

Preliminary Groundwater Total Hardness map

K. Tedd, S. Raymond, N.H. Hunter Williams, C. Kelly, M. Lee, S. Carey, D. Doherty and N. Duncan
Groundwater Section, Geological Survey of Ireland

Introduction

The Geological Survey of Ireland's Groundwater Section are producing a series of national groundwater chemistry maps. The first map in this series is a Groundwater Total Hardness map (Figure 1). It is hoped these maps will be a useful reference for professionals with an interest in groundwater and surface water, as well as the general public.

Total hardness is the concentration of dissolved calcium and magnesium. It is expressed as an equivalent concentration of calcium carbonate (CaCO_3). When hard water is heated, the soluble calcium bicarbonate decomposes to form insoluble calcium carbonate or limescale. Limescale can clog pipes, lower the efficiency of electric water heaters, raise the costs of heating the water and reduce the life of equipment. Many Irish industrial and domestic water users are concerned about the hardness of their water and invest in water softeners to counteract the impacts of hard water. In addition, Total Hardness is an ecologically important parameter. A number of Groundwater Dependent Terrestrial Ecosystems in Ireland are dependent on very hard groundwater (e.g. petrifying springs or alkaline fens).

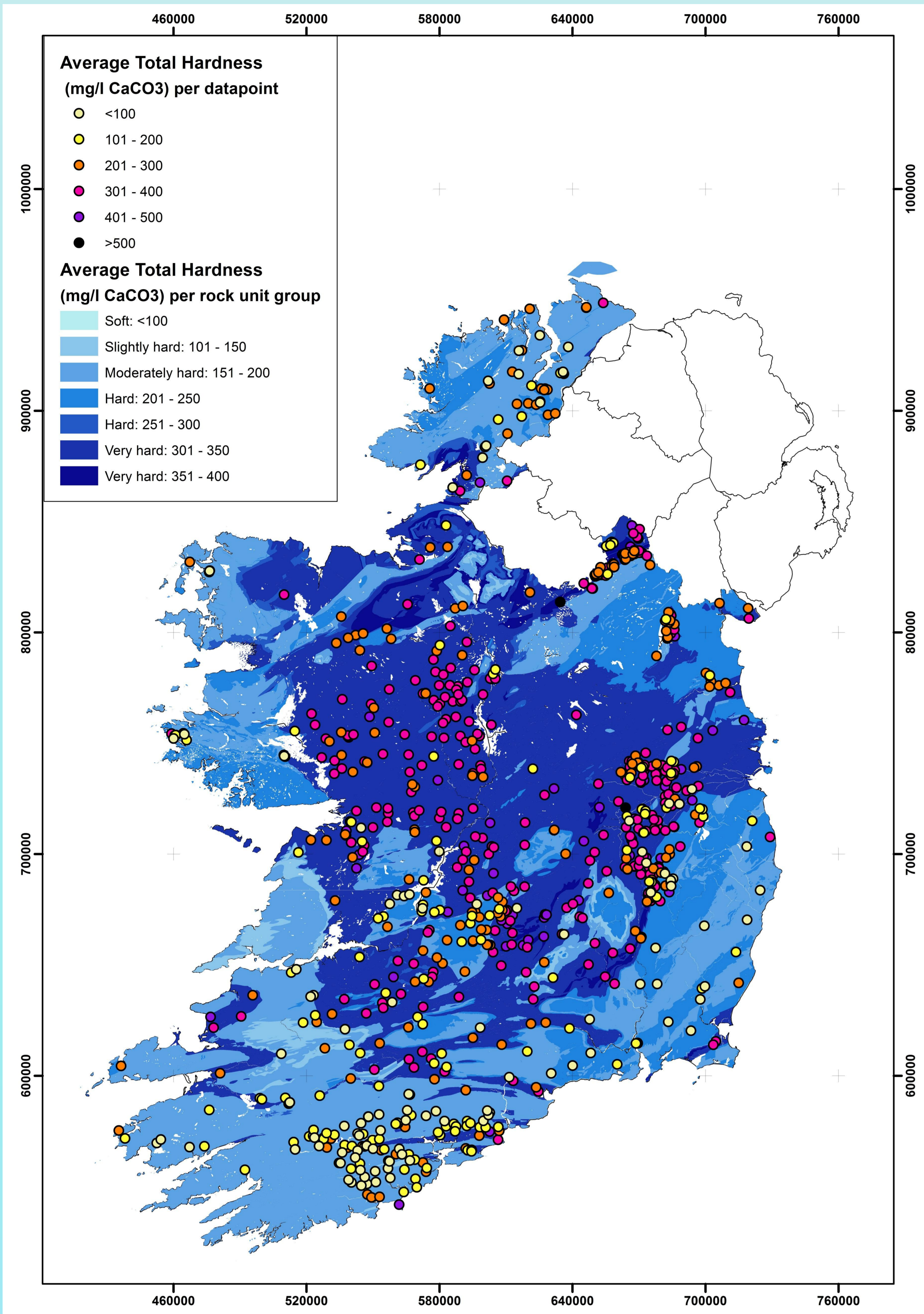


Figure 1 Groundwater Total Hardness map

Groundwater chemistry database

To underpin the series of groundwater chemistry maps, the Groundwater Section of the Geological Survey of Ireland are in the process of collating a national groundwater chemistry database. The database parameters include physico-chemical parameters, major ions, minor ions, nutrients and trace elements. Data have been sourced from a wide range of disparate sources. The data sources include:

- Geological Survey of Ireland's GEODATA database
- Environmental Protection Agency's groundwater monitoring data
- Public Water Supplies drinking water returns
- National Federation of Group Water Schemes groundwater sampling data
- Local Authority Private Well Grant Scheme groundwater chemistry data
- Irish Water groundwater raw water sampling

Figure 1 shows the data locations and average concentrations that have been used to create the preliminary groundwater total hardness map. The locations of these data points, plus those yet to be incorporated or collected are shown in Figure 2. The data compiled to date has been quality checked by using statistical screening and ionic balance calculations.

Preliminary groundwater total hardness map

The preliminary Groundwater Total Hardness map (Figure 1) displays the average Total Hardness (in mg/l as CaCO_3) for each Rock Unit Group (Figure 3). The map shows that groundwater in the Midlands, sourced from the Dinantian Limestones, has the highest average Total Hardness (up to 380 mg/l CaCO_3). Groundwater in coastal counties, particularly in the south west, sourced from the Namurian Sandstones, Dinantian Mudstone and Sandstones and the Old Red Sandstone has the lowest average Total Hardness (up to 150 mg/l CaCO_3).

Figures 4 and 5 show the variation of groundwater Total Hardness for each Rock Unit Group. These plots indicate that there is most variation in some of the non carbonate rock types such as the Dinantian Sandstones, the Granites and the Ordovician Volcanics. Low variation is observed in the Westphalian Shales, Namurian Shales and the Dinantian Upper Impure Limestones.

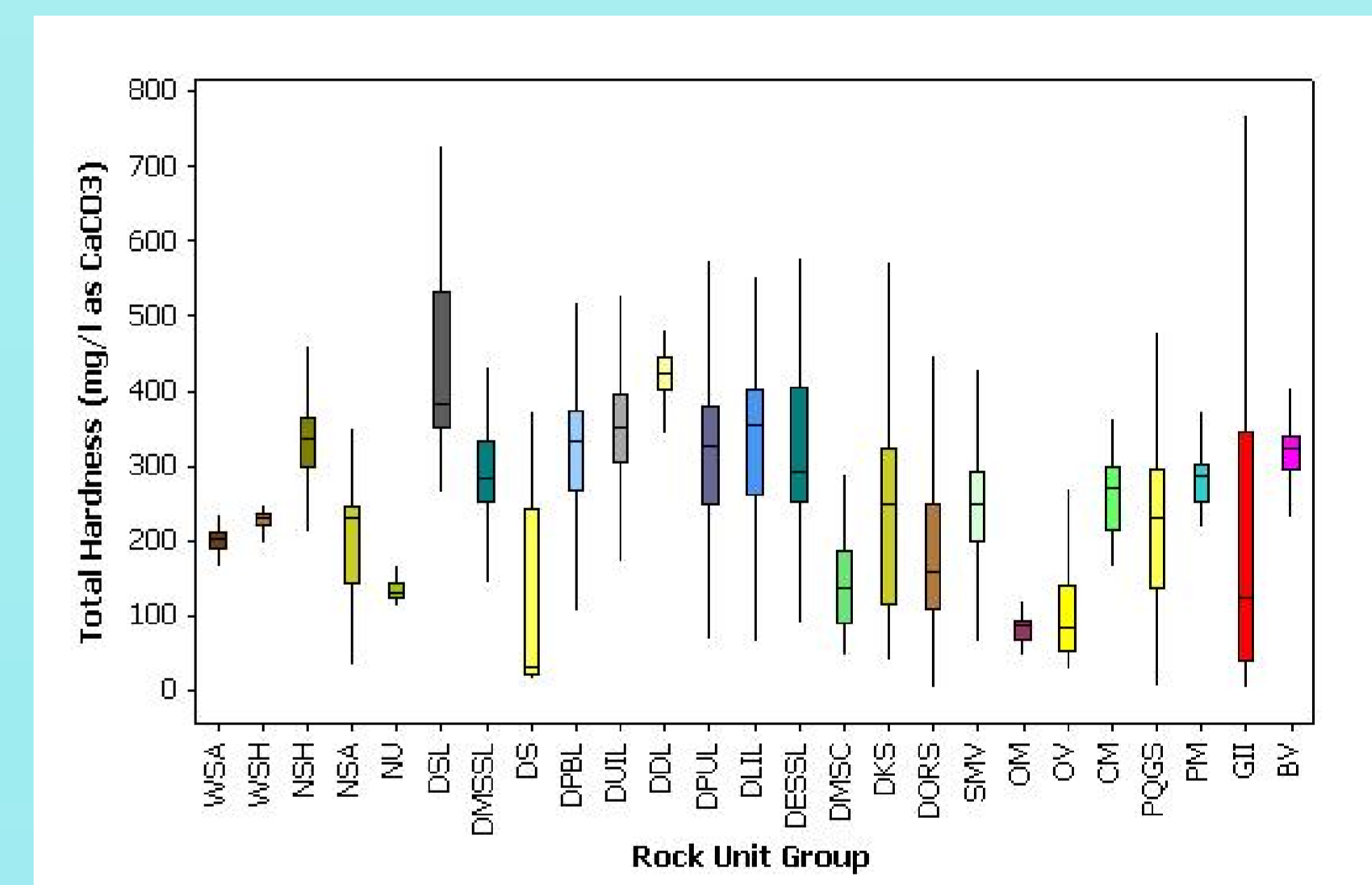


Figure 5 Box and whisker diagram showing the variation of groundwater Total Hardness across the rock unit groups.

The next steps

The preliminary groundwater total hardness map is the first in a series of national groundwater chemistry maps. The next steps will be to continue to populate the groundwater chemistry database (particularly to address spatial data gaps shown in Figure 2); to quality check the data; to update the Total Hardness map accordingly, and to develop national maps for other parameters. The next maps planned in the national groundwater chemistry series are for groundwater Iron and Manganese concentrations.

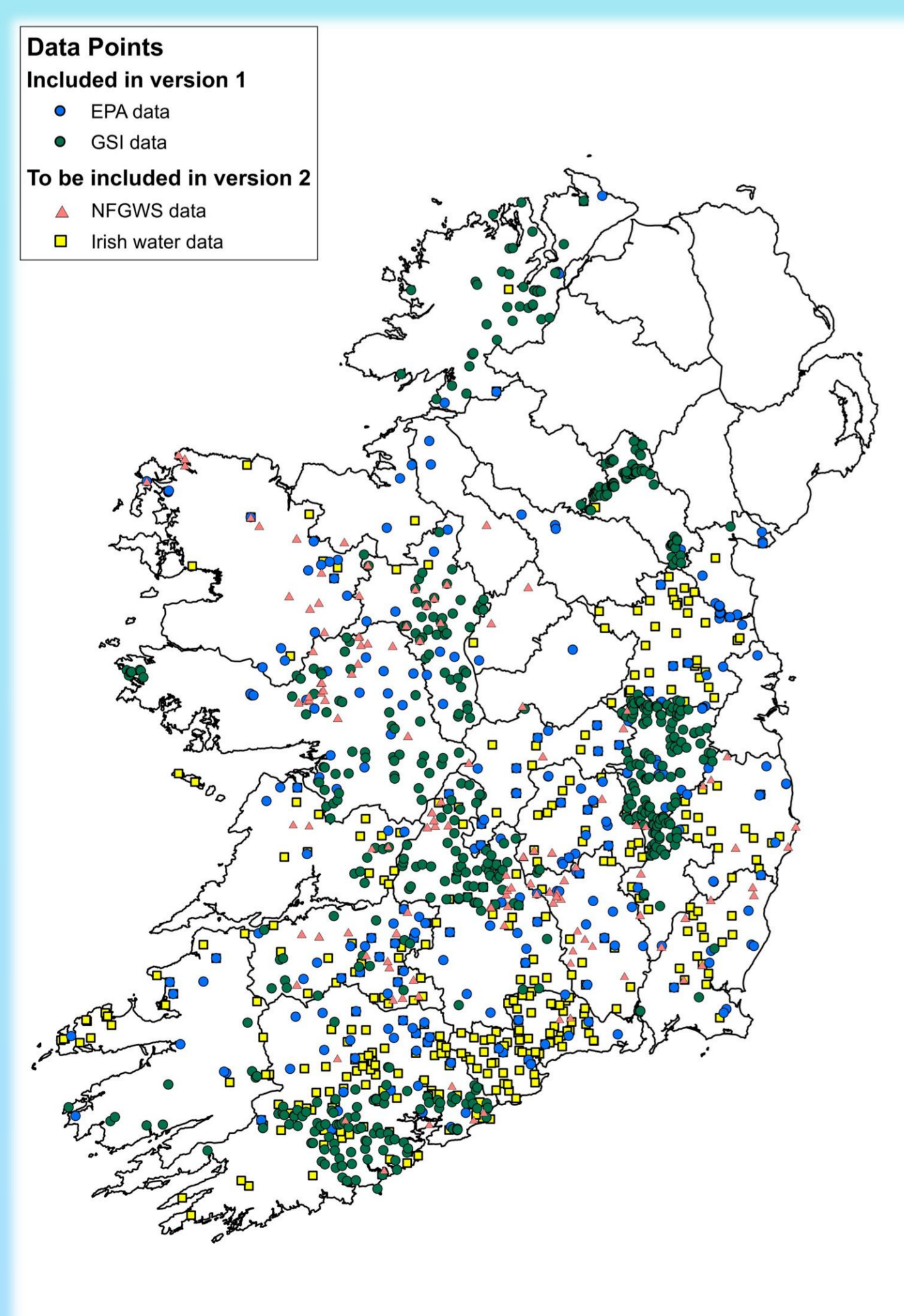


Figure 2 Data Points

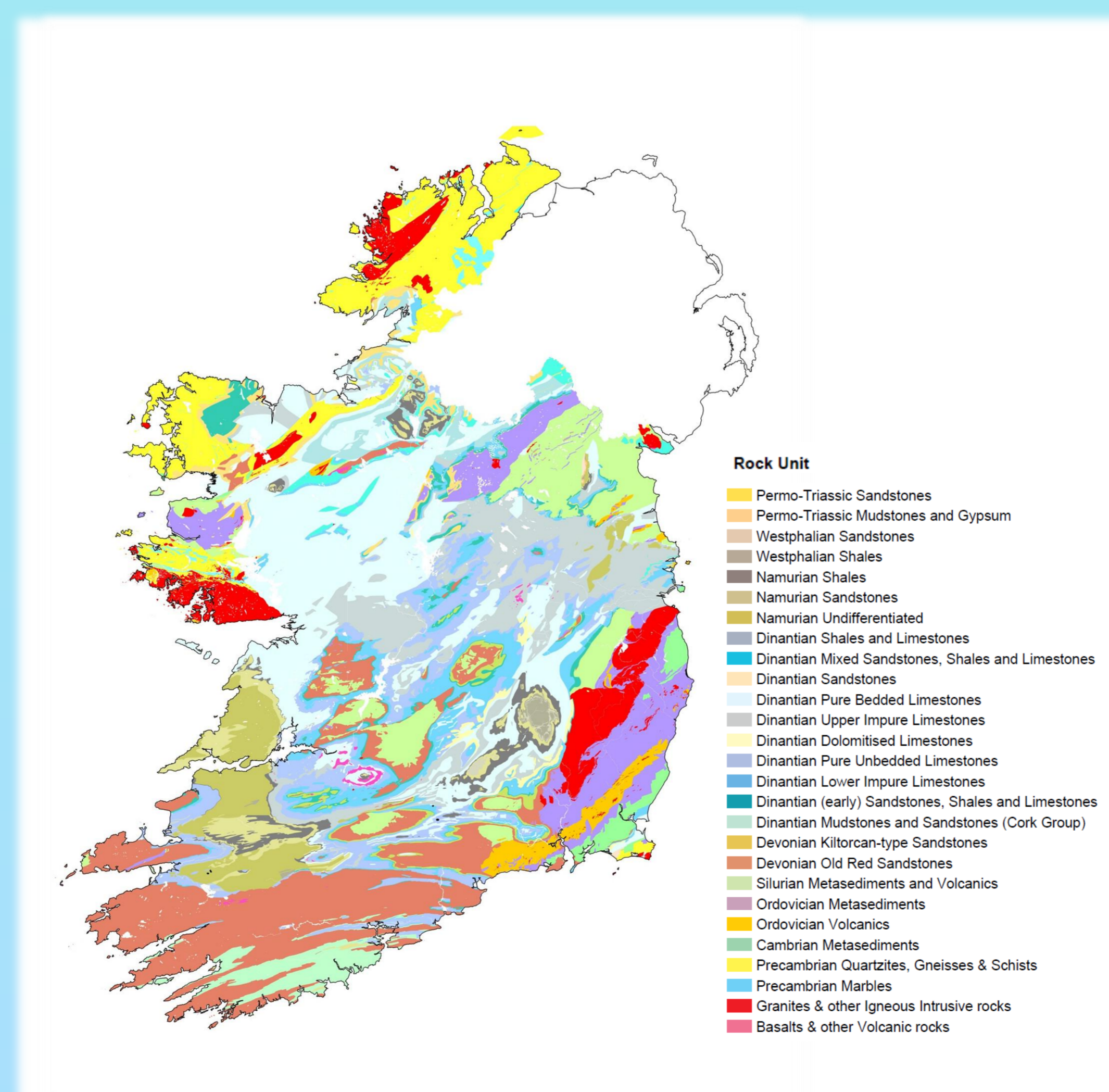


Figure 3. Rock unit map

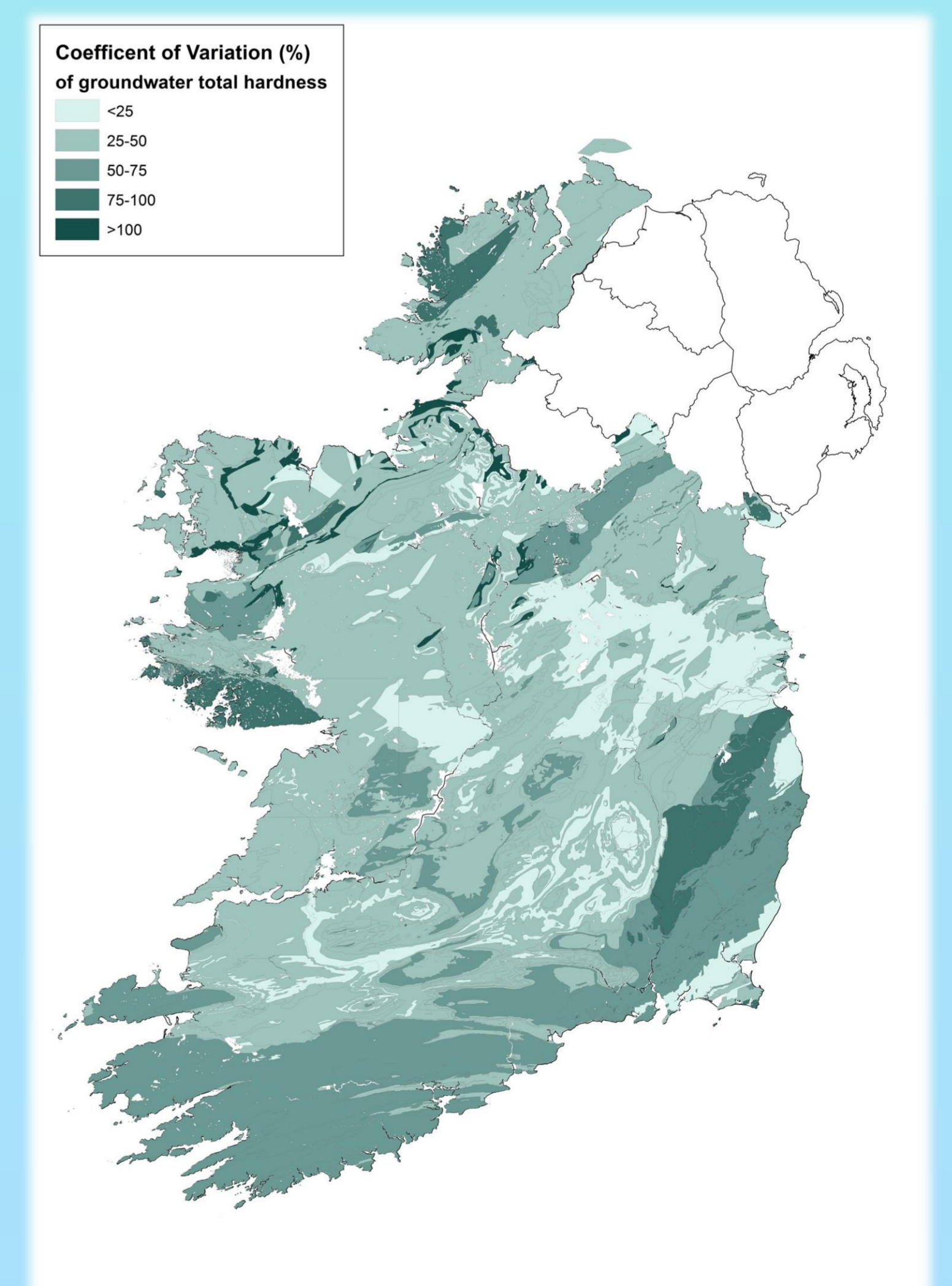


Figure 4 Coefficient variation map

Acknowledgements

This work is part of the Geological Survey of Ireland's Groundwater Section's "Groundwater 3D" project. The Groundwater Section are grateful to all who have provided groundwater chemistry data for incorporation into this map.

