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Ballymascanlan Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/42
March 2023

Geological Survey Ireland is a division of the Department of the Environment, Climate and Communications

Ballymascanlan Sand and Gravel Aquifer Description March 2023

This sand and gravel report forms part of a series representing the output of a body of work undertaken to re-evaluate previously mapped sand and gravel aquifers and to identify new sand and gravel aquifers. This study resulted in the refinement of existing sand and gravel aquifer mapped extents, the modification of some sand and gravel aquifer categories, and the removal of some previously mapped sand and gravel aquifers, as well as identification of new aquifers. In addition to mapping the extent and depths of the sand and gravel aquifers, the investigations consider the hydraulic properties.

The study, undertaken as part of the GW3D project (2015-2019), comprised three parts:

1) Desk study and fieldwork preparation

Sand and gravel bodies above a minimum size criterion were extracted from the GSI Quaternary Sediments 1:50,000 map. Where it was known that the surface expression of the sands and gravels was only a small portion of the subsurface body, such areas were retained. This process left several hundred sand and gravel bodies remaining as a starting point for field work.

2) Fieldwork including mapping and data collection

Field work included a visit to each of the areas which had the potential to be (at least) a Locally Important Sand and Gravel Aquifer owing to its area. In such areas, gravel pits and sand pits were visited and depth and type of sediment recorded, other exposures into the subsurface were visited and logged, wells (whether Public Supply, Group Scheme or private farm or domestic) were dipped and any information on depths recorded, and data was collected where geological and hydrogeological data existed for the area.

3) Data collation, analysis and reporting.

All field data, and information from earlier reports and studies, were compiled and analysed. Where a sand and gravel body had qualifying aquifer properties (either 10 m depth sand and gravel, or 5 m depth saturated sediments), these areas were digitised in a GIS. The aquifer area was then ascertained and drawn up. Such areas formed the basic building blocks for the sand and gravel aquifer map, which included details on the aquifer name, area, aquifer resource value (Rg or Lg), confidence level, county, and any important aspects to note for each body.

The updated mapped sand and gravel aquifers are found on the Geological Survey Ireland site https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx#Aquifers

The GW3D Mapping Team involved in the current revision of delineated sand and gravel aquifers were:

Geological Survey Ireland staff:

- Dr. Sophie O'Connor, Groundwater Programme / Land Mapping Unit
- Dr. Sarah Blake, Groundwater Programme

Consultant support:

- Dr. Robbie Meehan, Talamh Ireland
- Coran Kelly, Tobin Consulting Engineers
- Damien Doherty, independent Consultant Geologist/ Tobin Consulting Engineers
- Natalie Duncan, independent Consultant Geologist
- Sara Raymond, independent Consultant Geologist
- James McAteer, Gavin and Doherty Geosolutions

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Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
06 - Newry, Fane, Glyde and Dee Louth County Council	**Rivers:** Ballymascanlan River **Streams:** Several unnamed, minor streams **Lakes:** None	Dundalk Bay SAC Dundalk Bay SPA Dundalk Bay pNHA	3

Topography	The Ballymascanlan sand and gravel aquifer is situated along the southwestern side of the Cooley peninsula, on the north side of Dundalk Bay and just northeast of Dundalk Town. The body includes marine gravels and sands (often raised) and marine beach sediments. The marine deposits are present in part due to the change in sea levels since the last ice age (An Forás Forbartha and GSI, 1982). To the northeast at Slievenaglogh, bedrock outcrops among till deposits. To the south the aquifer is bounded by Dundalk Bay and the Irish Sea. The elevation across the body varies between sea level and 10 m AOD.	
Geology and Aquifers	**Aquifer categories**	The Ballymascanlan sand and gravel is confirmed have a saturated thickness greater than 5 m. The thickness, saturated thickness and areal extent satisfy the criteria of a **Locally Important Sand and Gravel Aquifer (Lg)** (DELG/EPA/GSI, 1999; GSI, 2017).
	Main aquifer lithologies	This aquifer includes marine beach sands, and a mixture of marine gravels and sands (often raised).
	Key structures	The underlying bedrock is of undifferentiated Dinantian Limestones (GSI,2023a) which is a Locally Important bedrock aquifer (GSI,2023a).
	Key properties	The sand and gravel deposit is assumed to be dominated by coarse material; therefore permeability and storativity are expected to be high. The groundwater is considered to be generally unconfined. The slope of the water table is expected to be relatively subdued due to the permeable nature of the aquifer body.
	Thickness	Borehole records (GSI, 2023b) indicate that the thickness of the sands and gravels varies between 5 m and 10 m. As the water table is close to the surface across the majority of the area of the aquifer, most of this thickness is saturated.
Overlying Strata	**Lithologies**	Alluvium covers a small portion of the aquifer area.
	Thickness	The thickness of the overlying alluvial strata, where present, is unknown, but are not likely to be greater than approximately 3 m.
	% area aquifer near surface	Approximately 90% of the sand and gravel body has sands and gravels just below the surface.
	Vulnerability	Most of the aquifer is at the surface and therefore vulnerable; consequently pollutants can easily infiltrate the aquifer. Sand and gravel aquifers are categorised as having either 'High' or 'Extreme' vulnerability (DELG/EPA/GSI, 1999), with the vulnerability classification determined by the depth to the water table from ground level. Measured water levels range from 0.6 m to 7.9 m below ground level at Ballymascanlan. In areas where the water table is less than 3 m below ground level the aquifer vulnerability is mapped as 'Extreme', which covers almost 90% of the aquifer area. Where the water table is greater than 3 m below ground level, the aquifer vulnerability is mapped as 'High'
Recharge	**Main recharge mechanisms**	The aquifer receives both direct and indirect recharge. Diffuse recharge occurs *via* infiltration of rainfall through the unsaturated sands and gravels. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope (DELG/EPA/GSI, 1999). Typically the proportion of recharge that infiltrates to ground water in sand and gravel is around 85% (Hunter Williams *et al.*, 2011). Rejected recharge from the surrounding hills will increase the amount of available recharge to this lowland-setting, coastal aquifer.
	Est. recharge rates	The rainfall in the area of the Ballymascanlan sands and gravels is 830 mm (Walsh, 2012), and the estimated recharge rate to the aquifer from direct recharge is 365 mm/yr. The minimum direct groundwater throughput in the aquifer is estimated to be 940 m^3/d, which rises to 3,380 m^3/d when the significant proportion of this arising from rejected recharge, from the steep mountain slopes to the north, is included.

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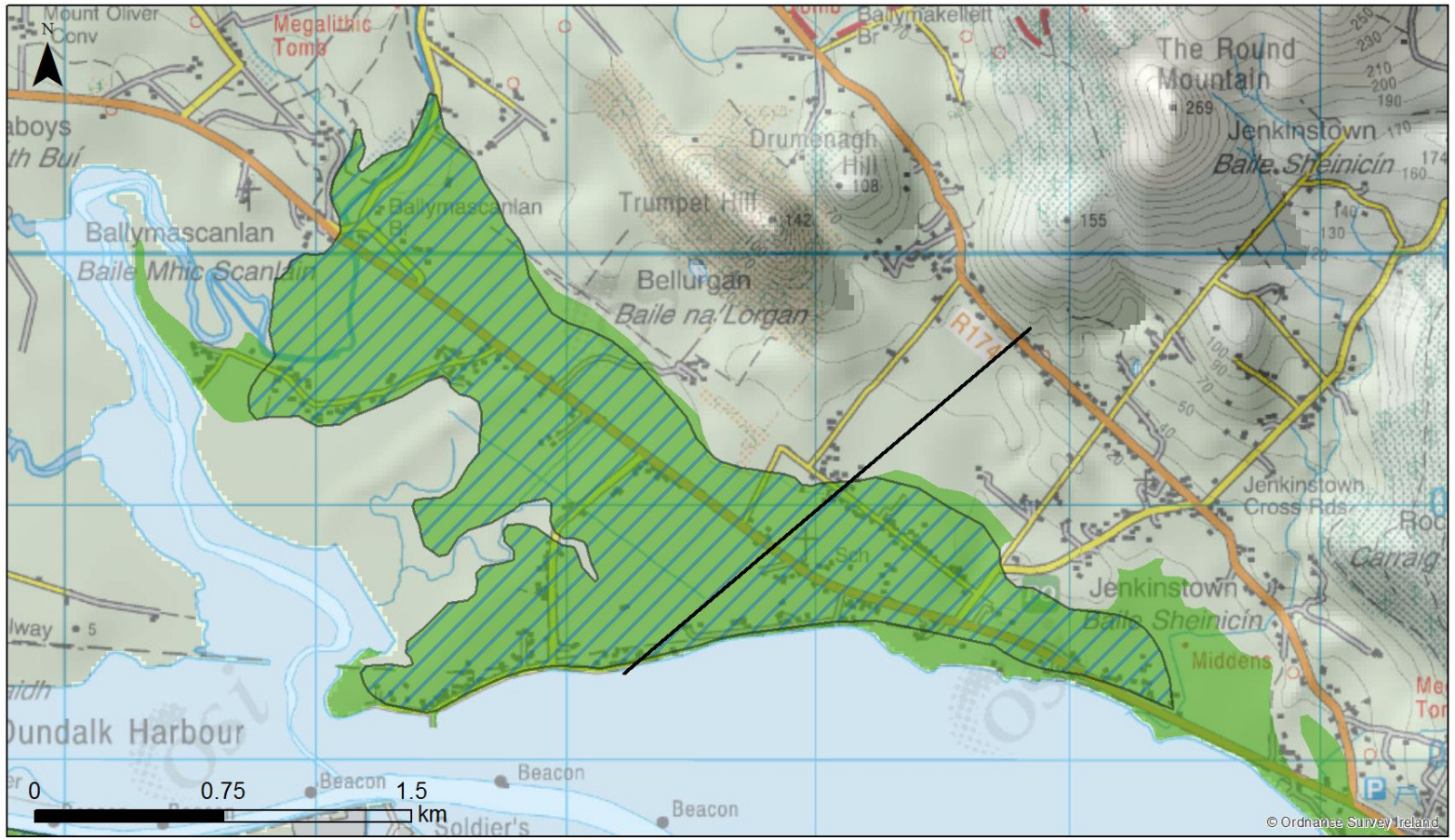
Discharge	**Large springs and large known abstractions (m^3/d)**	There are no large springs or abstractions recorded from this aquifer body. Estimated yields from wells within in the aquifer are between 5.2 m^3/day and 25.9 m^3/day (An Forás Forbartha and GSI, 1982), thus generally 'Poor'.
	Main discharge mechanisms	The main discharge mechanisms are discharge along the coastline and to land drains and streams which run through the aquifer. The sands and gravels are thought to be in hydraulic connectivity with the undifferentiated limestones beneath it; it may also discharge to the bedrock, depending on the water levels.
	Hydrochemical Signature	The groundwater in the Ballymascanlan aquifer body has a calcium bicarbonate signature (An Forás Forbartha and GSI, 1982).
Groundwater Flow Paths		Groundwater flow paths are short due to the restricted lateral extent of the aquifer. Information on the water levels is limited. There are not enough hydrogeological data to calculate precise groundwater gradients, but any low gradients are expected to be of relatively short extent, typical of sand and gravel bodies that are relatively restricted in area. This would seem to be the case given the extent and geometry of the body at Ballymascanlan.
Groundwater & Surface water interactions		Hydraulic connection between the groundwater and surface water is expected to be high.
Conceptual model	• This locally Important aquifer has an area has an area of 3 km^2. • The marine sand and gravel deposits are present at their current elevation in part due to the change in sea levels since the last Ice Age (An Forás Forbartha and GSI, 1982). • The boundaries of the aquifer are delimited for the most part by the extent of the mapped sands and gravels deposit (GSI, 2023a). • The average saturated thickness is estimated to be at least 5 m. • The aquifer is, in general, unconfined. • This aquifer receives direct recharge from precipitation and indirect rejected recharge from the slopes to the north. • Groundwater recharges directly as water percolated through the unsaturated zone to the water table. • Groundwater is not expected to be retained in the sediment but rather to flow quickly to discharge zones along the coast. This may contribute to the low yields recorded in this aquifer. • The minimum direct groundwater throughput in the aquifer is estimated to be 940 m^3/d, which rises to 3,380 m^3/d when the significant proportion of this arising from rejected recharge, from the steep mountain slopes to the north, is included.	
Attachments	Figure 1: Location and extent Figure 2: Cross sections Figure 3: Groundwater vulnerability	
Instrumentation	**Hydrometric gauges:** **National Water Monitoring Stations;** **River:** **Groundwater:**	None present RS06B020450 (u/s Ballymascanlan Br (u/s STW)) TW21006032EB1001 (CN100- Ballymascanlan Bridge) RS06B020500 (Ballymascanlan Br) RS06F020700 (Ballymascanlan Br) None present

Information Sources	• An Forás Forbartha and Geological Survey Office (1982). Groundwater Resources in the N.E.(R.D.O). Region. March 1982. Volumes 1 to 3. • Daly, E.P. (1980). An Interim Report on the Cooley Peninsula Sand and Gravels. Unpublished Report, Groundwater Section, Geological Survey of Ireland. • DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. • EPA map viewer. https://gis.epa.ie/EPAMaps/ • GSI (2017). A description of Irish aquifer categories. 3 pp. Available from: https://www.gsi.ie/documents/GSI%20Aquifer%20Category%20Descriptions.pdf • GSI (2023a). Geological Survey Ireland Spatial Resources Viewer. https://www.gsi.ie/en-ie/data-and-maps/Pages • GSI (2023b). Geological Survey Ireland. Internal Groundwater Database • Hunter Williams, N., Misstear, B., Daly, G., Johnston, P., Lee, M., Cooney, P. and Hickey, C. (2011). National Groundwater Recharge Map for Ireland. Geological Survey Ireland and Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. • McCabe, A.M (2008). Glacial Geology and Geomorphology: The Landscapes of Ireland Dunedin Academic Press, Edinburgh. • Murphy, O. (2012) County Louth Groundwater Protection Scheme. Report to Louth County Council. Geological Survey of Ireland. • NPWS map viewer. http://webgis.npws.ie/npwsviewer/ • Ó'Riain, G. (2004). Water Dependent Ecosystems and Subtypes Draft Report. WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG). • Robinson, K.W. (1973). A Resistivity Survey on the Cooley Peninsula Co. Louth for the Hydrogeology section. Unpublished MSc. Thesis, Trinity College Dublin. • Teillard., B. (2006). Results of Geophysical Investigation Carried out at Loughanmore and Riverstown, Cooley Peninsula, Couth Louth. Report by BMA GeoServices for Louth County Council. • Walsh S. (2012). A Summary of Climate Averages 1981-2010 for Ireland, Climatological Note No.14, Met Éireann, Dublin. • Wright G.R., Aldwell C.R., Daly, D. and Daly, E.P. (1982). Groundwater resources in the Republic of Ireland, vol 6. In: European community's atlas of groundwater resources, SDG, Hannover, Germany.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations and assumptions based on the information sources described above and established hydrogeological formulae. Figures 1, 2 and 3 are used for illustrative purposes only.

Ballymascanlan Sand and Gravel Aquifer



Legend

- Cross Section
- Sand and Gravel Aquifer
- Sand and Gravel Extent

Figure 1. Ballymascanlan Sand and Gravel Aquifer extent with cross section location.

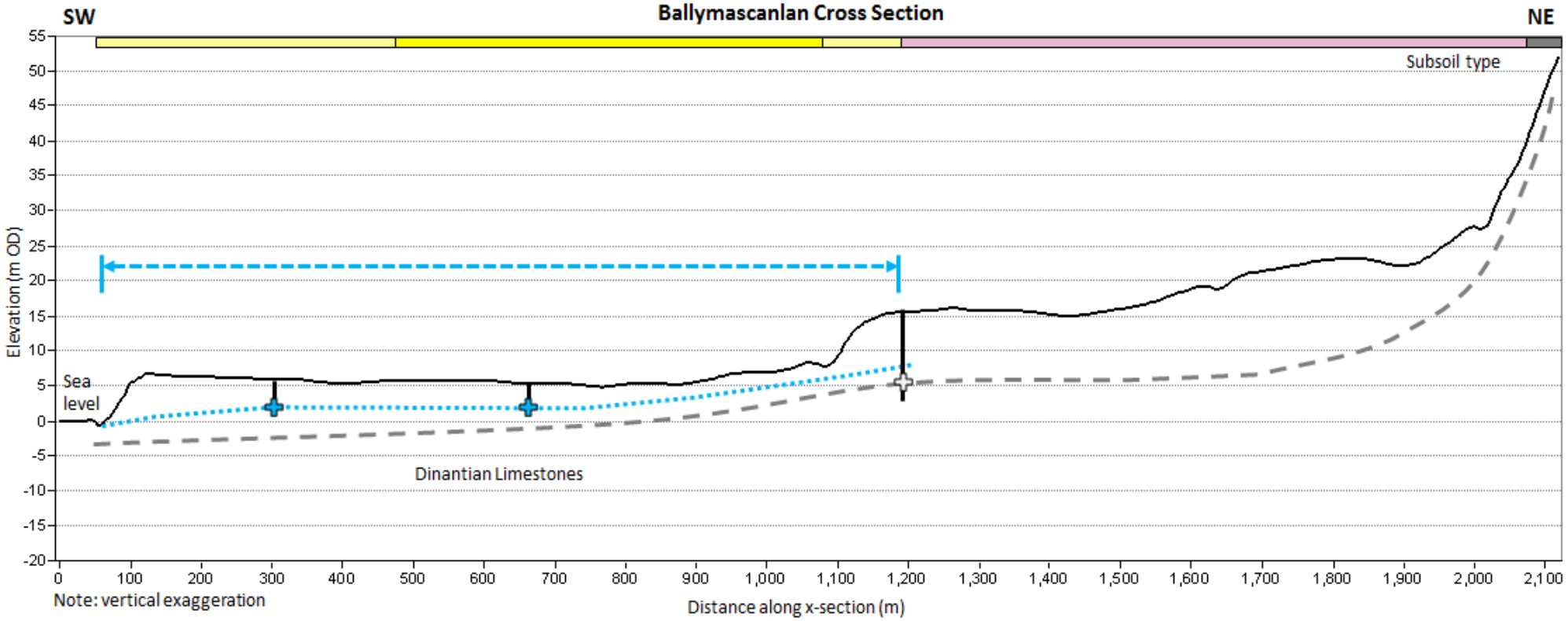


Figure 2. Cross section through the Ballymascanlan Sand and Gravel Aquifer body.

Ballymascanlan Sand and Gravel Aquifer Vulnerability

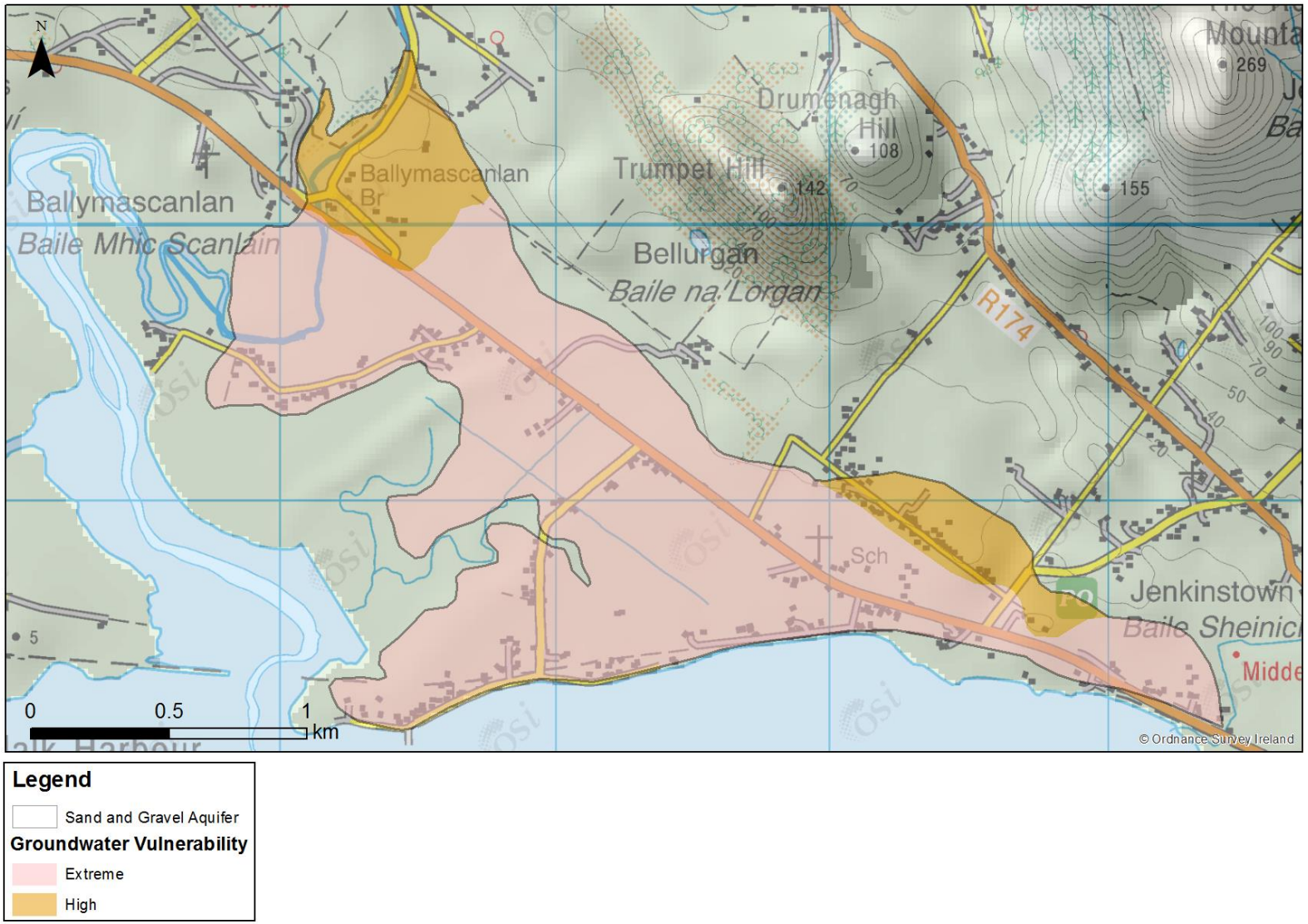


Figure 3. Groundwater vulnerability across the Ballymascanlan Sand and Gravel Aquifer.