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Killaloe Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/03
January 2023

Killaloe Sand and Gravel Aquifer Description January 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



Killaloe Sand and Gravel Aquifer Description January 2023

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Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
25 – Lower Shannon Clare County Council		Rivers: River Shannon Streams: Several unnamed, minor streams Lakes: Lough Derg	Lough Derg (Shannon) SPA Lough Derg pNHA	0.93
Topography	The Killaloe sand and gravel aquifer is located on the northern side of Killaloe Town, in southeastern County Clare (Figure 1). The aquifer is set at the eastern edge of the Slieve Bernagh Mountains, above the western shore of Lough Derg, and has a topography classified as ‘hummocky glaciofluvial sediments topography’ (GSI, 2023a). The land surface is particularly hummocky and rests at elevations between 28 m and 79 m AOD. The highest elevations occur on the western fringes of the aquifer, and beyond this, outside the aquifer boundary, the elevations rise steadily to a peak of 166 m AOD.			
Geology and Aquifers	Aquifer categories	Four geotechnical data points are available from within the sand and gravel aquifer body. The aquifer is considered to be unconfined, and exceeds the groundwater throughput threshold of 1,000 m ³ /d, with rejected recharge contributing significantly to the throughput. Based on its areal extent, inferred thickness, inferred 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 Lower Palaeozoic sandstones and shales (GLPSsS).		
	Key structures	Exposure is very poor within the area of this sand and gravel body, and no good profiles were identified within the area during fieldwork.		
	Key properties	There are four desk study data points which have groundwater level data from within the body, and one of these points show that at least 12 m depth of saturated sand and gravel is present at one locality (GSI, 2023b). Using these data, along with water levels from the streams and rivers, it has been inferred that approx. 24% of the aquifer area has greater than 5 m depth of saturated sands and gravels. Particle size distribution analyses are available from three boreholes logs from within the aquifer; two of these are 1 m below ground level and have less than 18% fines, and the third, at 1.5 m below ground level, contains 4% fines (GSI, 2023c). In general, sand and gravel aquifers consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó’Súilleabháin, 2000).		
	Thickness	The thickness of the deposits varies throughout the aquifer area, and no proven depths to bedrock data points are available. However one borehole in Ballyvally Townland has 30 m depth of sand and gravel (GSI, 2023b). In general, the subsoil thicknesses are expected to be greater than 10 m throughout the aquifer area, excepting along the western fringe.		
Overlying Strata	Lithologies	Approximately 25% of the area of the aquifer body is overlain with alluvium, with sand and gravel assumed beneath.		
	Thickness	The thickness of the alluvium has been proven to be 3 m at one point locality in Knockcloyaun Townland (GSI, 2023c), and the thickness of the remaining areas of alluvium is consequently expected to be approx. 3 m in depth.		
	% area aquifer near surface	Approximately 75% of the area of the sand and gravel aquifer is at the surface, with the remainder beneath overlying alluvial strata.		
	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 depths > 3 m, the vulnerability is classed as ‘High’ (77% of the aquifer area, Figure 3).		



Killaloe Sand and Gravel Aquifer Description January 2023

Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sand and gravel. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table. In the areas of the aquifer that is covered by alluvium a much lower proportion of the available recharge will percolate downwards. Rejected recharge has also been included for this aquifer, emanating from the Poor Bedrock Aquifer (PI) at higher elevations to the west.
	Est. recharge rates	The annual average rainfall for the aquifer is 1,368 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 700 mm/yr. The minimum direct groundwater throughput in the aquifer is estimated to be 449 m ³ /d, which increases to a minimum potential 2,478 m ³ /d when the 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, though some small, lowlying springs and 'rises' as seen on OSI 6 inch raster map (1830s -1930s) in Knockyclovaun and Ballyvally Townlands.
	Main discharge mechanisms	Groundwater is inferred to discharge into Lough Derg, and through the small, lowlying springs and 'rises' in Knockyclovaun and Ballyvally 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. Based on the geomorphology of the sand and gravel aquifer and the pattern of streams within it, the groundwater flow paths are not expected to exceed 500 m.
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 aquifer topography is classified as 'hummocky glaciofluvial sediments topography' (GSI, 2023a), and is found at elevations between 28 m and 79 m AOD. - The greatest known depth of sand and gravel is 30 m at Ballyvally Townland, with 12 m of this depth fully saturated (GSI, 2023b). - Approximately 24% of the aquifer area 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. - Particle size distribution analyses are available from three borehole logs from within the aquifer area; 4% fines has been recorded at 1.5 m below ground level at one of the boreholes in Knockyclovaun Townland (GSI, 2023c). - Approximately 25% of the aquifer is overlain with alluvium, with sand and gravel assumed beneath. - Rejected recharge from the surrounding Poor Bedrock Aquifer (PI) at the west contributes significant groundwater recharge into the sand and gravel aquifer. - The minimum direct groundwater throughput in the aquifer is estimated to be 449 m³/d, which increases to a minimum potential 2,478 m³/d when the 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:	25073 (Ballyvally) 25074 (Killaloe) None present None present

Killaloe Sand and Gravel Aquifer Description January 2023

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. • GSI (2023c). 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.

Killaloe Sand and Gravel Aquifer Description January 2023

Killaloe Sand and Gravel Aquifer

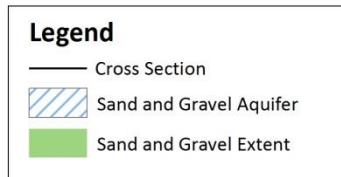
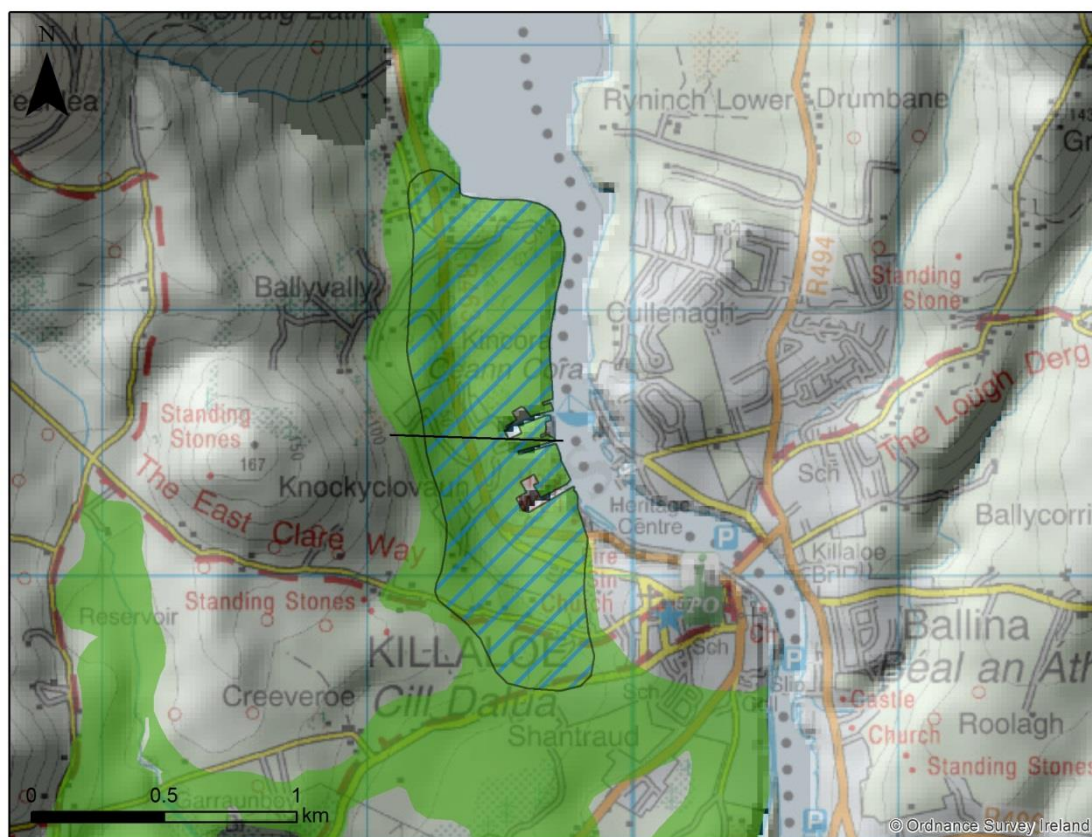


Figure 1: Killaloe Sand and Gravel Aquifer extent with cross section location.

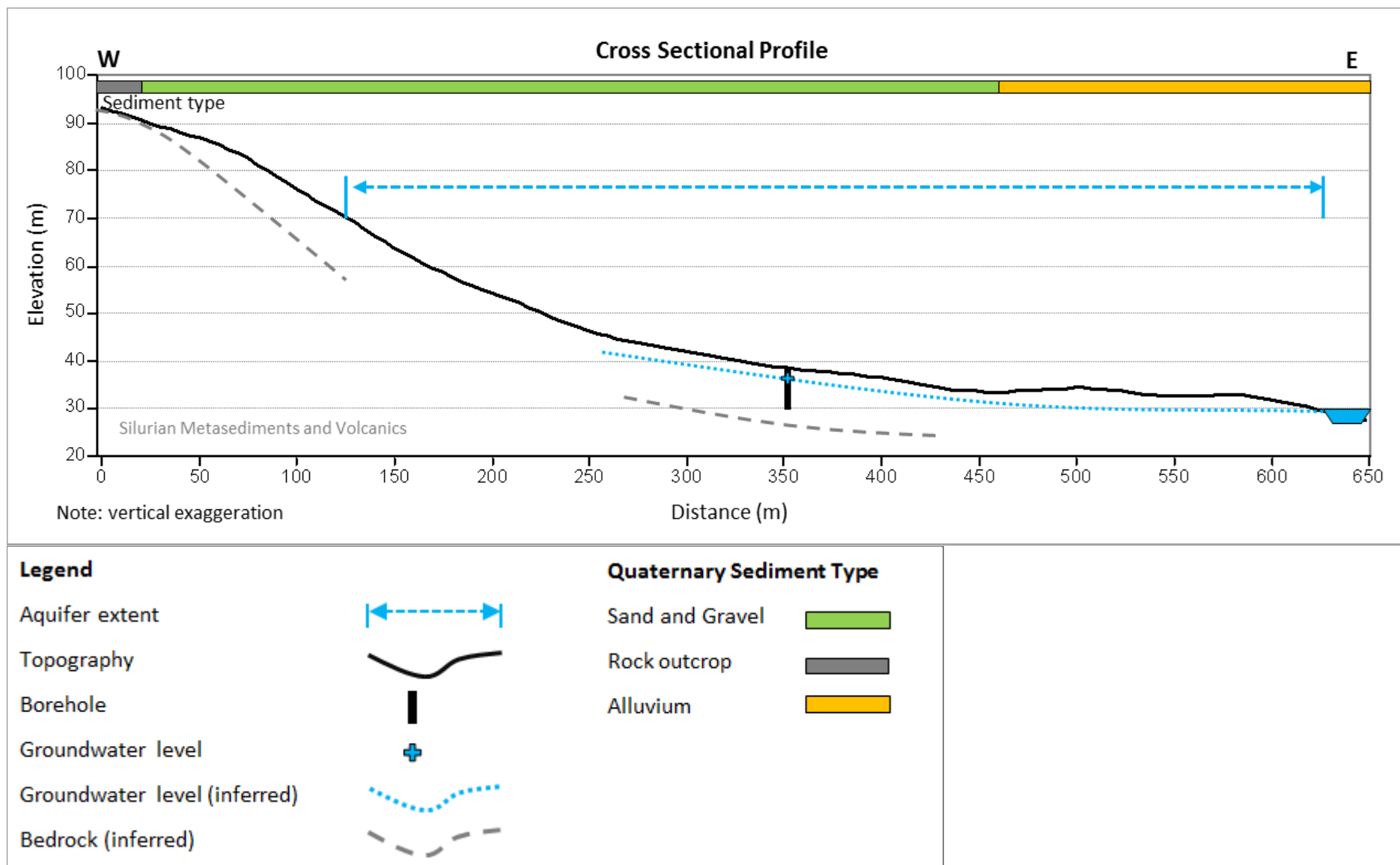


Figure 2: Cross section through the Killaloe Sand and Gravel Aquifer body.

Killaloe Sand and Gravel Aquifer Description February 2023

Killaloe Sand and Gravel Aquifer Vulnerability

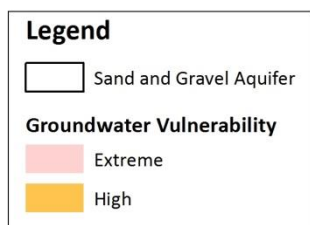
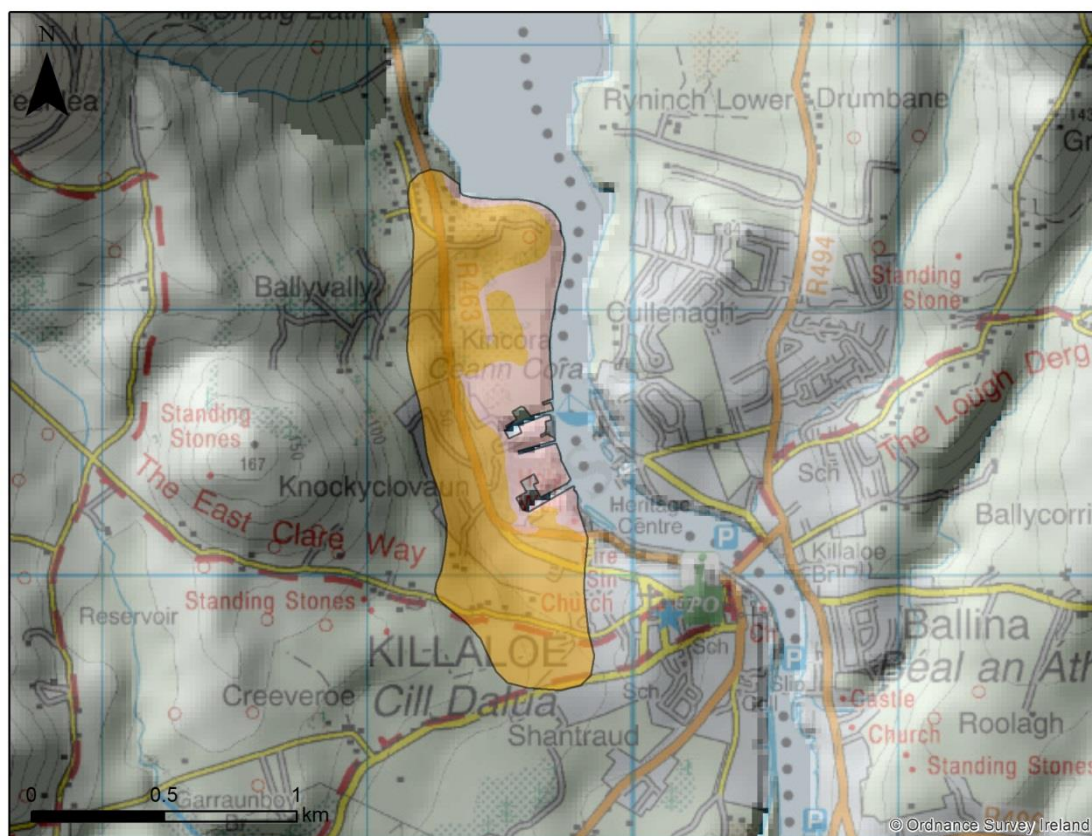


Figure 3: Groundwater vulnerability across the Killaloe Sand and Gravel Aquifer.