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Geological Survey
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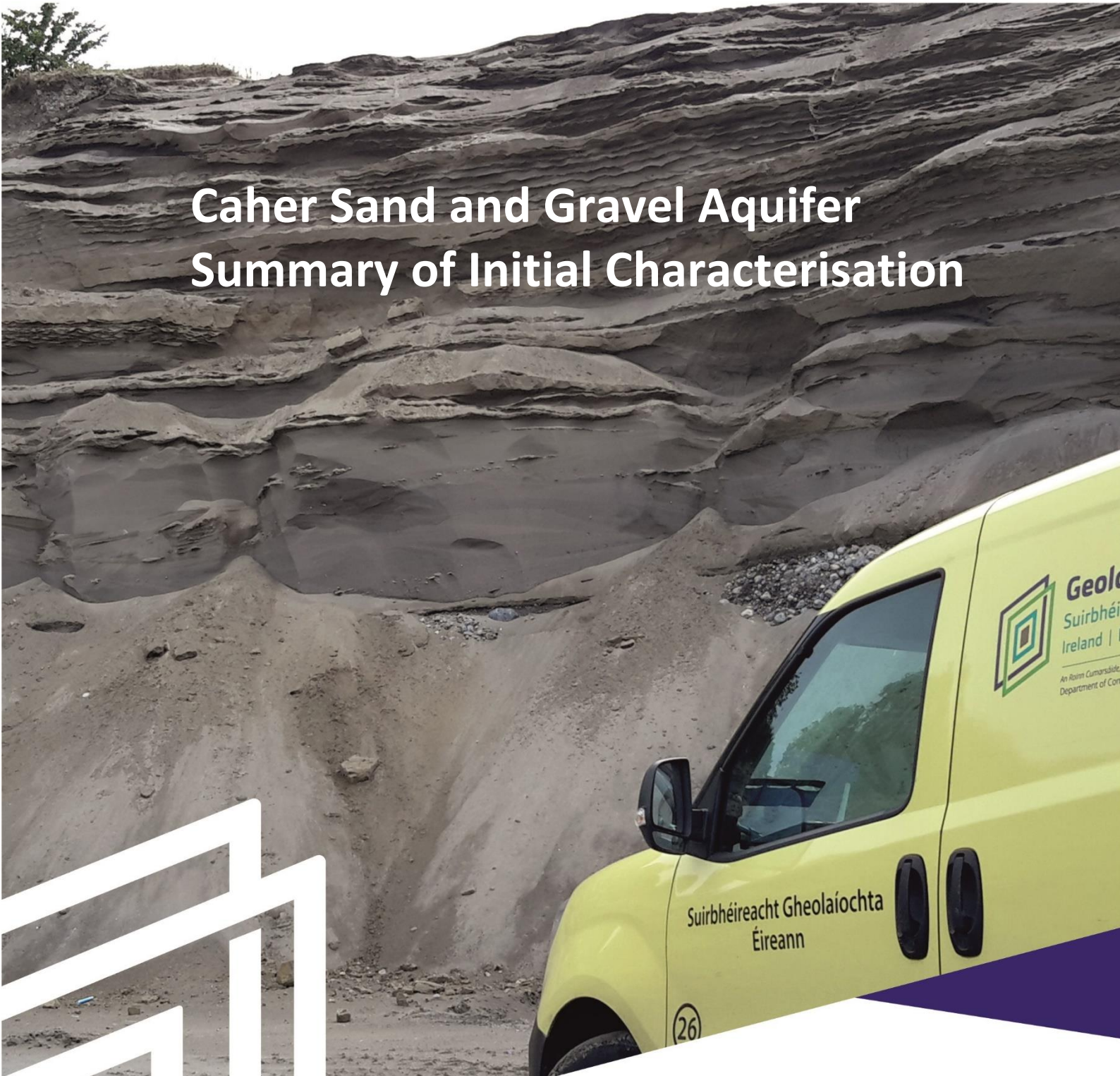
Caher Sand and Gravel Aquifer
Summary of Initial Characterisation



GW3D Project Report TR2023/23
February 2023

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

Caher Sand and Gravel Aquifer Description February 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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Caher Sand and Gravel Aquifer: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
16 – Suir Tipperary County Council	**Rivers:** River Ara, River Aherlow, River Suir **Streams:** Several unnamed streams. **Lakes:** Several unnamed ponds	Lower River Suir SAC	10.9

Topography	The Caher sand and gravel deposit covers an area of 10.9 km^2 to the east of the Glen of Aherlow and northwest of Caher Town. The River Ara flows through the most northwestern portion of the aquifer and then meets the River Aherlow, which then joins the River Suir. The body comprises a wide outwash deposit associated with the deglacial River Suir and a glacial lake. The elevation across the aquifer area range between 40 m AOD and 95 m AOD. Tills at higher elevations surround the sand and gravel deposits (GSI, 2023b), and to the south the steep slopes of Slieveanard and the northeastern end of the Galtee Mountains are seen, from which a number of streams flow and then join the main rivers within the sand and gravel body.	
Geology and Aquifers	**Aquifer categories**	This sand and gravel deposit includes the glaciofluvial terraces of the Aherlow, Ara and Suir river systems and a portion of the Ballydrehid Delta (GSI, 2023b). There are limited water level and subsoil logging data available from within the area of this sand and gravel deposit. The saturated thickness of the subsoils is unconfirmed over much of the area, but based on the morphology of the deposits it is considered that a large portion of the sand and gravel is greater than 10 m in thickness and has at least a 5 m saturated thickness. Based on likely geometry and extent this deposit has been categorised as a **Locally Important Sand and Gravel Aquifer (Lg)** (DELG/EPA/GSI, 1999; GSI, 2017).
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from Devonian sandstones (GDSs), and alluvium (A) (GSI, 2023b).
	Key structures	The Locally Important bedrock aquifer beneath the Caher sands and gravels has a high degree of rejected recharge associated with it. Therefore much of the groundwater is expected to be retained within the sand and gravel aquifer, which floors the confluence of a number of wide valleys. The subsoils overlie bedrock of Dinantian Upper Impure Limestones in the northwest, and Dinantian Lower Impure Limestones to the south and east, all of which are Locally Important Aquifers **(Ll)**. Along the base Slieveanard are Devonian Kiltorcan-type Sandstones which are a Regionally Important Aquifer **(Rf)** (GSI, 2006).
	Key properties	There are no measured, empirical hydrogeological data available for his aquifer but mapping within gravel pits in the area indicates that coarse material predominates. It is therefore expected that permeability and storativity are high.
	Thickness	Quarry exposures at the Ballydrehid Delta show that sand and gravel is known to reach up at least 20 m in thickness.
Overlying Strata	**Lithologies**	Alluvium and/or lake sediments have been deposited above the sands and gravels either along the courses of the main three rivers, or in some localised hollows (GSI, 2023b).
	Thickness	Where present, the overlying alluvial and/or lake sediments are expected to be less than 3 m thick.
	% area aquifer near surface	Approximately 57% of the sand and gravel body has sands and gravels just below the surface.
	Vulnerability	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 m bgl where groundwater has been exposed at the base of the gravel pit in Ballydrehid to 4 m bgl in Ballygorteen in the northwest. In areas where the water table is less than three metres below ground level the aquifer vulnerability is 'Extreme' and where it is greater than three metres below ground level the aquifer vulnerability is 'High'.

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Recharge	**Main recharge mechanisms**	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, particularly those at the southwest, will increase the amount of available recharge to this aquifer. Depending on the position of the water table within the aquifer, and the river stage, it is also likely that stream water will also recharge the aquifer.
	Est. recharge rates	The rainfall in the area of the Caher sand and gravel is 1,106 mm (Walsh, 2012), and the estimated minimum recharge rate to the aquifer from direct recharge is 430 mm/yr. The minimum direct groundwater throughput in the aquifer is consequently estimated to be 2,444 m^3/d, but with rejected recharge the throughput increases to an approximate potential 18,500 m^3/d.
Discharge	**Large springs and large known abstractions (m^3/d)**	There are no known large springs or abstractions from this aquifer body.
	Main discharge mechanisms	There is likely to be groundwater seepage from the extremities of the gravel body at the lower elevations, which may appear as springs or seeps. Where the water table is sufficiently close to the surface such that the riverbed elevation is lower than it is, the aquifer will contribute groundwater to the baseflow of the Ara, Aherlow and Suir Rivers.
	Hydrochemical Signature	There are no data readily available to assess the hydrochemistry of this aquifer.
Groundwater Flow Paths		The length of flowpaths in sand and gravel aquifers depends on the size and extent of the deposit. In general, locally important sand and gravel aquifers are expected to have relatively short flow paths *i.e.* up to a few hundred metres. This is likely to be the case at Caher, given the geometry, topography and surface hydrology of the aquifer body.
Groundwater & Surface water interactions		Hydraulic connection between the groundwater and surface water is expected to be high due to the interpreted general shallow positioning of the water table, and the high permeability of the sand and gravel aquifer.
Conceptual model		• The sand and gravel aquifer is comprised of glaciofluvial terraces of the Aherlow, Ara and Suir river systems and a portion of the Ballydrehid Delta (GSI, 2023b). These are all mapped as being in hydraulic connectivity. • Subsoil logging and water level data are scarce in this area. The aquifer boundaries are for the most part delineated based on the mapped extent of sand and gravel deposits on the Quaternary sediments map, and subsequent review during field mapping (GSI, 2023b). • The main underlying bedrock aquifers are Locally Important **(Ll)** and therefore a high proportion of groundwater is expected to be retained in the sand and gravel subsoil. • Diffuse recharge occurs *via* rainfall percolating through the unsaturated sands and gravels. Minimum recharge to the aquifer from direct recharge is estimated at 430 mm/yr. • The length of the flow paths is expected to be in the order of several hundred metres. • Groundwater discharges to the rivers which flow over the aquifer and *via* seeps and springs. • The minimum direct groundwater throughput in the aquifer is consequently estimated to be 2,444 m^3/d, but with rejected recharge the throughput increases to an approximate potential 18,500 m^3/d.

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Attachments	Figure 1: Location and extent Figure 2: Cross sections Figure 3: Groundwater vulnerability	
Instrumentation	**Hydrometric gauges:**	16007 KILLARDRY (Active Recorder)
	National Water Monitoring Stations;	
	River:	RS16A030600 Ara Br, 2.8 km d/s Bansha RS16A030700 Ara Bridge, u/s Aherlow River Confluence RS16A030750 0.6km d/s Ara Br (Lisheen) RS16A010800 Cappa Old Br RS16A010900 Killardry Br
	Groundwater:	None present
Information Sources	• DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. • EPA (2023). Environmental Protection Agency 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 internal groundwater database. • GSI (2023b). Geological Survey Ireland Map Viewer. https://www.gsi.ie/en-ie/data-and-maps • Hunter-Williams, N.H., Misstear, B.D.R., Daly, D. and Lee, M. (2011). Development of a national groundwater recharge map for the Republic of Ireland. Quarterly Journal of Engineering Geology and Hydrogeology, 46(4):493-506. • NPWS (2023). National Parks and Wildlife Service Map Viewer. http://webgis.npws.ie/npwsviewer • Ó'Suilleabháin, 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 calculations 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.	

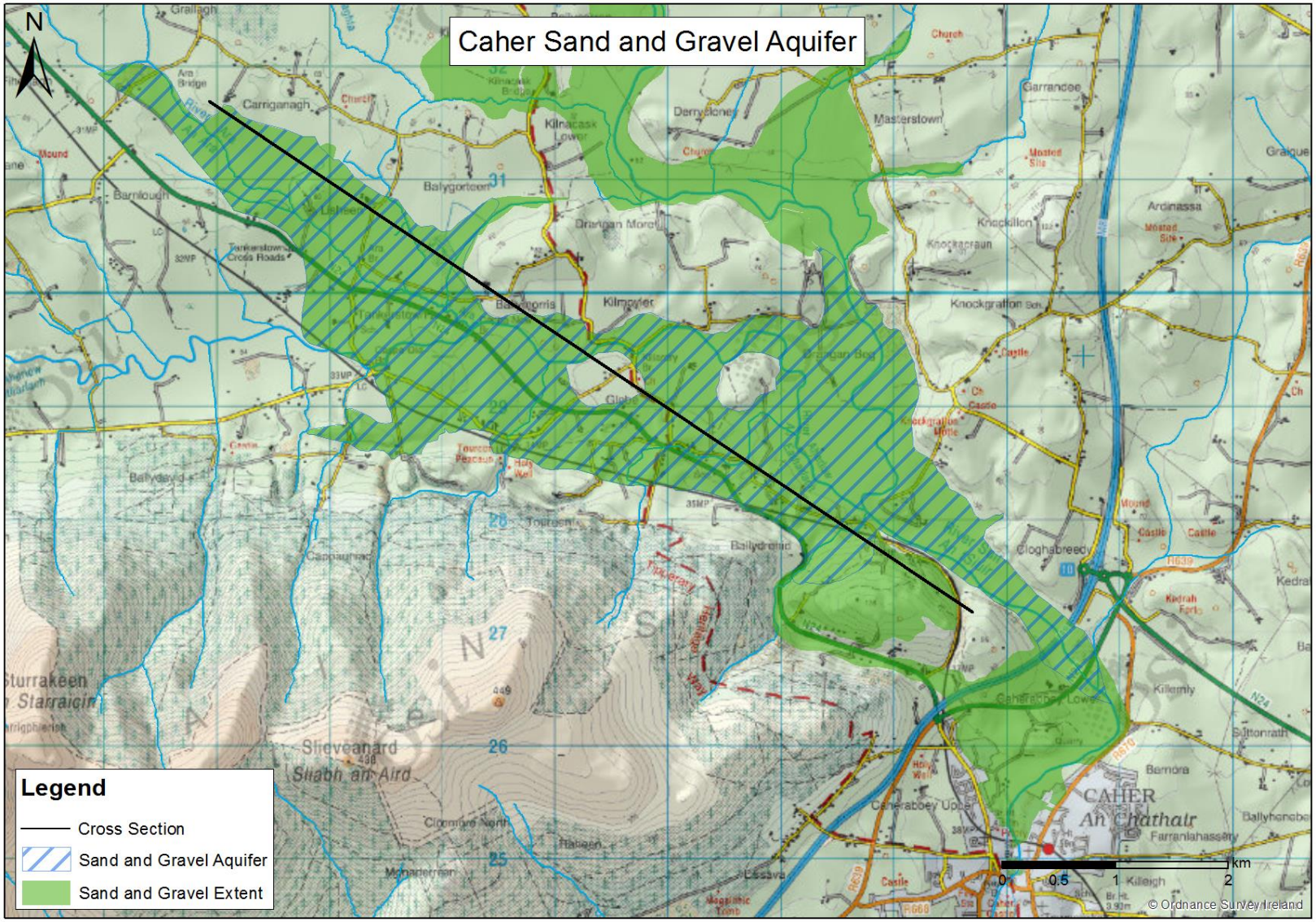
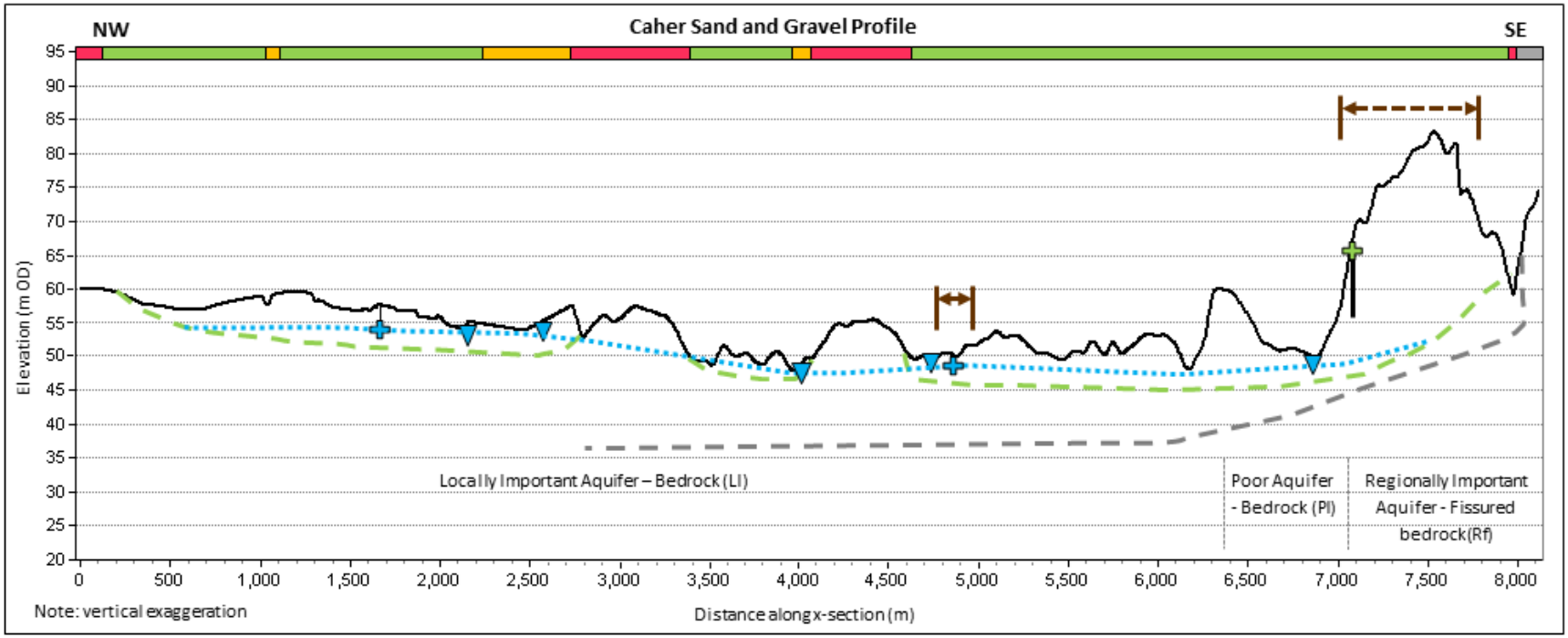


Figure 1: Caher Sand and Gravel Aquifer extent with cross section location.



Elevation		Presumed Groundwater level	
Groundwater level		Minimum expected depth of S&G	
Top of S&G		Top of bedrock	
Borehole/Trial Pit		Till	
Aquifer Extent		Alluvium	
Quarry		Rock outcrop	
River		Sand and gravel	

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

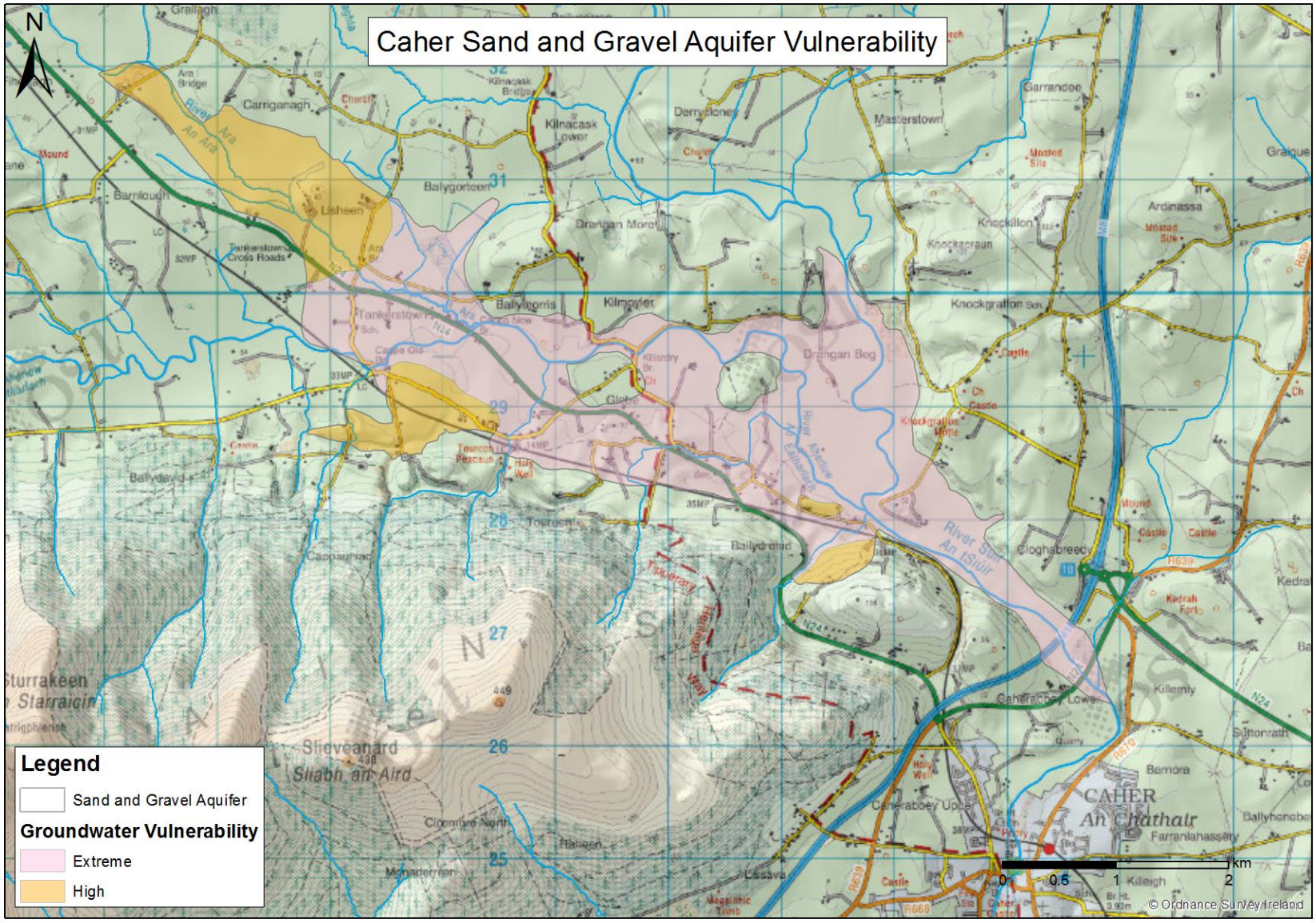


Figure 3: Groundwater vulnerability across the Caher Sand and Gravel Aquifer.