River Basin Management Plans (2015 – 2021)

Groundwater Classification Methodology
Trend Assessment and Points for Trend Reversal

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Trend Assessment
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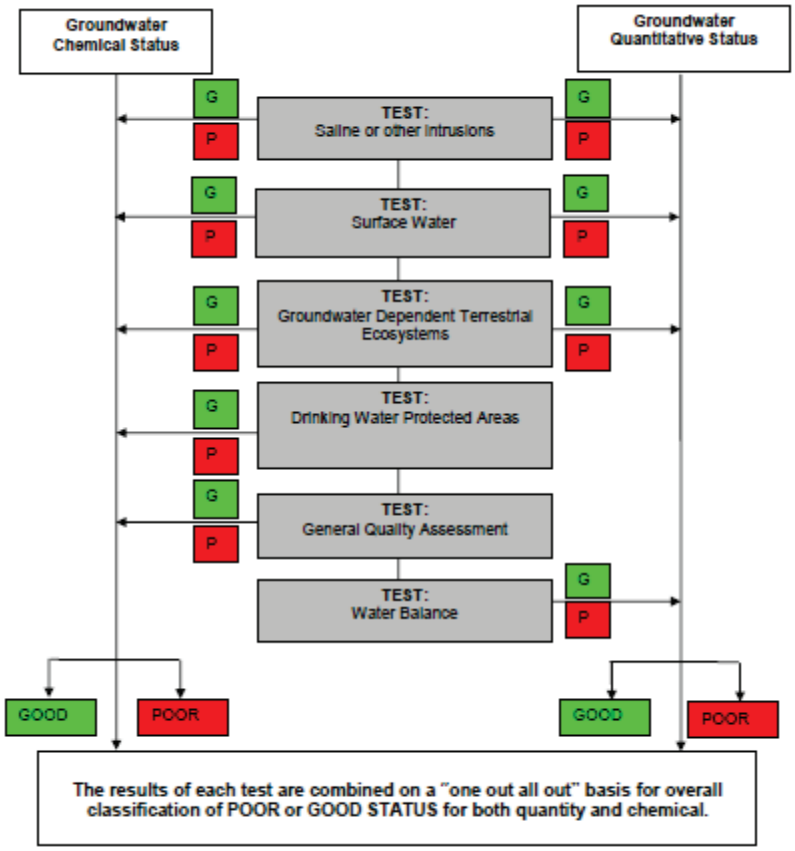
Introduction

All groundwater bodies in Northern Ireland were classified in 2014-2015 to establish whether they are at good or poor status utilising monitoring data from the past six years (2009 to 2014). Status is divided in to qualitative and quantitative status and a number of tests were carried out for each, see Figure 1. For the Drinking Water Protected Areas test and Saline Intrusion test, the conduction of trend assessment is required.



Northern Ireland Groundwater Monitoring Programme

Groundwater quality in Northern Ireland is measured through the collection of samples from a network of boreholes and springs that are mostly owned and operated by third parties. The public water supply provider, Northern Ireland Water, does not currently utilise groundwater, with the exception of Rathlin Island, a small island off the north coast of Northern Ireland. NIEA therefore rely mostly on third party boreholes and the co-operation of land/ property owners to continue sampling from their sources for the groundwater chemical monitoring programme. The groundwater chemical monitoring network can therefore change due to businesses closing or modifying their groundwater usage.

The network consists mainly of industrial boreholes where groundwater is utilised for manufacturing or food/ drinks production. A small number of springs or boreholes purpose-installed by NIEA, which are purged prior to sampling, are also monitored. The selection of

monitoring stations to date has been based on a pressure-pathway assessment of the groundwater bodies and the availability of potential monitoring points. As a result, only a few long-term records suitable for trend assessments are available.

Trend assessments are carried out for individual monitoring points where the annual mean for the previous six years for relevant determinands specific to the individual test exceeds the threshold values.

Where individual parameter concentrations (or values) are below the Limit of Quantification (LOQ), the values used within the calculation of the annual mean and the trend assessment are replaced by half of the value of the highest LOQ of the specific determinand being analysed.

A time series length of at least one cycle was considered appropriate in the detection of statistically significant increasing trends. However, a time series of this length was not always possible given the limited datasets available for some monitoring points.

Trend Assessment Methodology

As datasets for which trend assessments can be conducted are often limited NIEA commissioned the British Geological Survey to review methods of trend assessment applicable to small datasets. The recommendation made by the review was to combine multiple statistical tests in the trend assessment to increase confidence. The trend assessment has been carried out using the inbuilt function of the AquaChem software package, which was designed by Schlumberger Water Services in conjunction with the Environment Agency England specifically to assess trends within groundwater monitoring data collected for the purposes of WFD classification and characterisation. The software also includes a forward projection capability to predict concentration levels for the next river basin planning cycle. Statistically significant increasing trends were detected where multiple tests indicated an increasing trend and through statistical comparison of the AquaChem software output slopes.

The methodology for undertaking trend assessments is summarised below Stuart (2012).

1. Select stations for which at least three years of data or at least six datapoints are available. Input groundwater monitoring point data from this river basin planning cycle (plus historic data where available for more robust statistical assessment) for the relevant determinands into the AquaChem database.

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2. Undertake trend assessment analysis within the AquaChem software using Mann Kendall, Sen's test and Linear Regression statistical tests with a forward projection to 2021 for relevant determinands.

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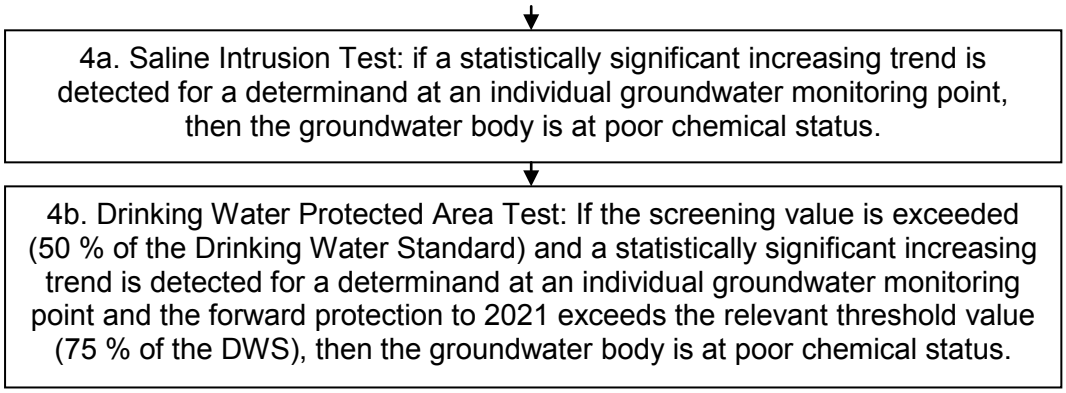
3. Statistically significant increasing trends were detected where all of the criteria below were fulfilled:

- Mann-Kendall-test returned an increasing trend
- Sen's test returned increasing trend
- coefficient of variation between the Sen's test and the Linear Regression slopes is less than ± 10 %
- assessment of linear regression fit: $r^2 > 0.5$
- coefficient of variation between predicted concentrations in 2021 using Sen's test and Linear Regression is less than ± 10 %



The method can also be applied to establish falling trends.

Article 17(5) of the WFD states that the starting point for trend reversal within the Drinking Water Protected Area Test should be defined as 75 % of a relevant environmental standard or threshold value, but that an earlier or later starting point can be chosen to meet environmental objectives cost effectively. The starting points for trend reversal are set at quite low concentrations to allow measures to be put in place to reverse increasing trends in sufficient time to avoid failure of WFD environmental objectives. Default starting points for trend reversal (75 %) have been chosen in Northern Ireland.

Establishment of groundwater threshold values

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 (UKTAG, 2012). As there is a lack of historic groundwater monitoring data within Northern Ireland, threshold values have been derived from those established for Scotland and the Republic of Ireland, which have similar hydrogeological properties and landuse pressures to Northern Ireland. New threshold values for classification were introduced by UK Technical Advisory Group who consulted on them in 2012. Threshold values used for classification can also be found in the Groundwater (Amendment) Regulations (Northern Ireland) 2014.

There is a lack of historic groundwater monitoring data within Northern Ireland for a reliable evaluation of background levels to be undertaken. Threshold values have been based on those established for Scotland and the Republic of Ireland, which have similar hydrogeological properties and landuse pressures. A Republic of Ireland study of baseline levels for substances that occur both naturally and from anthropogenic sources was considered in the establishment of threshold values for Northern Ireland.

Threshold values for Northern Ireland have been established in conjunction with the Republic of Ireland. Additionally, the Republic of Ireland is part of UKTAG, which ensures consistency in approach to the establishment of threshold values across the UK and Ireland.

References

Stuart, M.E. (2012). *Trend analysis and prediction for small groundwater quality datasets from Northern Ireland*. British Geological Survey Commissioned Report, CR/12/037. 38pp.

UKTAG. (2012). *Groundwater Chemical Classification for the purposes of the Water Framework Directive and the Groundwater Directive*. UKTAG Paper 11b(i) V0.9.