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Kilkea Sand and Gravel Aquifer Summary of Initial Characterisation

GW3D Project Report TR2023/33
March 2023

Kilkea 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: River Greese Streams: None Lakes: None	None	1.28
Topography	This sand and gravel aquifer is located in and around Kilkea Castle Demense, in south County Kildare (Figure 1). The aquifer has a ‘hummocky glaciofluvial sediments’ topography (GSI, 2023a), and is found at elevations between 69 m and 79 m AOD. The River Greese flows through the centre of the sand and gravel body. The surrounding landscape is dominated by Mullaghreelan Hill, which is a bedrock cored ridge that rises to 149 m AOD, 1 km to the southeast of the delineated aquifer.			
Geology and Aquifers	Aquifer categories	There were data available from two borehole records from within the body, and the aquifer exceeds the groundwater throughput threshold of 1,000 m ³ /d due to the inclusion of rejected recharge from the neighbouring, higher elevation Locally Important (LI) and Poor Bedrock Aquifers (PI and Pu). 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), with some alluvium (A).		
	Key structures	Exposure is poor within this sand and gravel body, and no significant sand and gravel sedimentary structures were noted during fieldwork.		
	Key properties	There are two water level data points available from within the sand and gravel aquifer area which have allowed for inferences to be made on water levels throughout the body, and approx. 38% of the area is inferred to have a depth of saturated sands and gravels greater than 5 m. Sand and gravel aquifers generally consist of unconsolidated, coarse-grained material, usually containing less than 8% fines (Ó’Súilleabháin, 2000).		
	Thickness	One of the boreholes in the aquifer suggests 24 m depth of sands and gravels with 18 m depth of this saturated (GSI, 2023b, Figure 2). The thickness of saturated sands and gravels is expected to reduce towards the isolated pocket of bedrock at Mullaghreelan Hill (Figure 1). In general, sediment thicknesses are inferred to be greater than 10 m throughout the remainder of the aquifer area.		
Overlying Strata	Lithologies	Approximately 11% of the aquifer area is overlain with alluvial deposits, with sands and gravels assumed beneath.		
	Thickness	The thickness of the alluvium, where present, is inferred to be less than 3 m thick.		
	% area aquifer near surface	Approximately 89% of the sand and gravel aquifer is at the surface, with the remainder beneath the alluvial deposits.		
	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 23% of the aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as ‘High’ (77% of the area, Figure 3).		
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 (LI), and Poor Bedrock Aquifers (PI and Pu), has also been included in calculations of throughput.		
	Est. recharge rates	The annual average rainfall for the aquifer is 810 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 245 mm/yr. The minimum direct groundwater throughput in the aquifer is estimated to be 323 m ³ /d, which increases to a potential 1,495 m ³ /d when rejected recharge from the surrounding higher ground is included.		



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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 River Greese which flows through the aquifer.	
	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. Given the geomorphology of the body and the pattern of watercourses within it, this would also seem to be the case at Kilkea.	
Groundwater & Surface water interactions		Groundwater is inferred to discharge into the River Greese, therefore connectivity between groundwater and surface water is expected to be high.	
Conceptual model	• The aquifer has a topography of ‘hummocky glaciofluvial sediments’ (GSI, 2023a), at elevations between 69 m and 79 m AOD. • One of the boreholes from within the delineated aquifer area suggests 24 m depth of sands and gravels, with 18 m of this saturated (GSI, 2023b, Figure 2). • Approximately 38% of the aquifer area is inferred to have a depth of saturated sands and gravels greater than 5 m, with the remainder of the aquifer is inferred to have a saturated thickness less than this. • Approximately 11% of the area of the aquifer is overlain with alluvial deposits, with sands and gravels assumed beneath. • Diffuse groundwater recharge across the area of the aquifer body is estimated to be approx. 245 mm/yr. • An area of 1.82 km² of rejected recharge from the surrounding Locally Important (LI), and Poor Bedrock Aquifers (PI and Pu) has been included in throughput calculations. • The minimum direct groundwater throughput in the aquifer is estimated to be 323 m³/d, which increases to a potential 1,495 m³/d when rejected recharge from the surrounding higher ground 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 RS14G040380 (Greese – Bridge East of Kilkea) 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 (2023a). Geological Survey Ireland, Spatial Resources Viewer: Quaternary Geomorphology Map. https://www.gsi.ie/en-ie/data-and-maps/Pages • GSI (2023b). Geological Survey Ireland, Internal groundwater 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		



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Information Sources (contd.)	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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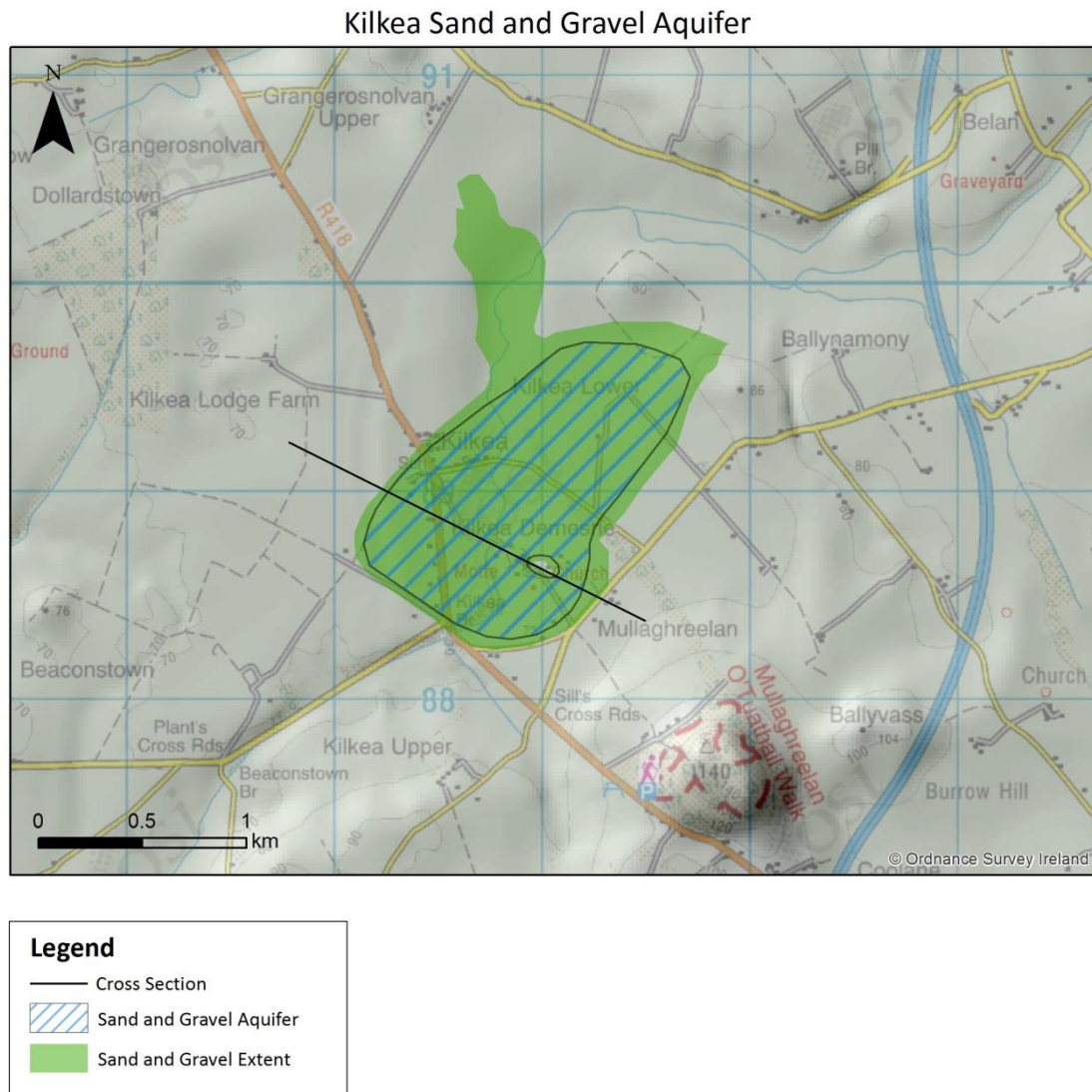


Figure 1: Kilkea Sand and Gravel Aquifer extent with cross section location.

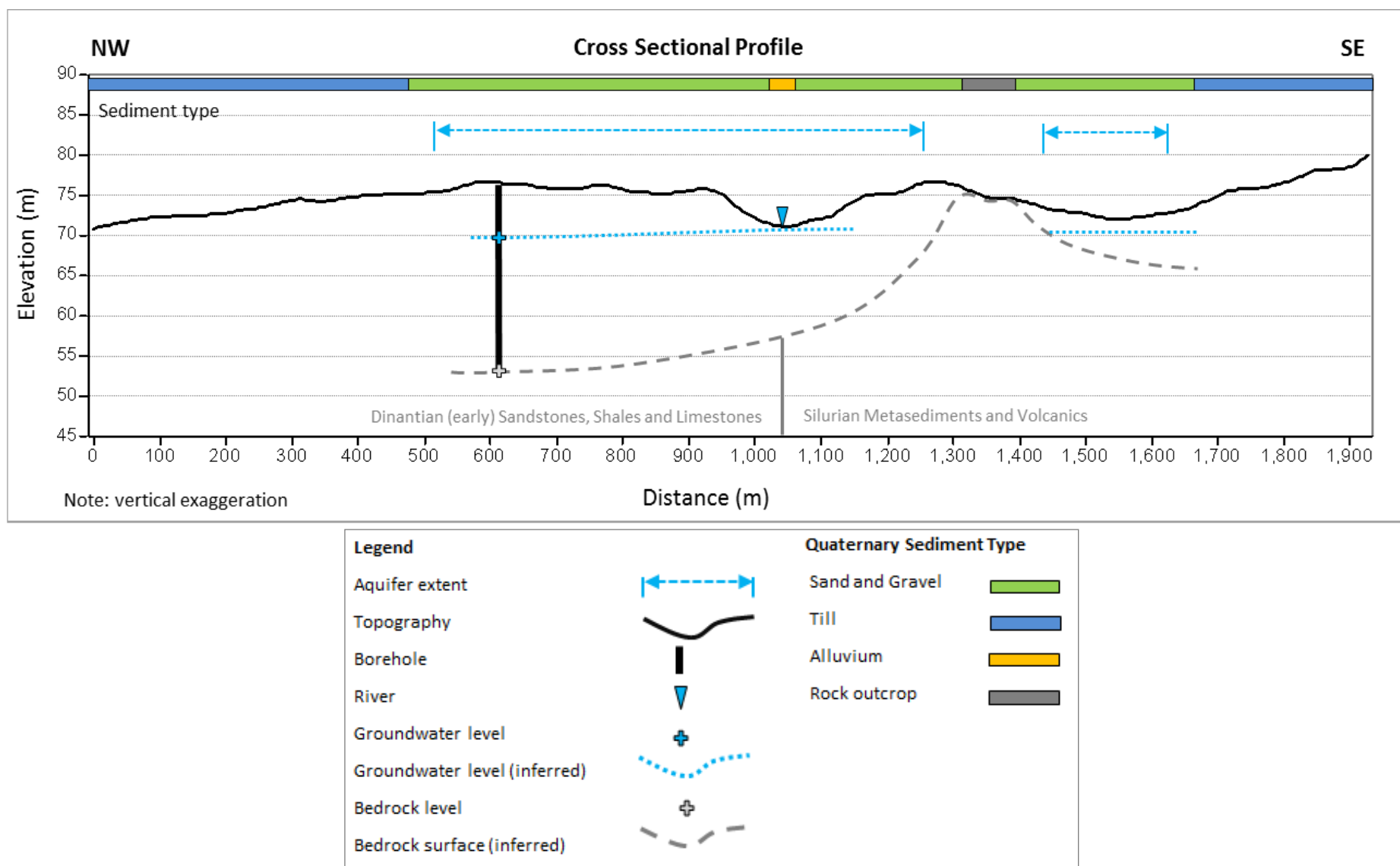


Figure 2: Cross section through the Kilkea Sand and Gravel Aquifer body.

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Kilkea Sand and Gravel Aquifer Vulnerability

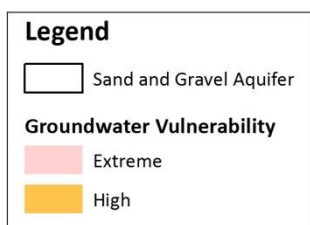
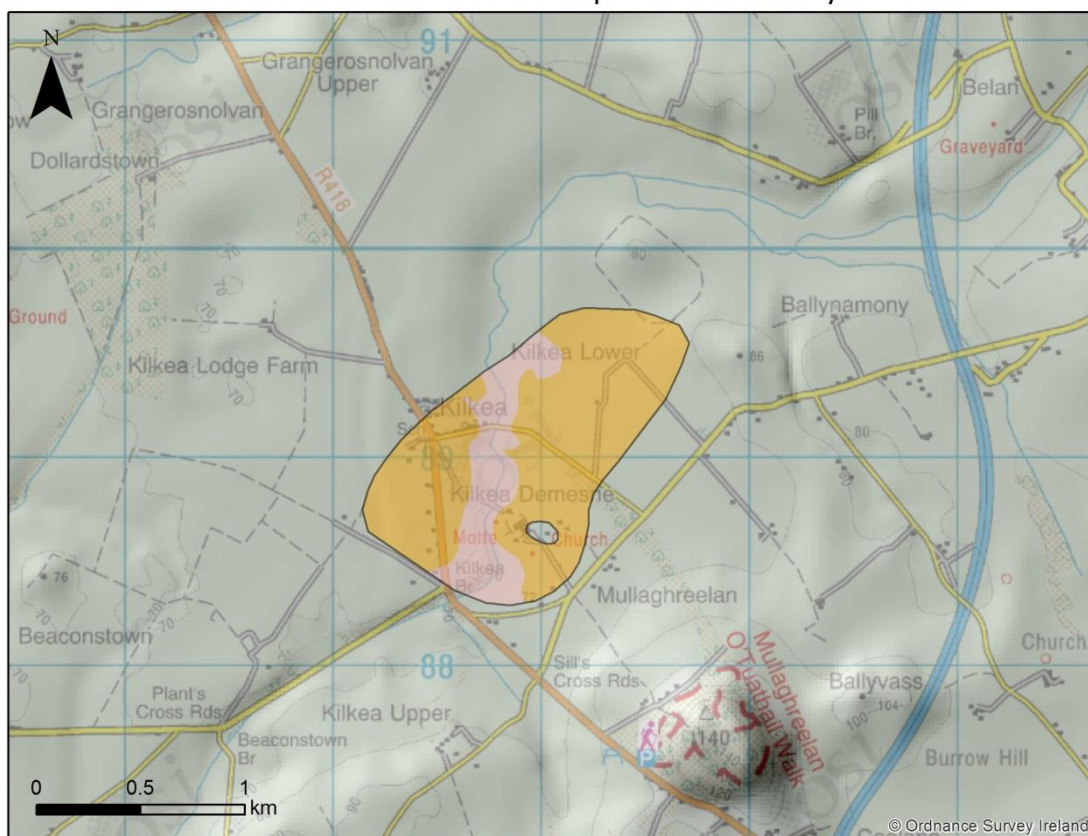


Figure 3: Groundwater vulnerability across the Kilkea Sand and Gravel Aquifer.