Supporting document

Groundwater Draft Classification Methodology: Saline Intrusion Test 2020/2021

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NIEA Northern Ireland Environment Agency www.daera-ni.gov.uk

An Agency within the Department of Agriculture, Environment and Rural Affairs www.daera-ni.gov.uk

Groundwater Classification Methodology: Saline Intrusion Test

Introduction

All groundwater bodies in Northern Ireland (NI) are classified in 2020 to establish whether they are at 'good' or 'poor' status utilising monitoring data for the past 6 years (January 2014 – December 2019). Status is divided into qualitative and quantitative status and a number of tests are carried out for each, see Figure 1.

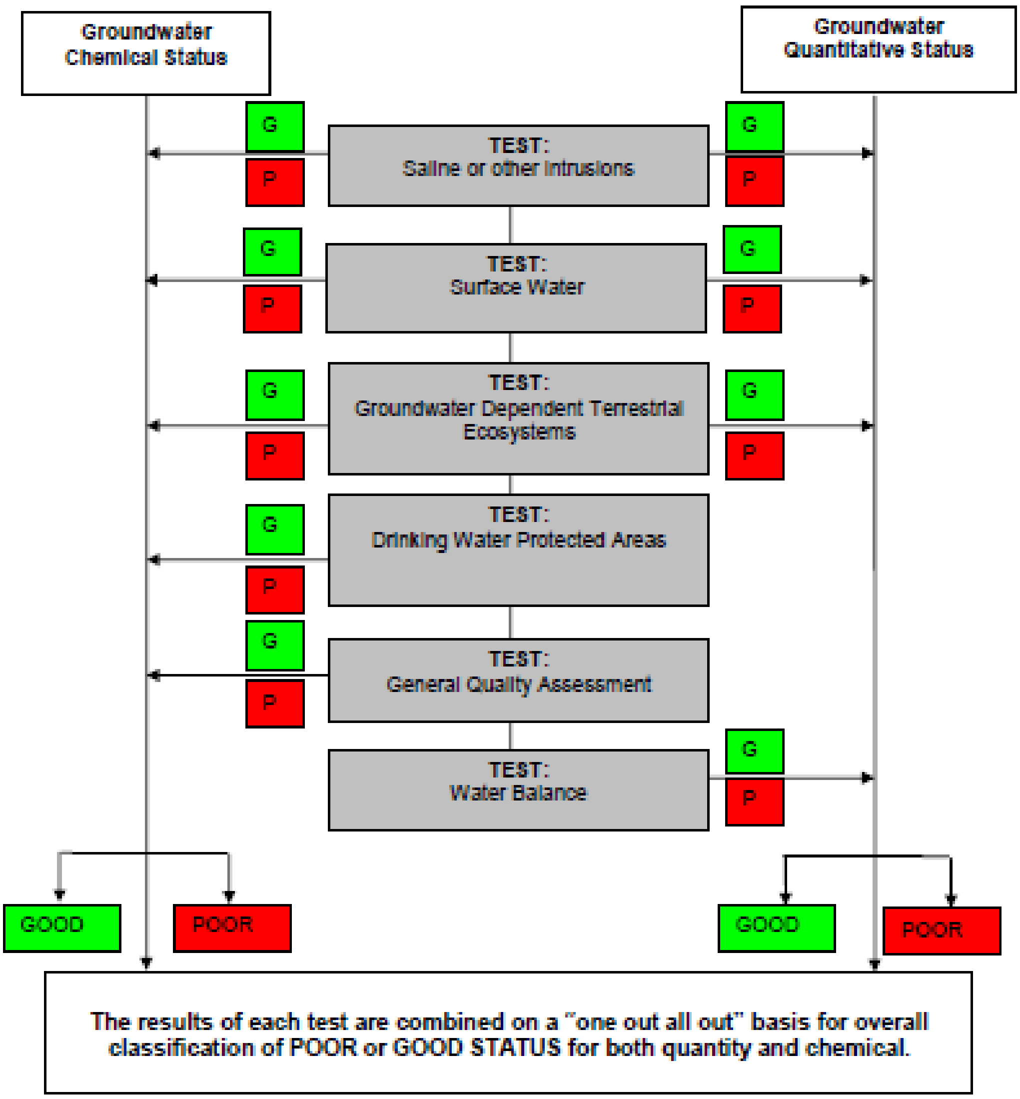


Figure 1: Overview of classification tests [from UK Technical Advisory Group paper 11b(i)].

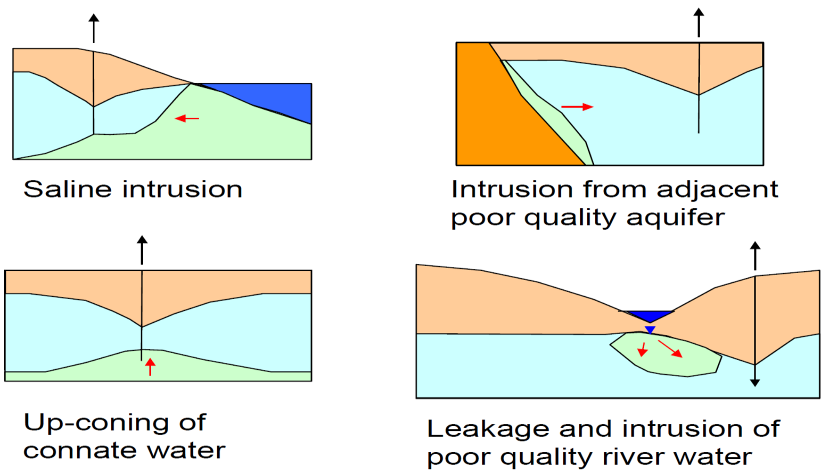
Saline Intrusion classification

The saline intrusion test assesses if an abstraction of groundwater or set of abstractions are likely leading to the intrusion of poorer quality water into a water body.

Saline intrusion can be considered as both a chemical and quantitative pressure. It is the abstraction of groundwater that can then lead to deterioration in the quality of groundwater. Assessing the likelihood that saline intrusion is occurring within a groundwater body is a case of assessing both the scale of abstraction in relation to freshwater recharge and analysis of chemical monitoring data from the groundwater abstractions. However, it is the latter that provides more reliable evidence that saline intrusion is occurring and greater emphasis should be placed on it when undertaking this assessment.

There are 4 key types of anthropogenic induced intrusion that can be considered. These are demonstrated in Figure 2 below.

Figure 2: Types of intrusion



The primary potential for impact from 'intrusion' in NI is along coastal areas and adjacent to tidal rivers. The related potential for intrusion will be dependent upon the nature of the aquifer, overlying deposits and the abstraction pressures operating close to these areas.

Due mainly to the dominant fractured bedrock hydrogeology of NI, abstraction of groundwater is limited. Conceptually therefore the potential for intrusion is expected to be limited.

The process of assessing the status of the Saline Intrusion test for a groundwater body, as defined above, is laid out below. This method is derived from the UKTAG guidance for classification, updated for the second River Basin Planning (RBP) cycle (UKTAG, 2012a).

1. Does a groundwater body contain representative monitoring for a period of at least 6 years?

Yes ↓

2a. Calculate one average over last 6 years for each monitoring point. Are threshold values exceeded:
(electrical conductivity 800 µS/cm, chloride 25 mg/l)?
If no, groundwater body is at 'good' status.
If yes, proceed to step 3a.

↓

3a. Carry out trend assessment. If there is a statistical significant rising trend, groundwater body is at 'poor' status, otherwise continue at step 4a.

↓

4a. Is there a significant impact on a point of abstraction as a consequence of an intrusion? If yes, groundwater body is at 'poor' status otherwise good status.
Also consider other lines of evidence: is the groundwater body at 'poor' status?

↓ No - use multiple lines of evidence approach

2b. Does all or part of the groundwater body lie within a 3 km buffer of the NI coastline?
If no groundwater body is at 'good' status. If yes proceed to 3b.

↓

3b. Is the water balance for this groundwater body 'poor' or 'good'?
If good the groundwater body is at 'good' status. If poor proceed to 4b.

↓

4b. Is there a significant impact on a point of abstraction as a consequence of an intrusion?
If yes, groundwater body is at 'poor' status otherwise 'good' status.
Also consider other lines of evidence: is the groundwater body at 'poor' status?

Groundwater Abstractions

The licensing of abstractions was introduced in NI in 2007. It is assumed that the majority of the large and therefore significant groundwater abstractions have now been licensed and are included within the NIEA abstraction licensing database. It is however acknowledged that there are a lot of small abstractions, such as those associated with farming, that as yet have not been licensed and are therefore not included within the NIEA abstraction licensing database.

For the purposes of this assessment, the current NIEA abstraction licensing database was queried for all groundwater abstractions. This would exclude spring or spring fed abstractions. The total annual volume of abstraction was calculated for each groundwater body.

Monitoring Data

Groundwater monitoring data has been collected since 2000 when the first regional groundwater monitoring network was established. Monitoring was stopped in 2007 and a new network of monitoring points was established in an attempt to meet CIS guidance (2007) and UKTAG guidance (2007).

A network of operational and surveillance monitoring points (both boreholes and springs) have been sampled between 2 to 4 times per annum for a wide range of chemical parameters. The network contains around ~65 monitoring points which are mainly full time operated abstraction boreholes. In recent years many of these abstracted boreholes have been taken out of service and a considerable number of monitoring points have therefore been lost from the network. Raw water samples are collected from each monitoring point for testing.

The monitoring network has collected field observed electrical conductivity and tested samples for chloride. This data is available to have a trend assessment performed on it.

Threshold Values

In 2009, threshold values for assessing groundwater chemical status of Northern Ireland groundwater bodies were defined, as per Annex 1 of the Groundwater Daughter Directive (GWDD) (2006). Threshold values are not environmental standards but are used for the purpose of groundwater body chemical classification as a measure of their status. They are based on the specific receptor which requires protecting. For example, the drinking water standard for electrical conductivity is 1500 µS/cm. The threshold value is set lower than this so that the potential for saline intrusion can be detected before it becomes a human health problem.

For the saline intrusion status test, thresholds values for electrical conductivity and chloride have been established. These are 800 µS/cm and 25 mg/l respectively.

Trend Assessment

Identifying significant and sustained upward trends of certain parameters is important for ensuring that objective IV of the Water Framework Directive (WFD) is met. An upward trend is indicative of an anthropogenic pressure on a groundwater body. Analysing monitoring data for a significant and sustained upward trend is therefore important.

One of the difficulties with analysing monitoring data for a significant and sustained upward trend is the need for a large dataset upon which to perform a trend analysis. In the case of groundwater monitoring data, this is not always available to derive a result which is robust.

The NIEA commissioned the British Geological Survey (BGS) to review methods of trend assessment applicable to small datasets. The recommendation made by the review was to utilise the trend assessment inbuilt function of the AquaChem software package. This was designed by Schlumberger Water Services in conjunction with the Environment Agency of England and Wales specifically to assess trends within groundwater monitoring data collected for the purposes of WFD classification and characterisation. Crucially, the assessment method includes a forward projection capability. This is important for risk characterisation as it enables a significant and sustained upward trend to be further assessed to classify its scale and whether projected concentrations are likely to exceed threshold values and/or relevant standards by 2026.

Further information on the trend assessment method can be found in Stuart (2012).

References

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