River Basin Management Plans – Groundwater Classification

Saline Intrusion

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NIEA Northern Ireland Environment Agency
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1.0 Purpose

This paper describes the method used to assess the Water Framework Directive (WFD) quantitative status of groundwater bodies with respect to saline intrusion related to groundwater abstraction.

2.0 Background

The WFD requires that groundwater bodies must be classified as good or poor for both chemical status (in relation to a large range of pollution pressures) and quantitative status (in relation to groundwater abstraction pressures).

Intrusion of saline water is one of four tests that have been developed for groundwater body quantitative classification, based on WFD requirements and guidance provided at an EC and UK level[1]. The four tests consider the impacts of groundwater abstraction both on the groundwater body itself, and also on the ecological receptors which depend on it. The worst result from all four tests is taken as the overall quantitative status result for each groundwater body.

The primary potential for impact from 'intrusion' in Northern Ireland 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.

As there is no history of large-scale deep mining (and associated dewatering) or concentrated 'deep' water abstraction, intrusion associated with upward or lateral movement of poorer quality (higher conductivity) water into freshwater zones is considered highly unlikely. Additionally there is an absence of exploitable, fully confined aquifer systems where over-abstraction could potentially draw 'connate' water up-gradient.

The initial characterisation of groundwater bodies undertaken for the WFD Article 5 report identified only one groundwater body potentially at risk from saline intrusion. This was a groundwater body where over-abstraction in the past had resulted in some saline intrusion but where the abstraction pressure was now reduced due to changes in local water demand and supply.

In areas where there is coastal/tidal river interaction and in the absence of any abstraction pressure it would be expected that there would be a natural transition from freshwater (lower conductivity) to saline water (higher conductivity). This transition zone will vary depending on many factors such as the hydrogeological setting, tidal ranges, but for the most part would be expected to affect only a relatively narrow zone around the interface between saline water bodies and landward groundwater. Additionally, around coastal areas, the natural chemistry of rainfall, and subsequently recharge to groundwater, would be expected to be influenced by factors such as sea spray and proximity to saline water such that a marginally elevated chloride concentration may be expected compared to further inland. A study of rainfall chemistry for 1972-94 (Jordan, 1997) reported data from four Northern Ireland rainfall stations. In bulk precipitation samples, rainfall-weighted, mean annual concentrations of chloride varied between 3.8 (Hillsborough) and

[1] UK Technical Advisory Group on the Water Framework Directive. Paper 11b(ii): Groundwater Quantitative Classification for the purposes of the Water Framework Directive. This paper can be downloaded from the www.wfduk.org web site.

7.6 mg/l (Silent Valley) with conductivity between 29 (Hillsborough) and 41 µS/cm (Silent Valley).

3.0 Classification

This assessment has been undertaken to support the following elements of classification:

Chemical Classification

- No saline or other intrusion

Quantitative Classification

- No saline or other intrusion

Assessment of chloride and conductivity data, including consideration of trends, from available monitoring points was undertaken to inform the final classification.

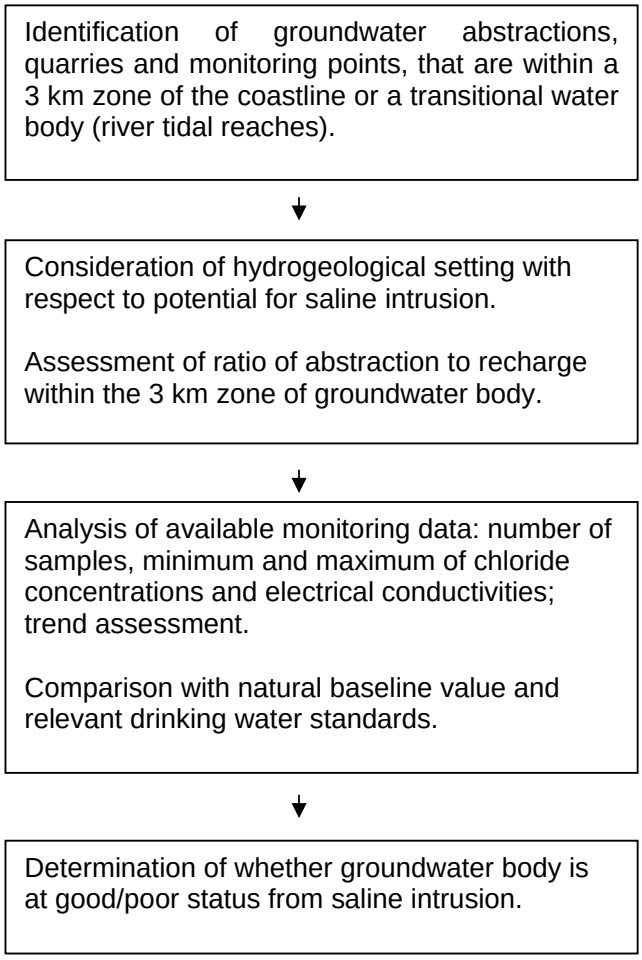
4.0 Assessment Process

A 3 km wide investigation zone was defined around the coast and tidal river reaches based on knowledge of aquifer types and abstraction pressures. This zone was sub-divided according to the dominant aquifer type (bedrock or superficial) considered to be most likely to be in hydraulic contact with the sea/tidal river. All known abstractions (based upon groundwater body units) were assessed to identify proximity to coast/tidal river and degree of abstraction. Consideration was also given to any other pressures such as quarrying or engineering dewatering which might involve water abstraction leading to induced saline intrusion.

Available data from NIEA (2000-2008) and British Geological Survey (BGS) (1992-1994) monitoring programmes along with data from public water supplies was reviewed with respect to electrical conductivity and chloride concentrations. Trends were then compared against an estimate of what the natural baseline concentration is expected to be (based upon local data and data from the Republic of Ireland).

Natural baseline values taken for this assessment are

- Electrical Conductivity(EC) = 800 µS/cm
- Chloride = 25 mg/l



Overall groundwater abstraction in Northern Ireland constitutes a relatively low percentage of total recharge. Consequently the potential for significant saline intrusion is considered to be low. Nevertheless it is recognised that in a sensitive location, abstraction of a significant magnitude could lead to intrusion.

There are relatively few established monitoring points available in appropriate locations around coastal and tidal river areas in Northern Ireland and this can limit the confidence in determining if an impact is occurring where a pressure has been identified and where the hydrogeological setting can accommodate intrusion. Hence in these settings confidence has been assessed as low.

Confidence has been assessed as high for groundwater bodies not adjacent to coastal or transitional waters.

5.0 Outcome

Based upon the above assessment no groundwater bodies have been classified as being at “poor status” due to saline intrusion.

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There are relatively few established monitoring points available in appropriate locations around coastal and tidal river areas in Northern Ireland and this can limit the confidence in determining if an impact is occurring where a pressure has been identified and where the hydrogeological setting can accommodate intrusion. Confidence has been assessed as high for groundwater bodies not adjacent to coastal or transitional waters.

6.0 River Basin Planning Cycle

To improve confidence in this assessment for the next review period there is a need to:

- review availability of monitoring points in the few areas where the potential (both pressure and pathway) exists for saline intrusion and improve network where necessary;
- review frequency of monitoring and undertake more detailed monitoring in the most sensitive locations; and
- improve understanding of the local water balance and hydrogeological setting in the saline investigation zones for the ‘at risk’ bodies.

References

Jordan, C. 1997. Mapping of rainfall chemistry in Ireland 1972-94. Biology and Environment: Proc. Royal Irish Academy, Vol 97B, No 1, 53-73

Northern Ireland Environment Agency
17 Antrim Road
Lisburn
BT28 3AL

www.ni environment.gov.uk

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