PML | Plymouth Marine Laboratory

Research excellence supporting a sustainable ocean

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Environmental Monitoring at Calstock

Measuring the effectiveness of Nature-based Solutions

A bridge over the breach in the flood bank at Calstock flood defence improvement scheme, Jan 2022. Photo: Will Jay, Airborne Earth Observation Data Analyst at PML

Since the Calstock flood defence improvement scheme was completed in November 2021, scientists from the Marine Biogeochemistry and Observations team at Plymouth Marine Laboratory (PML) have been routinely visiting the site to monitor changes in water biology and chemistry as the area develops into an established wetland habitat.

Managed coastal realignment is one of many Nature-based Solutions (NbS) being delivered across the UK and internationally to restore lost habitats, increase biodiversity and respond to the impacts of climate change. It is important that we understand how these solutions impact water quality and climate regulating ecosystem services. This involves investigating rates of carbon storage and the production or consumption of greenhouse gases, such as nitrous oxide and methane, in the water.

Thanks are given to the partnership between the Environment Agency, Tamar Community Trust, Calstock Parish Council, Calstock Footpath Society and Tamar Valley AONB for allowing PML access to the Calstock wetland to conduct this scientific research.

What's being measured?

On each visit the PML team work over a 6-hour tidal cycle at the Calstock breach. Every 30 minutes a sample of water is collected from the channel which feeds water from the River Tamar into the site. This allows the team to measure what is coming in and out of the wetland with the rise and fall of the tide. The temperature and salt content of the water are recorded before dividing it into 11 smaller samples. These samples are then taken back to Plymouth Marine Laboratory where they are analysed for nutrients which include nitrate and phosphate, greenhouse gas concentrations, pH, dissolved and suspended carbon, bacteria, algae, and DNA. This tells us about the biological and chemical processes taking place in the water.

Member of the PML Marine Biogeochemistry and Observations team taking a water sample under the bridge at Calstock

How could this data be used?

Calstock has presented a unique opportunity to measure changes in climate relevant biogeochemical processes right from the initial stages of a wetland created through managed coastal realignment. The information collected will inform Earth System models to better understand regional and global climate processes and provide a case study for measuring the effectiveness of NbS in mitigating the impacts of climate change. This will help environmental managers and policy makers to make informed decisions based on robust scientific evidence in the design and implementation of future NbS.

What are the results so far?

Initial results show that the new Calstock wetland is 'cleaning' the water that flows in and out of it by reducing nutrients. This is important because excess nutrients from agriculture and wastewater treatment can cause blooms of microorganisms during a process known as eutrophication. This uses up the oxygen in the water and makes it difficult for other species, including fish and other important microorganisms, to survive. The team at PML will be closely monitoring this story and how it might affect climate-relevant processes now and into the future.

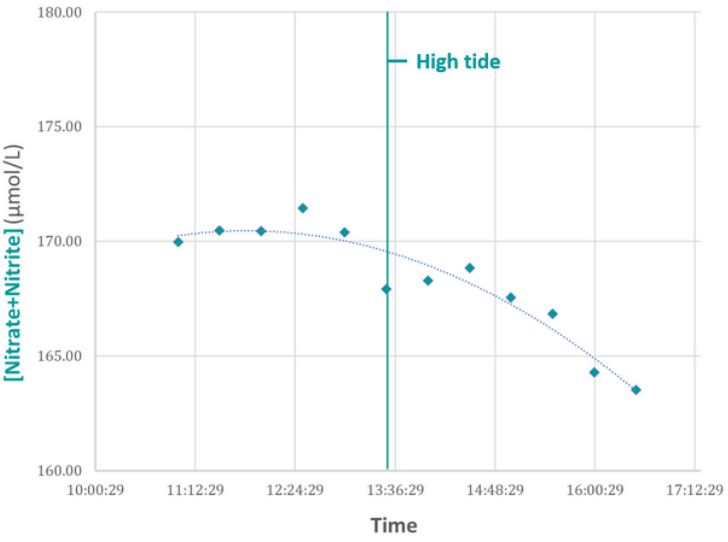
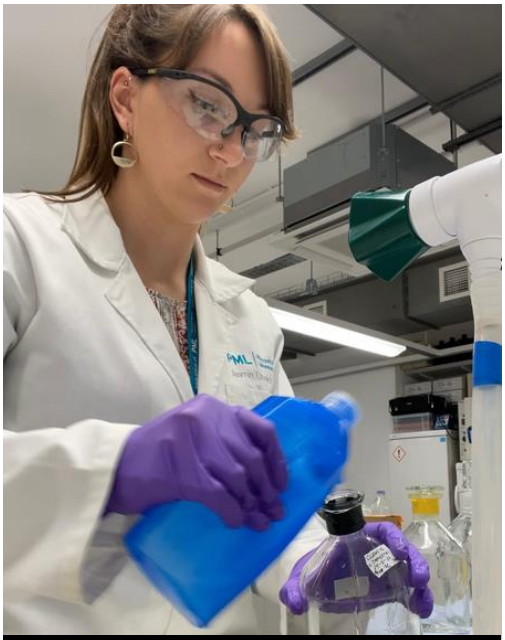


Figure 1. December 2021 Nitrite+Nitrate (µmol/L) reduction over 6-hour tidal cycle at Calstock flood defence improvement scheme. Data analysed by Malcolm Woodward, Plymouth Marine Laboratory



Member of the PML Marine Biogeochemistry and Observations team preparing water sample bottles in a laboratory

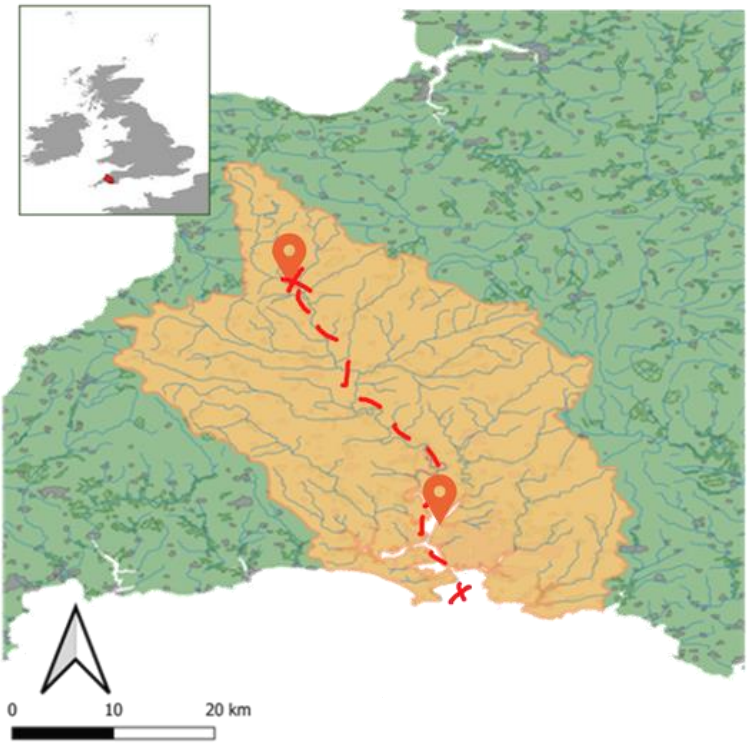


Figure 2. A map of the River Tamar catchment in Devon, South West UK. The red dashed line depicts the environmental monitoring transect along the River Tamar from river to coast

The Big Picture: from catchment to coast

The Marine Biogeochemistry and Observations team at Plymouth Marine Laboratory have been gathering information on nutrient, carbon and greenhouse gas cycling processes from river catchments to coastal seas. The Land Ocean Carbon Transfer (LOCATE) project was delivered between 2017-2022 and produced an extensive and detailed dataset highlighting key areas in the River Tamar catchment and surrounding tributaries important for climate regulating processes. This work is continuing through the AgZero+ project between 2022-2025 which seeks to better understand the effects of land management practices, including NbS, on freshwater and marine biogeochemical cycles and efforts toward achieving net-zero emissions of greenhouse gases. This work has been funded by the NERC Cross-centre National Capability.

For more information contact:

Dr Andy Rees - Marine Biogeochemist
apre@pml.ac.uk

Jasmin Dorinda - PhD Researcher in Environmental Sciences
jaur@pml.ac.uk