Monitoring soil hydrology for Giant Gippsland Earthworm *Megascolides australis* on a streamside bank in Gippsland, Victoria.

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Key points

- Soil moisture is a key influence on detection rates “gurgles” of the GGE in known colonies at a pilot study in Arawata, Gippsland, Victoria.
- Unusually dry conditions occurred throughout dry times during the projects duration
- This led to a decrease in soil moisture and reduced gurgle counts suggesting GGE moved away from the surface which had hotter and drier conditions than those at 80cm depth.
- Dry seasonal conditions resulted in a more rapid drawdown of moisture in areas where vegetation had been planted prior to the projects initiation confirming the importance of zoned planting.

Abstract

The Giant Gippsland Earthworm (*Megascolides australis* McCoy 1878; GGE) has been identified by the Australian Government as a Saving Native Species (Priority Species). It is listed as Vulnerable under the Environment Protection and Biodiversity Conservation Act 1999 and Endangered under the Flora and Fauna Guarantee Act 1988, with populations at risk from altered soil hydrology.

In a 21-month pilot study, we monitored soil hydrology within habitat occupied by a healthy GGE colony at Arawata, Gippsland, and in adjacent uncolonised areas. Colony activity was assessed through counts of audible "gurgles", which are produced when moving earthworms displace water within their burrows. Environmental probes monitored soil moisture and temperature to a depth of 80 cm, and soil oxygen at 30 cm.

GGE occupy specialised habitat within moist clay-based soils on hillslopes with terracettes and along creek banks in South and West Gippsland. As an anecic species, they move vertically through the soil profile in response to changing environmental conditions.

Monitoring was undertaken in known habitat areas and adjacent sites to better understand soil moisture conditions within and between colonies. During the study period, Gippsland experienced below-average rainfall for extended periods. Surface soil moisture and temperature showed high variability in response to rainfall, while deeper soils remained comparatively stable.

As soil moisture declined, fewer gurgles were detected, suggesting reduced earthworm activity under drier conditions. A revegetated site also exhibited a rapid decline in deeper soil moisture during summer, potentially associated with vegetation drawdown. These findings indicate that reductions in soil moisture may limit GGE mobility and increase risk to the species, highlighting the importance of careful land management and revegetation planning near known colonies.

Keywords

Giant, Gippsland, Earthworm, clay, waterway, revegetation moisture, monitoring

Introduction

The Gippsland Giant Earthworm (GGE) occurs within a relatively small area of south and west Gippsland, Victoria, broadly bounded by Warragul in the north and Loch and Korumburra in the south. Although its overall range is about 40,000 ha, individual occupied sites are often very small, sometimes less than 10 m^2. Remaining colonies are commonly associated with streamside habitats in the upper reaches of small tributaries and creeks. The species typically occurs in deep, moist clay soils along creeklines and soaks, indicating that soil moisture is critical to its survival. However, the specific soil and hydrological conditions needed to support healthy populations remain poorly understood. Like other earthworms, GGE depends on soil moisture to breathe, move and feed, exchanging gases through its skin via a thin film of water. Without adequate moisture, it cannot survive.

The implications of streamside and waterway management for GGE habitat are therefore important to the conservation of this species. As with the property used for this pilot study, revegetation is sometimes undertaken with good intentions on or near GGE colonies. In a concurrent project, Landcare networks, threatened species action groups and subject experts assessed multiple sites in detail and developed an app to help local landholders record GGE presence on their properties.

Because much of this habitat was cleared for agriculture 150 – two hundred years ago, many sites now lack native vegetation, and the species is found mainly in exotic dairy pastures (Van Praagh and Yen 2010). Unlike many native terrestrial species affected by clearing, GGE has persisted in these modified landscapes, although its distribution appears to have contracted to small, localised habitats such as creek banks and steep hillsides with terracettes.

Previous studies and consultant surveys found that most GGE populations occur within 40 m of a stream bank and are often confined to within 5 – 10 m of the bank (Van Praagh 1999) and (Van Praagh 2026). Protecting stream banks is therefore essential and may include fencing to exclude livestock, reducing pugging and compaction and allowing natural regeneration and revegetation. Because GGE likely depend on soil moisture, revegetation should avoid dense plantings of larger shrubs and trees that could alter local soil water conditions. This is especially important for projects funded by Melbourne Water, Landcare groups and private landholders, so that GGE habitat needs, including soil moisture, are properly considered when planning streamside revegetation.

Aims

The aims of the pilot study project were to monitor soil moisture, temperature, and oxygen levels over a 22-month period at multiple key GGE sites adjacent to a waterway in Gippsland, Victoria. This involved:

- Site selection within a suitable property (identified by Bass Coast Landcare Network, in collaboration with the project partners);
- Development of a soil probe monitoring network, for assessment of parameters to a depth of 80cm, for known GGE habitat site with an active colony and non-earthworm activity (outside habitat and colony) running upbank from a waterway;
- Monitoring soil parameters of soil moisture and temperature (depth at 10cm intervals to 80cm), soil oxygen to 30cm depth;
- Determination of weather conditions, using local weather stations and soil parameters over the monitoring period;
- Comparison of data between GGE habitat within the colony and adjacent non-GGE habitat outside the colony; and
- Analyse the success of probes and determine opportunities for improvements with the equipment.

An ancillary objective was to share project findings through a public field day, educational video production, and the expansion of resources on www.giantearthworm.org.au, including use of the interactive GGE habitat tool developed in a previous project.

During the project an additional probe to measure soil moisture and temperature was placed in adjacent fenced land that the landholder had recently revegetated to compare data in that site compared to the remainder of the probes linking the concurrent projects (Van Praagh 2026 and Oates 2026).

Figure 1 Property used for GGE soil hydrology monitoring at Arawata, Victoria

Method

This project examined the role of soil hydrology in sustaining GGE colonies. A long-term monitoring program was established to measure soil moisture, temperature and oxygen at depth, together with rainfall and earthworm activity (gurgling) over almost a two -year period (May 2024 – February 2026). The aim was to identify how moisture conditions vary through the soil profile and how these changes influence earthworm presence and activity.

At Arawata, Gippsland soil probes (Figure 2) were installed to monitor conditions at multiple depths (10 – 80 cm) across four locations on a south-east facing slope:

- Two areas with active GGE colonies
- One area with no earthworms (comparison site)
- One revegetated area within colony

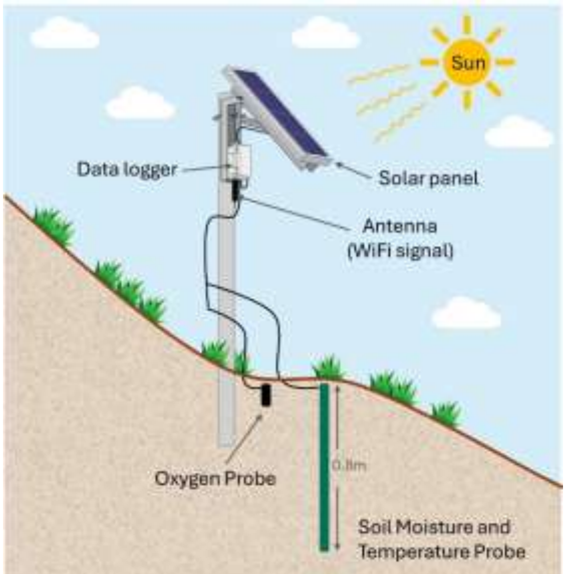

Figure 2 Probe and data logger

Site selection

Site selection was undertaken to identify locations that were suitable for environmental monitoring while minimising potential impacts on GGE and their habitat. Selection was informed by habitat characteristics, evidence of GGE presence, monitoring requirements, and long-term site management considerations. The final locations of the environmental monitoring probes following site selection are shown in Figure 3.

Key factors that informed site selection included:

- **Presence of a colony (GGE)**: Gurgles from GGE movement through moist tunnels were detected prior to probe placement. Gurgles were assessed acoustically – surveyors listened at each location for a set period, and any gurgle heard was recorded along with the location and time.
- **Soil characteristics**: Manually assessed to confirm suitability. The species is associated with grey and red clay-based soils.
- **Exploratory digs**: A small exploratory dig was carried out by Invert-Eco experts at each probe site to confirm tunnel presence and to allow worms the opportunity to move clear of the impact area before the auger was used for probe placement.
- **Monitoring potential**: The site allowed for installation of environmental probes both within and between colonies across a habitat gradient.
- **Site accessibility and longevity**: The property could be accessed safely and consistently for ongoing maintenance and monitoring.
- **Land tenure and management**: The landholder granted consent for site access, and the site offered potential for long-term protection, with fencing installed to exclude cattle from probe locations.
- **Habitat diversity**: The site featured a range of microhabitat conditions, including:
  - Blue-grey clay soils in the creek bank
  - Terraced creek banks and soaks
  - South-facing slopes

Habitat assessment was carried out by Invert-Eco during May and July 2024, using standardised GGE survey techniques, including acoustic listening for gurgles and small exploratory quadrat digs to identify burrows.

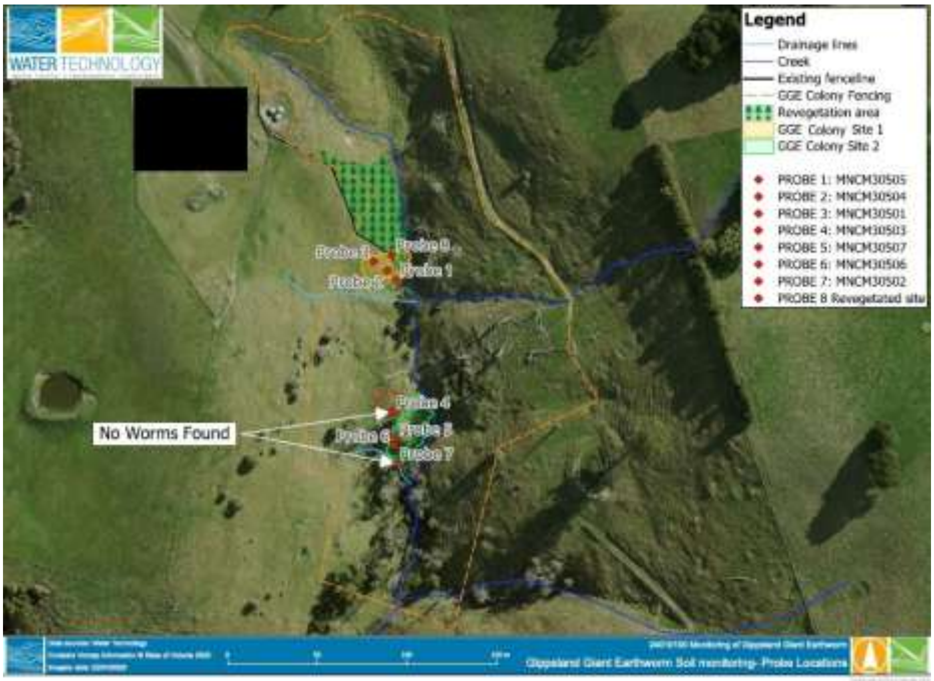

Figure 3 Aerial map of probe locations and site

Results

Rainfall

Overall, rainfall during the study period (June 2024 – mid March 2026) deviated substantially from the long-term average pattern for the area (Figure 4). While the region typically receives relatively evenly distributed rainfall throughout the year (approximately 60 – 95 mm per month, with the most in spring), observed rainfall during the monitoring period was characterised by pronounced variability from the average between months. Extended periods of below-average rainfall for six months (December 2024 – June 2025) were interspersed with isolated high-intensity rainfall months (e.g., July 2024, July 2025, and October – November 2025). In January 2026 much lower than average rainfall occurred exacerbating the dry conditions shortly after higher-than-normal rainfall events. This rainfall fluctuation provides important context for interpreting the observed soil moisture and soil temperature dynamics.

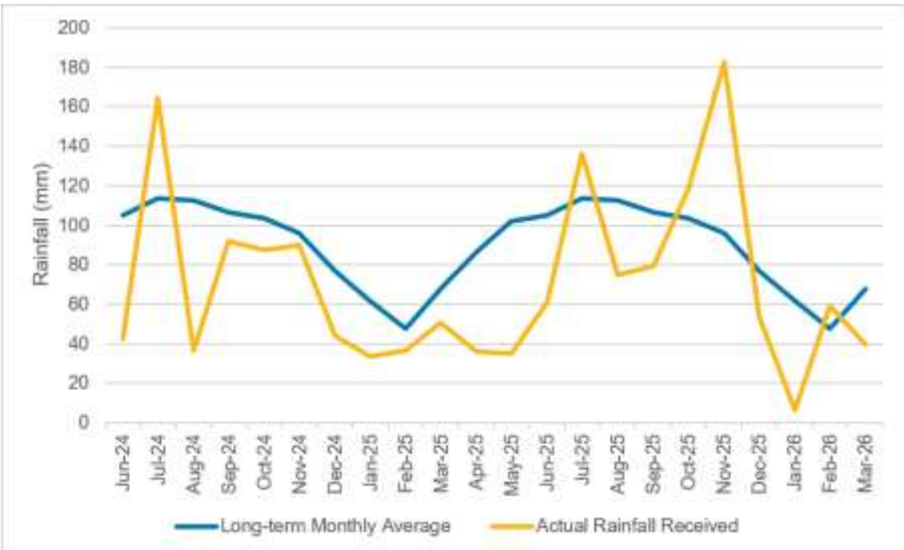

Figure 4 Graph comparing the average rainfall vs the actual monthly rainfall between May 2024 and to mid-March 2026

Soil moisture

The original graphs contained data from eight monitoring depths, making visual interpretation complex. To improve readability and facilitate comparison between monitoring locations, three representative depths were selected for presentation in all figures: shallow (surface soil 10 cm), mid-depth (40 cm), and deep (80 cm, the maximum probe depth).

Annual soil moisture trends observed during the monitoring period (Figure 5) included:

- Strong episodic spikes following rainfall events.
- Shallow soil moisture (10 cm) responded immediately after rainfall events and were characterised by:
    - high variability;
    - sharp increases after rainfall; and
    - rapid decline during dry periods.
- Mid-depth soil moisture (40 cm) responded more gradually and were characterised by:
    - moderate variability;
    - delayed recharge following rainfall events; and
    - slower rates of drying.
- Deep soil moisture (80 cm) exhibited the slowest and least pronounced response to rainfall and were characterised by:
    - the greatest stability in soil moisture conditions;
    - slow recharge and drying rates; and
    - soil moisture patterns that reflected longer-term water balance processes rather than short-term rainfall events.

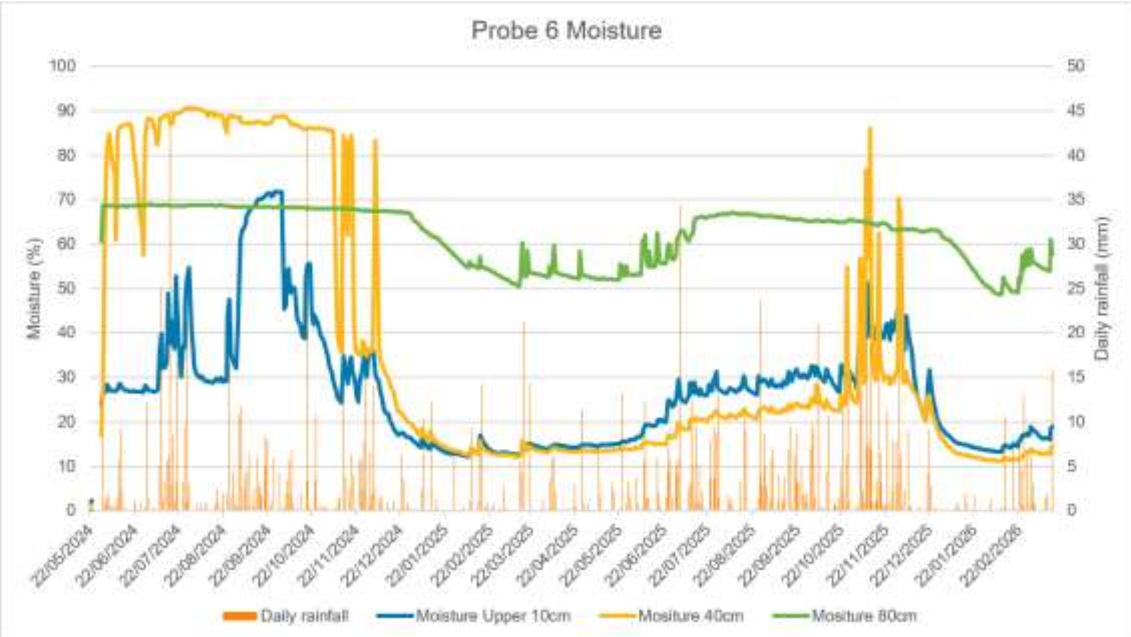

Figure 5 Graph showing the data from May 2024 – March 2026 of moisture for probe 6 at three depths and daily rainfall

Revegetation site

This probe didn't consistently work through unknown reasons. However, sufficient data was collected to make a comparison between the site here and an adjacent probe that was not revegetated, within the same colony. Using the soil moisture monitoring probe (probe 8) located within the revegetation site in the Site 1 colony, we compared data during the August to December 2024 time period.

Comparison of the revegetation site (Figure 6) and the closest non-revegetated probe (Figure 7) over a short duration (6 months) showed the following differences and similarities:

- A different response to dry weather with a sudden decline at depths of 80cm and less response to rainfall events.
- After initial large peaks and flows response to rainfall events was not as dramatic in the revegetated location compared to non-revegetated site.

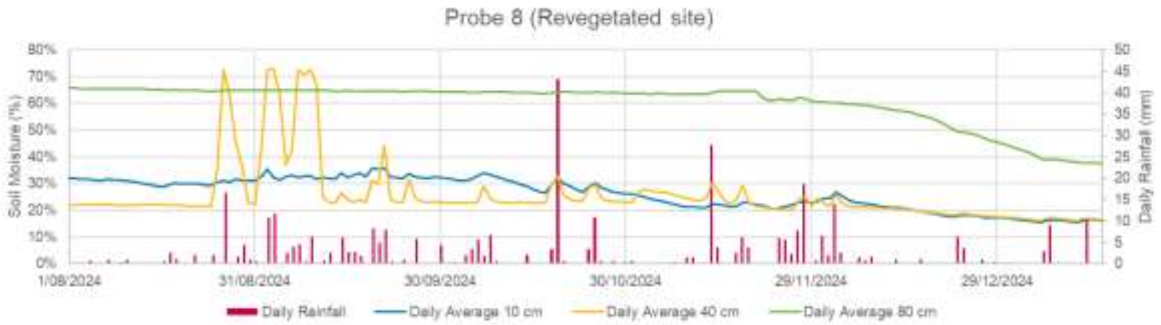

Figure 6 Percentage of soil moisture at probe 8 between August 2024 – January 2025 against daily rainfall

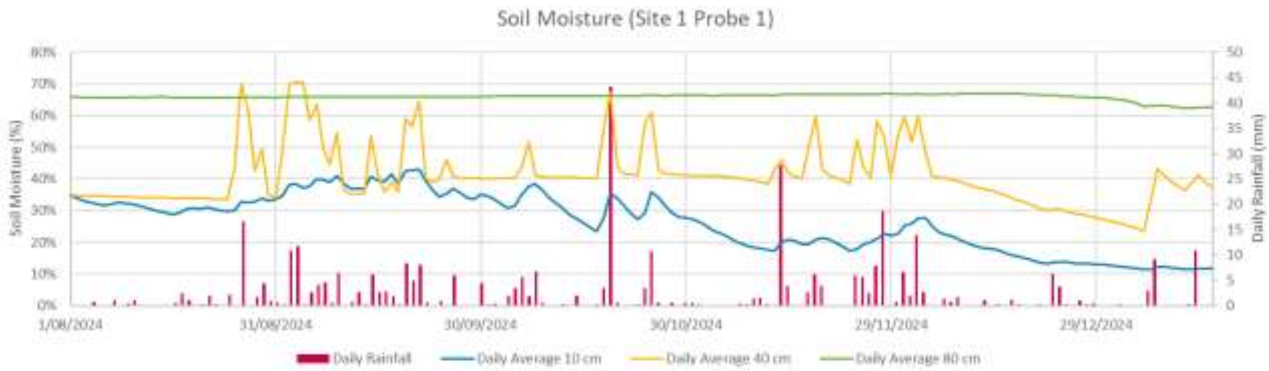

Figure 7 Percentage of soil moisture at probe 1 between August 2024 – January 2025 against daily rainfall

Gurgle count changes with soil moisture

"Gurgles" the movement of individual worms through soil can be heard from above ground when a disturbance (e.g. noise impacting ground) is made. In formal counts of GGE while traversing the colony, Van Praagh (2026) found that a higher number of gurgles occurred at the start of the project during site selection in May 2024 (55 which were located both across (27) and between (28) the two sites) and during probe installation (multiple were heard) in late May 2024. In an assessment on 15 May 2025 just three gurgles, one at site 1 and two at site 2 were heard. While on 16 October 2025 six gurgles were detected, one within site 1 and 4 within site 2. An opportunistic observation of 16 gurgles was observed in wetter conditions in November 2025 (Oates *pers comm.* 2025). Two assessments in January and February 2026 did not detect any GGE at either of the sites using the same method. However, on 4 March 2026, one gurgle was located and opportunistic observations located 2 gurgles on 18 March 2026 during data retrieval.

The impact on GGE colonies as a result of the seasonal changes in weather and soil moisture content:

- GGE near the soil surface would experience high variability in conditions.

- GGE at depths likely benefited from more stable conditions and would have potentially buried themselves deeper within the soil in drier times whilst in sustained moist times were likely to be near the surface.

From a soil/GGE interaction perspective:

- Temperature stability increases with depth.
- Deeper placed GGE experience less thermal stress.
- Surface layers are more vulnerable to rapid temperature swings, suggesting GGE may move deeper to avoid desiccation.

Extreme heat events influence shallow soil most strongly but are moderated quickly with depth which may be avoided by GGE and explain their capacity to live in the Gippsland soils for as long as they have.

The following Figure 8 shows the number of GGE "gurgles" at the project site vs Probe 6 as an indicator of soil moisture.

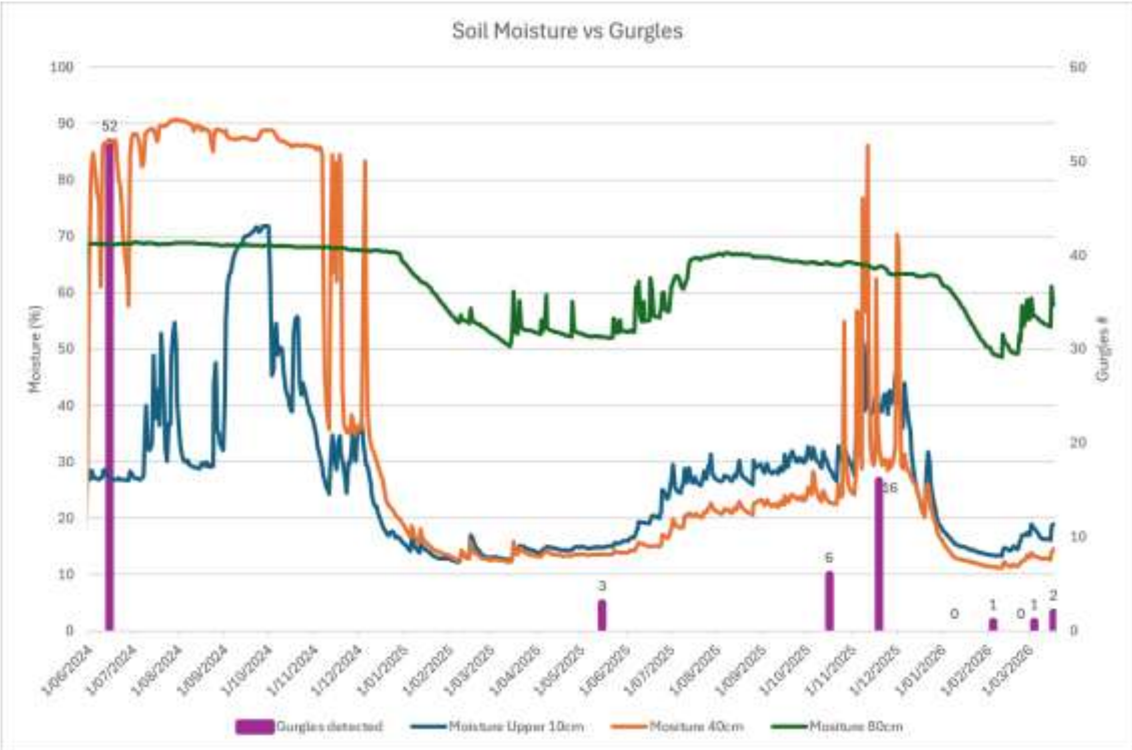

Figure 8 Graph showing the soil moisture at one probe (probe 6) compared to Gurgles across site May 2024 – March 2026

Reason for this research

This project "*Threat Mitigation and Soil Hydrology in Giant Gippsland Earthworm Habitat*", funded by the Australian Government under the Saving Native Species Program, set out to better understand how soil moisture and hydrology influence GGE habitat, and to support landholders in protecting this unique species.

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For further information visit info@giantearthworm.org.au

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