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Garrafrauns Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/37
March 2023

Garrafrauns 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)
30 – Corrib Galway County Council		Rivers: None Streams: Several unnamed streams Lakes: None	None	1.48
Topography	The Garrafrauns sand and gravel body consists of glaciofluvial deposits situated in a generally low-lying, flat to hummocky area situated c. 500 m southeast of Garrafrauns Village, approximately 4 kilometres northwest of Dunmore, and resting at elevations between 50 m and 75 m AOD. The sands and gravels here are part of the wider Tuam-Dunmore-Ballyhaunis Esker system (Warren and Ashley, 1994). The deposits are nestled between drumlins that are generally oriented northeast-southwest. The Slieve Dart bedrock ridge extends from the northern extent of the aquifer towards the northeast, for a distance of 10 km. The area is drained by streams, some issuing from within the sands and gravels themselves. These flow southwards and enter the Sinking River approximately 1 km south of the aquifer body.			
Geology and Aquifers	Aquifer categories	It is considered that a large portion of the aquifer has >10 m depth sands and gravels, based on analysis of topography, geotechnical data and exposures. Water level data suggest that groundwater levels are generally deep below ground surface, and are, in some cases, below the stream levels in the central portion of the aquifer. Based on likely geometry and extent, this deposit is classified as a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017). The subsoils overlie bedrock of predominantly Dinantian Pure Unbedded Limestones, Dinantian Mixed Sandstones, Shales and Limestones, and Dinantian Lower Impure Limestones, all of which are locally important bedrock aquifers (LI) (GSI, 2017).		
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from limestones (GLs; GSI, 2023b), with smaller areas of alluvium (A), cutover peat (Cut) and lacustrine sediments (L).		
	Key structures	Sand and gravels at Addergoole Beg comprise well sorted, medium bedded sands and gravels. Northwest of Gortnagoyne Townland, exposures show poorly sorted, interbedded sands and gravels. At Darray North, exposures also show moderately well sorted, interbedded pebble sands and gravels.		
	Key properties	There are no known data in this aquifer on yields, permeabilities or transmissivities. Sand and gravel aquifers generally consist of unconsolidated, coarse-grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000). Typically transmissivity ranges from 200 – 1500 m ² /d (Kelly et al., 2015). Specific yield is expected to be high (10%). Groundwater is considered to be unconfined within the aquifer at Garrafrauns. The data are inadequate to calculate groundwater gradients, but these are expected to be relatively flat, in the order of 0.001, typical of sand and gravel aquifers.		
	Thickness	There are nine definitive depth to bedrock data points from within the delineated body of the aquifer, mostly located in the eastern half. The depth to bedrock ranges from 5.4 m to 22.6 m below ground level. Exposures from a sand and gravel pit at Addergoole Beg show up to 10 m depth of sands and gravels. Further exposures from gravel pits 500 m south and southeast of Darray North, in the western half of the aquifer body, show up to 10 m depth of sands and gravels. Based on this evidence, and interpretations from topography, it is considered that that majority of the aquifer has >10 m depth sands and gravels.		
Overlying Strata	Lithologies	Glaciofluvial sands and gravels at surface, with relatively small portions covered by cutover raised peat, alluvium and/or lacustrine sediments.		
	Thickness	Where cutover raised peat, alluvium and/or lacustrine sediments occur, they are inferred to be less than 3 m thick.		
	% area aquifer near surface	Approximately 82% of the delineated aquifer area has sands and gravels just below the surface.		
	Vulnerability	The groundwater vulnerability of the sands and gravels aquifer is 'Extreme' wherever the water table is <3 m from the surface, whereas in all other areas where the water table is at depths >3 m from surface, the vulnerability is classed as 'High'. Extreme vulnerability occurs over approximately 38% of the aquifer area.		



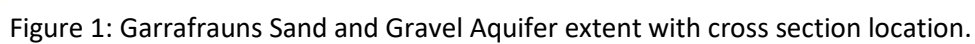
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Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table where sands and gravels are at surface. Rejected recharge also enters the aquifer mainly from the Slieve Dart ridge, at Gortnalea, to the north.
	Est. recharge rates	Recharge to the aquifer is estimated at 547 mm/yr, based on an average annual rainfall of 1,185 mm/yr (Walsh, 2012). This gives a minimum direct groundwater throughput of 615 m ³ /d, which rises to a potential 2,067 m ³ /d when rejected recharge from the Slieve Dart ridge to the north has been 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 <i>via</i> some small lowlying springs as seen on OSI 6 inch raster map (1830s – 1930s) at, for example, Carrowntomush and Addergoole Beg Townlands. Groundwater also discharges, <i>via</i> seeps, to various streams that both issue from and flow through the aquifer body.
	Hydrochemical Signature	There are no data readily available to assess the hydrochemistry of this aquifer; however, based on the geology of the area, it is expected that the hydrochemical signature is of calcium bicarbonate (Ca-HCO ₃).
Groundwater Flow Paths		Generally the drainage density is low across sand and gravel bodies; this is not the case at Garrafrauns, as there are several pockets of low-lying peat and alluvium within the area of the sands and gravels. The length of flow paths depend on the size 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. This is expected to be the case at Garrafrauns, given the geometry and setting of the sand and gravel body.
Groundwater & Surface water interactions		Groundwater is expected to discharge to springs and to the streams, as specified above. Hydraulic connection between the groundwater in the aquifer, and the adjacent streams, is therefore expected to be high.
Conceptual model	- The Garrafrauns sand and gravel aquifer consists of hummocky, glaciofluvial sands and gravels derived chiefly from limestones (GLs). - The deposits are situated in a generally lowlying, flat to hummocky area, resting at elevations between 50 m and 75 m AOD. - The aquifer is covered by relatively extensive areas of cutover raised peat, alluvium and/or lacustrine sediments, all covering approximately 18% of the delineated aquifer area. - The subsoils overlie bedrock of predominantly Dinantian Pure Unbedded Limestones, Dinantian Mixed Sandstones, Shales and Limestones, and Dinantian Lower Impure Limestones, all of which are locally important bedrock aquifers (LI). - The sand and gravel aquifer is inferred to be greater than 10 m thick over much of its extent, with c. 28% of the aquifer estimated as having ≥5 m depth sand and gravel saturation. - Across approximately 38% of the aquifer area, groundwater levels are mapped as <3 m below ground level. - The length of flow paths is expected to be in the order of several hundred metres. - Groundwater discharges <i>via</i> seeps and springs to several unnamed streams that issue from and flow through the delineated aquifer body. - Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels. Recharge to the aquifer is estimated as 547 mm/yr. - This gives a minimum direct groundwater throughput of 615 m³/d, which rises to a potential 2,067 m³/d when rejected recharge from the Slieve Dart ridge to the north has been included.	

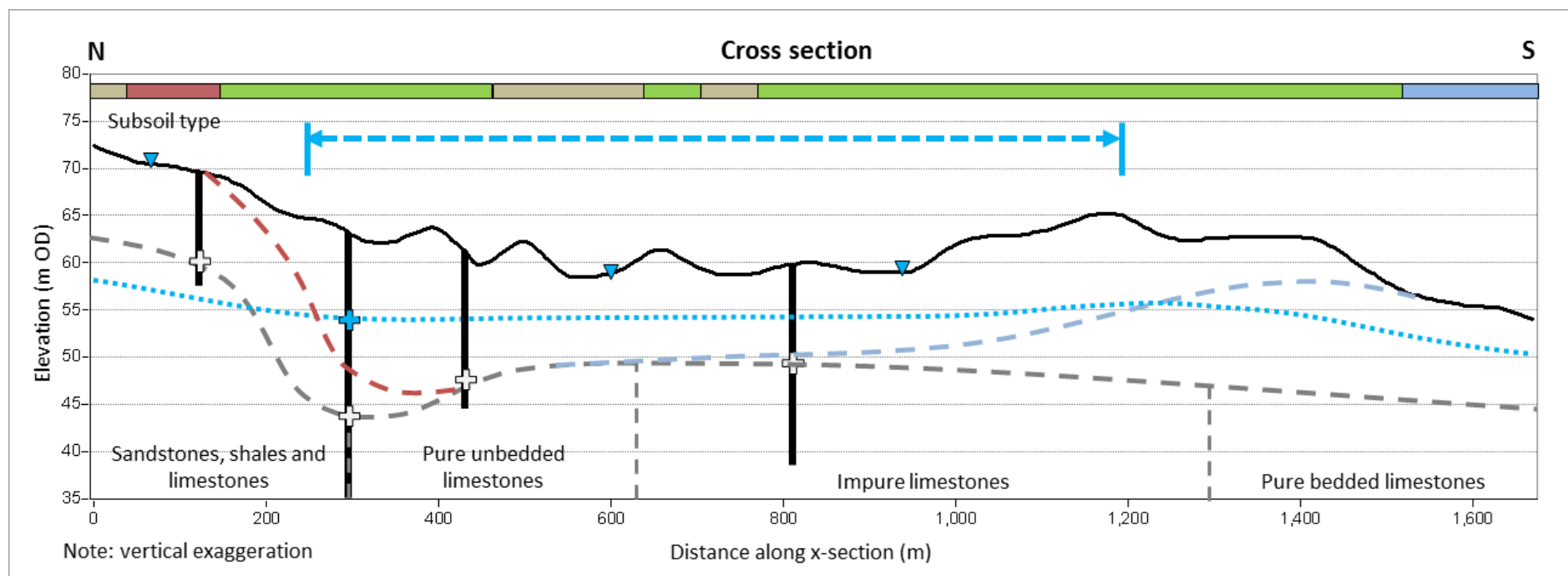
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Attachments	Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability
Instrumentation	Hydrometric gauges: None present National Water Monitoring Stations; River: None present Groundwater: None present
Information Sources	• DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. • EPA (2023a). Environmental Protection Agency Map Viewer. https://gis.epa.ie/EPAMaps. • EPA (2023b). Groundwater Monitoring Data to End 2017. • 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 • Kelly, C., Hunter Williams, T., Misstear, B.M. and Motherway, K. (2015). Irish Aquifer Properties – A reference manual and guide. Prepared on behalf of the Geological Survey of Ireland and the Environmental Protection Agency. 110 pp. • NPWS (2023). National Parks and Wildlife Service Map Viewer. http://webgis.npws.ie/npwsvviewer • 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. • Warren, W. and Ashley, G. (1994). Origins of the ice-contact stratified ridges (eskers) of Ireland. Journal of Sedimentary Research, 64A, 433-449.
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.

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LEGEND			
Feature		Subsoil Type	
Topography		Sands and gravels	
Groundwater level		Esker	
Top of bedrock		Windblown sands	
Borehole/Trial Pit		Till	
Dug well		Peat	
S&G exposure		Rock outcrop	
Active quarry		Alluvium	
Freshwater lake		Lake sediments	
GW Ponding		Top of S&G	
River		Top of till	
Stream/drainage channel		Karst Feature	
Spring		Spring	
Aquifer envelope		Turlough	

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

Garrafrauns Sand and Gravel Aquifer Vulnerability

