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**Geological Survey**  
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# Clonard-Ballyboggan Sand and Gravel Aquifer Summary of Initial Characterisation



**GW3D Project Report TR2023/50**  
**March 2023**

## Clonard-Ballyboggan 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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### Clonard-Ballyboggan Sand and Gravel Aquifer: Summary of Initial Characterisation.

| Hydrometric Area<br>Local Authority                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Associated surface water features                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Associated terrestrial ecosystem(s) | Area (km <sup>2</sup> ) |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------|
| 07 – Boyne<br>Meath County Council<br>Kildare County Council |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Rivers:</b> River Boyne, Castlejordan River, Glash River<br><b>Streams:</b> Several unnamed streams<br><b>Lakes:</b> None Present                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | None                                | 15.0                    |
| <b>Topography</b>                                            | The Clonard-Ballyboggan sand and gravel aquifer comprises a series of glaciofluvial terraces on either side of the River Boyne, which trend southwest to northeast, in southwest County Meath and north County Kildare. A tongue of the aquifer extends southeastwards just south of Broadford, and is bounded by a ridge cored by 'Dinantian Upper Impure Limestones' bedrock along the southern edge of the aquifer body. The aquifer topography is characterised as hummocky sands and gravels, with associated interfingering eskers, and rests at elevations between 65 m and 120 m AOD. A total of 10 sand and gravel pits were identified within the body, along with a number of smaller, disused pits which continue to alter the topography on a local scale. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                     |                         |
| <b>Geology and Aquifers</b>                                  | <b>Aquifer categories</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Based on its areal extent, inferred thickness, saturated thickness, groundwater throughput and position in the landscape the deposit is classified as <b>Locally Important Sand and Gravel Aquifer (Lg)</b> (DELG/EPA/GSI, 1999; GSI, 2017). There are 37 borehole data points available from within this sand and gravel body, with the majority containing geotechnical logs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                     |                         |
|                                                              | <b>Main aquifer lithologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Hummocky, glaciofluvial sand and gravel deposits derived chiefly from limestone (GLs) and tunnel fill esker deposits which are classified as basic in chemical reaction (BasEsk).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                         |
|                                                              | <b>Key structures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | The key depositional structures noted in the body are thickly bedded sand and gravel sheets, which were seen at several exposures in pits in the centre of the deposit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                     |                         |
|                                                              | <b>Key properties</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | There are 33 water level data points available from within the sand and gravel aquifer. Three boreholes, in Kilrathmurry, Ballyonan and Kilglass Townlands, have approx. 18 m depth of sand and gravel (Galvin, 2007; GSI, 2023a). Approx. 15 m depth of saturated sands and gravels is inferred to be present in the borehole in Ballyonan Townland (GSI, 2023a). The water levels from water wells and boreholes have allowed for inferences to be made on water levels throughout the entire area of the delineated sand and gravel aquifer. Using the desk study data and data collected in the field, it is inferred that approx. 42% of the aquifer area has a depth of saturated sands and gravels greater than 5 m (Figure 2). Particle size distribution analyses obtained from samples taken in a pit in Kilrathmurry Townland has four samples which contain less than 5% fines (Kilsaran, 2003). Sand and gravel aquifers generally consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000). |                                     |                         |
|                                                              | <b>Thickness</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | All the boreholes indicate that the subsoil thickness is likely to be greater than 10 m over the majority of the area of the delineated aquifer; one borehole in Kilrathmurry Townland has observed 38 m depth of subsoil before bedrock was encountered (GSI, 2023b). There is one locality where data suggests depth to bedrock is less than 5 m; this is restricted to a small area along the eastern boundary of the aquifer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                         |
| <b>Overlying Strata</b>                                      | <b>Lithologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Approximately 23% of the aquifer is overlain with cutover raised peat, lake sediments and/or alluvial deposits, with sand and gravel assumed beneath.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                     |                         |
|                                                              | <b>Thickness</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Borehole logs have thicknesses of alluvial deposits recorded between 1 m to 3 m in Ballyonan Townland (GSI, 2023a). The cutover raised peat, lake sediments and the remainder of the alluvial deposits are inferred to be less than 3 m thick.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                     |                         |
|                                                              | <b>% area aquifer near surface</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Approximately 77% of the sand and gravel aquifer is at the surface, with the remainder beneath the cutover raised peat, lake sediments and/or alluvial deposits. Tunnel fill esker sands and gravels cover less than 3% of the area, mostly at the northern end.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                     |                         |
|                                                              | <b>Vulnerability</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 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 45% of the aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (55% of the area, Figure 3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                     |                         |





## Clonard-Ballyboggan Sand and Gravel Aquifer Description March 2023

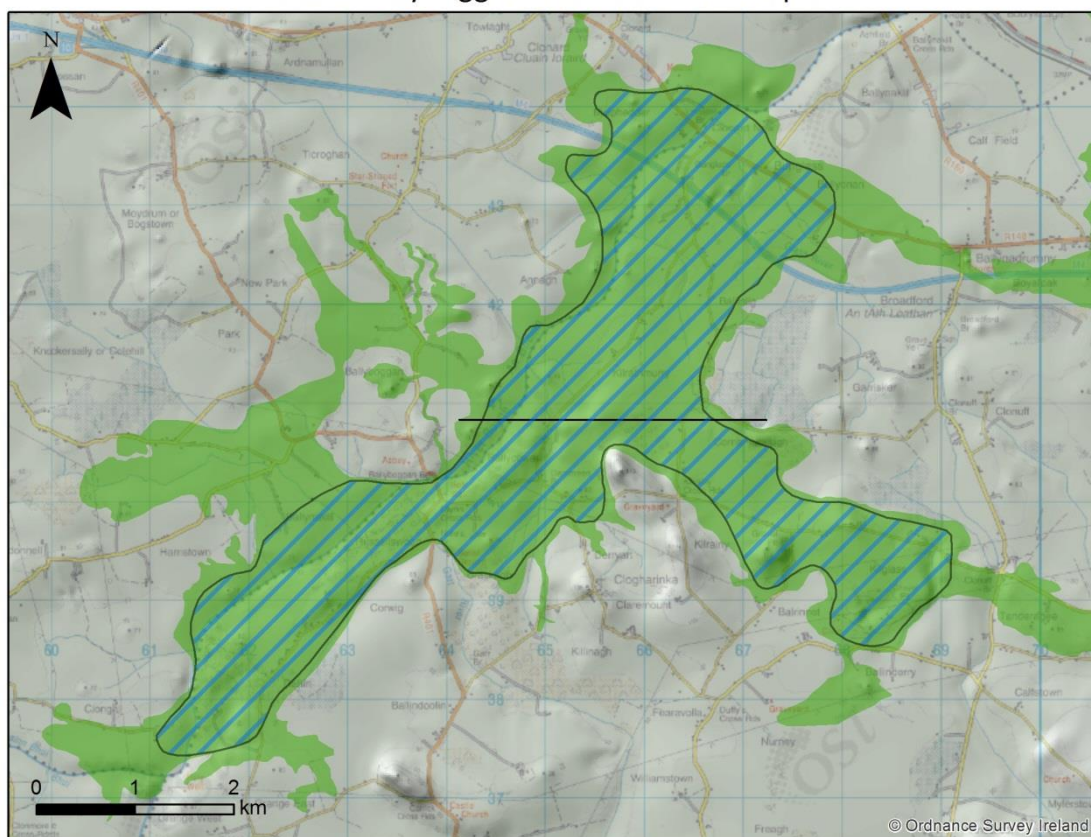
|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 cutover raised peat, lacustrine deposits or alluvium overlie the sands and gravels, the proportion of rainfall that recharges the water table will be significantly less. |
|                                          | Est. recharge rates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The annual average rainfall for the aquifer is 871 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge rate of 313 mm/yr. The minimum direct groundwater throughput in the aquifer is consequently estimated to be 5,474 m <sup>3</sup> /d.                                                                                                                                                      |
| Discharge                                | Large springs and large known abstractions (m <sup>3</sup> /d)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | There are no known large springs or abstractions from this aquifer body.                                                                                                                                                                                                                                                                                                                                                |
|                                          | Main discharge mechanisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Groundwater is expected to discharge into the rivers and streams that flow through the aquifer. Some small lowlying springs are seen on OSI 6 inch raster map (1830s – 1930s) at, for example, Kilrathmurry and Cornamucklagh Townlands.                                                                                                                                                                                |
|                                          | Hydrochemical Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Raw water samples were taken from a borehole situated in sand and gravel pit located at Kilglass Townland, in January 2007. The groundwater has a calcium bicarbonate (CaHCO <sub>3</sub> ) signature, it is moderately hard, with alkalinity values of 172 mg/l CaCO <sub>3</sub> , and electrical conductivity values of @20°C 454 µS/cm (Galvin, 2007).                                                              |
| 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 sand and gravel body at Clonard – Ballyboggan, and the pattern of streams, this is also expected to be the case here.                                    |
| Groundwater & Surface water interactions |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Groundwater is expected to discharge into the streams that flow through the aquifer, therefore connectivity between the groundwater and surface water is expected to be relatively high.                                                                                                                                                                                                                                |
| Conceptual model                         | <ul style="list-style-type: none"> <li>The aquifer comprises a series of glaciofluvial terraces on either side of the River Boyne, which trend southwest to northeast either side of the river itself.</li> <li>The aquifer topography consists of hummocky sands and gravels and associated interfingering eskers, at elevations between 65 m and 120 m AOD.</li> <li>Borehole data are available from within the aquifer area; one log suggests 15 m depth of saturated sands and gravels (GSI, 2023a), with another suggesting 38 m depth of subsoil above bedrock (GSI, 2023b), these are found in Ballyonan and Kilrathmurry Townlands respectively.</li> <li>Particle size distribution analyses obtained from a pit in Kilrathmurry has four samples which contain less than 5% fines (Kilsaran, 2003).</li> <li>Approximately 42% of the aquifer is inferred to have greater than 5 m depth of saturated sands and gravels, with the remainder inferred to have a saturated thickness less than this.</li> <li>Diffuse groundwater recharge is estimated to be approx. 313 mm/yr.</li> <li>The minimum direct groundwater throughput in the aquifer is estimated to be 5,474 m<sup>3</sup>/d.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Attachments                              | <p>Figure 1: Location and extent</p> <p>Figure 2: Cross section</p> <p>Figure 3: Groundwater vulnerability</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Instrumentation                          | <p><b>Hydrometric gauges:</b></p> <p><b>National Water Monitoring Stations;</b></p> <p><b>River:</b></p> <p><b>Groundwater:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>07013 (Rahan)</p> <p>RS07B040400 (Ballyboggan Bridge)</p> <p>RS07B0400500 (Boyne – Leinster Bridge)</p> <p>RS07G020600 (Bridge u/s Boyne River confluence)</p> <p>None present</p>                                                                                                                                                                                                                                   |

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|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Information Sources</b> | <ul style="list-style-type: none"> <li>• DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey Ireland.</li> <li>• EPA map viewer. <a href="https://gis.epa.ie/EPAMaps/">https://gis.epa.ie/EPAMaps/</a></li> <li>• GSI (2017). A description of Irish aquifer categories. 3 pp. Available from: <a href="https://www.gsi.ie/documents/GSI%20Aquifer%20Category%20Descriptions.pdf">https://www.gsi.ie/documents/GSI%20Aquifer%20Category%20Descriptions.pdf</a></li> <li>• GSI (2023a). Geological Survey Ireland, Internal geotechnical borehole databases.</li> <li>• GSI (2023b). Geological Survey Ireland, Internal bedrock databases.</li> <li>• Galvin, P. (2007). Environmental Impact Statement for the proposed extension to an existing sand and gravel pit. Completed by Environmental Efficiency (Ire.) Ltd. on behalf of Roadstone Dublin Ltd. for Kildare County Council.</li> <li>• Geotech Specialists Limited (2000). N4: Kinnegad-Enfield-Kilcock, Preliminary Site Investigation, Factual Report. Carried out for Westmeath County Council.</li> <li>• Kilsaran Concrete Limited (2003). Environmental Impact Statement for the proposed development at Clonard-Ballyboggan County Kildare. Kilsaran Concrete Limited.</li> <li>• NPWS viewer. <a href="http://webgis.npws.ie/npwsviewer/">http://webgis.npws.ie/npwsviewer/</a></li> <li>• 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.</li> <li>• Walsh, S. (2012). A Summary of Climate Averages 1981-2010 for Ireland, Climatological Note No.14, Met Éireann, Dublin.</li> </ul> |
| <b>Disclaimer</b>          | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## Clonard-Ballyboggan Sand and Gravel Aquifer Description March 2023

### Clonard-Ballyboggan Sand and Gravel Aquifer



#### Legend

- Cross Section
-  Sand and Gravel Aquifer
-  Sand and Gravel Extent

Figure 1: Clonard-Ballyboggan Sand and Gravel Aquifer extent with cross section location.

# Clonard-Ballyboggan Sand and Gravel Aquifer Description March 2023

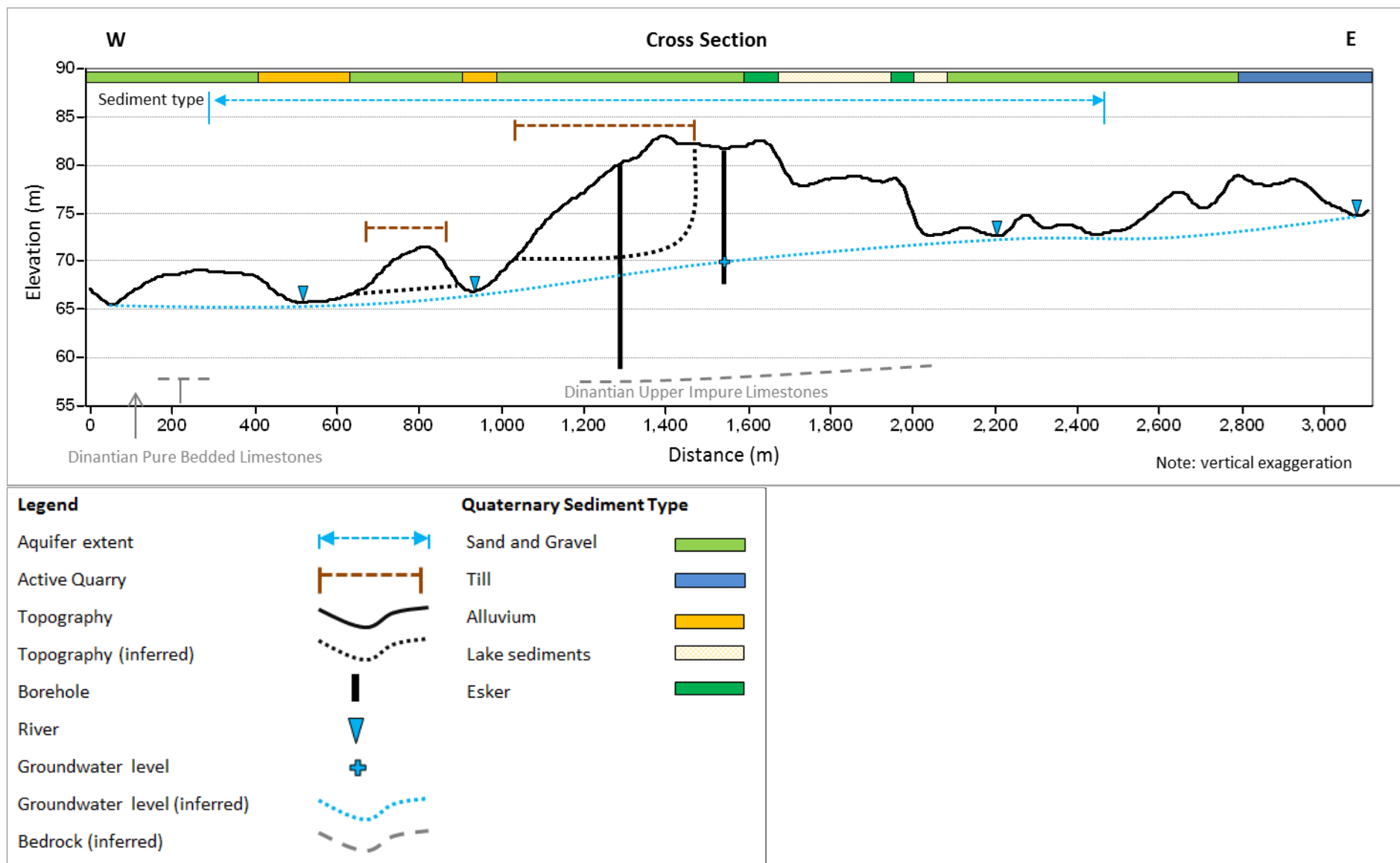


Figure 2: Cross section through the Clonard-Ballyboggan Sand and Gravel Aquifer body.



## Clonard-Ballyboggan Sand and Gravel Aquifer Description March 2023

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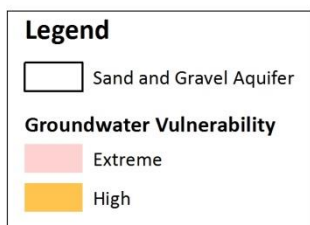
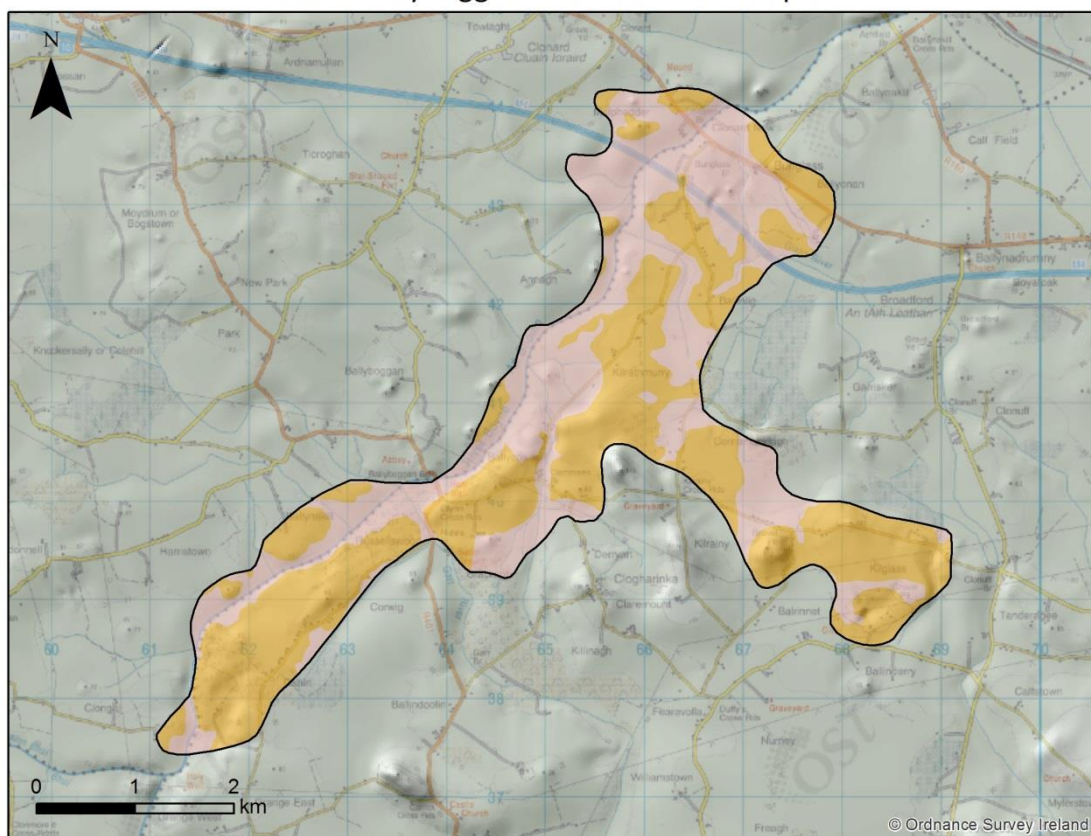


Figure 3: Groundwater vulnerability across the Clonard-Ballyboggan Sand and Gravel Aquifer.