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Eddleston Groundwater Monitoring

ECAR programme
Open Report 25/030



BRITISH GEOLOGICAL SURVEY

ECAR PROGRAMME

OPEN REPORT 25/030

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Front cover

Downloading groundwater
levels in the rain. February
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Bibliographical reference

Holliday, L, Brickell, J. 2025.
Eddleston Groundwater
Monitoring. *British Geological
Survey Open Report*,
OR/25/030. 8pp.

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L Holliday and J Brickell

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British Geological Survey offices

**Nicker Hill, Keyworth,
Nottingham NG12 5GG**

Tel 0115 936 3100

BGS Central Enquiries Desk

Tel 0115 936 3143

email enquiries@bgs.ac.uk

BGS Sales

Tel 0115 936 3241

email sales@bgs.ac.uk

**The Lyell Centre, Research Avenue South,
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Tel 0131 667 1000

email scotsales@bgs.ac.uk

**Natural History Museum, Cromwell Road,
London SW7 5BD**

Tel 020 7589 4090

Tel 020 7942 5344/45

email bgslondonstaff@bgs.ac.uk

**Cardiff University, Main Building, Park Place,
Cardiff CF10 3AT**

Tel 029 2167 4280

**Geological Survey of Northern Ireland, 7th Floor,
Adelaide House, 39-49 Adelaide Street, Belfast, BT2 8FD**

Tel 0289 038 8462

www2.bgs.ac.uk/gsni/

**Natural Environment Research Council, Polaris House,
North Star Avenue, Swindon SN2 1EU**

Tel 01793 411500

Fax 01793 411501

www.nerc.ac.uk

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Contents

- Contents..... 1
- 1 Project Scope 2
- 2 Darnhall Floodplain Monitoring 4
- 3 Cringletie Hillslope Monitoring 6
 - 3.1 Groundwater Levels 6
 - 3.2 Soil Moisture Sensors and Rain Gauges 6
- 4 Conclusions..... 7
- References..... 8

FIGURES

- Figure 1: (a) Map of Eddleston experimental sites (Contains OS data © Crown copyright and database rights 2024. OS AC0000824781 EUL); (b) Monitoring boreholes at Darnhall (reproduced from Ó Dochartaigh et al. 2019; available under License Creative Commons Attribution 4.0; British Geological Survey © UKRI 2018). (c) Schematic map locating the piezometers, soil moisture sensors and rainfall gauges installed at the Cringletie hillslope monitoring site. BGS © UKRI 2025. 3
- Figure 2: Groundwater levels within Darnhall floodplain boreholes for period December 2021 to February 2025. 5
- Figure 3: Groundwater levels for the two remaining sites at Cringletie after barometric compensation, from December 2021 to February 2025..... 7

1 Project Scope

This report describes work undertaken to continue monitoring at two experimental sites on the Eddleston Water, a tributary of the River Tweed. The Eddleston experimental sites were set up as part of the wider Eddleston Water Project, which aims to reduce the impact of flooding in and downstream of the village of Eddleston.

The first experimental site is part of Darnhall Mains Farm, adjacent to the village of Eddleston (Ó Dochartaigh et al. 2019). It is approximately 0.2 km² (approximately 400 m by 500 m) and covers most of the width of the Eddleston Water floodplain on both sides of the river (Figure 1). The site is farmland predominately comprising mixed livestock farming on improved grassland, but part of the floodplain has been fenced which has allowed trees to be planted and vegetation to recover. The monitoring at this site comprises eight boreholes in which groundwater level is recorded. Previous data are stored with the National Geoscience Data Centre (<https://www.bgs.ac.uk/geological-data/national-geoscience-data-centre/>, ID 128585). A key objective of the experimental site is to improve understanding of the role of groundwater in floodplain environments and in flooding, and of how groundwater interacts with climate, rivers and soils.

The second experimental site is the Cringletie hillslope observatory (Figure 1; Peskett et al., 2020). The site is approximately 2500 m² (approximately 50 m by 50 m) and comprises two transects parallel to the slope: one through a narrow forest strip and one on improved grassland used for mixed livestock farming (see Peskett et al., 2020). The installed monitoring equipment comprises soil moisture sensors, rain gauges and piezometers fitted with pressure transducers. The site was set up by Dr Leo Peskett as part of his PhD and was handed over to the BGS in 2020. The aim of the experimental site was to determine whether forest strips planted perpendicular to a hillslope can reduce surface runoff during flood events. Further information about the observatory is available in Peskett et al. (2020).

Since 2022/2023, the monitoring has been unfunded and kept going sporadically by BGS staff. In 2024/2025 BGS received a small portion of funding from the FDRI programme to download all data at the Eddleston sites and reset the loggers; audit broken equipment; and collate, process and quality check the data. This will enable a decision whether Eddleston will be included as part of the wider Tweed FDRI research sub-catchment and monitoring of shallow groundwater levels continue at Eddleston through FDRI.



Figure 1: (a) Map of Eddleston experimental sites (Contains OS data © Crown copyright and database rights 2024. OS AC0000824781 EUL); (b) Monitoring boreholes at Darnhall (reproduced from Ó Dochartaigh et al. 2019; available under License Creative Commons Attribution 4.0; British Geological Survey © UKRI 2018). (c) Schematic map locating the piezometers, soil moisture sensors and rainfall gauges installed at the Cringletie hillslope monitoring site. BGS © UKRI 2025.

2 Darnhall Floodplain Monitoring

Five pairs of shallow (< 4 m) and deep (4 to 12 m) monitoring piezometers were installed at the Darnhall floodplain site (Ó Dochartaigh et al. 2012; Ó Dochartaigh et al. 2019).

In late February 2025, data from pressure transducers for 6 out of 8 piezometers was successfully downloaded. Following removal of the treeline by the farmer and subsequent agricultural activity on site, two piezometers (EDS4a and EDS4b) were not able to be accessed as their host borehole could not be located.

Pressure transducers located within EDS1a and EDS2b were replaced with new units due to depleted battery. The transducer within EDS2b ceased to record data beyond 19th August 2024. The pressure transducer monitoring atmospheric pressure ceased to record data on 28th January 2025 and was also replaced. All remaining transducers were cleared, reset and reinstalled at the end of each visit.

The groundwater level data were barometrically compensated for atmospheric pressure and quality checked. Due to the lack of barometric pressure measurements at Darnhall from 28th January 2025 to 25th February 2025, barometric pressure data collected by a transducer installed at Cringletie was used for this period, with a correction applied based on the difference in barometric pressure between the two sites for their final corresponding measurement.

The processed groundwater level data is presented in Figure 2. Data spans from December 2021 to February 2025 for most accessed piezometers, other than EDS1b and EDS2b, were data spans from December 2020 to February 2025 and December 2021 to August 2024 respectively.

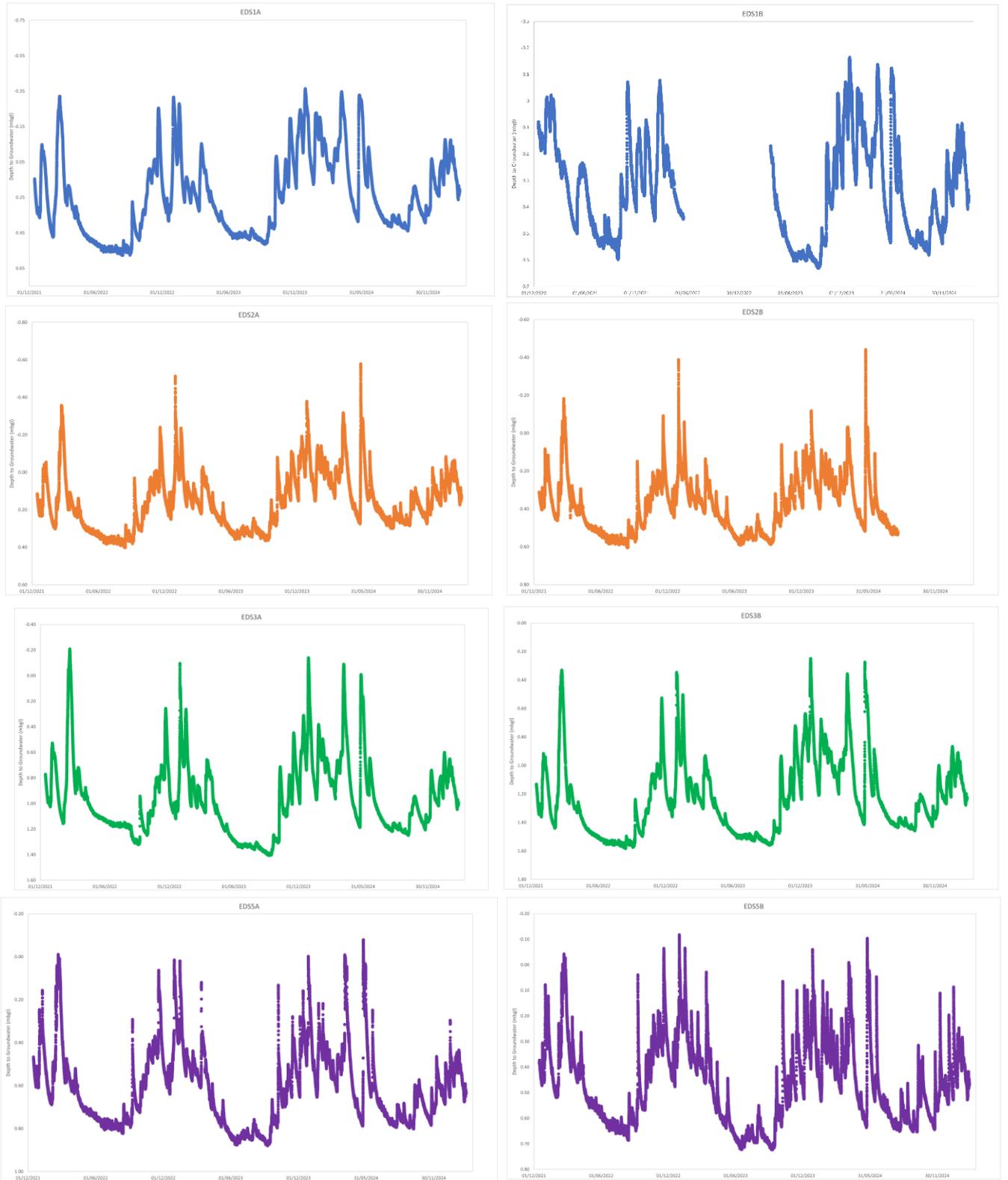


Figure 2: Groundwater levels within Darnhall floodplain boreholes for period December 2021 to February 2025.

3 Cringletie Hillslope Monitoring

In 2020, Dr Leo Peskett ceased maintaining the Cringletie hillslope observatory installed during his PhD (Peskett et al. 2020). The site consists of 14 soil moisture sensors, 2 rain gauges and 7 piezometers fitted with pressure transducers. BGS have since kept a low level of infrastructure maintenance and continued to download the data.

Following the site visit, current monitoring infrastructure appears to be predominantly redundant, as outlined in Section 3.1 and 3.2. It is recommended that either a) the Cringletie monitoring infrastructure is removed and the site decommissioned or b) redundant infrastructure is replaced, along with deepening of boreholes located within the transects, to allow for a more complete timeseries of groundwater level data to be collected.

3.1 GROUNDWATER LEVELS

Only 4 of the 7 piezometers were located during the February 2025 site visit: one grassland transect (G1); and three forest transect (F1b, F2a and F2b), all located within or immediately adjacent to the fenced woodland area. Piezometer F2a was no longer capped at the surface and had been infilled with debris. The pressure transducer within this piezometer was no longer attached and is believed to have fallen down the hole. Data was therefore only downloaded at three piezometers.

The transducer located within piezometer G1 was replaced by a new unit, due to low battery. Battery for the transducers located within piezometers at F1b and F2b, along with a third transducer monitoring atmospheric pressure within F2b remains low, but lack of spare transducers meant these could not be replaced. These remaining transducers were cleared, reset and reinstalled at the end of the visit.

The groundwater level data were barometrically compensated for atmospheric pressure and quality checked. Lack of previous processing and installation information, combined with the borehole being dry at the time of data download created difficulty with processing groundwater level data collected from F2b, therefore this site has been excluded from analysis.

Piezometers G1 and F1b were dry for significant periods, particularly throughout the majority of summer months, as can be seen from the data (Figure 3).

3.2 SOIL MOISTURE SENSORS AND RAIN GAUGES

In March 2023, it became evident that the soil moisture sensors had reached the end of their functional life and most were removed, initially for servicing and repair work. Subsequent discussions resulted in the decision for these soil moisture sensors to not be reinstalled. By February 2025, the remaining soil moisture sensors appeared to be in poor condition and their removal is also recommended.

During the February 2025 visit, the rain gauges which were previously in poor condition, were no longer functional. The lower slope rain gauge was destroyed, along with its perimeter fence, and whilst the upper slope rain gauge was in-situ, it no longer appeared functional. Removal of the remaining rain gauge is recommended.

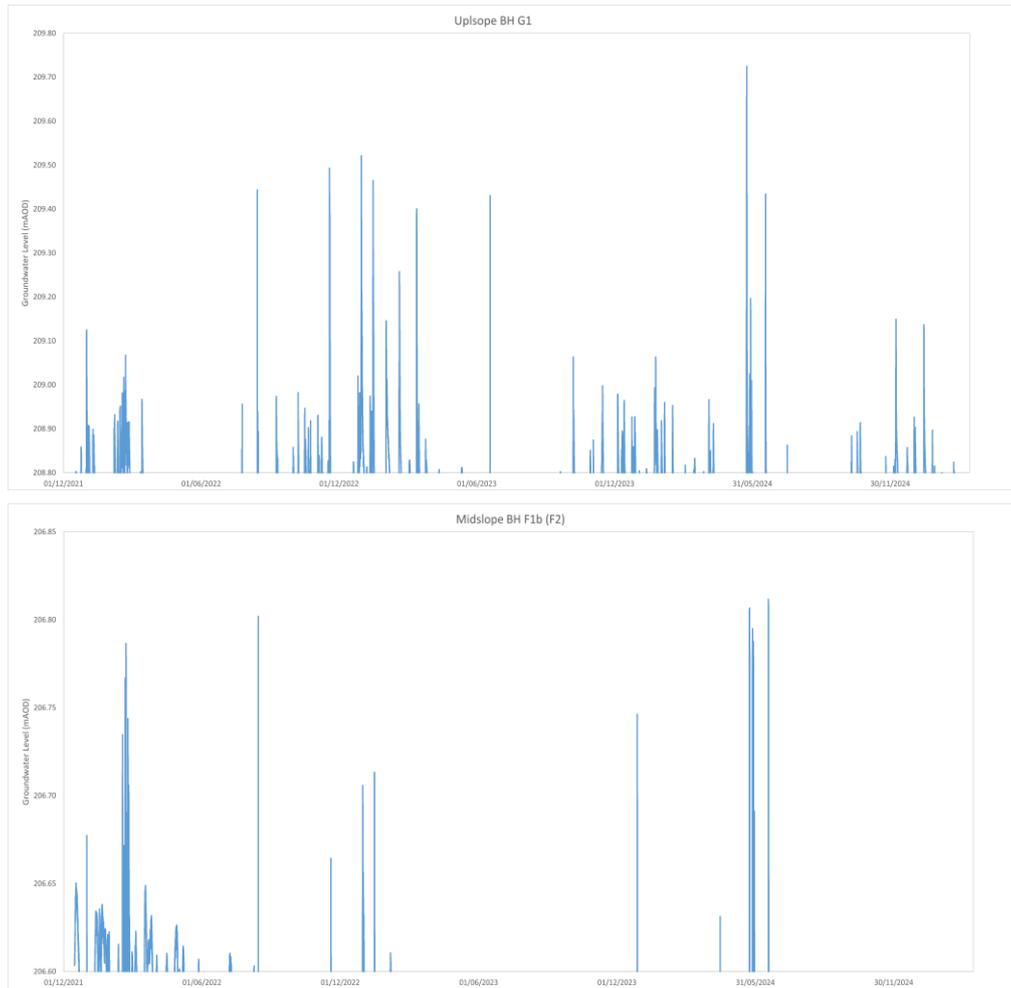


Figure 3: Groundwater levels for the two remaining sites at Cringletie after barometric compensation, from December 2021 to February 2025.

4 Conclusions

Monitoring at the Darnhall Floodplain in Eddleston remains ongoing for most locations. Following the latest download, good quality data records are available for six of eight original piezometers. Equipment within these six piezometers has been replaced as required, and it is recommended for monitoring to continue at all six sites, as this dataset is currently providing a useful and long-term dataset of good quality, providing insights into the differential responses between the main floodplain and the floodplain edge.

Unfortunately, the monitoring network at Cringletie is no longer fully operational. Minimal data was recovered during the last data download, with only four of the seven original piezometers located, two of which are continuing to collect groundwater level data. The soil moisture sensors and rainfall gauges are no longer functional. It is recommended that this monitoring network is decommissioned. Should the site be selected for future monitoring, design and installation of any network should commence from the beginning.

Data collected will be uploaded in due course to the National Geoscience Data Centre (<https://www.bgs.ac.uk/geological-data/national-geoscience-data-centre/>) to complement the pre-existing dataset (ID 128585).

References

The British Geological Survey holds most of the references listed and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at <https://of-ukrinerc.olib.oclc.org/folio/>

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