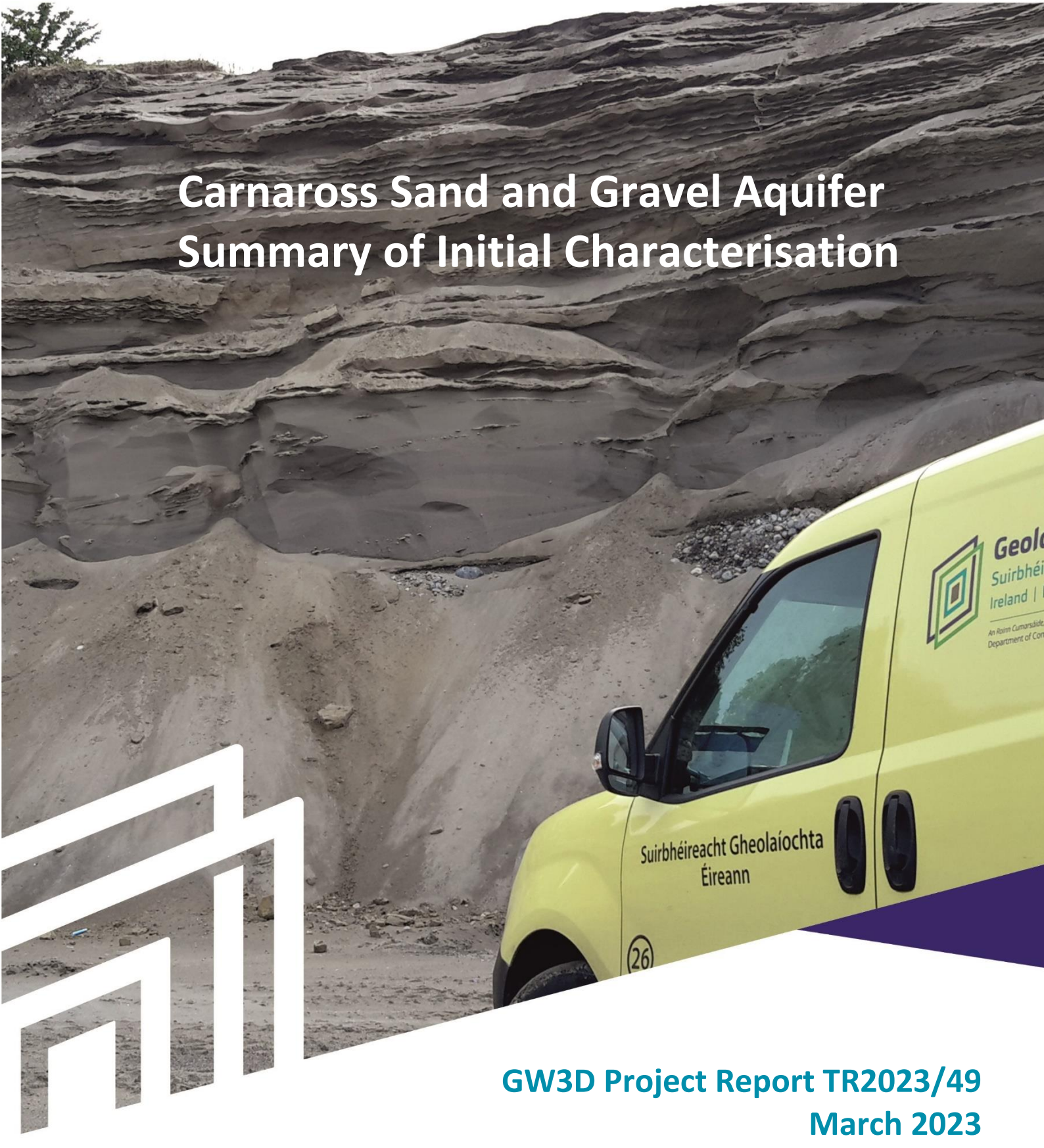
Rialtas na hÉireann
Government of Ireland

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann



Carnaross Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/49
March 2023

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

Carnaross 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

Carnaross Sand and Gravel Aquifer Description March 2023

Carnaross Sand and Gravel Aquifer: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
07 – Boyne Meath County Council Cavan County Council	**Rivers:** River Blackwater, Pottlereagh River, Killyconny River, Balgree River, Killaconin River **Streams:** Several unnamed streams **Lakes:** Several small, unnamed ponds	River Boyne and River Blackwater SAC River Boyne and River Blackwater SPA	5.86

Topography	The Carnaross sand and gravel aquifer is situated largely in County Meath, along the valley of the River Blackwater, with a small portion of it's area in southernmost County Cavan. The aquifer body rests at elevations between 75 m and 95 m AOD, northwest of Drumbaragh in County Meath. The valley incises into elevated, bedrock cored ridges which are at the southwest and northeast of the valley lowland (Figure 1). The general topography of the area of the sand and gravel body is of an intensely hummocky area, with numerous pronounced hummocks and deep hollows of up to 15 m amplitude. The landscape to the north is dominated by drumlins of much higher amplitude again.	
Geology and Aquifers	**Aquifer categories**	Based on its areal extent, inferred thickness, saturated thickness, groundwater throughput and position in the landscape the deposit is classified as **Locally Important Sand and Gravel Aquifer (Lg)** (DELG/EPA/GSI, 1999; GSI, 2017). There are 23 geotechnical data points available from within the sand and gravel body. The aquifer exceeds the groundwater throughput threshold of 1,000 m^3/d, with rejected recharge also contributing significantly to the throughput.
	Main aquifer lithologies	Hummocky, glaciofluvial sand and gravel deposits derived chiefly from Lower Palaeozoic sandstones and shales (GLPSsS), with small pockets of esker sands and gravels derived from rocks of acidic reaction (AcEsk).
	Key structures	The key depositional structures noted in the body are thickly bedded sand and gravel sheets. Cross beds and stacked planar beds record outwash processes in a wide meltwater river (Meehan, 1998). Collapse structures have been interpreted as illustrating the presence of buried ice during deposition, which also ties in with the abundance of deep kettle holes throughout the sand and gravel swathe (Meehan, 1998).
	Key properties	Sufficiently deep deposits of saturated sand and gravel are expected to exist along parts of the River Blackwater. Historically, depths of 15 m were exposed in Hartons Pit (Meehan, 1998). It is anticipated that the properties of the deposits are suitable to allow sufficient groundwater flow to be characterised as a locally important aquifer **(Lg)**. There are a number of particle size analysis results from within the aquifer area, where fines range from 2% to 8% in Woodpole and Castlekeeran Townlands (GSI, 2023). Sand and gravel aquifers generally consist of unconsolidated coarse-grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).
	Thickness	Subsoil thicknesses are considered to vary greatly throughout the area of the aquifer body. Borehole data from within the body shows between 3.2 m and 14.85 m depth of subsoils before bedrock was met (Northwest Hoist, 2003, see boreholes on Figure 2). The greatest depths are seen through the central portion of the aquifer body, along the course of the river.
Overlying Strata	**Lithologies**	Approximately 17% of the aquifer is overlain with cutover raised peat, lake sediments and/or alluvial deposits, with sand and gravel assumed beneath.
	Thickness	The alluvial deposits have a thickness of between 1.5 m to 3.2m in Derver Townland (Northwest Hoist, 2003). The cutover raised peat, lake sediments and the remainder of the alluvium are inferred to be less than 3 m thick.
	% area aquifer near surface	Approximately 83% of the sand and gravel aquifer is at the surface, with the remainder underneath the cutover raised peat, lake sediments and/or alluvial deposits. Tunnel fill esker sand and gravel deposits cover less than 1% of the area of the aquifer body, and are found at the southern end of the aquifer.

	Vulnerability	The groundwater vulnerability of the sand and gravel is 'Extreme' where the water table is inferred to be < 3 m from the surface, this accounts for 43% of the aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (57% of the area, Figure 3).
Recharge	**Main recharge mechanisms**	Diffuse recharge occurs *via* rainfall percolating through the unsaturated sands and gravels. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table. Rejected recharge from the surrounding land of higher elevation, which is underlain by a Poor Bedrock Aquifer **(Pl)**, has also been included in calculations of throughput.
	Est. recharge rates	The annual average rainfall for the aquifer is 984 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge rate of 387 mm/yr. The minimum direct groundwater throughput in the aquifer itself is consequently estimated to be 2,690 m^3/d, which increases to a minimum throughput of 6,433 m^3/d when rejected recharge is included.
Discharge	**Large springs and large known abstractions (m^3/d)**	There are no known large springs or abstractions from this aquifer body, however moderate-sized abstractions by the quarrying industry are known in the northern end of the aquifer.
	Main discharge mechanisms	Groundwater is inferred to discharge *via* springs, at for example Toberboyoga Spring in Drumbaragh Townland, and also into the streams and rivers which flow through the aquifer.
	Hydrochemical Signature	There are no data readily available to assess the hydrochemistry of this aquifer, but given the surrounding subsoils and bedrock geology, the groundwater is likely to have a calcium-bicarbonate signature.
Groundwater Flow Paths		The length of flow paths depend on the extent of the sand and gravel deposit. In general, locally important sand and gravel aquifers are expected to have relatively short flow paths *i.e*. up to several hundred metres. Given the geomorphology of the Carnaross sand and gravel body, and the pattern of streams within, this is also likely to be the case here.
Groundwater & Surface water interactions		Groundwater discharges *via* lowlying springs that flow into the River Blackwater and its tributaries, as seen on the OSI 6 inch raster map (1830s – 1930s), at for example Balgree, Woodpole and Drumbaragh Townlands. Groundwater is also expected to discharge to streams and directly to the river itself.
Conceptual model		• The Carnaross sand and gravel aquifer is situated along the valley of the River Blackwater, between Drumbaragh and the Cavan County boundary, at elevations between 75 m and 95 m AOD. • The valley incises into elevated, bedrock cored ridges which bound the southwestern and northeastern sides of the valley. • Borehole data from within the body shows between 3.2 m and 14.85 m depth of subsoils above bedrock (Northwest Hoist, 2003). • There are a number of particle size analysis results from samples taken from sediments within the aquifer, where fines range from 2% to 8% (GSI, 2019). • Approximately 43% of the aquifer area is inferred to have greater than 5 m of saturated sands and gravels, with the remainder inferred as having less than this. • The key depositional structures noted in the body are thickly bedded sand and gravel sheets (Meehan, 1998). • Diffuse groundwater recharge is estimated to be approx. 387 mm/yr. • An area of 3.34 $km^2$of rejected recharge from the surrounding Poor Bedrock Aquifer **(Pl)** has been included in throughput calculations. • The minimum direct groundwater throughput in the aquifer itself is consequently estimated to be 2,690 m^3/d, which increases to a minimum throughput of 6,433 m^3/d when rejected recharge is included.

Carnaross Sand and Gravel Aquifer Description March 2023

Attachments	Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability	
Instrumentation	**Hydrometric gauges:** **National Water Monitoring Stations;** **Rivers:** **Groundwater:**	07011 (Daly's Bridge) RS07B011000 (Daly's Bridge) RS07B011080 (Blackwater) None present
Information Sources	• DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey 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 (2023). Geological Survey Ireland, Internal groundwater databases. • Meehan, R. T. (1998). The Quaternary Geology and last glaciation and deglaciation of northwest Meath and adjacent parts of Westmeath and Cavan. Unpublished PhD Thesis, National University of Ireland, Dublin, 504pp. • Northwest Holst (2003). Report on a Ground Investigation at N3 Navan to North of Kells, on behalf of Arup Consulting Engineers for Meath County Council. • NPWS viewer. http://webgis.npws.ie/npwsviewer/ • Ó'Súilleabháin, C. (2000). Assessing the boundary between high and moderately permeable subsoils. Unpublished MSc., University of Dublin. Department of Civil, Structural and Environmental Engineering, Trinity College Dublin • Walsh, S. (2012). A Summary of Climate Averages 1981-2010 for Ireland, Climatological Note No.14, Met Éireann, Dublin.	
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.	

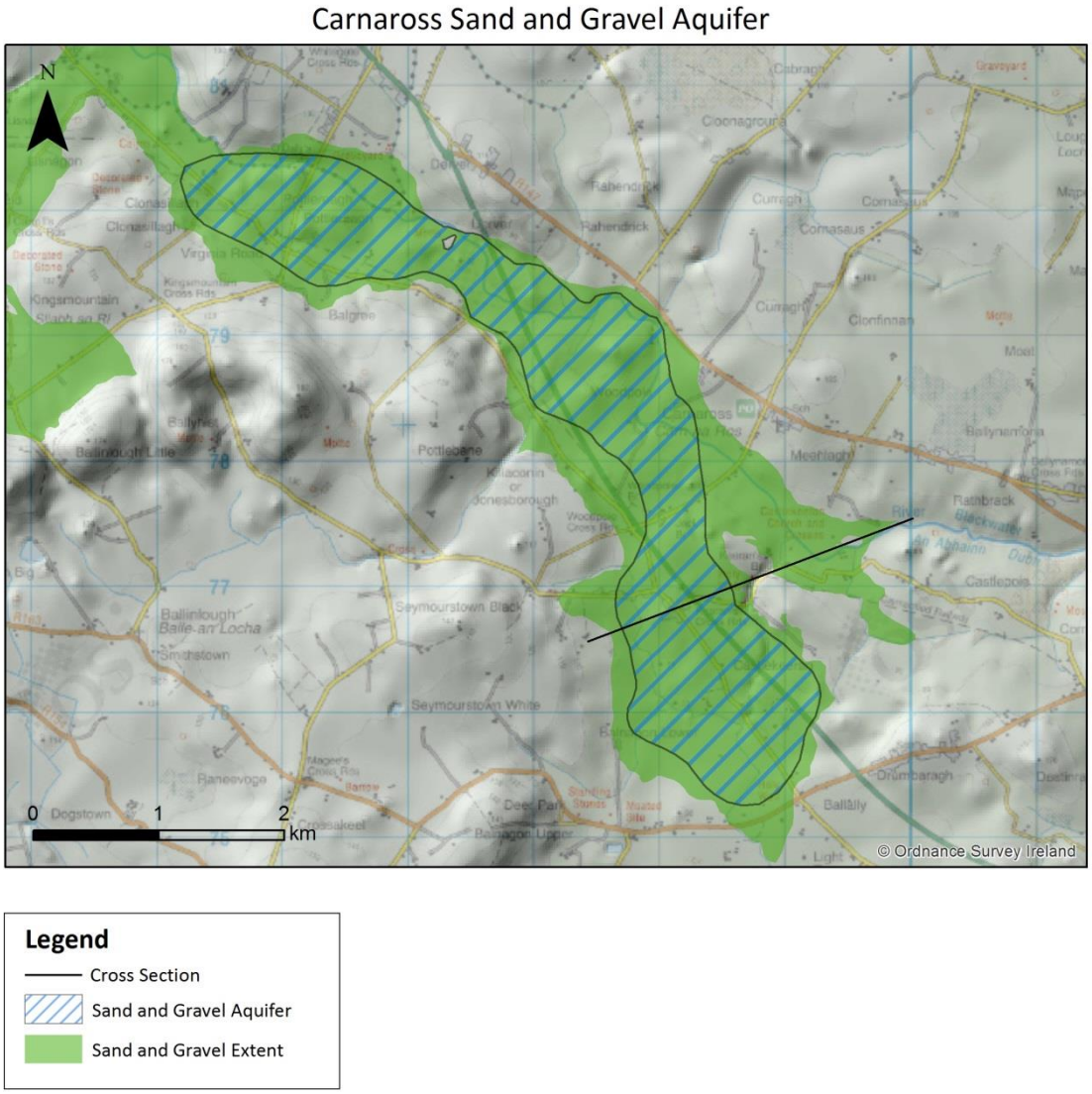


Figure 1: Carnaross Sand and Gravel Aquifer extent with cross section location.

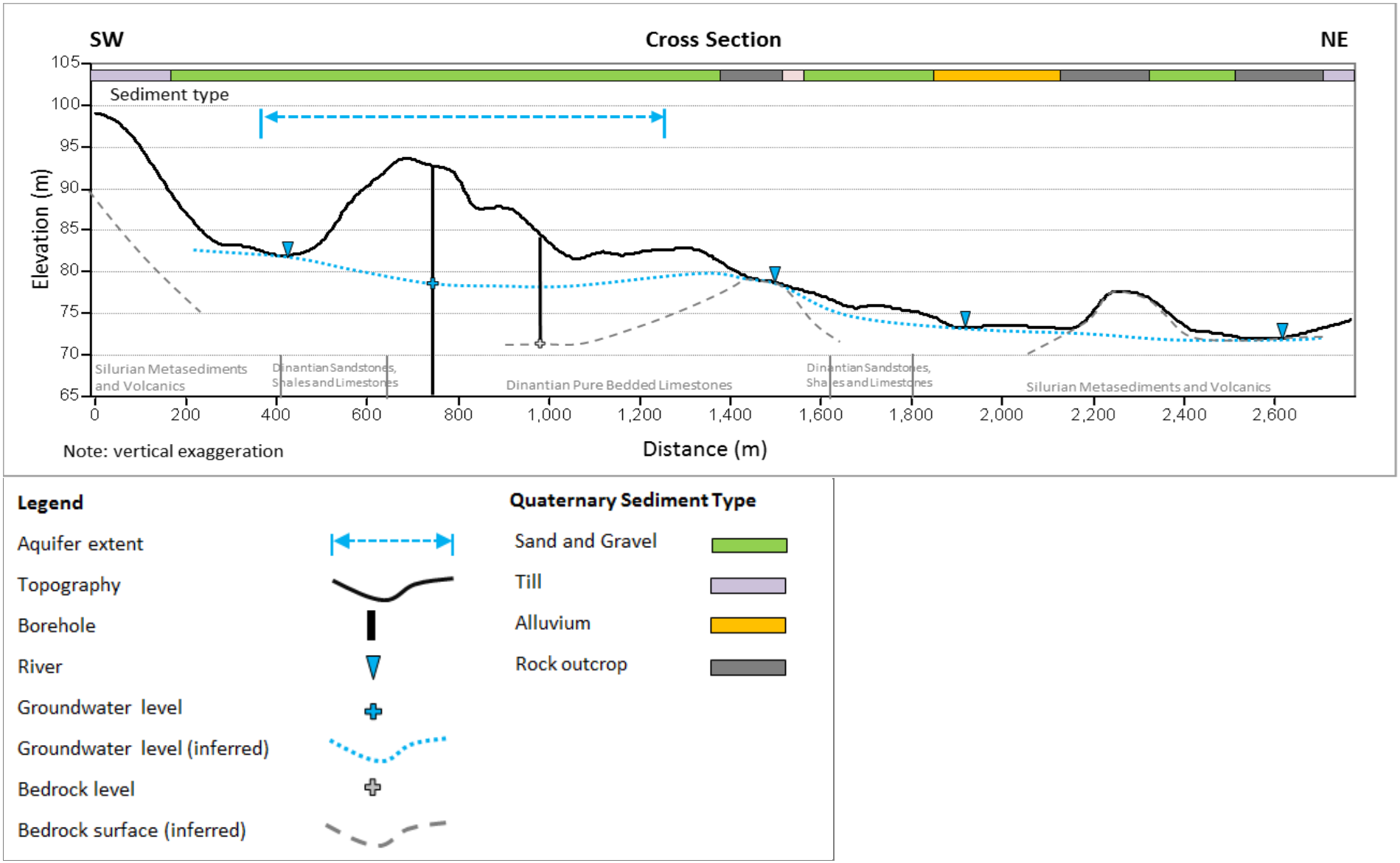


Figure 2: Cross section through the Carnaross Sand and Gravel Aquifer body.

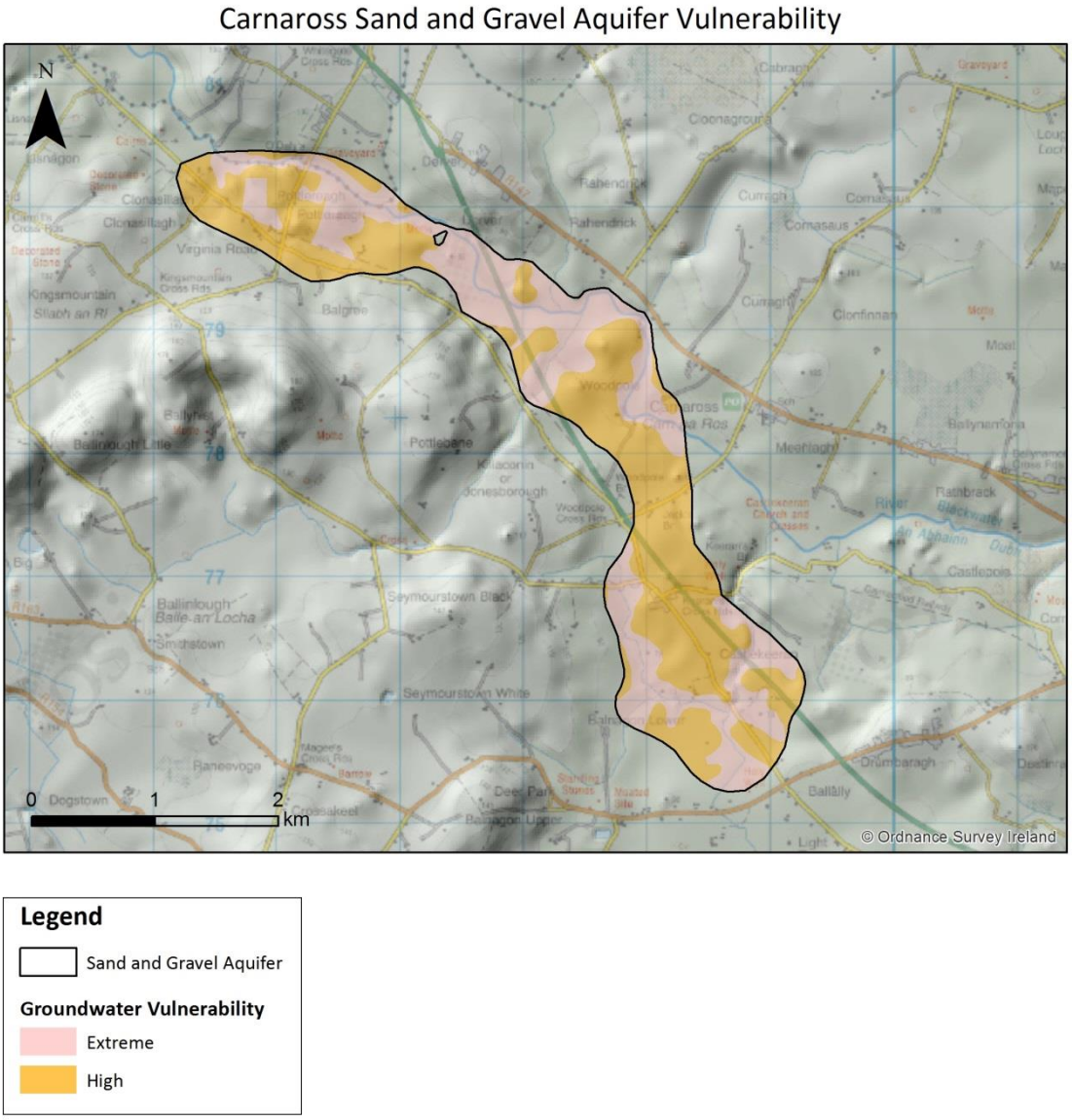


Figure 3: Groundwater vulnerability across the Carnaross Sand and Gravel Aquifer.