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Ardfert Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/18
February 2023

Ardfert 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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Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
23 – Tralee Bay - Feale Kerry County Council		Rivers: Larha River Streams: Several unnamed, minor streams Lakes: None	None present	0.65
Topography	The Ardfert sand and gravel body is located approx. 1 km north of Ardfert Village in north County Kerry (Figure 1). The aquifers topography is gently undulating and is situated on a 'coastal plain' (GSI, 2023), at elevations between 8 m and 16 m AOD. The surrounding landscape rises to 40 m AOD on the northern, eastern and southern sides, and is characterised as 'rolling ice-moulded' topography (GSI, 2023). The coastal plain landscape continues to the west of the aquifer area towards the coast. The local landscape has been altered significantly in and around a limestone rock quarry, less than 1 km east of the aquifer. The quarry floor has an elevation of approx. 50 m AOD.			
Geology and Aquifers	Aquifer categories	The sand and gravel aquifer occupies an area of approx. 0.65 km ² . The aquifer is considered to be unconfined, and could extend beneath adjacent areas mapped as glacial till (Kelly and Dillon, 2012). The aquifer extent as mapped during field work does not exceed the groundwater throughput threshold of 1,000 m ³ /d, but proven historical abstraction volumes from Public Water Supply boreholes in the sand and gravel body exceed this threshold, suggesting that there may be extensions to the sand and gravel area beneath surrounding glacial till sediments. Based on its inferred thickness, inferred saturated thickness and proven abstraction volumes from the subsoils, the body has been classified as a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017).		
	Main aquifer lithologies	Flat to gently undulating, glaciofluvial sands and gravels derived chiefly from Namurian sandstones and shales (GNSSs).		
	Key structures	Subsoil exposure was poor in the aquifer area and no good profiles were identified during fieldwork for this project. The available geological information from the aquifer body suggest that there are two sand and gravel lenses present, separated by a till unit (Kelly and Dillon, 2012).		
	Key properties	It is inferred that the entire aquifer has at least 5 m depth of saturated sand and gravel, but possibly not in one continuous unit (Kelly and Dillon, 2012). The transmissivity of the sand and gravel ranges from 418 to 1,017 m ³ /d, with sustained daily abstractions yielding between 1,200 and 1,920 m ³ /d (Kelly and Dillon, 2012). 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 the deposits is unknown but borehole records indicate that depth to bedrock is between 18 m and 20 m below ground level at the Public Water Supply site in Commons North Townland (Kelly and Dillon, 2012, Figure 2). With these data, the thicknesses of the subsoils are inferred to be up to 20 m throughout the delineated aquifer area.		
Overlying Strata	Lithologies	Approximately 20% of the aquifer is overlain with cutover raised peat, with sand and gravel proven to be beneath, in discrete lenses.		
	Thickness	Based on field observations, the thickness of the cutover raised peat is relatively thin and approx. 0.4 m in thickness, 300 m north of the aquifer (Kelly and Dillon, 2012). The cutover raised peat overlying the sand and gravel is expected to be less than 3 m in depth.		
	% area aquifer near surface	Approximately 80% of the sand and gravel aquifer is at the surface, with the remainder beneath the overlying cutover peat 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 70% of the aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (30% of the aquifer area, Figure 3).		



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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 are covered by cutover raised peat, a much lower proportion of the available recharge will percolate downwards. Owing to the topographic setting of the sand and gravel body, it is expected to accept water from the bedrock aquifer which surrounds it at higher elevations (Kelly and Dillon, 2012). Thus, this groundwater is not rejected recharge, but actual groundwater within the Regionally Important Karstified Bedrock Aquifer (diffuse) (Rkd) which seeps laterally into the sands and gravels following ready vertical infiltration into the bedrock.
	Est. recharge rates	The annual average rainfall for the aquifer is 1,095 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 430 mm/yr. The minimum direct groundwater throughput in the aquifer is therefore estimated to be 768 m ³ /d, which increases to over 1,920 m ³ /d when the laterally conducted recharge from the bedrock aquifer is included.
Discharge	Large springs and large known abstractions (m ³ /d)	There are no known large springs in the aquifer body, but Ardfert Public Water Supply Scheme abstracts between 1,200 and 1,920 m ³ /d from boreholes in the aquifer (Kelly and Dillon, 2012).
	Main discharge mechanisms	Groundwater is inferred to discharge into the Larha River that rises <i>via</i> a spring in the area of the aquifer, as well as discharge into the nearby streams and rivers to the north and south of the body.
	Hydrochemical Signature	Three groundwater samples taken in 2017 at Ardfert Public Water Supply, show that the water is very hard, with total hardness values of 330–356 mg/l (equivalent CaCO ₃), and electrical conductivity (EC) values of 716 to 774 µS/cm (average 743 µS/cm). This indicates that the groundwater has a calcium bicarbonate (CaHCO ₃) hydrochemical signature. Alkalinity ranges from 305–316 mg/l CaCO ₃ (EPA, 2018).
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 the flow paths are not expected to exceed 1 km.
Groundwater & Surface water interactions		Groundwater rises in the Commons North Townland as springs and forms the Larha River, as annotated on the OSI 6 inch raster map (1830s – 1930s).
Conceptual model	- The aquifer topography is flat to gently undulating and is situated on a 'coastal plain' (GSI, 2023), and found at elevations between 8 m and 16 m AOD. - Approximately 20% of the aquifer is overlain with cutover raised peat, with sand and gravel proven as beneath this at various point localities. - The available geological information suggests that there are two extensive sand and gravel lenses present in the aquifer body, separated by a till unit (Kelly and Dillon, 2012). - The exact thickness of the deposits is unknown but the borehole records indicate that depth to bedrock is between 18 m and 20 m below ground level (Kelly and Dillon, 2012). - The transmissivity of the sand and gravel ranges from 418 to 1,017 m³/d, with sustained daily abstractions yielding 1,200 to 1,920 m³/d (Kelly and Dillon, 2012). - The specific capacity of the Public Water Supply boreholes ranges from 342 to 545 m³/d/m, using the abstraction regime of 2012 (Kelly and Dillon, 2012). - Groundwater samples taken in 2017 indicate that the groundwater has a calcium bicarbonate hydrochemical signature (EPA, 2018). - Owing to the topographic setting of the sand and gravel body, it is expected to accept water from the bedrock aquifer which surrounds it at higher elevations. - The sand and gravel aquifer as mapped does not exceed the groundwater throughput threshold of 1,000 m³/d, but proven historical abstraction volumes from Public Water Supply boreholes exceed this value.	



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	The minimum direct groundwater throughput in the aquifer is therefore estimated to be 768 m³/d, which increases to over 1,920 m³/d when the laterally conducted recharge from the bedrock aquifer 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 None present GWIE_SH_G_00813000002 (South Ardfert)
Information Sources	- DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey Ireland. - EPA (2018). Groundwater Monitoring Data to End 2017. - 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, Spatial Resources Viewer: Quaternary Geomorphology Map. https://www.gsi.ie/en-ie/data-and-maps/Pages - Kelly, C. and Dillon, J. (2012). Establishment of Groundwater Source Protection Zones: Ardfert Water Supply Scheme, Ardfert South Borehole. Report for the EPA. - 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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Ardfert Sand and Gravel Aquifer

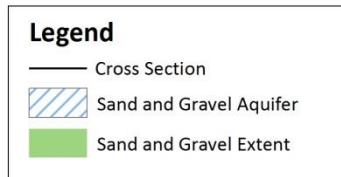
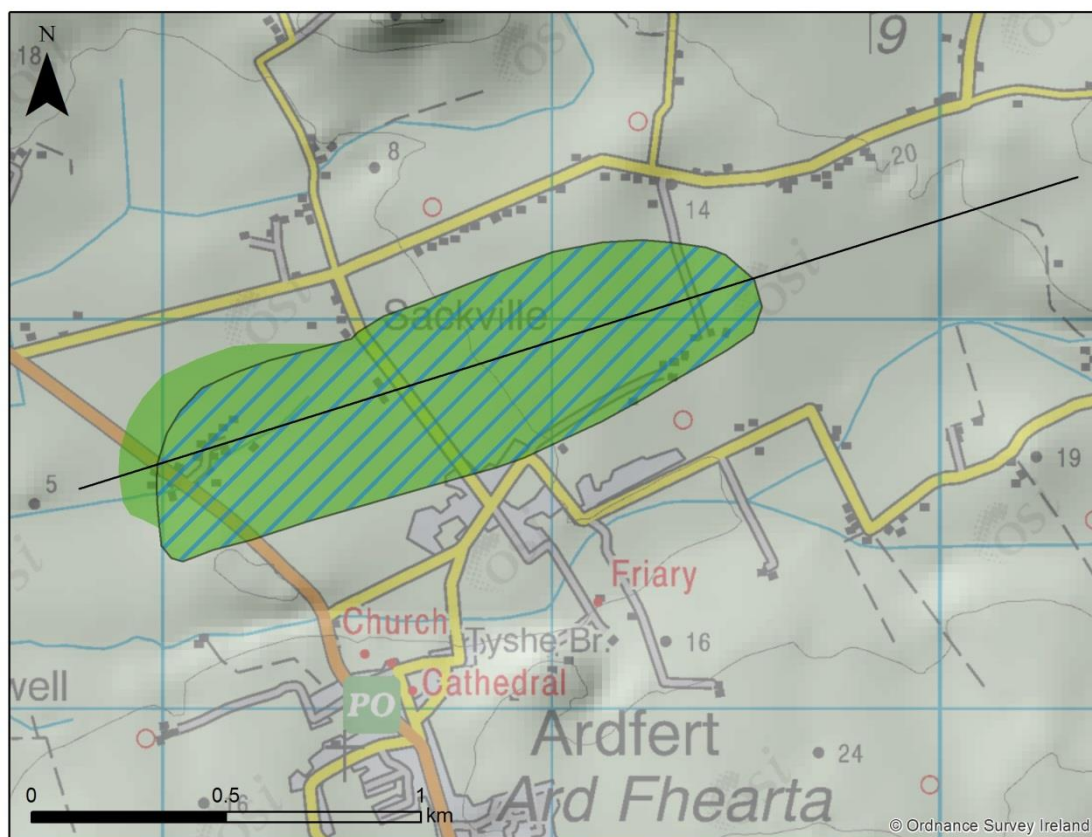


Figure 1: Ardfert Sand and Gravel Aquifer extent with cross section location.

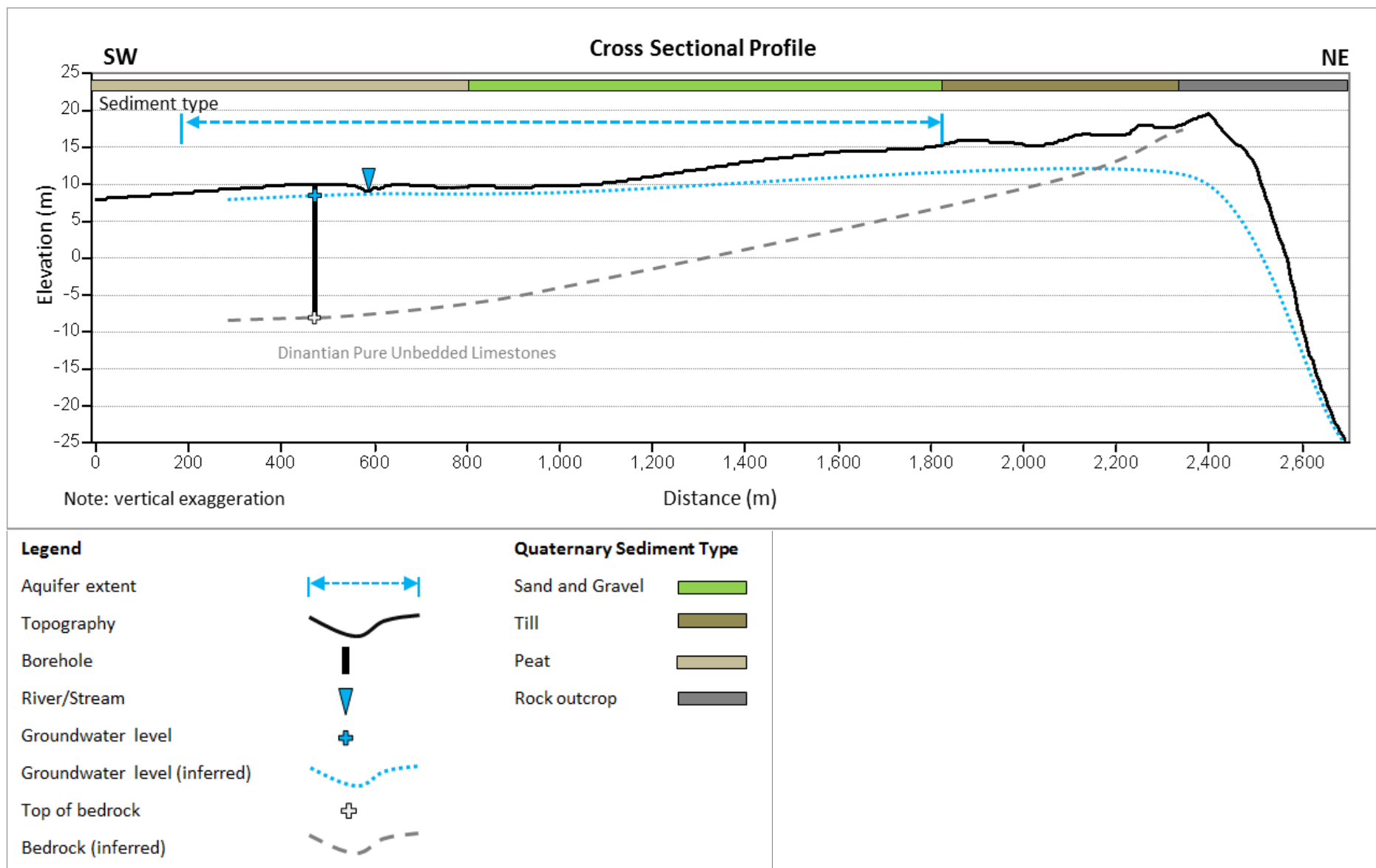


Figure 2: Cross section through the Ardfert Sand and Gravel Aquifer body.

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Ardfert Sand and Gravel Aquifer Vulnerability

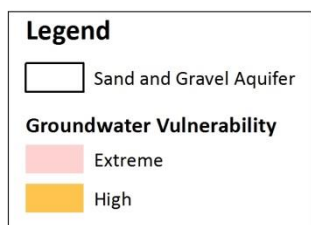
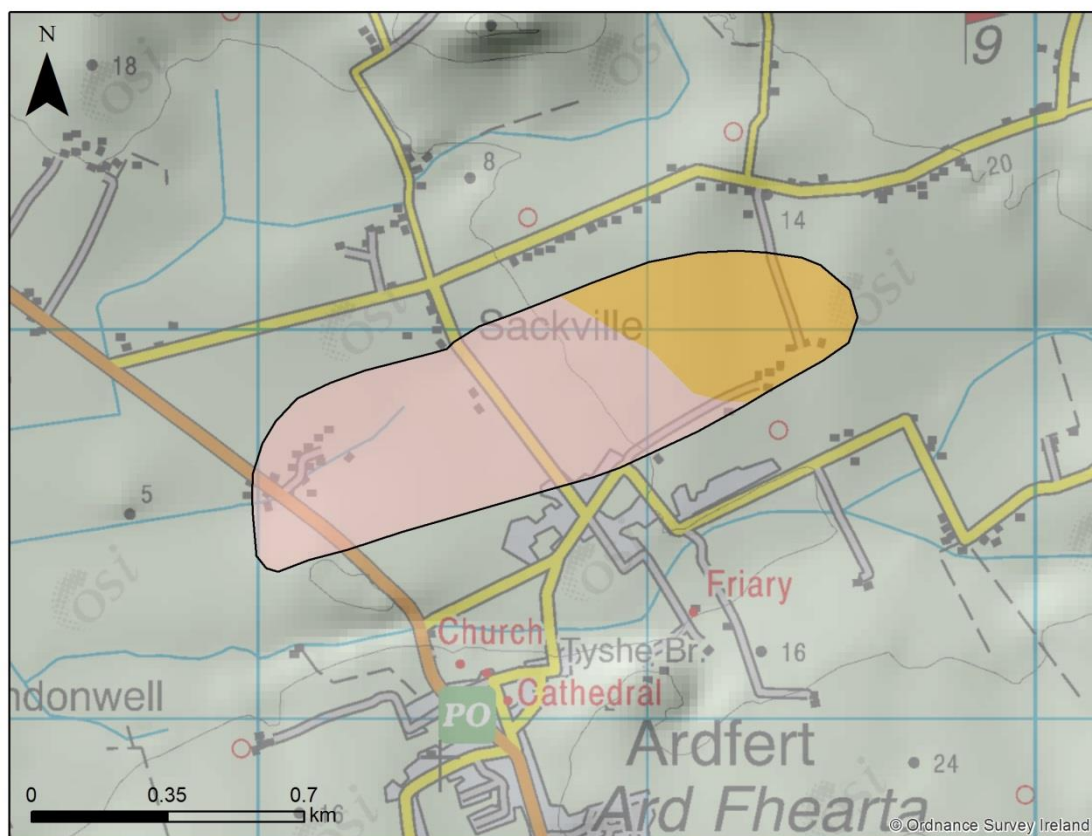


Figure 3: Groundwater vulnerability across the Ardfert Sand and Gravel Aquifer.