

# GROUNDWATER MONITORING

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CASE STUDY COMPILATION



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Groundwater monitoring can be used for a multitude of applications, each with their unique importance. Around the world, groundwater data is impactful to help key decision makers work more efficiently and with more information than ever. We've compiled 3 customer highlights from across the globe that exemplify the importance of groundwater monitoring:



AQUIFER MONITORING  
AROUND THE NORTHERN  
TEXAS PANHANDLE



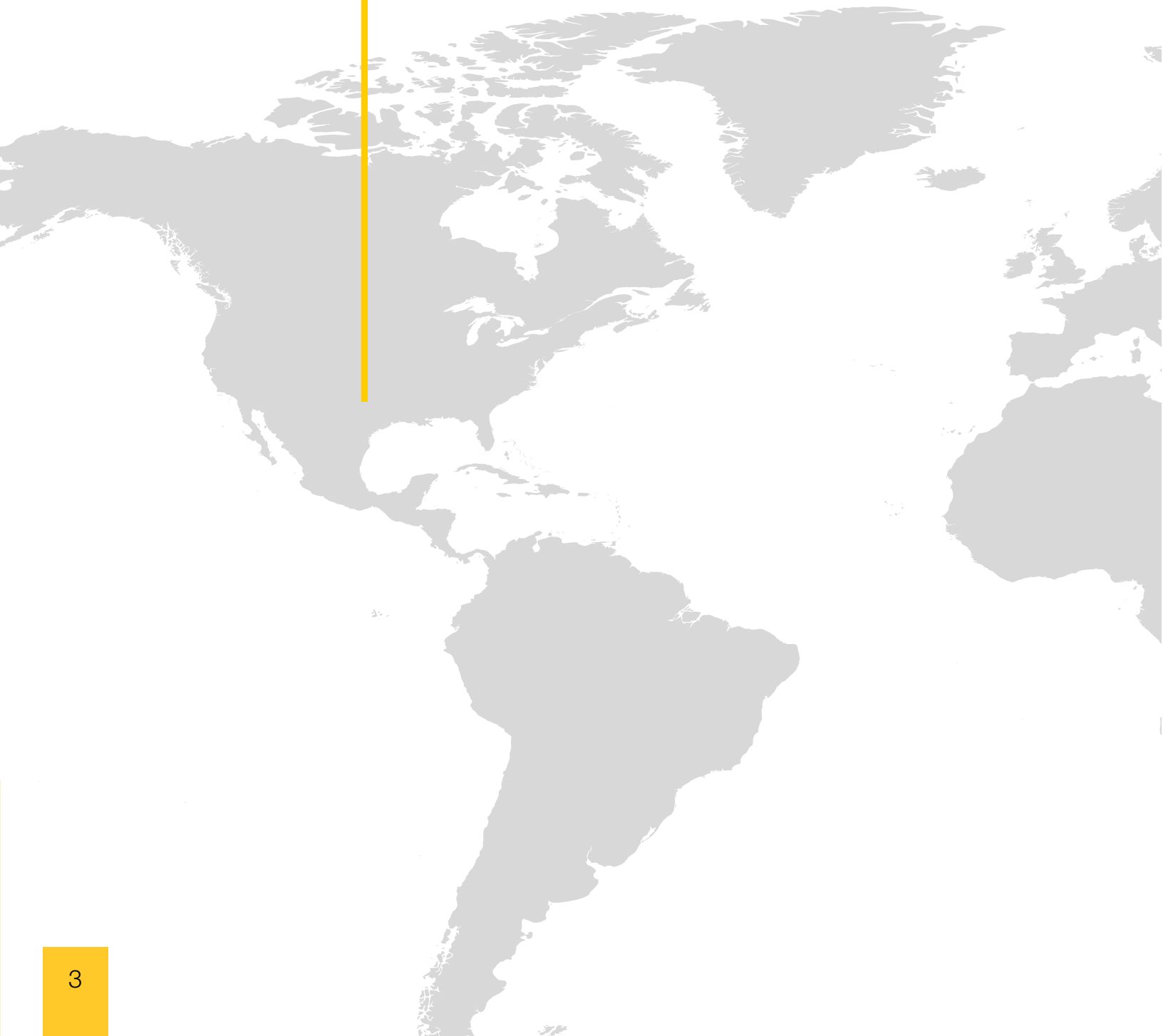
ADDRESSING MINING POLLUTION  
ACROSS THE UNITED KINGDOM



MONITORING PEATLAND  
RESTORATION IN SCOTLAND

# AQUIFER MONITORING AROUND THE NORTHERN TEXAS PANHANDLE

 Texas | United States





# BACKGROUND

Established in 1955, the North Plains Groundwater Conservation District identifies future groundwater concerns in the northern Texas panhandle and creates solutions for anticipated problems before they develop. It does this through a variety of methods, including collecting groundwater information, performing water quality analyses, and providing a number of well system tests.

In 1982, the district began a monitoring well program to track water levels for the Ogallala aquifer in the district. Approximately 95% of water from the Ogallala aquifer within the district goes to irrigation for crops, and the aquifer has very little recharge. This makes measuring water rise and decline rates crucial for the district, so the local Board of Directors can make wise decisions concerning the district's water resources. Besides crop irrigation, the aquifer also supplies industrial usage and municipal usage for nearby cities.

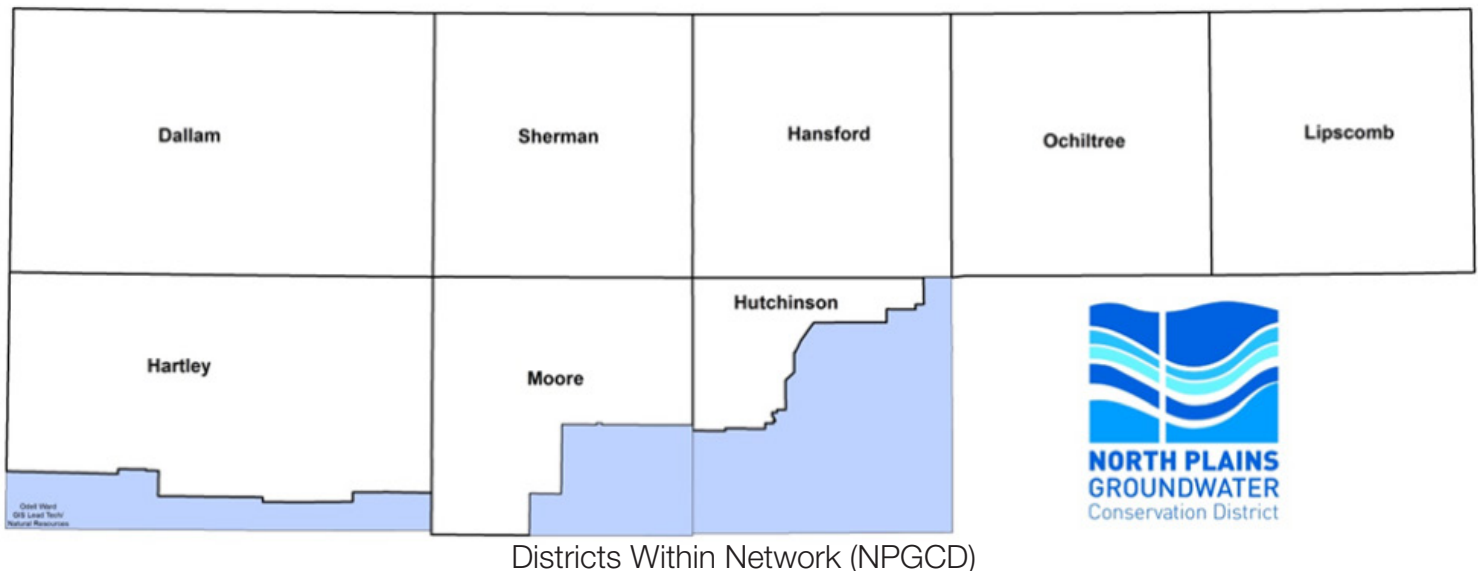


North Plains Landscape (NPGCD)



# MONITORING NETWORK

The groundwater monitoring program spans across approximately 165 miles from West to East, and (in places) approximately 60 miles from North to South. It borders Oklahoma on the North and East and New Mexico on the West to cover all or portions of 8 different Texas counties.



Since 1982, measurements were taken once a year manually. In 2006, the district upgraded their technology to measure more frequently for more insightful data.

The NPGCD began working with [SUTRON](#), a product brand of OTT HydroMet, around 2016 after realizing a need for telemetry, or remote communication, capabilities. Over time the district installed approximately 48 monitoring wells with telemetry. 37 sensors are [OTT ecoLog 500's](#) for groundwater monitoring and they are equipped with cellular units. For 11 remote stations where it was nearly impossible to get consistent cellular coverage, [Iridium Wellcaps](#) were added to send daily data through Iridium satellite communication. [OTT PLS pressure sensors](#) were also added to each of the 11 Wellcaps.

The entire program consists of 433 observation wells, of which 48 are monitored on a daily basis through OTT HydroMet equipment. Each of the 48 sites gives insight on decline rates during pumping season by measuring depth of water, temperature of water, and battery life of the sensor. The NPGCD has established an online interactive map of each station so citizens can check water level rates, which are updated every 24 hours. This near real-time data is possible through telemetry, allowing data to travel from each station to the NPGCD's local servers.

OTT HydroMet was selected for both their telemetry options and an easy and efficient setup. When the first 12 SUTRON logging transmitters were installed, several OTT HydroMet team members flew directly on-site to aid installation and provide maintenance tips. When asked why the NPGCD chose OTT HydroMet, Program Coordinator Odell Ward said, "Telemetry data allows producers within the district to better see how other wells affect their wells and the time frame for recovery after the pumping season ends. You can have data sent into the server and then get it out publicly within 24 hours."

## VALUE OF MONITORING

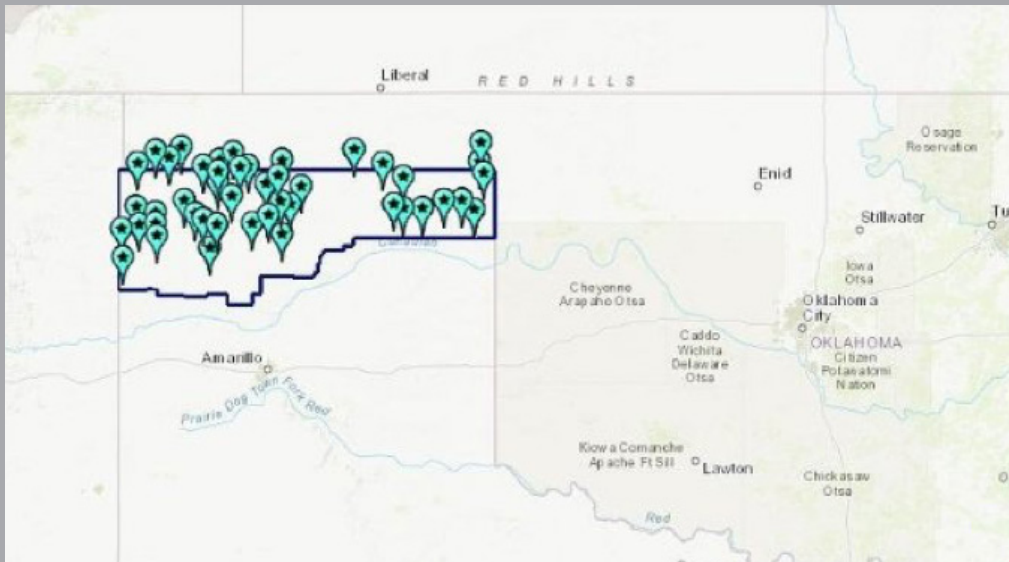
The value of near real-time data is only growing. The NPGCD particularly appreciates how transparent and visible the data has become for the producers of the NPGCD.

“It’s great how readily accessible this data is. Someone can come in and see their own area, and how it compares to other areas in terms of water decline rates and recovery (if any). You can consider putting in a new well, plan upcoming costs, and more.

– Odell Ward, Program Coordinator

The constantly updated online map serves as a tool for the public to track their aquifer data without having to wait for a yearly report. This process of disseminating is more streamlined due to the monitoring program implemented by the NPGCD.

The provided information is essential for anyone from local farmers and property owners to local government agencies and helps further the NPGCD's goal of maintaining way of life through 'conservation, protection, and preservation of groundwater resources'.



Texas Panhandle Real-Time Network (NPGCD)



A SUTRON Iridium Wellcap (NPGCD)

# ADDRESSING MINING POLLUTION ACROSS THE UNITED KINGDOM

 **United Kingdom**







## BACKGROUND

During the 1700's when the Industrial Revolution progressed in England, coal mining became more widespread as demand for coal energy grew (NCM, 2019, p. 2).

In more recent years as the coal mining industry has declined, abandoned mines have become one of the biggest pollution threats in Britain due to mine water, which can contain heavy metals and pollutants, being discharged into public waterways through groundwater in particular (Environmental Agency, 2008, p. 5).

The Coal Authority was established in 1994 to manage the nation's coal assets and the historical liabilities from British Coal. Their role is to protect the public and safeguard the environment from historic mining issues, including polluted water from disused coal and metal mines.

The Coal Authority currently operates approximately 75 mine water treatment schemes, to prevent 4000 metric tons of iron solids from entering the UK's water courses, including drinking water aquifers, each year. This includes aquifer protection for 500,000 people with benefits valued at £30.5 million per year (The Coal Authority, 2019). These schemes are spread out across the United Kingdom, and they are built to treat the raw mine water and then discharge to the water course within stipulated consents.

Responsibilities of the Coal Authority include:

- managing the effects of past coal mining
- providing mining information and property search services
- licensing coal mining operations in Britain
- providing a 24-hour emergency service for public safety hazards

(The Coal Authority, 2019)

Beyond the concern of minerals like iron in public and natural waterways that could turn water orange, disrupting aquatic habitats and life, there are several concerns with mining that need to be understood and mitigated. The old entrances of mines, both shafts and adits, can be hazardous for the public. Underground water can also become polluted and can compromise the environment if it works its way to the surface.



Outdoor View of Enclosures (Severn Trent Services, 2018)

## MONITORING NETWORK

In 2015, the Coal Authority contracted Severn Trent Services to operate and maintain mine water treatment schemes, pumping stations and mine gas facilities across Scotland, the north east and north west of England, central England and South Wales. This is made up of 85 sites that contain over 850 monitoring points, and specifically consist of: 10 subsidence pumping stations, 73 mine water treatment schemes, and 2 metal mines.

By combining the expertise of Coal Authority and Severn Trent Services, both organizations aim to enhance solving water pollution from coal and metal mines to “deliver innovation and schemes with strong economic and environmental benefits,” as stated by Simon Reed, the Coal Authority’s former Chief Operating Officer (Ballard, 2018).

Data collected includes water depth, temperature, pumping rates, flow rates, energy usage and sampling, each with their own necessary frequency. Severn Trent Services collects this information and provides data reports to the Coal Authority team for analysis to assess how schemes are performing and whether water levels are rising. Conclusions are pulled from the analysis conducted to see which decisions need to be made for further improvement or changes.

Severn Trent Services enlists OTT HydroMet for over 100 instruments spread across the United Kingdom, with plans for expansion. They first found the company through online research, began work in early 2016, and currently focus on OTT ecoLog 500 level loggers to measure groundwater depth and temperature.

The data allows the Coal Authority to satisfy their obligations to relevant environmental bodies by supporting their project teams when assessing and designing schemes moving forward.



Water Treatment Scheme in Hockery Brook (2015)

Insights from data also allow their Tech Team to offer advice to various external bodies and their internal design teams.

One project involving the OTT HydroMet team is the Force Crag Mine, which is a mine that was abandoned in 1991 as the last working metal mine in the Lake District. This is where the Coal Authority (in collaboration with the National Trust, Newcastle University, the Environment Agency and Defra) built one of its first treatment schemes to address pollution in water from abandoned metal mines; the site was historically used to mine lead, zinc, and barytes (Force Crag Mine, 2013).

The original monitoring system for Force Crag comprised of OTT ecoLog 500's that transmitted data through SIM cards via cellular transmissions. However, the surrounding natural landscape of valleys and the remote location of the sensors made cellular telemetry difficult, and the team reached out to OTT HydroMet to design a solution with radio transmission.

Initially, the OTT HydroMet team carried out a walkover and radio survey on the site to assess the feasibility for radio data logging and remote data transfer. The team worked with the two organizations to recommend the following full site plan for the Force Crag scheme:

- 14 monitoring locations
- 9 locations with radio transmitters
- 5 locations with single sensor and radio transmitter
- 4 locations with 2 sensors wired to a single radio transmitting unit
- 1 location with the sensor wired directly into a GPRS transmission station
- 2 GPRS Transmission Sites

The first phase of the plan involves installing two [OTT netDL 500 Data Loggers](#) and 14 sensors to measure water depth and temperature at the site. These will transmit data to an FTP server in the cloud, which will then be processed and uploaded to an SQL database.

“ Our support from OTT HydroMet has been absolutely brilliant. They’ve come onsite to offer advice, show how to install equipment, and more.  
– Paul Robinson, MI, Data & Support Manager,  
Severn Trent Services

It is envisaged that the existing OTT ecoLog 500 loggers will remain in position for up to 2 weeks to ensure no loss of data while staff confirm the new system is collecting data accurately. After this, the older loggers will be removed and redistributed across the estate managed by Severn Trent Services.

Telemetry capabilities have had a big impact on data collection for the two collaborating organizations. Staff no longer need to go into the field to manually check sensors. For a government agency like the Coal Authority with a set budget, more accessible telemetry options help reduce staff involvement and consolidate costs. Now, staff only need to check equipment for maintenance purposes but on the whole, can leave sites running unattended.

More efficient and advanced monitoring networks allow organizations like the Coal Authority and Severn Trent Services to continue doing their important work to protect waterways and the environment.



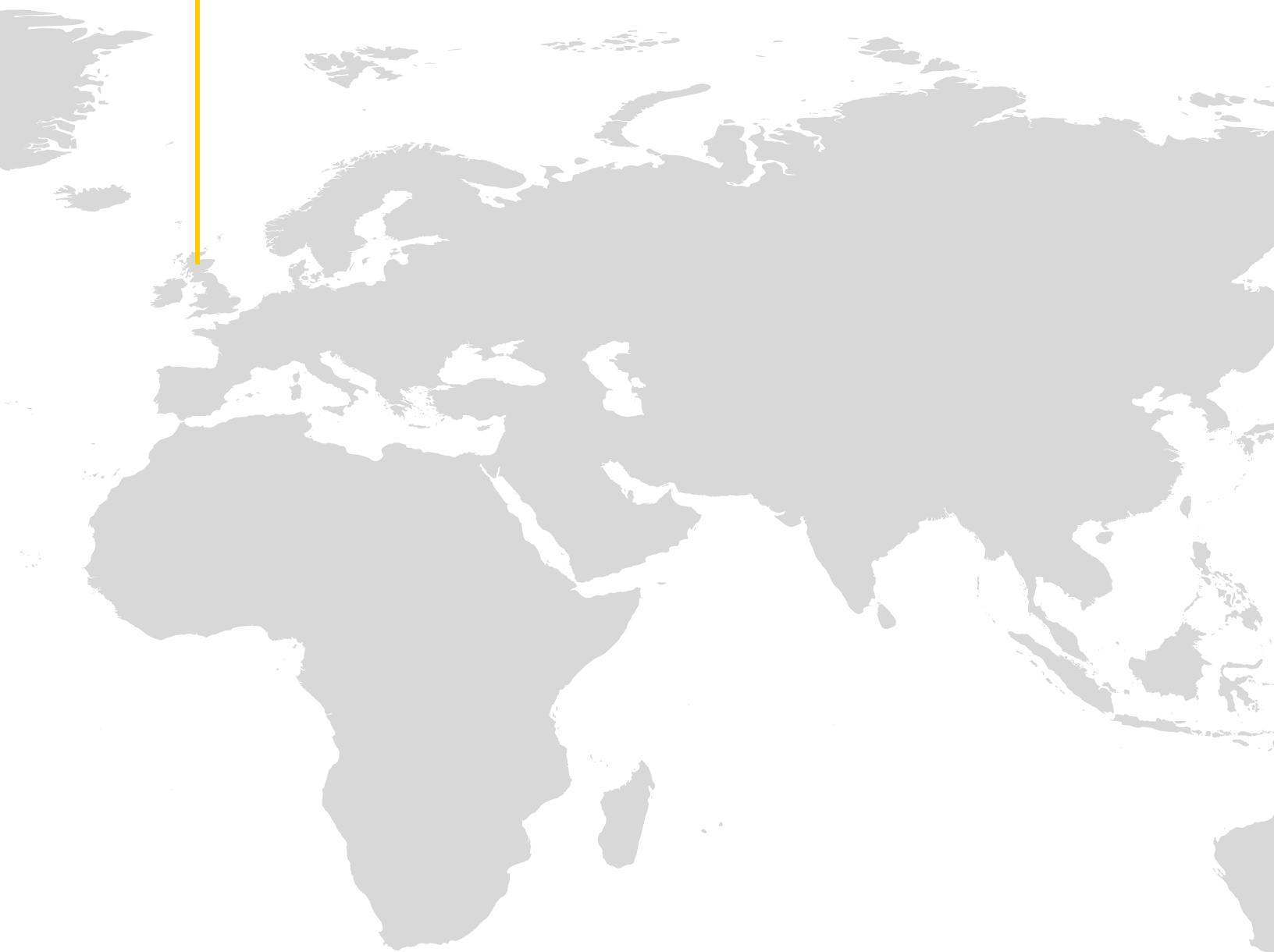
Restoration in Water Treatment Scheme (Severn Trent Services, 2018)



Logger in the Field (Severn Trent Services, 2018)

# MONITORING PEATLAND RESTORATION IN SCOTLAND

○ Scotland | United Kingdom





## BACKGROUND

Scotland is well renowned for its natural beauty. From breath-taking mountain landscapes to unique wildlife, the Scottish environment has a wide variety of noteworthy features.

This makes protecting their natural environment all the more important. One organization, [Scottish Natural Heritage](#) (NatureScot), has been dedicated to securing conservation and enhancement of Scotland’s natural heritage, including its wildlife, habitats, and landscapes, since 1992. NatureScot now employs professionals throughout Scotland who aid conservation efforts and advise the government on all environmental policy needs.

The importance of nature conservation has grown over the years, particularly through the 2020 challenge established in 2013 by the Scottish Government that calls for 3 main initiatives:

- “protect and restore biodiversity on land and in our seas, and to support healthier ecosystems.
- connect people with the natural world, for their health and wellbeing and to involve them more in decisions about their environment.
- maximize the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth.”

(The Scottish Government, 2013, p. 6)

The Peatland ACTION fund is one such program that was born from these initiatives and was largely driven by the Scottish Government’s Climate Change Action Plan –

it is a project designed to restore areas of degraded peatland across Scotland. The project is funded by the Scottish Government through grants and it's administered by NatureScot.

Peatlands are expanses of land dominated by peat soils, which are formed from plant matter, particularly sphagnum mosses. The plant matter accumulates over time under water-logged conditions that prevents normal decomposition. Peatlands provide a variety of benefits, including carbon regulation, flood risk mitigation, and natural water filtering (University of Leicester, 2019). They also provide a unique habitat for wildlife (NatureScot, 2017).

Scotland contains approximately 60% of the UK's peatlands. However, an estimated 80% of Scottish peatlands are degraded, making restoration efforts a priority (Scotland's soils, 2018). The current Peatland ACTION sites include blanket bog, lowland raised bog, intermediate bog, and fens, with the vast majority of the sites being bogs. The project includes both designated and undesignated land and a wide variety of owners and managers including sporting estates, farmers, local authorities and conservation bodies (NatureScot, 2017).

## VALUE OF MONITORING



Sphagnum Mosses Growing at the Flows NNR, Forsinard, Caithness (Lorne Gill/ NatureScot/2020VISION, 2011)

Lucy, a Data Officer with NatureScot, gives a first-hand look into the project:

“ I'm currently responsible for looking into the effectiveness of the peatland restoration project, which includes measuring the recovery of the water table. It's important to have a high-water table that doesn't fluctuate too intensely.  
– Lucy Elliff, Peatland ACTION Data Officer  
- Monitoring

Peatland ACTION has been conducting groundwater monitoring since 2014 to survey and monitor the water table. The height of the water table provides the team with direct insight to how healthy peatlands are and how effective their restoration efforts have been. They track depth to water over time to understand where more restoration efforts are needed and what human intervention is required to help stabilize the water table, if unstable.

When peatlands are degraded, they are often drier than they should be, with a low water table that fluctuates rapidly in response to rain or drought. They are typically caused by manmade drainage, forestry, agriculture and other land use pressures. By measuring the water table, the Peatland ACTION team can make decisions about which areas need interventions to help raise the height of the water table and can monitor the success of this work. Groundwater monitoring can potentially consume many personnel hours if manual measurements are taken. By using automated data loggers, monitoring is much more efficient, and staff are able to quickly collect info for both short-term and long-term trends, without compromising too much personnel time.

## MONITORING NETWORK

The groundwater monitoring network has grown to consist of numerous sites spread across Scotland and across various types of peatland. It includes approximately 85 [OTT ecoLog 500 level loggers](#) and 41 [OTT Orpheus Mini water level loggers](#) of which some are fitted with the OTT ITC (Intelligent Top Cap). Measured hydrological data is collected by the Scottish Environmental Protection Agency (SEPA). The OTT HydroMet team came on site during installation to provide a training course for Peatland ACTION and their contractors.

“The OTT HydroMet team was proactive with problem solving and making suggestions for solutions to any problems encountered on site.”

– Deborah Spray, Advisory Officer, Wetland Ecology



Peatland Restoration Using Coir (Coconut) Log Dams (Stephen Corcoran, 2018)



Data is automatically transmitted remotely via cellular transmissions once a week through SEPA, who cleans it and sends it consolidated as spreadsheets. The Peatland ACTION team intakes a massive amount of data as water table depth is logged every hour, with some loggers measuring once every half hour. Before telemetry was used, the team could only monitor groundwater levels once annually due to the personnel time required to manually go into the field to check each sensor.

Their challenge now is taking the large sets of data they have collected and analyzing it to get a more detailed understanding of the water table over time and to build a long-term set of data. New roles have been created for professional data officers to analyze the raw data and produce results that can be used to inform peatland restoration.

The program is currently on the mainland of Scotland and the Isle of Arran, but the Peatland ACTION team is hoping to eventually expand to more island locations. The team is excited to delve deeper into the data they gain from groundwater monitoring, and how it all feeds back into restoration techniques for peatlands.

**“ I appreciate how all of this data goes into improving the sites and turns into positive action for the sites. It isn't just research. ”**

– Lucy Elliff



Forsinard Flows National Nature Reserve (Lorne Gill/NatureScot)

# REFERENCES

- Background Information: Early Mining [PDF]. (2019). West Yorkshire: National Coal Mining Museum for England.
- Ballard, D. (2018). MULTI-MILLION POUND AWARD TO PROTECT NATION'S ENVIRONMENT. Retrieved from <https://www.stservices.co.uk/multi-million/>
- Benefits of healthy peatlands. (2017). Retrieved from <https://www.nature.scot/climate-change/taking-action/carbon-management/restoring-scotlands-peatlands>
- Cairngorms Nature. (2018). [Mountainside Natural Peatland].
- Cairngorms Nature. (2018). [Peatland Restoration Using Coir (Coconut) Log Dams].
- Force Crag Mine. (2013). Retrieved from <http://www.visitcumbria.com/cm/force-crag-mine/>
- Hockery Brook mine water treatment scheme [Digital image]. (2015, August). Retrieved from <https://www.stservices.co.uk/multi-million/>
- Lorne Gill/NatureScot. (n.d.). [Forsinard Flows National Nature Reserve].
- Lorne Gill/NatureScot/2020VISION. (2011). [Sphagnum Mosses Growing at the Flows NNR, Forsinard, Caithness].
- N. (n.d.). [North Plains Landscape]. Retrieved from <http://northplainsgcd.org/about-us/who-we-are/>
- N. (2016, July 19). [On-Site Crops]. Retrieved from <https://www.facebook.com/NPGCD/photos/a.1277328865652351/1277335192318385/?type=3&theater>
- N. (n.d.). [Districts Within Network]. Retrieved from <http://northplainsgcd.org/about-us/history/>
- NPGCD. (n.d.). [A SUTRON Iridium Wellcap].
- NPGCD. (n.d.). [Texas Panhandle Real-Time Network].
- Peatland restoration. (2018, March 23). Retrieved from <https://soils.environment.gov.scot/resources/peatland-restoration/>
- Scotland. (2013, June 19). 2020 Challenge for Scotland's Biodiversity. Retrieved from <https://www.gov.scot/publications/2020-challenge-scotlands-biodiversity-strategy-conservation-enhancement-biodiversity-scotland/>
- Severn Trent Services. (2018). [Logger in the Field].
- Severn Trent Services. (2018). [Outdoor View of Enclosures].
- Severn Trent Services. (2018). [Overflow Channel at Water Treatment Scheme].
- Severn Trent Services. (2018). [Restoration in Water Treatment Scheme].
- The Coal Authority, & SEPA. (2008, August). Abandoned mines and the water environment (Rep. No. SC030136-41). Retrieved [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/291482/LIT\\_8879\\_df7d5c.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291482/LIT_8879_df7d5c.pdf)
- The Coal Authority. (2019). 200 years of the coal industry in Britain. Retrieved from <https://www2.groundstability.com/history-of-coal-mining-timeline-page/>
- The Coal Authority. (ca. 2019). The Coal Authority [LinkedIn page]. Retrieved from <https://www.linkedin.com/company/the-coal-authority/about/>
- [Water Treatment Scheme in Hockery Brook]. (2018). Retrieved from <https://www.stservices.co.uk/multi-million/>
- What are peatlands? (2016, December 07). Retrieved from <https://www2.le.ac.uk/departments/geography/research/projects/tropical-peatland/what-are-peatlands>

# TECHNOLOGY USED



## OTT ecoLog 500 Water Level Logger

Water level sensor with built-in datalogger for surface and groundwater applications.



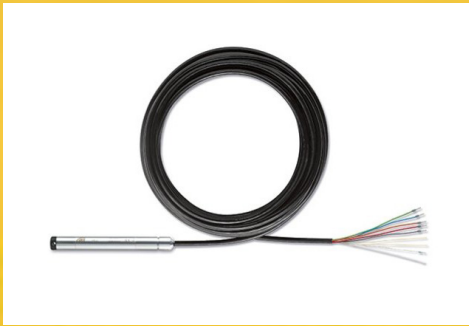
## OTT ecoLog 800 Water Level Logger

Groundwater level and conductivity sensor with built-in datalogger and telemetry.



## OTT Orpheus Mini Water Level Logger

Pressure level transducer with datalogger for longterm groundwater monitoring.



## OTT PLS - Pressure Level Sensor

Robust ceramic pressure transducer for water level measurement.



## Sutron Well Cap

Versatile Groundwater telemetry system.



## OTT ITC - Intelligent Top Cap

Remote monitoring of groundwater data.



## OTT netDL Data Logger

Data loggers for remote data collection and long term monitoring.



## OTT Hydromet Cloud

Streamlined data management across all devices.

# CONTACT US

Let our team create the perfect groundwater monitoring solution based on your needs. Get in touch today:

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