread to compromise the use of the groundwater resource either currently or in the future. It is not intended to assess local pollution impacts.

8.2 This test should only be carried out where there is sufficient monitoring across the groundwater body or group of groundwater bodies to assess the potential for widespread impact of pollutants. The groundwater body may be subdivided into areas representative of the distribution of chemical pressures, flow characteristics and vulnerability.

8.3 Data are aggregated from sites representative of the groundwater body or group of groundwater bodies and compared with standards or thresholds. The aim is to identify if the combination of the spatial extent and degree of exceedance of the threshold represents a significant environmental risk, which may result in a significant widespread impact within a groundwater body or a significant impairment of human uses of the groundwater body.

8.4 The outlined process in Figure 14 is summarised below:

a) Screening and risk characterisation. Compare the operational monitoring point concentrations with the screening values in Annex I. Is the groundwater body at risk?

b) If a risk is identified in a groundwater body, assign the threshold value for the relevant substance causing the risk (e.g. for nitrates 37.5 mg/l as NO_3).

c) Assess if the threshold value is exceeded by six yearly average monitoring results in any one monitoring point in the body or group of bodies. If it is not exceeded, the groundwater body is at good status. If it is exceeded then further investigation is required.

Steps (d) – (e) comprise a further investigation to assess if the impact is sufficiently widespread to compromise the use of the groundwater resource either currently or in the future.

d) Is there evidence that the drinking water resource has been compromised anywhere in the groundwater body or group of bodies i.e. <u>Is the drinking water standard for the substance</u>

(e.g. for nitrates 50 mg/l as NO_3) exceeded in any sample from any monitoring point? If not, the groundwater body is good status. If it is exceeded, then proceed to step (e).

e) Does the exceedance of the threshold value occur across an area sufficiently widespread to compromise the use of the groundwater resource either currently or in the future? The assessment is undertaken differently depending on the conceptual understanding of the nature of the pressure and its distribution across the body as follows:

- *Cumulative impacts of a large number of small releases over a wide area (e.g. diffuse pollution).* These activities are not always controlled at a site specific level and the location of all individual pollutant inputs cannot therefore be defined. Because of this lack of site specific information we need to rely on body-wide monitoring to help develop the overall weight of evidence. The information from each monitoring point can be used to derive an overall average using a simple average, weighted average, or more complex modelling depending on the variability of pressure across the groundwater body. The average of all monitoring points in the groundwater body or group of bodies, is calculated from the overall average of each monitoring point. If the average across the groundwater body exceeds the threshold value the groundwater body is at poor status for this test.
- *Sites where individual inputs of pollutants are of sufficient magnitude to pose a risk to local pollution or deterioration in status.* These inputs are usually controlled at a site specific level and the location of pollutant inputs is therefore well defined (e.g. a soakaway for treated sewage effluent, a landfill site). They include significant inputs from pollution incidents or uncontrolled historic activities, which are also identified at a site specific level. The assessment of status involves validating the predicted large scale impact on the water body of pollution plumes arising from individual pressure sites. In these situations, we can use a combination of site specific operational, investigative monitoring, and modelling that is relevant to the pressure. Is the threshold value exceeded as an average in any one operational monitoring point? If so, does the combined weight of investigative, modelling or other evidence indicate that the threshold value is exceeded as an average across a significant proportion of the groundwater body? If so, the groundwater body is at poor status for this test. In accordance with EU CIS Guidance No. 18, a “significant proportion” is defined as at least 20% of the minimum size of a groundwater body. The minimum areal size of a groundwater body is defined in UKTAG guidance[4] as 10 km^2. Therefore the smallest areal size of plume that would constitute a failure of this test is 2 km^2.

Step (f) comprises an assessment of the confidence in the status result.

f) Review supporting lines of evidence for the extent of the problem and assign confidence. Confidence is derived from the overall weight of evidence, combining a judgement of a) the number of suitable monitoring points used in the further investigation, b) the statistical confidence that the threshold is exceeded at each monitoring point, and the extent by which the threshold is exceeded, c) the availability of supporting lines of evidence from e.g. chemical concentrations in groundwater dependent rivers, modelling of pollutant loads, and reports of quality problems from groundwater drinking water supplies. Confidence in this status assessment should be reported as indicated in Figure 13.

[4] *GWTT guidance on GWB Delineation, 2012*

Status	Confidence	Criteria
Good	**High**	Risk Characterisation indicates that the groundwater body is not at risk for this test AND Relevant threshold values have not been exceeded in the groundwater body and supporting lines of evidence agree that there are no widespread pollution impacts
	Low	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value, but further investigation confirms that a drinking water or other use based standard has not been exceeded OR The groundwater body extent that is impacted is not widespread or there is a discrepancy between available monitoring and the conceptual model of pressures and impacts
Poor	**Low**	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value and at least one sample exceeds a drinking water or other use based standard AND Further investigation confirms that the impact is widespread. However there is a discrepancy between available monitoring and the conceptual model of pressures and impacts
	High	Risk Characterisation indicates that the groundwater body is at risk for this test AND At least one monitoring site exceeds an appropriate threshold value and at least one sample exceeds a drinking water or other use based standard AND All supporting lines of evidence, including groundwater monitoring, validate the conceptual model and confirms that the impact is widespread

Figure 13 – Assigning confidence to the status test for the general chemical assessment

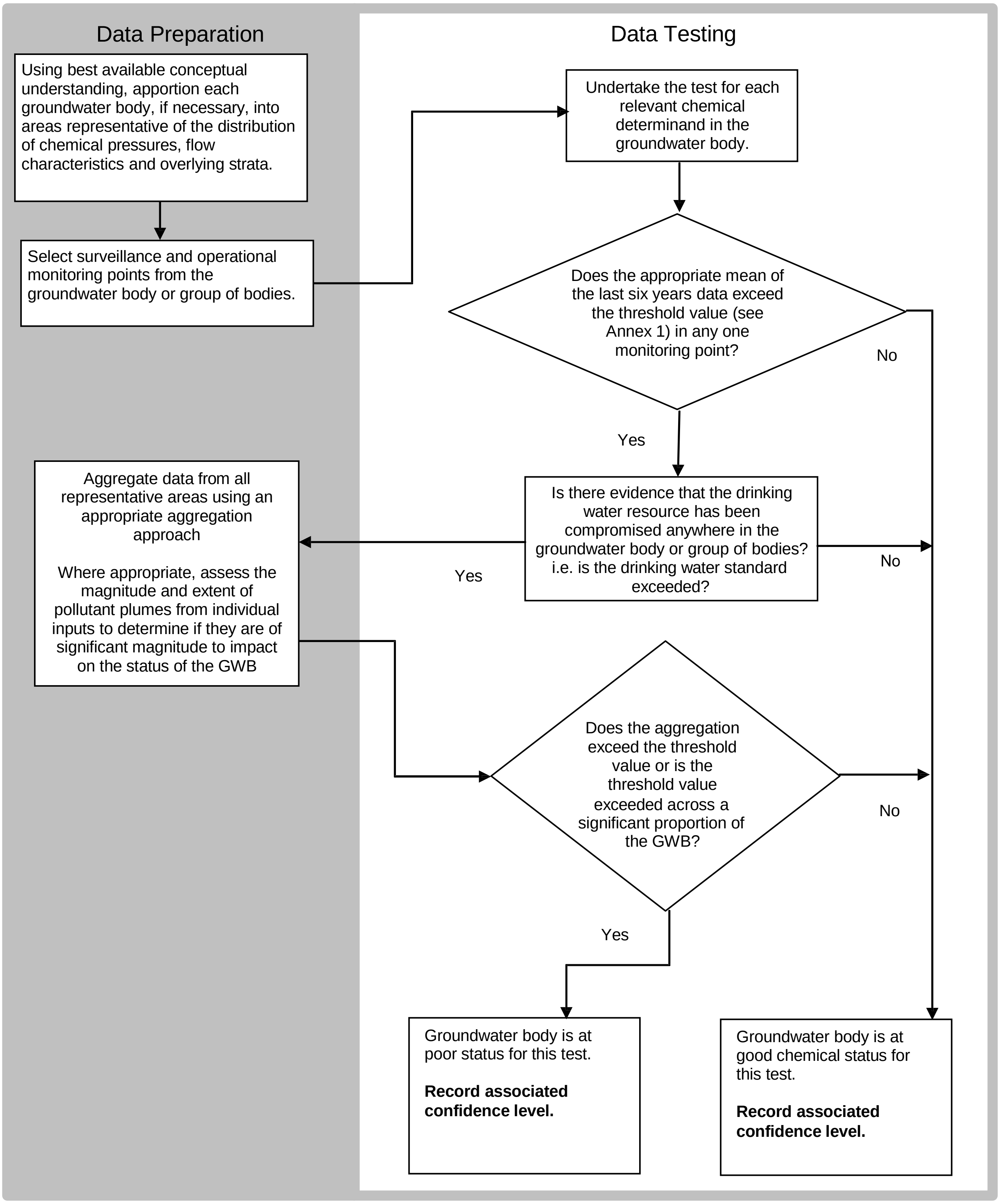

Figure 14 - Outline of procedure and data preparation for status test for general groundwater quality

Annex I: Threshold Values and Lists of Indicator Determinands

<table>
<tr><th><u>Trigger for test</u></th><th><u>Screening Values</u></th><th><u>Threshold Values (TVs)</u></th></tr>
<tr><td colspan="3">Saline or Other Intrusions</td></tr>
<tr><td>Elevated chloride and/or Electrical conductivity caused by abstraction pressure</td><td>Natural Substances – upper limit of NBL relevant for each monitoring site</td><td>Upper limit of NBL.</td></tr>
<tr><td colspan="3">SW Ecological & Chemical Status</td></tr>
<tr><td>SW < Good Status</td><td>EQS (with a check against upper limit of NBL)</td><td>TV = 0.5 x (EQS/Dilution Factor); or upper limit of NBL</td></tr>
<tr><td colspan="3">GWDTE</td></tr>
<tr><td>A damaged wetland</td><td>Wetland Threshold Values – as determined by the Wetlands Task Team for GWDTE (UKTAG, 2012) for the appropriate GWDTE type and altitude. Currently these are only determined for Nitrate.</td><td>Wetland Threshold Values (these are only reported as TVs for groundwater bodies where it is confirmed that the necessary environmental supporting conditions for the GWDTE are not being met as a result of pressures transmitted through the groundwater body).

<table>
<tr><th colspan="4">Threshold Values for nitrate in groundwater (Wetlands Task Team, 2012)</th></tr>
<tr><td></td><td colspan="3">Annual mean concentration of nitrate (mg/l NO_3)</td></tr>
<tr><td rowspan="2">GWDTE category</td><td colspan="3">Altitude</td></tr>
<tr><td>less than 175m AOD</td><td>greater than 175m AOD</td><td>any altitude</td></tr>
<tr><td>Quaking bog</td><td>18</td><td>4</td><td></td></tr>
<tr><td>Wet dune</td><td></td><td></td><td>13</td></tr>
<tr><td>Fen (mesotrophic) and Fen Meadow</td><td>22</td><td>9</td><td></td></tr>
<tr><td>Fen (oligotrophic and wetlands at tufa forming springs)</td><td>20</td><td>4</td><td></td></tr>
<tr><td>Wet grassland</td><td>26</td><td>9</td><td></td></tr>
<tr><td>Wet heath</td><td>13</td><td>9</td><td></td></tr>
<tr><td>Peatbog and woodland on peatbog</td><td></td><td></td><td>9</td></tr>
<tr><td>Wetland directly irrigated by spring or seepage</td><td></td><td></td><td>9</td></tr>
<tr><td>Swamp (mesotrophic) and reedbed</td><td></td><td></td><td>22</td></tr>
<tr><td>Swamp (oligotrophic)</td><td></td><td></td><td>18</td></tr>
<tr><td>Wet woodland</td><td>22</td><td>9</td><td></td></tr>
</table></td></tr>
<tr><td colspan="3">DWPA</td></tr>
<tr><td>Threshold exceedance due to anthropogenic inputs</td><td>Fifty percent of DWS or other DWD requirement</td><td>Seventy five percent of DWS[5]; or upper limit of NBL.</td></tr>
<tr><td colspan="3">General Chemical Assessment</td></tr>
<tr><td>River Basin Characterisation risk data and pollutant concentrations elevated above background.</td><td>Measured at individual monitoring points (mean of last six years data):
a) The screening value is taken as 50% of the relevant GWD standard:
i. Nitrate screening value = 25 mg/l NO_3;
ii. Individual Pesticides screening value = 0.05 ug/l;
iii. Total Pesticides screening value = 0.25 ug/l;</td><td>Measured at individual monitoring points (mean of last six years data):
a) The threshold value is taken as 75% of the relevant GWD standard[6]:
i. Nitrate threshold value = 37.5 mg/l NO_3;
ii. Individual Pesticides threshold value = 0.075 ug/l;
iii. Total Pesticides threshold value = 0.375 ug/l;
b) For other relevant drinking water</td></tr>
</table>

[5] Further information on the development of threshold values for drinking water or other use based determinands is provided in an assessment of threshold values (GWTT guidance on establishing Nitrates Threshold Values, UKTAG, 2012)

[6] Note, the GWD standards for Nitrate and Pesticides are the same as the Drinking Water Standards

	b) For other relevant drinking water parameters the screening value = 50% of the DWD standard; c) For Natural Substances the screening value = upper limit of NBL; d) For Synthetic Substances the screening value = Limit of detection.	parameters the threshold value = 75% of the DWD standard; c) For Natural Substances the threshold value = upper limit of NBL or relevant use based standard, whichever is the most stringent; d) For Synthetic Substances the threshold value = any relevant use based standard. *If any sample exceeds an appropriate Drinking Water Standard and the TV is exceeded at an individual monitoring point:* a) Compare the weighted aggregated concentration across the groundwater body with: (i) an appropriate threshold value; or (ii) the upper limit of NBL (if applicable) or (iii) any relevant use based standard for synthetic substances, whichever is the most stringent (note 1); or b) Determine the extent of the contaminant plume

Note 1: The resource value will often be dictated by the current or future potential of the groundwater body to provide water for human consumption. Other widespread uses such as irrigation should also be considered. The most stringent standard applies. Occasionally, the groundwater body is, and will not be, used for drinking water supply (for example, due to the poor natural quality of the groundwater).