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What are the environmental monitoring probes measuring?

- The Vindolanda Trust is at the forefront of data collection and analysis on climate change and its impact on Hadrian's Wall. As of 2026, we are the only archaeological site on the Wall collecting buried environment data.
- We have underground probes at both Magna and Vindolanda. We also have two weather stations, one at each site. These systems were installed at Magna in 2022 and Vindolanda in 2023. The probes take readings of 8+ factors every 15 minutes. Combined, these factors help us to better understand the conditions of the soil at various depths across the site.
- As of January 2026, we have 9 million data points. This means we get more than 2,000 data points per day from Magna, and more than 5,000 from Vindolanda.
- The most important variables for general knowledge are: rainfall, groundwater level, pH, and Oxidation-Reduction Potential (ORP or Redox).
- These probes will collect data for ten years. This data is owned by the Vindolanda Trust, and is being interpreted by a team of specialists, both in-house and in wider academic circles. This means we have a large quantity of complex data that can be used to inform our decisions on how to manage the site.
- These probes were installed as a direct response to observed changes in the preservation of some of the organic artefacts.
- The sensors are placed at different depths up to 2.40m below ground level.



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What is the difference at the two sites?

- The Vindolanda Trust monitors environmental conditions at both Vindolanda and Magna, allowing researchers to compare how climate change is affecting each site differently.
- At Vindolanda, soil conditions are changing in an unpredictable, erratic way rather than following expected seasonal patterns - unlike Magna, where conditions still broadly follow the seasons.
- Organic artefacts (such as wood, leather, and textiles) found during current excavations at Vindolanda are more degraded than similar objects uncovered in earlier digs at the same depth, suggesting conditions underground are worsening.
- Vindolanda has a weather station and three underground monitoring probes: one in the Antonine water channels in the civilian settlement, one in the Severan rampart, and one in the south-western area of the 3rd-century fort, each tracking changes in different parts of the site. These underground probes range from 120cm - 240cm in depth.
- At Magna, monitoring equipment includes a weather station with a probe array in the northern field, plus a series of piezometers (devices that measure water pressure and movement in the ground) installed at four locations across the site in 2021. A new probe array was installed in summer 2026 in the southern ditch of the fort.
- The data gathered at Vindolanda will directly shape future decisions about excavation, helping to identify which areas are deteriorating fastest and need to be prioritised in the next Scheduled Monument Consent (SMC) application.
- At Magna, the monitoring data will be used to predict how the landscape might change in the future, helping the Trust plan how best to protect the site in the long term.



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What is the impact of extreme weather patterns?

- The UK climate is warming. Four of the ten hottest summers recorded up to 2019 happened in the last two decades and these more extreme weather patterns are directly affecting conditions underground at both sites.
- When soil dries out, it leaves more room for fresh water from rainfall to enter it. This rainfall has a higher oxygen content, which activates microbes in the soil, breaking down organic materials like wood, leather and textile. And so, the more oxygen-rich the soil, the faster artefacts decay.
- Heavy, sudden rainfall has an equally damaging effect. It causes sudden shifts in soil chemistry that destabilise preservation conditions. 2024 was the wettest year on record since records began in 1774, and both sites experienced notable dry periods in 2023 and in winter/spring 2025, showing how rapidly conditions can swing between extremes.
- Volatility in data readings at Vindolanda is particularly surprising at depths of up to 240cm, conditions at that depth would not normally be expected to fluctuate so sharply. Even where average readings appear relatively stable, the environment is not consistently stable enough to reliably preserve organic material.
- One possible response to drying conditions might be to rewild or reflood sites to raise water levels, but this carries serious risk. Introducing the wrong type of water or changing the water chemistry too quickly could actively accelerate decay rather than prevent it.
- Any intervention to manage water levels would need very careful planning, taking into account water chemistry, the rate of environmental change, and the specific conditions at each site.



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What will we lose and why?

- The soil conditions at both Vindolanda and Magna are changing, and the monitoring data shows this is already having a real impact on the preservation of organic artefacts, such as wood, leather, and textile.
- The last textile to be excavated at Vindolanda was found in 2018, more than 7 metres underground. Research into the leather objects already in the collection has shown that, at a cellular level, they register higher levels of degradation in situ from the 1990s onwards.
- Some artefacts will still be found in future excavations, but they are likely to be in poorer condition than those found in the past, meaning less information can be recovered from them. Other artefacts, like textiles and tablets, might not be found at all. We also risk losing ecofacts, such as insects and vegetation, which help us provide a more complete picture of the ancient environment and the diets of people.
- Wood survives best in low-oxygen (reducing) conditions, where microbial activity is slowed right down. When conditions shift, as they increasingly are, decay accelerates rapidly.
- In acidic conditions, a chemical process called hydrolysis breaks down cellulose, causing the inner cell walls of wooden objects to collapse and disintegrate.
- In alkaline conditions, wood swells and its internal structures break down, particularly lignin, the compound that gives wood its rigidity and natural resistance to rot.
- In oxygen-rich (oxidising) conditions, microbes and fungi feed on both cellulose and lignin.
- The writing tablets and other organic finds from Vindolanda are irreplaceable. Once the conditions that preserved them for nearly 2,000 years are gone, so too is everything still buried that we haven't yet found.



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How are we changing policy?

- For decades, the guiding principle in archaeology has been that buried remains are safe if left undisturbed. This idea is enshrined in the 1992 Valletta Convention, an international agreement that shapes how archaeological sites across Europe are managed and protected.
- The research at Vindolanda and Magna is directly challenging this assumption. The data shows that buried material is no longer automatically safe, changing climate conditions mean that leaving artefacts in the ground is not the preservation strategy it once was.
- The work being done at these sites aims to understand the full consequences of this shift, and to use that evidence to push for updated guidance and policy that reflects the reality of a changing climate.

'Climate Change is a myth'- challenging assumptions

- Whether or not someone believes in climate change being influenced by humans, the archaeological evidence at these sites is measurable and concrete - soil conditions are changing, and organic artefacts are degrading faster than they were in previous decades.
- In an archaeological context, the consequences are straightforward: changing conditions in the soil mean we are losing organic artefacts, and with them, irreplaceable evidence about everyday life nearly 2,000 years ago.
- There is, however, a positive message here. We have the tools to monitor, understand and potentially influence these changes. The research at Vindolanda and Magna puts archaeology at the forefront of that effort.



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