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Castledermot Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/27
March 2023

Castledermot 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)
14 – Barrow, Kildare County Council		Rivers: Lerr River, Saint Johns River, Graney River, Knockaphuca River, Davidstown River Streams: Several unnamed streams Lakes: None	River Barrow and River Nore SAC	3.78
Topography	This sand and gravel aquifer is located immediately east and southeast of the town of Castledermot, in south County Kildare, and comprises a north-south oriented belt which flanks the eastern side of the Lerr River (Figure 1). Two extensions of this body, to both the west and the east, occur at the southern end of the feature. The sand and gravel body rests at elevations generally between 80 m and 113 m AOD, but elevations are at their lowest on the western side, at 73 m AOD, where the Lerr River exits the body. There are a number of small sand and gravel pits within the southern portion of the aquifer, which have altered the natural, local topography slightly. The aquifer is surrounded by high, bedrock-cored ridges on its western and eastern sides, which range in elevation from 91 m to 168 m AOD.			
Geology and Aquifers	Aquifer categories	The sand and gravel aquifer occupies an area of just under 4 km ² , and there were data available from seven borehole records from within the area of the body. The aquifer exceeds the groundwater throughput threshold of 1,000 m ³ /d. 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).		
	Main aquifer lithologies	Hummocky, glaciofluvial sands and gravels derived chiefly from limestones (GLs).		
	Key structures	The exposures recorded in the southern half of the body during fieldwork showed generally thickly bedded sheets of sands and gravels.		
	Key properties	There are 10 water level data points available from within the area of the sand and gravel body which have allowed for inferences to be made on water levels throughout its extent. Using these data, along with the river level information, it has been inferred that approx. 45% of the area of the aquifer has a depth of saturated sands and gravels greater than 5 m. In general, sand and gravel aquifers consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).		
	Thickness	The exact thickness of sands and gravels in this aquifer are unknown, however there are three boreholes in the body which have subsoil thicknesses of at least 8 m, in Abbeyland, Saint John's and Castledermot Townlands (GSI, 2023a, b). The borehole at Castledermot has greater than 10.5 m depth of subsoil, and 6 m of this depth is interpreted to be saturated, based on the borehole log (GSI, 2023b). In general, thicknesses of sorted sands and gravels are interpreted to be greater than 10 m throughout the majority of the aquifer area.		
Overlying Strata	Lithologies	Approximately 16% of the aquifer is overlain with alluvial deposits and cutover raised peat, with sands and gravels assumed beneath.		
	Thickness	The thickness of the alluvium has been measured at 2.8 m at one point locality at Abbeyland Townland (GSI, 2023b); here, and in the remainder of the alluvium and across the entire area of cutover raised peat, thicknesses are inferred to be less than 3 m.		
	% area aquifer near surface	Approximately 84% of the sand and gravel aquifer is at the surface, with the remainder underneath the alluvial deposits and cutover raised peat.		
	Vulnerability	The groundwater vulnerability of the sands and gravels is 'Extreme' where the water table is inferred to be < 3 m from the surface, this accounts for 54% of the area of the aquifer body. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (46% of the area, Figure 3).		



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Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> 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 Locally Important Bedrock Aquifer (LI), which is at higher elevations, has also been included in throughput calculations.
	Est. recharge rates	The annual average rainfall for the aquifer is 825 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 265 mm/yr. The minimum direct groundwater throughput in the aquifer is consequently estimated to be 1,249 m ³ /d, which increases to 1,368 m ³ /d when rejected recharge from the surrounding, higher ground is included.
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	Groundwater is expected to discharge into the rivers that flow through the aquifer. Some small lowlying springs are also seen on the OSI 6 inch raster map (1830s – 1930s) at for example, Davidstown and Graney West Townlands.
	Hydrochemical Signature	There are no data readily available to assess the hydrochemistry of this aquifer, but the groundwater is likely to have a calcium bicarbonate (CaHCO ₃) 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>i.e.</i> up to several hundred metres.
Groundwater & Surface water interactions		Groundwater has been seen to discharge <i>via</i> lowlying springs; therefore connectivity between groundwater and surface water is expected to be high.
Conceptual model	- The body comprises a north-south oriented area at elevations generally between 80 m and 113 m AOD. The aquifer also contains two extensions of sands and gravels at lower elevations to the west of the main ridge, along the Lerr River valley, and to the east, along the Graney River valley. - Depth to bedrock is expected to vary throughout the area of the aquifer, with one borehole in Castledermot having a measured depth of subsoil greater than 10.5 m (GSI, 2023b), and at least 6 m of this depth is interpreted to be saturated, based on the borehole record. - Approximately 45% of the delineated area of the aquifer body is inferred to have a depth of saturated sand and gravel greater than 5 m, with the remainder of the aquifer inferred to have a saturated thickness less than this. - Diffuse recharge <i>via</i> rainfall percolating through the unsaturated sands and gravels is estimated to be 265 mm/yr. - Rejected recharge from a small area of 0.36 km² from the surrounding Locally Important Bedrock Aquifer (LI) contributes some groundwater recharge into the aquifer. - The minimum direct groundwater throughput in the aquifer is estimated to be 1,249 m³/d, which increases to 1,368 m³/d when rejected recharge is included.	
Attachments	Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability	
Instrumentation	Hydrometric gauges: National Water Monitoring Stations; River: Groundwater:	None present RS14L010100 (Lerr) RS14G070300 (Graney) None present



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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/ • Glanville, C. (1994). Report on Quaternary mapping across Sheet 26/33 SE, south County Kildare. Unpublished report for Quaternary Section, GSI. • 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 databases. • GSI (2023b). Geological Survey Ireland, Internal geotechnical borehole databases. • 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.

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Castledermot Sand and Gravel Aquifer

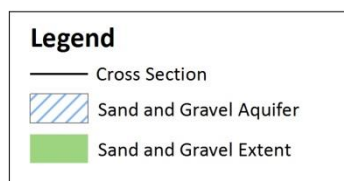
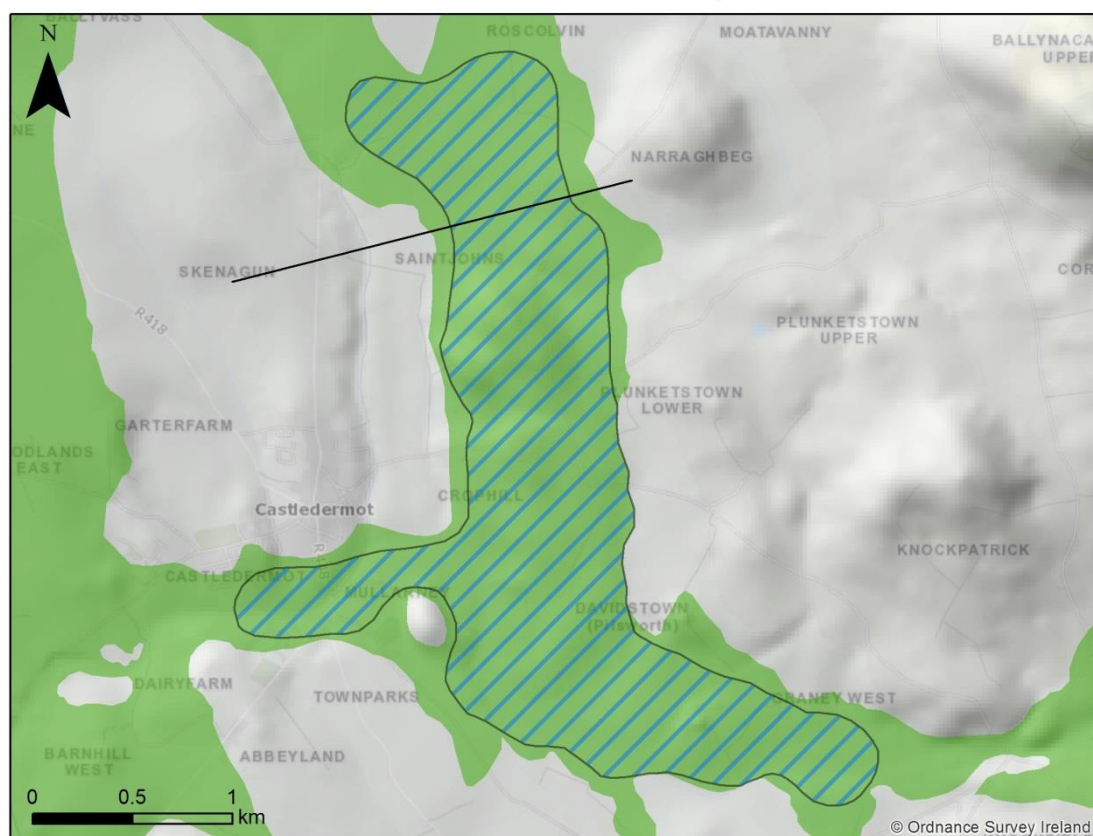


Figure 1: Castledermot Sand and Gravel Aquifer extent with cross section location.

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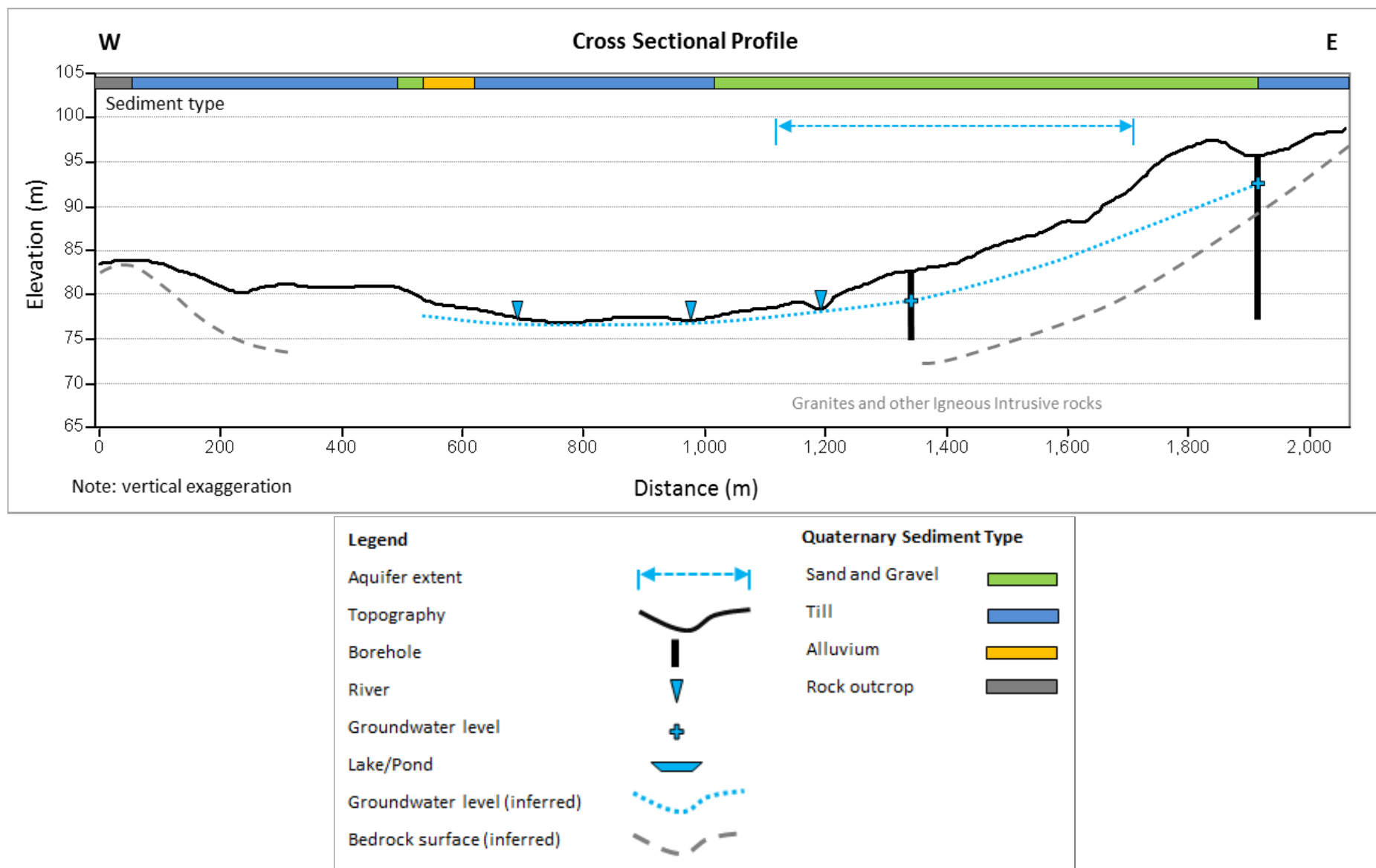


Figure 2: Cross section through the Castledermot Sand and Gravel Aquifer body.



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Castledermot Sand and Gravel Aquifer Vulnerability

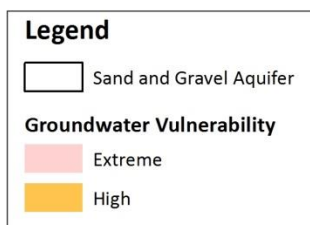
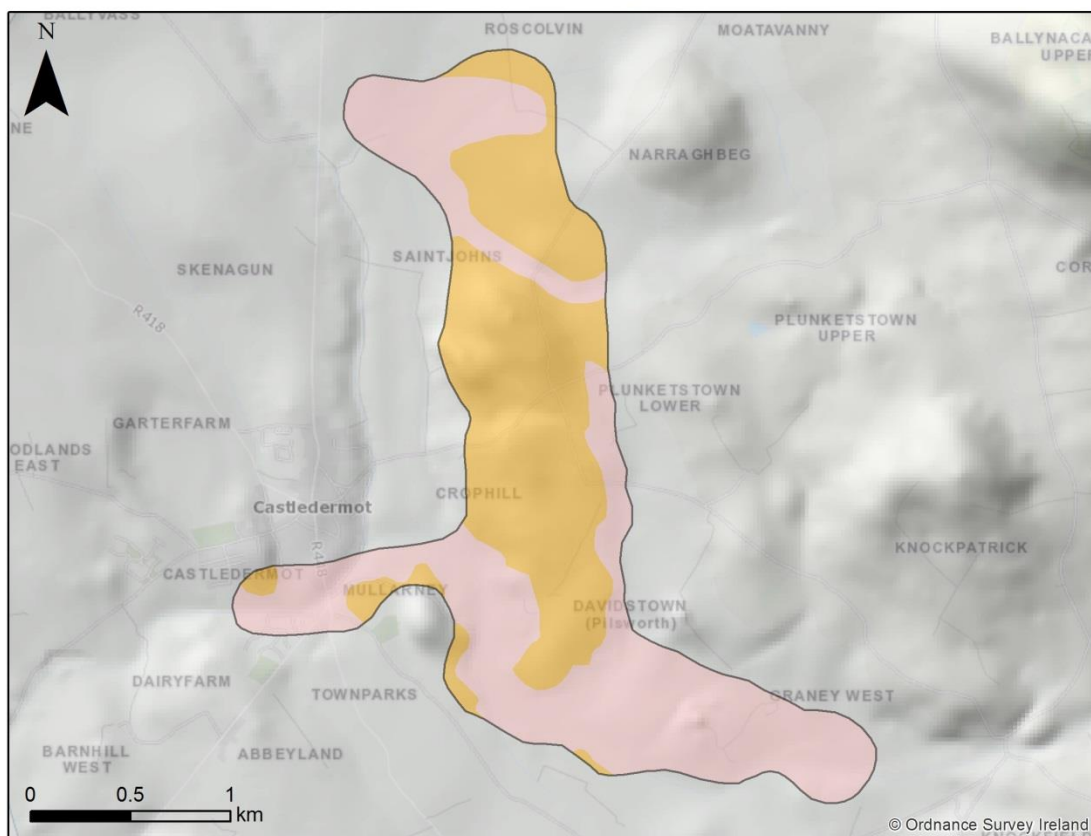


Figure 3: Groundwater vulnerability across the Castledermot Sand and Gravel Aquifer.