LIFE Multi Peat

LIFE20 CCM/DE/001802

Annual Monitoring Report (Actions D.1 & D.2)

(January 2025 - December 2025)

Co-funded by the European Union

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1 Introduction

The LIFE Multi Peat project aims to reduce greenhouse gas emissions and promote biodiversity through peatland management measures which involve raising peatland water levels. To make progress and the achievement of these goals measurable, scientific monitoring is being carried out. This involves the measuring of ecological parameters, as well as direct measurements of greenhouse gas emissions.

The first monitoring report of action D.2 (Project sites monitoring) was merged with the deliverables of actions A.2 (Initial surveys of the project sites) and D.1 (Monitoring of Project Performance and Socio-economic impacts) as "Joint report on the Common Documentation of Initial Surveys, Baseline Monitoring report, and Annual Monitoring Report 1" (LIFE Multi Peat, 2023). The hydrogeomorphological setting of each monitoring site, as well as the current hydrological situation, a description of the current vegetation, below ground carbon stocks, as well as a baseline estimation of greenhouse gas emissions based on the greenhouse gas emission site types "GEST" (Couwenberg, 2011) can be found in here.

The second monitoring report (LIFE Multi Peat, 2024) is part of the second annual monitoring report of Action D.1 and covers the period 01/01/2023-31/12/2023. It gives a refined calculation of the carbon stocks, including the above ground biomass, further a pre-rewetting analysis of the site hydrological site conditions using drone or satellite imagery and finally shows the first set of data gained from the monitoring of hydrology and environmental parameters, which will later be used for the modelling of GHG-balances (soil temperature, soil moisture, PAR).

The Mid-term Monitoring Report (LIFE Multi Peat, 2025), which is also the Third Monitoring Report, shows the updated records of the monitored parameters, as well as first GHG-fluxes for those sites that have the measurements running for at least one year (Germany, Ireland, Netherlands and Poland). Additionally, Belgium, Germany, Netherlands and Poland, show the results of the first vegetation monitoring.

This fourth monitoring report now, contains the socio-economic impact assessment (SEIA) for the year 2025 as reporting on the D.1 actions. Further it shows the D.2 results of ongoing measurements of environmental parameters, hydrology, GHG, and vegetation (vegetation only for Germany, Netherlands, Poland).

2 Belgium

2.1 Project Site

The Belgium project site is situated in the Valley of the Grote Beek (Figure 1).

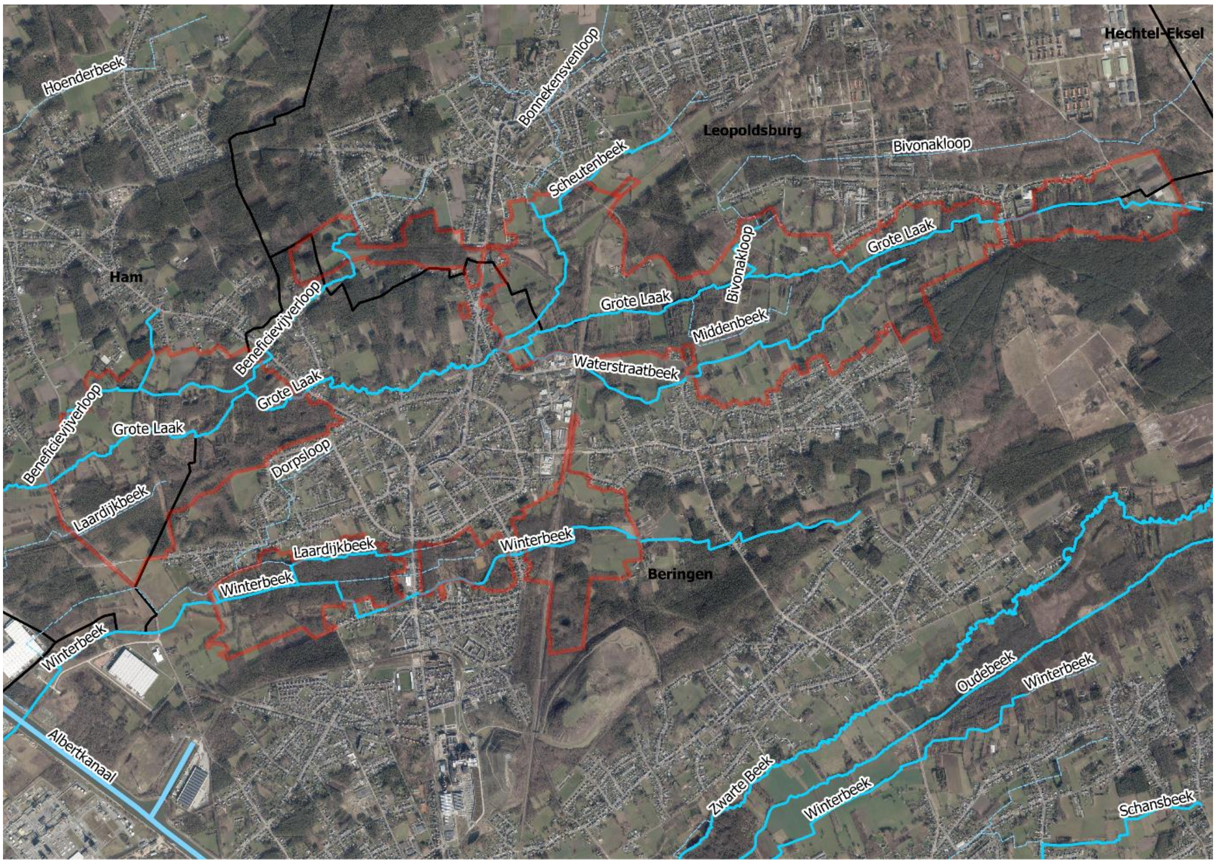


Figure 1: Map of the Belgium project site in the Grote Beek and the Kleine Beek creek valleys

The largest part of the nature reserve consists of alder swamp forest. Within the valley 230 hectares are under nature management. Spread over 3 cities: Beringen, Ham and Leopoldsburg (Limburg, Belgium). The valley actually consists out of 2 creek valleys: the Grote Beek (Northern part) and the Kleine Beek (Southern part) and is situated close to the valley of the Zwarte Beek (the largest peatland in Flanders (Southeast on the map)). Within this nature reserve a peat layer is present of up to 3m thick. It is heavily degraded in parts of the area and is currently drying out throughout the valley. Peatland restoration within LIFE Multi Peat will restore the carbon storing capacities of this very important and sensitive ecosystem.

2.2 Current State

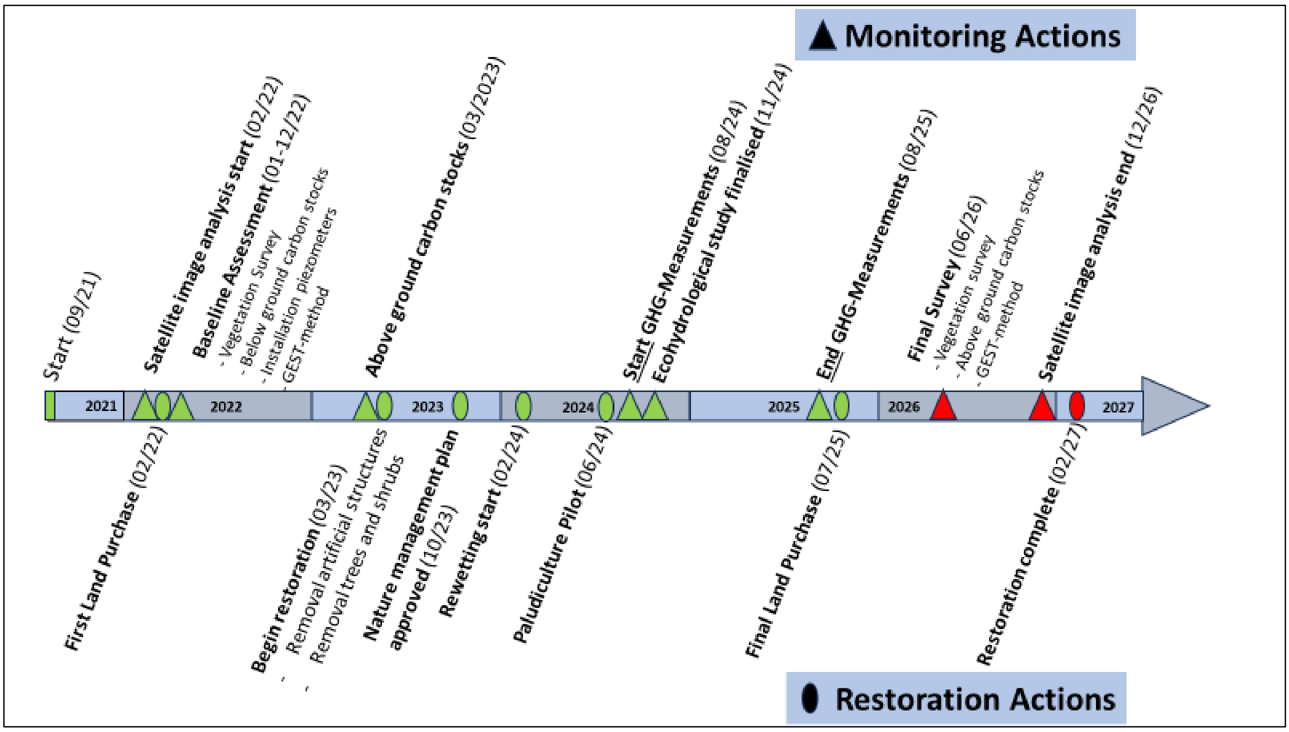


Figure 2: Timeline showing restoration- and monitoring progress for Belgium. In green: already achieved, in red: in progress or yet to be carried out.

2.3 Results

2.3.1 Hydrological Monitoring

The network of water level loggers is still maintained (Figure 3). However, while a lot of rewetting of the Valley of the Grote Beek was carried out in 2025, we do not see this in the water levels throughout the valley (Figure 4 & Figure 5). The number of average lowest groundwater level throughout the valley (see communications indicators) thus gives a wrong impression of our rewetting results. This can be simply explained by the general weather in Flanders. In 2023 it was an extremely wet year, making our baseline overestimating the actual water levels. 2024 broke all records, this was the most wet year ever. While 2025 was characterised by extreme droughts. The fact that the average groundwater level throughout the valley is not lower than in our baseline proves that rewetting does have a big effect. If we look at the core peat areas that were rewetted, we see that the water tables in 2025 are the same as in 2023.

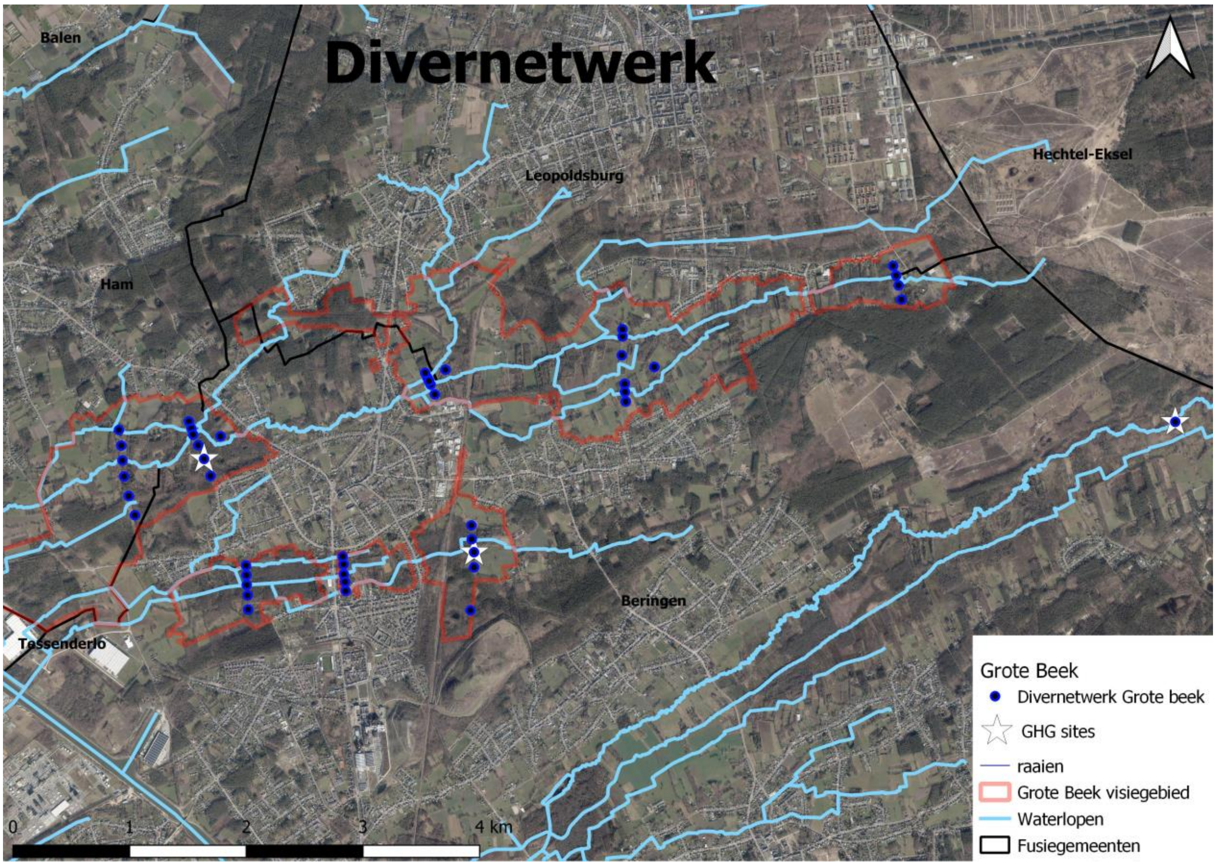


Figure 3: locations of the water level loggers (piezometers) within the Valley of the Grote Beek. Water level loggers were installed in transect starting in the main creeks, within the peatland up to the valley flanks. No water level loggers were installed in the infiltration areas.

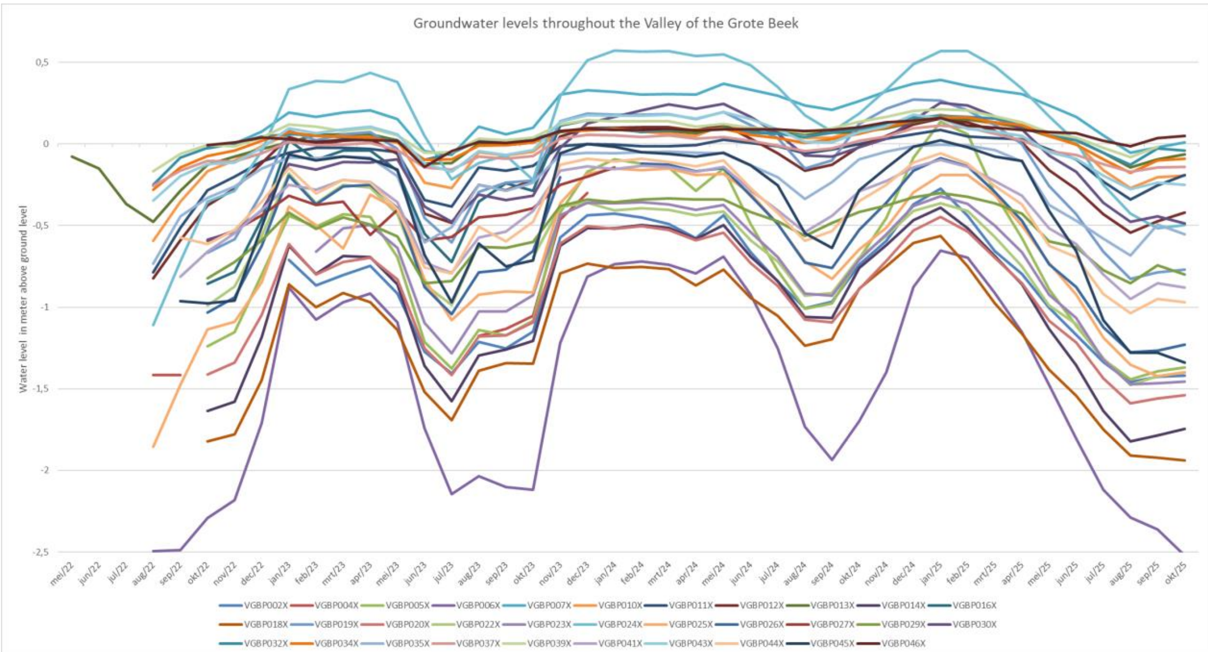


Figure 4: water levels in the Grote Beek Valley. Although not so clear on the graph because of the very dry period after rewetting, we can see the effects of rewetting slightly by looking at the highest water levels. One can see a steady increase in the highest water level for most of the locations equipped

with water level loggers. The loggers are installed throughout the valley, so also on the flanks. Deeper water level can thus be expected for some of these.

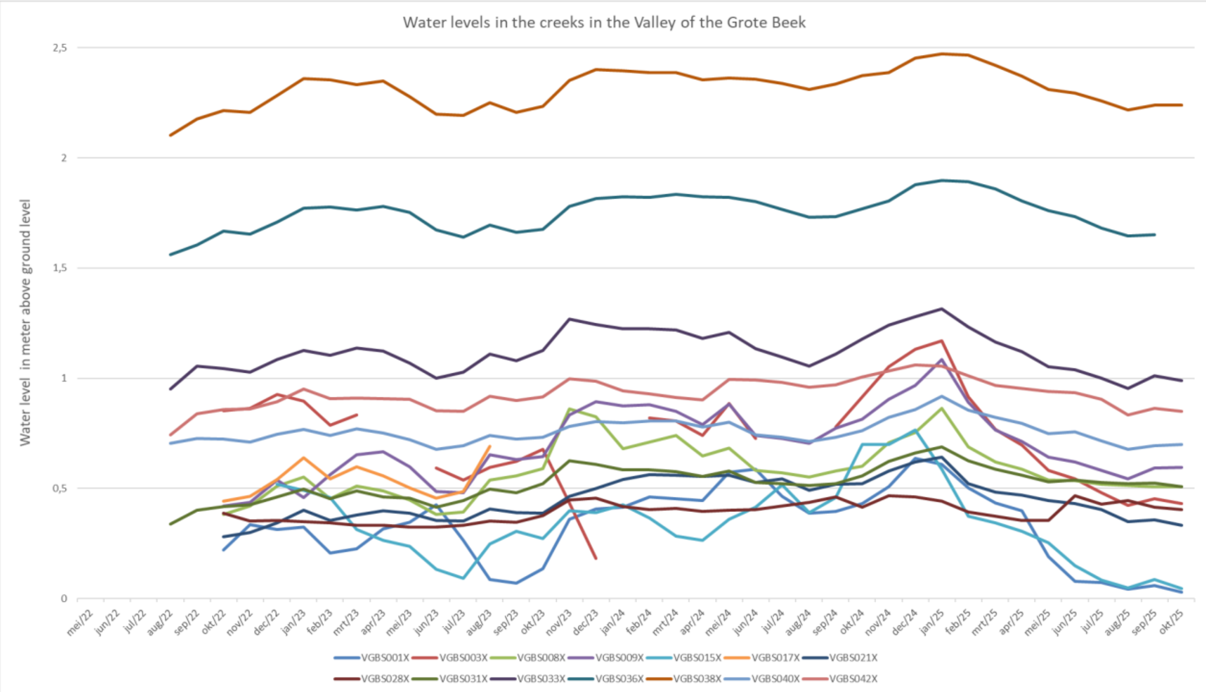


Figure 5: In comparison to the graph above, we don't see clear differences in the water levels within the main creeks in the valley. These creeks are not yet relevelled nor dammed.

2.3.2 Environmental Parameters

The sensors installed at the GHG measurement plots were removed since the GHG measurements are finished. The local weather station is however still following up some environmental parameters for the larger area. This data is only needed in case some weird results come up that could be explained by specific weather events.

2.3.3 GHG-Measurements

The GHG measurements are finished. The data is now being analysed.

The models for CO_2 are finished, but for CH_4 we wait for the hourly water level data to be processed. This takes extra time since water levels are standard measured each 12h in Flanders, the country-wide network of barodivers is set to measure each 12h as well. We thus need our own barodata to be added to the portal and use this to calibrate the piezometer measurements. This all needs to happen manually by the Institute for Nature and Forest Research. Once we have this data, CH_4 can be modelled. We also measured N_2O, these will not be modelled but will be included in the total emissions by using basic interpolation techniques.

Furthermore, to assess carbon uptake from trees, a second above ground carbon stock analysis will be carried out on the plots where we did GHG measurements. This will be carried out in March 2026, exactly 3 years after the first mapping. This should give us a good average estimate of yearly carbon uptake by trees on the GHG plots. This uptake will be subtracted from the modelled yearly emissions.

2.3.4 *Vegetation Monitoring*

A final vegetation mapping on the same permanent quadrants as the baseline monitoring is planned in summer 2026. Results and comparisons with the baseline vegetation mapping will be reported in the final monitoring report.

2.4 *Discussion and Challenges*

Maintaining the hydrological network is still challenging. Water wells within creeks are often damaged by branches of trees getting stuck around them, adding to much pressure to the pipes. Or raising the water table next to the pipes, resulting is wrong measurements of the actual water level. Some water level pipes are damaged again by vandalism. This year, 2 pipes within creeks were flushed away, one of these was found and reinstalled, the other one disappeared completely and was replaced with the sensor from the GHG reference plot. Another pipe suddenly moved up 40cm probably by vandalism. This pipe needs to be recalibrated to use the data.

The GHG measurements in alder swamp forests proved to be very challenging. Alder swamp forests are quite hard to measure, have a lot of microrelief and it is difficult to find representative measures with the small chambers. Furthermore, seasonal flooding (reducing the chamber volume) and ground level oscillations (making it much more difficult to get exact groundwater levels) made it even more complex. A beaver in our reference plot 'disturbed' this stable area probably increasing the GHG emissions again. In the end we managed to get around this data, but it needed some adaptations compared to other sites and an extra careful approach when processing this data.

2.5 Communication Indicators

	INDICATORS						
	DIRECT			INDIRECT			
Units	**Economic contribu-tion**	**Ecosystem regulating services** (GHG emissions)	**Awareness raising**	**Ecosystem support-ing services** (habitat for species)	**Ecosystem provision-ing services** (raw materials, freshwater)	**Ecosystem regulating services** (Fire/flood prevention)	**Ecosystem cultural services** (recreation, aesthetic apprecia-tion, and inspiration)
Stakeholder and Duty holder engagement	3	1	51	16	23	15	6
Information boards/panels			3 +8 (temporary)				
Employment (Individuals/companies hired by the project)	9	5	5	5	5	5	
Amount spent (€)	1.453.223,24[1]						
Number of jobs (FTE and PTE)	12 PTE						
Number of events organised or participated	39	11	39	19	15	23	8
Number of participants in events organised by the beneficiary			284				
Number of hectares restored		110.689		110.689		110.689	110.689
GWP reduction (tons of GWP CO_2-eq/ha/yr)		9.775 t CO_2-eq/ha/y					
Number of Print media			5100 (leaflets) + 250 (brochure)				
Number of Publications/Reports, promotional material produced			25				

[1] Effective costs until 30/06/2025 + expected costs until 31/12/2025

Media coverage (newspaper articles, press releases, radio, podcast)			13					
Website visits – (natuurpunt.be)			942					
Climate Performance (tons/year CO_2)		1224						
Climate Performance (tons/year CH_4)		305						
Environmental Performance – resilience to flooding (ha)						Not computable		
Baseflow contribution of receiving water (m^3/s) by percentage						Not computable		
Average lowest groundwater level on the whole project site (cm below ground level)		-83.0						
Sustainable land use, agriculture, and forestry (hectares of agricultural land under sustainable management)					0.5 ha			
Habitats positively affected (ha) and change in percent cover of indicator species associated with their respective target habitat				NA			NA	

3 Germany

3.1 Project Site

The German project site, the Häsener Luch, is situated in the north-eastern part of Germany (see Figure 6a) and part of a long-stretched depression embedded in undulating ground moraine terrain of the Weichselian glaciation. The complex of around 120 ha is a terrestrialisation fen with reed and sedge peat overlying calcareous gyttja. The project site (see Figure 6b) covers approximately 60 ha, of which 53 ha have the conservation status “Naturschutzgebiet”. Nevertheless, about 60% of the project site is used as grassland, mainly as pastures and to produce forage. Therefore, the Häsener Luch is drained by a system of drainage ditches directing the water into the upper reaches of the artificial water body Welsengraben. Summer water level lies between 80-100 cm below surface. As a consequence, the topsoil peat is highly degraded and moorshified. It has to be assumed that peat layers were much thicker before human alterations of the site started. Peatland drainage started as early as 1650 by Dutch colonists, to be used as grassland. The very intense drainage was conducted during the time of the German Democratic Republic (GDR), which was accompanied by high resolution soil mapping. A comparison of peat thickness between 1969 and today shows that the ongoing oxidation of peat has already led to a vertical loss of around 65 cm of peat.

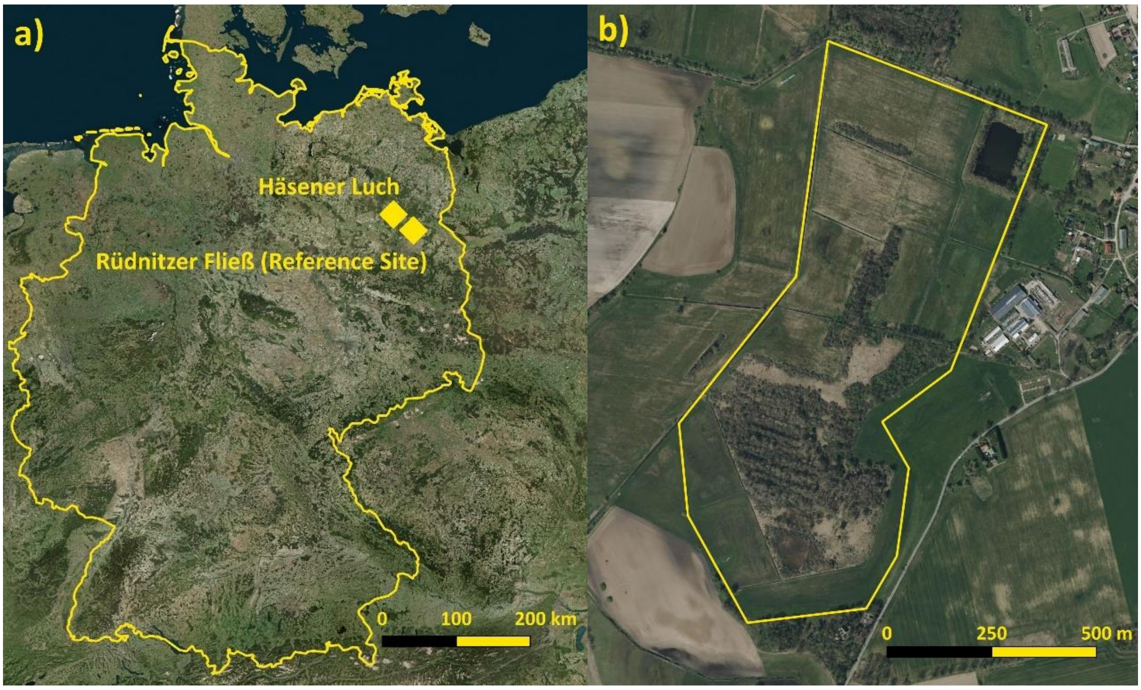


Figure 6: a) Map of Germany showing the situation of the “Häsener Luch” and the reference site “Rüdnitzer Fließ”; b) Project site “Häsener Luch” within the yellow boundary

The reference site, the Rüdnitzer Fließ (see Figure 6a), is a fen site at a distance of 35 km. It was successfully rewetted some 15 years ago and is now mainly covered with reeds (*Phragmites australis*).

3.2 Current State

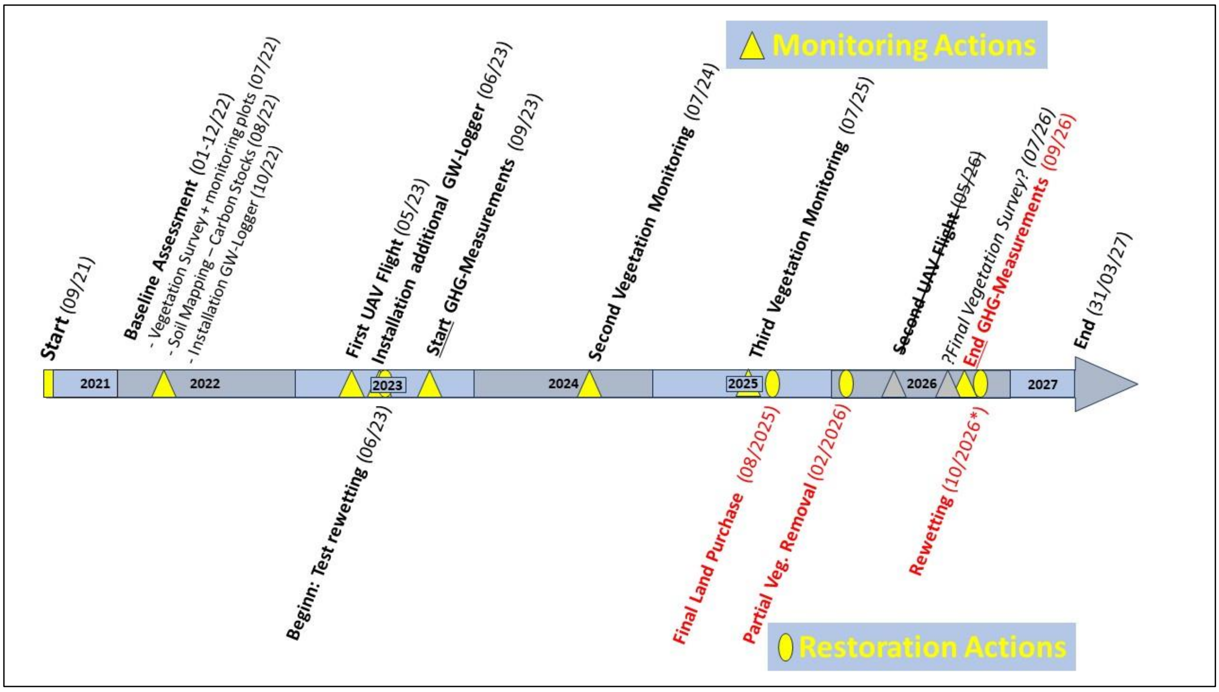


Figure 7: Timeline showing Restoration and Monitoring progress in Germany. In red: actions, which have been delayed.

The restoration measures had to be postponed to autumn (see Figure 7), because the water and soil association didn't give its consent on the restoration plan in time. Construction works will start after the breeding season in October. This has implications for the rest of the monitoring actions (see discussion and challenges).

3.3 Results

3.3.1 Hydrological Monitoring

Hydrological equipment was installed at the monitoring site at two different points of time. Five water loggers (Device: Meter "Hydros 21") HL_01 to HL_05 were installed in October 2022 (seeFigure 8). Six more sensors working with wireless data transmission (Device: MMM-tech "RKL-01-5") PSSS01 to PSSS03 and PSGW01 to PSGW03 were installed in June and July 2023 to monitor the "test rewetting" (Figure 10). The test rewetting refers to the reactivation of three old weir facilities to prove their effectiveness and build trust with local farmers. It started in June 2023 and is ongoing. The sensors named PSSS are directly implemented in the weirs and the sensors named PSGW were installed in the field in position, which supposedly are affected by a rise of the water levels in the respective ditches (see Figure 11).

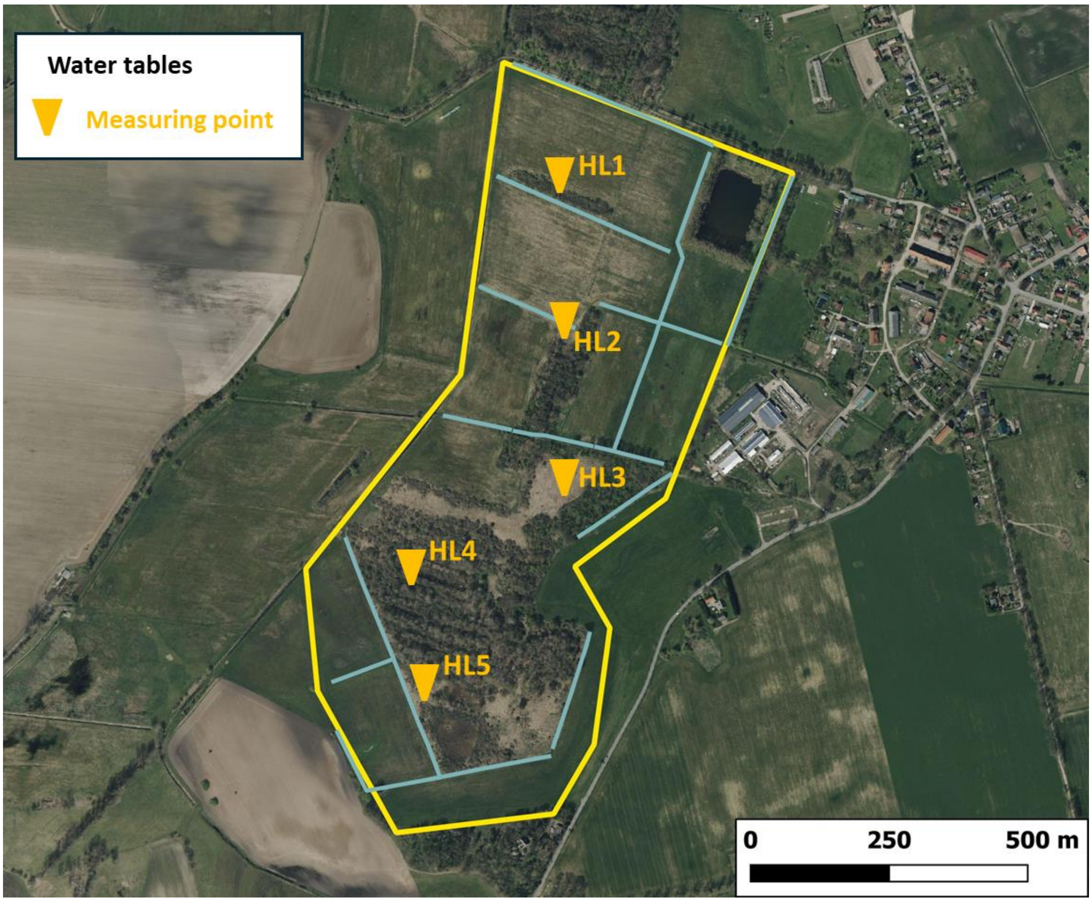


Figure 8: Positions of the water loggers at the project site in October 2022

The water levels (Figure 9) in the first half of the year 2025 have been characterised by a beaver dam, which has been removed by the water and soil association. Several high rainfall events in July, raised the water levels remarkably, and the low stand in summer was therefore much less pronounced, than in the two previous years.

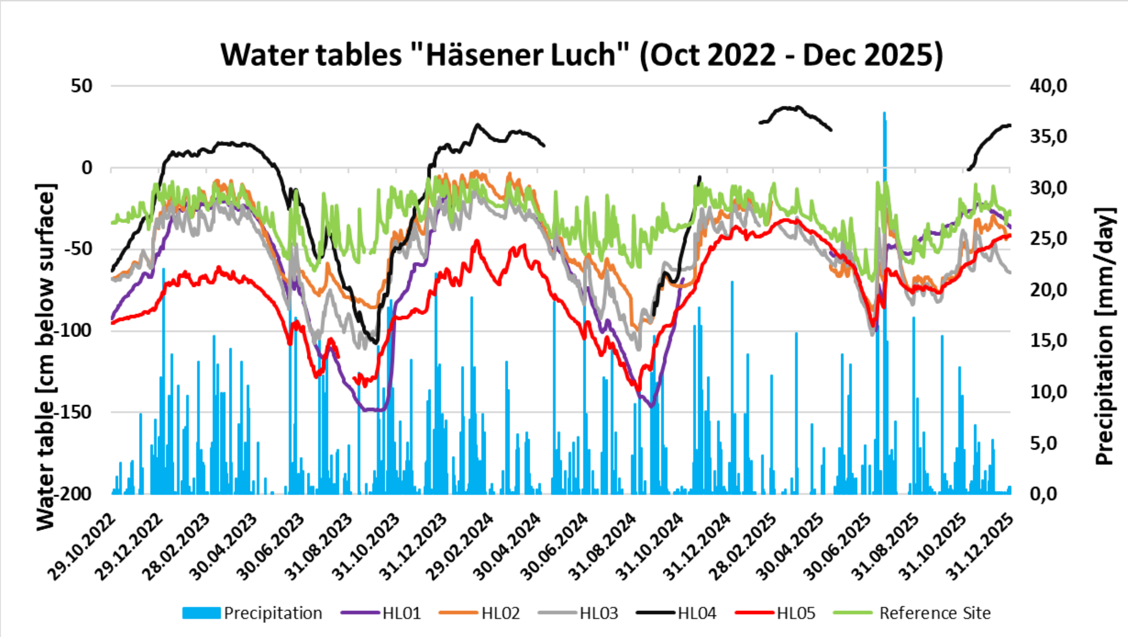


Figure 9: Water tables measured since October 2022 at the project site "Häsener Luch" and the reference site "Rüdnitzer Fließ".

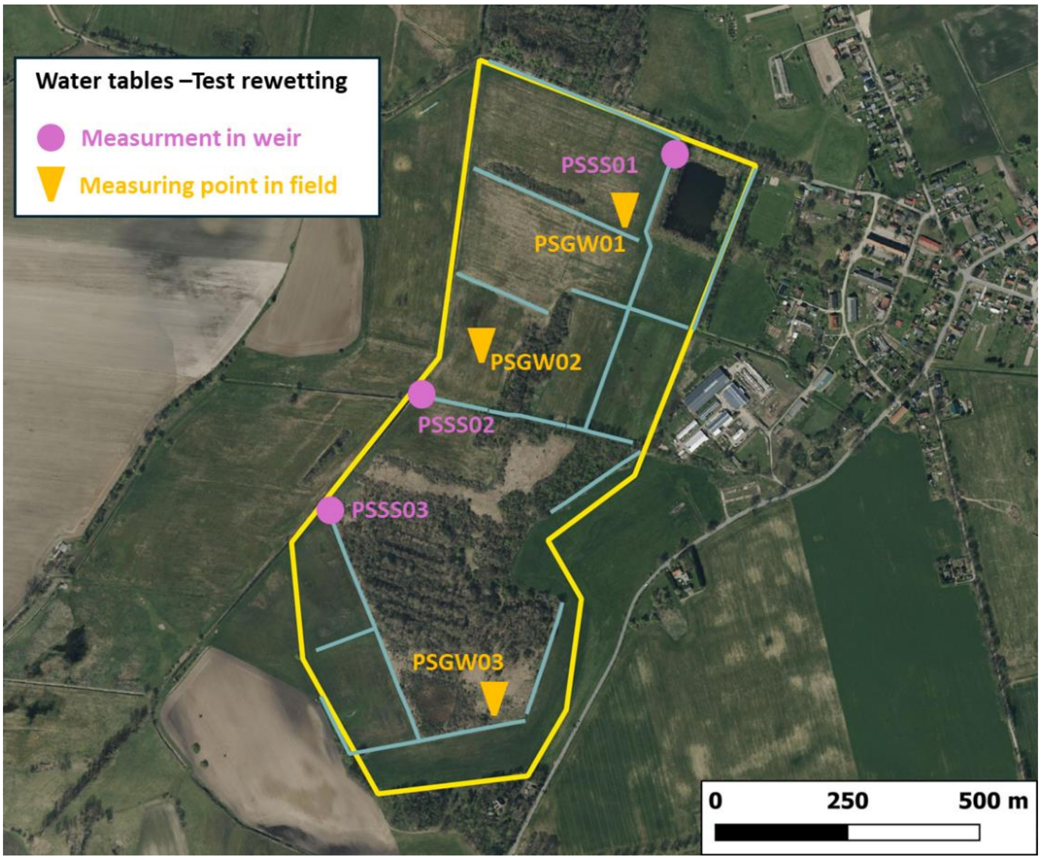


Figure 10: Positions of water loggers to monitor the test rewetting at the project site

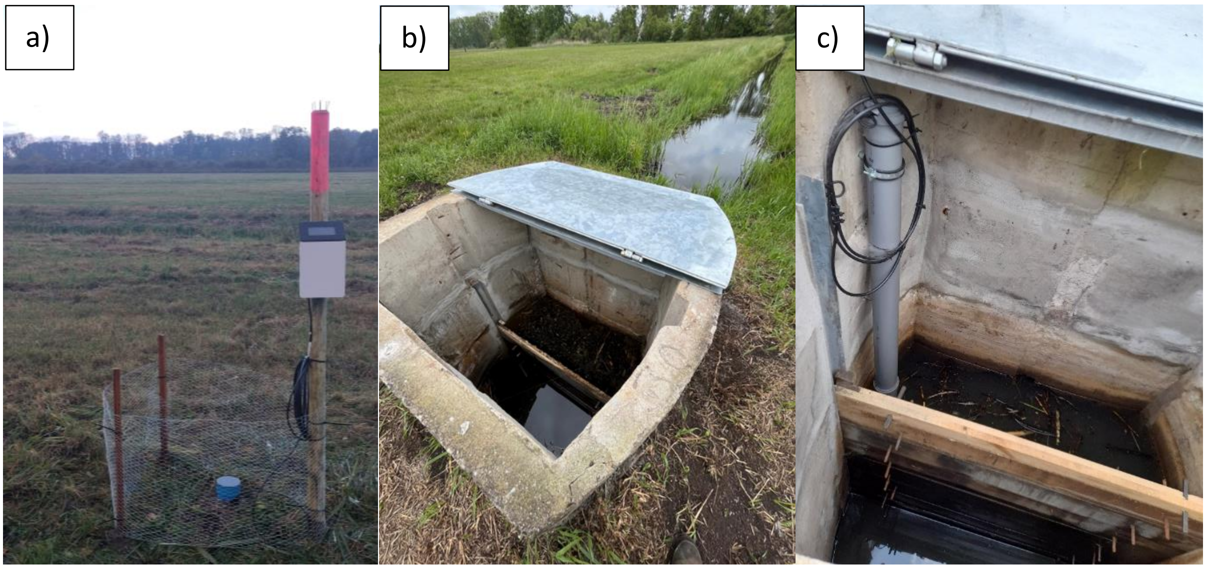


Figure 11: a) Installation of water level measuring point in the field; b) ditch blocking facility; c) installation of water level sensor in ditch blocking facility. Photos by: Andreas Herrmann

The water levels related to the test rewetting are shown in Figure 12. The two weirs PSSS01 and PSSS02 show stable water levels until late spring at the intended height of the weir. Especially, PSSS02 water levels are high, as in the end of 2024 a permit was given to raise the intended water height in the weir. In the southernmost weir PSSS03, the water levels didn't become very stable, probably caused by a leaking weir or the loss of water through sandy mineral substrate. The high precipitation in July are also visible in the record, showing, that the mean water levels have been higher in 2025 than in 2024. However, even though water levels in the weirs remain quite stable, those in the field are not, proving that retaining the water in the drainage ditches has limited spatial effects. Main reasons for this is an old underground drainage system, which was built in the 1970s. Knowledge about this drainage system was ascertained only recently, during the planning of the technical design for the site rewetting.

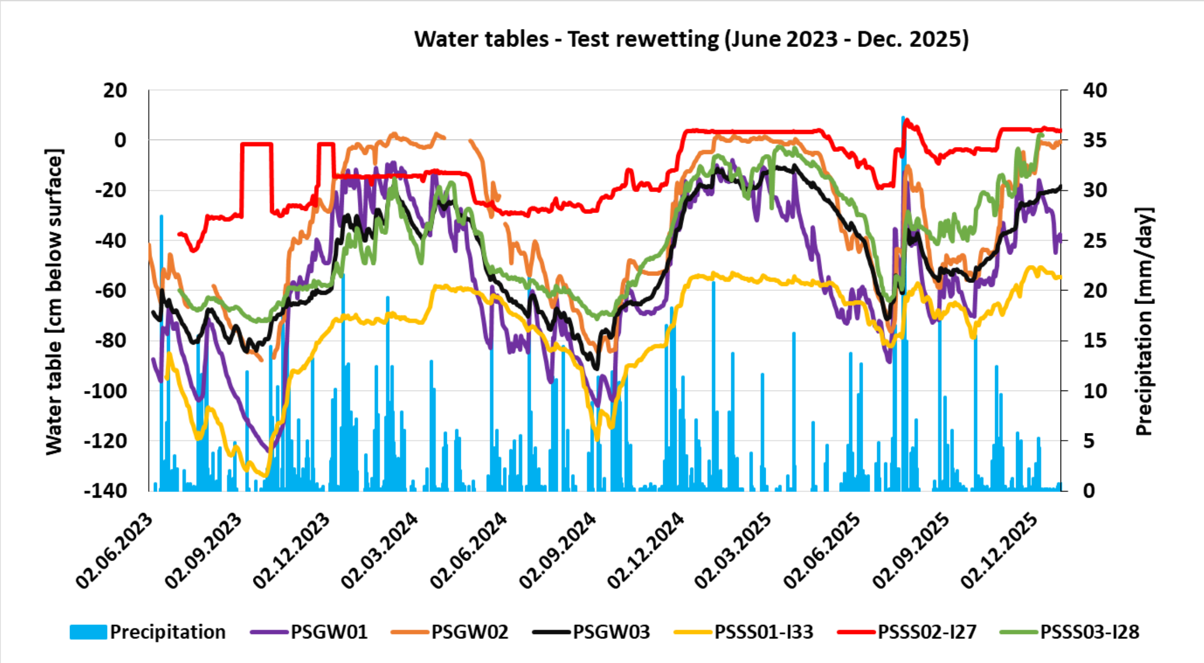


Figure 12: Water table measurements related to the test rewetting from June 2023 until December 2025.

3.3.2 Environmental Parameters

At the sites where greenhouse gases are measured (named HL01, HL02, and RF), the following environmental parameters are measured: Air temperature [°C] (Device: Meter "Atmos 14 Gen 2"), water temperature [°C] (Device: Meter "Hydros 21"), soil temperature [°C] (Device: Meter "Teros 11") in 5-10 cm. Also, the photosynthetically active radiation (PAR) [µmol m^{-2} s^{-1}] was measured.

The recorded data from each site are visible in Figure 13-Figure 15. The mean values of soil temperature, air temperature, PAR and water table depth are given in Table 1. Mean air temperature (9-11 °C), soil temperature (9-11 °C) and PAR (220-240 µmol m^{-2} s^{-1}) are very similar, between the three sites. The only irregularity, occurred in summer 2024 at site HL01, where hops (*Humulus lupulus*) covered the PAR sensor. The water levels of sites HL01 and HL02 show a higher fluctuation during the year than at the reference site, which is already restored and therefore more stable. Water levels at the reference site are also higher -0.34 m in 2025, vs. -0.52 m (HL02) and -0.55 m (HL01). A raise of the mean water table at HL01 was observed in 2025 when compared to 2024 and 2023. Reparation of the weir, a wet summer in 2025 and higher water levels in the main drainage system (Welsengraben), due to the above mentioned beaver dam, are likely reasons for that.

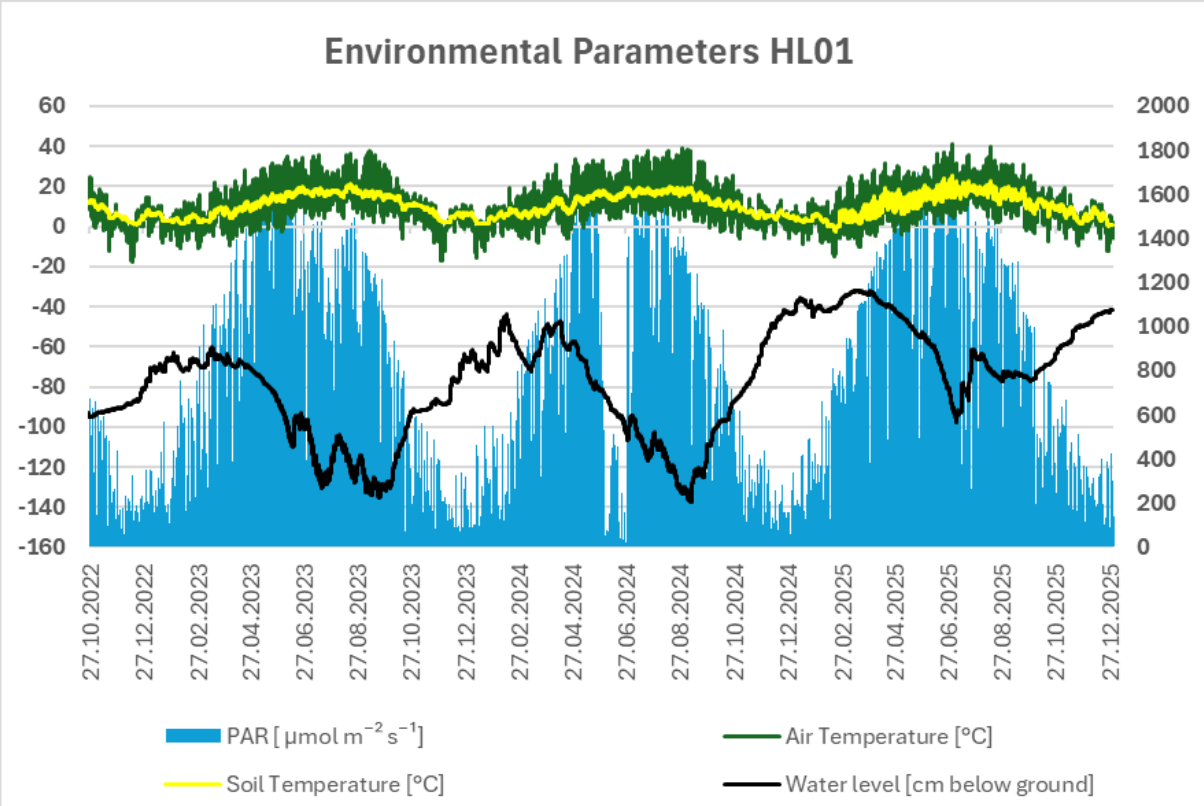


Figure 13: Environmental parameters at GHG-measuring site HL01.

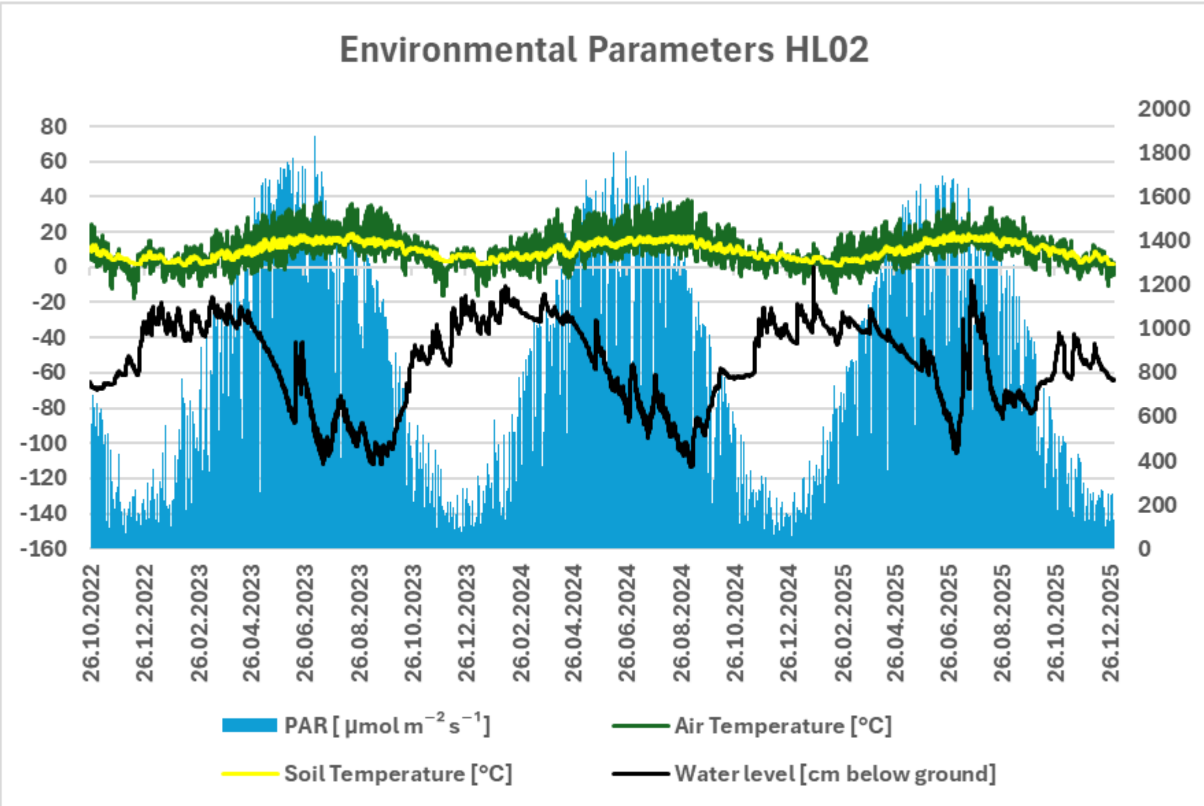


Figure 14: Environmental parameters at GHG-measuring site HL02.

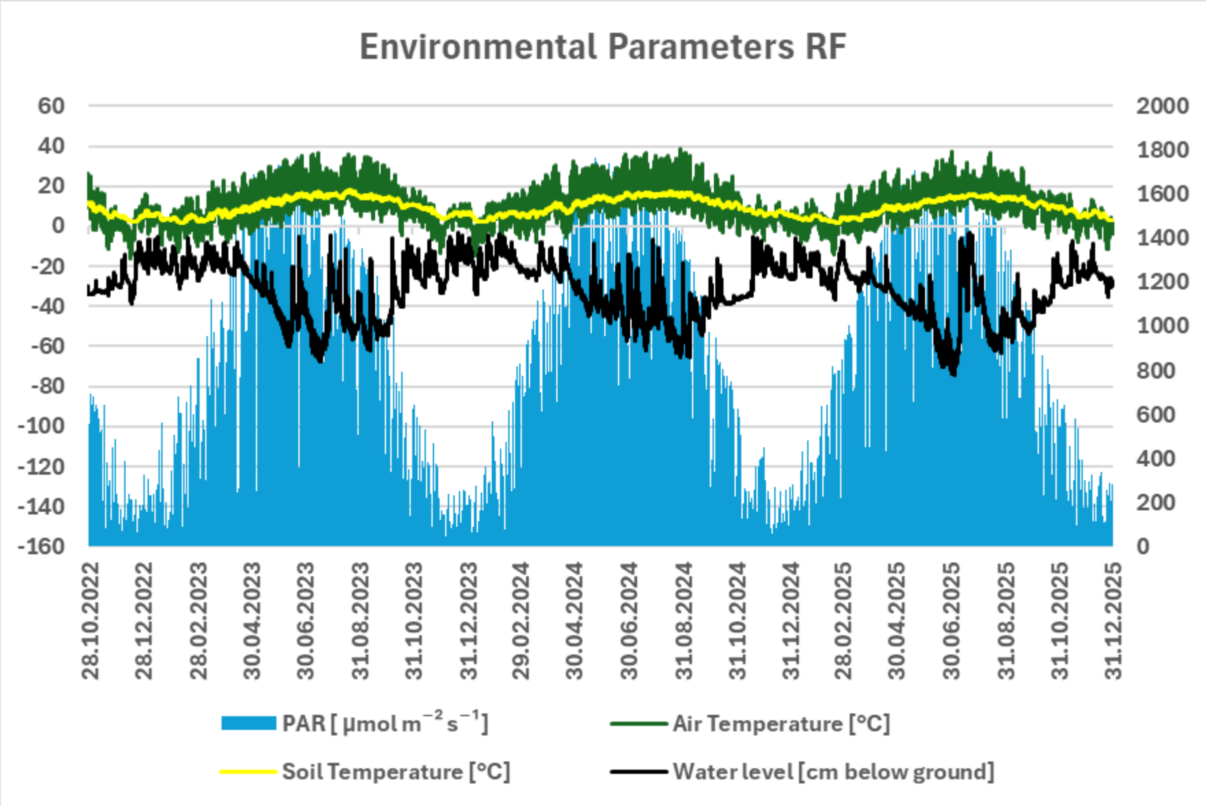


Figure 15: Environmental parameters at GHG-measuring site of the reference peatland Rüdnitzer Fließ.

Table 1: Comparison of mean environmental parameters of the three GHG-measuring sites. HL1= Häsener Luch 1; HL2 =Häsener Luch 2; RF = Reference Site "Rüdnitzer Fließ"

Year	Mean soil temp [°C]			Mean air temp [°C]			Mean water table [m]			Mean PAR [μmol m^{-2} s^{-1}]		
	HL01	HL02	RF	HL01	HL02	RF	HL01	HL02	RF	HL01	HL02	RF
2023	10.6	9.8	9.8	10.3	10.4	10.5	-0.91	-0.57	-0.30	220	240	229
2024	11.0	10.1	10.3	11.1	11.4	11.5	-0.81	-0.53	-0.31	179	233	237
2025	10.3	9.3	9.0	10.0	9.7	9.5	-0.55	-0.52	-0.34	233	232	237

3.3.3 GHG-Measurements

GHG measurements are still ongoing, and will be finished in September. Unfortunately, the effects of the restoration on the GHG-exchange cannot be measured within this timeframe. A first glimpse at preliminary results can be seen in Figure 16, showing Reco, GPP, NEE and water tables below ground for Site HL01. GPP is still overestimated, as it needs an adjustmend for the time outside of the vegetation period, where plants are not performing photosynthesis. As new data is still measured and final annual budgets will be modelled afterwards with the full data set, no values for annual budgets will be give here .

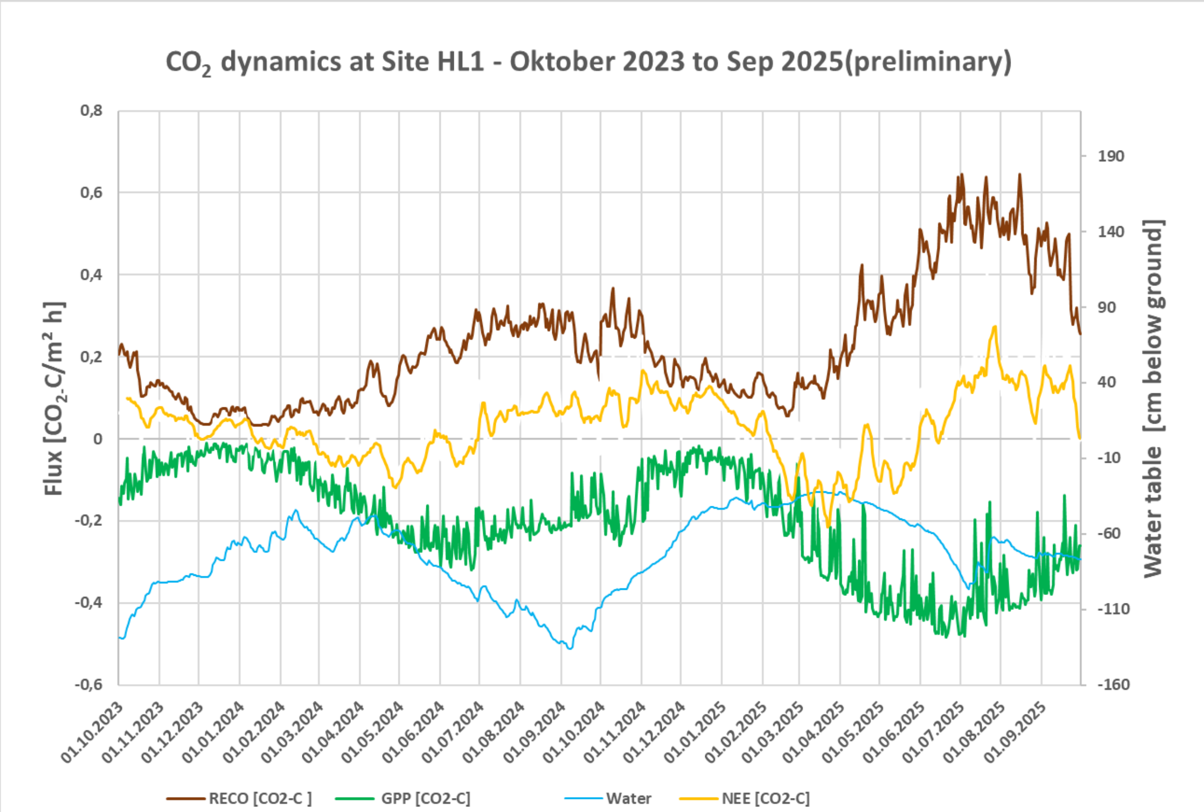


Figure 16: Preliminarily calculated hourly values for Reco, GPP and NEE values for site HL01.

3.3.4 Vegetation Monitoring

In June 2022, 20 vegetation monitoring plots were installed at different places and vegetation types of the project area (Figure 17). Each plot measures 5x5 meters and on the managed grassland they were marked with magnets in the ground, for finding them again. The vegetation description follows the rules of Braun-Blanquet (1964). In June 2024 the first repetition of the vegetation monitoring was conducted and in June 2025 the second.

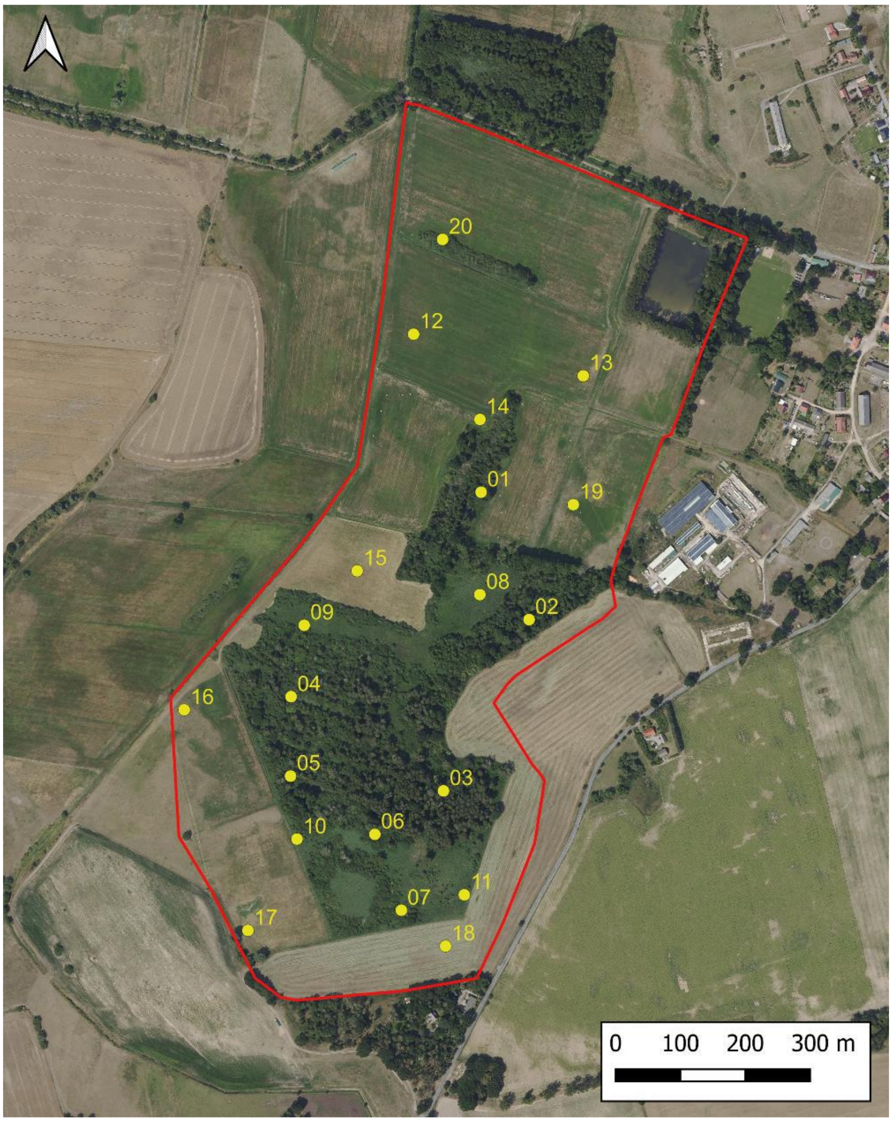


Figure 17: Positions of the 20 monitoring plots inside of the project site

The results are summarised in Table 2. In half of the vegetation plots the number of species was higher as in 2024, in the other half lower. Many vegetation plots have higher species numbers than in 2022, because all plots on the managed part of the peatland have been affected by hay cutting a few days before the vegetation mapping 2022 took place, and many species were hence not recognisable. The number if peatland typical species remains stable. A positive effect of the trial rewetting is so far not visible in the vegetation composition. The number of endangered species remains very low.

Table 2: Overview of vegetation plots (VP), with the parameters Number of Species, Peatland typical Species and Endangered Species for the years 2022, 2024 and 2025. Parameters with (+) show an augment in comparison to the previous year.

VP	Number of Species			Peatland typical Species			Endangered Species		
	2022	2024	2025	2022	2024	2025	2022	2024	2025
01	11	21 (+)	20	6	7 (+)	7	1	1	1
02	12	15 (+)	20 (+)	-	1 (+)	2 (+)	-	1 (+)	1
03	16	22 (+)	21	3	7 (+)	6	-	-	-
04	7	5	4	6	3	2	-	-	-
05	9	10 (+)	6	6	7 (+)	4	-	1 (+)	1
06	13	11	16 (+)	4	3	3	-	-	-
07	10	10	8	3	3	3	1	2 (+)	2
08	5	10 (+)	10	3	4 (+)	4	-	-	-
09	9	14 (+)	15 (+)	2	3 (+)	4 (+)	-	-	-
10	8	14 (+)	20 (+)	3	4 (+)	3	-	-	-
11	6	7 (+)	10 (+)	1	2 (+)	1	-	-	-
12	14	24 (+)	18	3	4 (+)	4	-	1 (+)	-
13	15	14	14	2	2	2	-	-	-
14	15	22 (+)	23 (+)	2	4 (+)	4	-	-	-
15	11	18 (+)	15	4	7 (+)	5	1	1	1
16	10	17 (+)	13	-	-	-	-	-	-
17	6	20 (+)	21 (+)	-	2 (+)	1	-	-	-
18	12	13 (+)	14 (+)	-	-	-	-	-	-
19	10	17 (+)	16	-	-	2 (+)	-	-	-
20	10	13 (+)	17 (+)	6	7 (+)	7	-	-	-

3.4 Discussion and Challenges

Fortunately, the outbreak of African Swine Flu close to the project site (see Midterm Monitoring Report, LIFE Multi Peat, 2025), didn't affect the monitoring. The associated restrictions didn't hinder the monitoring activities and were lifted in early summer.

As mentioned in 3.2., the construction works for the rewetting will start in October, in probably need two months to be finished. Two monitoring tasks are directly affected by this development. The final vegetation survey should be carried out around the same phenological stage, as in the former ones (End of June – beginning of July). Therefore, a final vegetation survey documenting changes after rewetting is not possible, within the running time of the project (March 2027). We argue for doing a final vegetation survey within the frame of an Afterlife monitoring programme. Secondly, the drone flight comparing the situation before and after rewetting is also not possible, within the running time of the project, as it would be only of value, when, likewise to the vegetation monitoring, the same time of the year is compared. In this case, this would be end of May. As there were problems with the first drone imagery anyways (hay cutting on aprox. half of project site days before the drone imagery was taken - see Second Annual Monitoring Report, LIFE Multi Peat, 2024), we would like to do an evaluation of remote sensing data (like done for Belgium), and also to the final comparison within the frame of the Afterlife programme.

3.5 Communication Indicators

	INDICATORS						
	DIRECT			INDIRECT			
Units	**Economic contribu-tion**	**Ecosystem regulating services** (GHG emissions)	**Awareness raising**	**Ecosystem support-ing services** (habitat for species)	**Ecosystem provision-ing services** (raw materials, freshwater)	**Ecosystem regulating services** (Fire/flood prevention)	**Ecosystem cultural services** (recreation, aesthetic apprecia-tion, and inspiration)
Stakeholder and Duty holder engagement			33 + Aprox. 200[2]				
Information boards/panels			0				
Employment (Individuals/companies hired by the project)	8						
Amount spent (€)	55.661,90[3]						
Number of jobs (FTE and PTE)	8 PTE						
Number of events organised or participated	7 events						
Number of participants in events organised by the beneficiary	84						
Number of hectares restored		10					0
GWP reduction (tons of GWP CO_2-eq/ha/yr)		n.a.					
Number of Print media			0				
Number of Publications/Reports, promotional material produced			4				
Media coverage (newspaper			0				

[2] Approximately 200 citizens received information on upcoming restoration activities via old-school mail.
[3] Effective costs for external assistance, travel, consumables, and other direct costs from 01/01/2025 to 31/12/2025.

articles, press releases, radio, podcast)							
Website visits – (nabu.de)		1077					
Website visits – LMP-Website (Multipeat.org) (Language)		GE: 628 NL: 340 IR: 278 BE:254 PL:239					
Climate Performance (tons/year CO_2)		1200					
Climate Performance (tons/year CH_4)		3,2					
Environmental Performance – resilience to flooding (ha)		10					
Baseflow con-tribution of receiving water (m^3/s) by percentage		n.a.					
Average lowest groundwater level on the whole project site (cm below ground level)		-102					
Sustainable land use, agriculture, and forestry (hectares of agricultural land under sustainable management)	0						
Habitats positively affected (ha) and change in percent cover of indicator species associated with their respective target habitat				0			0

4 Ireland

4.1 Project Site

The Irish project area is located in the West of Ireland approximately six km southwest of the town of Oughterard in County Galway. The project site lies within the Cloosh Valley Windfarm managed by SSE. The project consists of two sites: Doire Fhada (~178ha), which is the northernmost site, and Fionnán (~62ha) which is the southernmost site.

Elevation at Doire Fhada decreases from south to north with an elevation change of approximately 200m within the site. The site is situated at an elevation of approximately 100m to 300m. There is no evidence of peat harvesting within the site, however, ground works in preparation for tree planting have taken place in the past and has resulted in numerous furrows along areas of blanket bog (Figure 18). Most of the site consists of blanket bog with varying peat depths. Part of the site is planted with a conifer plantation, with other sections of the site drained, but not planted.

Figure 18: Photos from Doire Fhada, which shows the steeply sloping ground onsite, and past tree planting (lower)

There is very little elevation change within Fionnán, which is located at a lower elevation ranging from approximately 100-110m.

There are three monitoring stations located at Doire Fhada in three different Ecotopes: Blanket Bog (BB), Sitka Spruce (SS), and Open Forestry (OF). There are two monitoring stations at Fionnán: Blanket Bog (FBB), and Sitka Spruce (FSS).

4.2 Current State

Galway County Council granted permission on the 14/07/2025 for tree felling and restoration works at Doire Fhada. Works commenced on the 25th September 2025. Tree felling has been completed at Doire Fhada (Figure 19, and drain blocking is ongoing at the time of writing.

Permission for restoration works was then granted at Fionnán on the 02/10/2025. Works are expected to commence in the coming months.

Figure 19: Current state of Doire Fhada. Tree felling is complete and drain blocking is ongoing.

4.3 Results

Prior to any field work, we selected sampling stations within the project area based on representative habitats within the site. The selected stations correlate with the GHG/environmental monitoring stations (Figure 20). Four sampling stations were selected at

Doire Fhada: Control site, Blanket Bog, Open Forestry and Sitka Spruce. The Control Site represents an area of intact/ undisturbed Blanket Bog. Three sampling stations were selected for Fionnán: Blanket bog, Sitka spruce and Open Forestry.

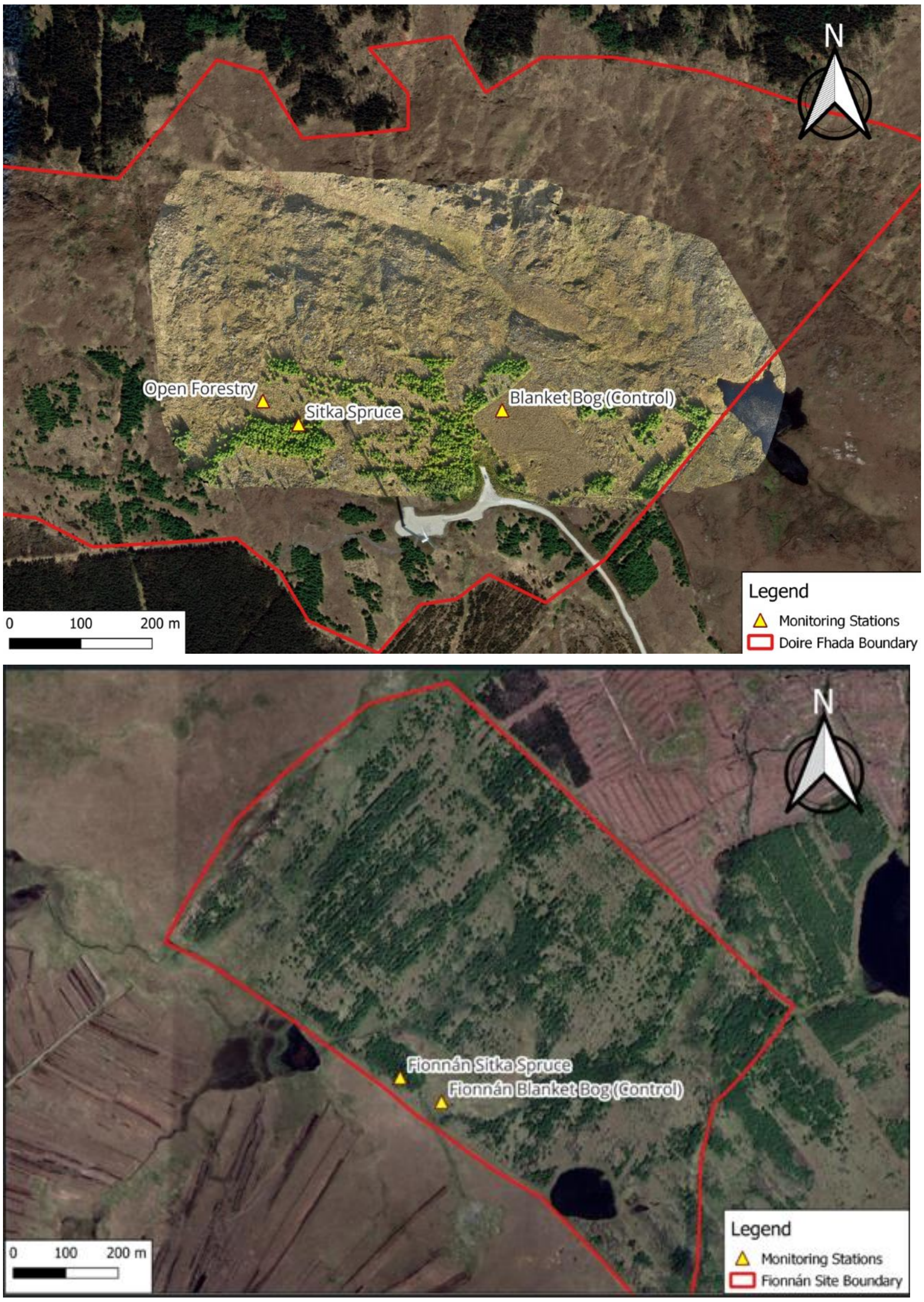
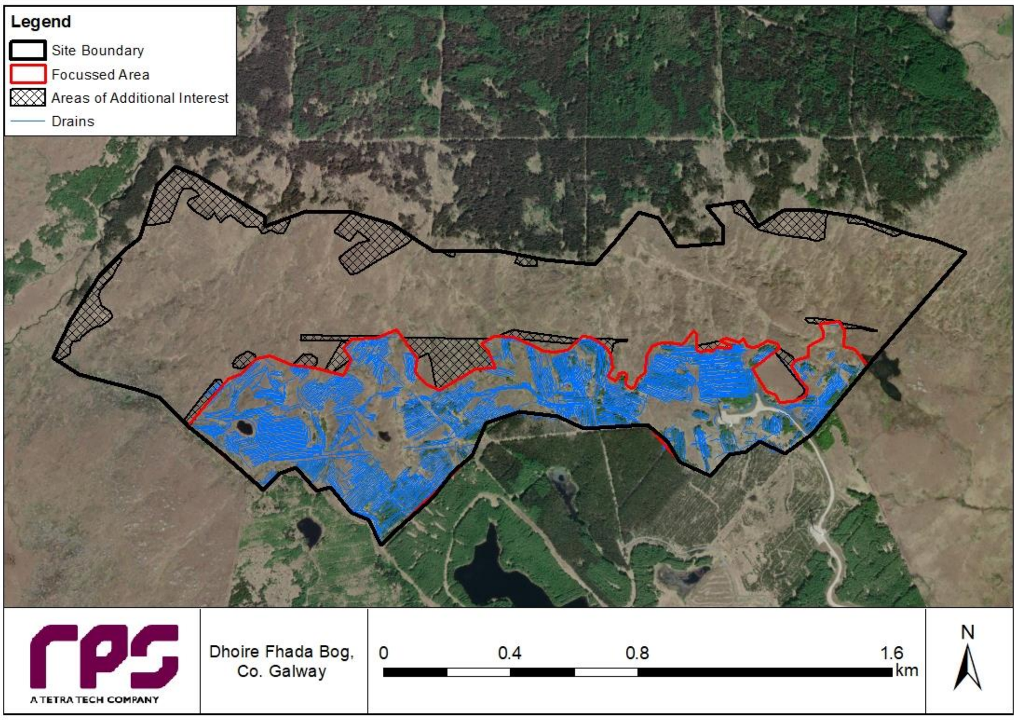


Figure 20: Monitoring stations at Doire Fhada (Top) and Fionnán (bottom)

4.3.1 Hydrological Monitoring

In order to design a restoration plan, a LiDAR flight was conducted over the project area to map the drainage network onsite (Figure 21). The flight mapped the entire drainage network within the bog, and under the canopy of the trees.



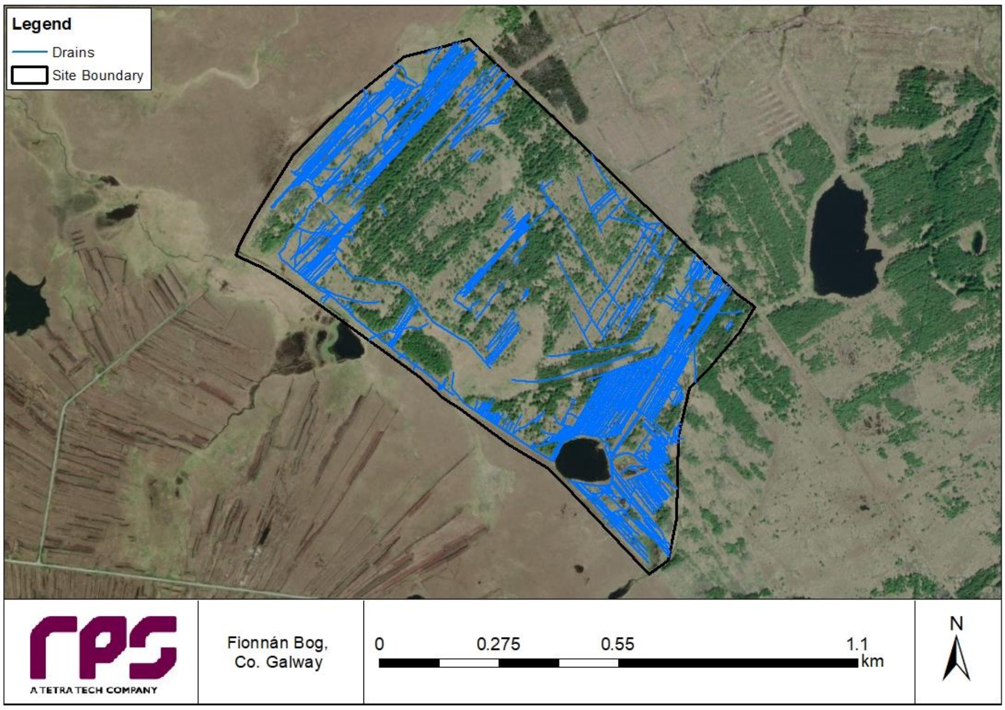


Figure 21: Pre-restoration LiDAR and drainage blocking maps for Doire Fhada (Top) and Fionnán (bottom).

Groundwater levels at Doire Fhada and Fionnán were monitored continuously by Zentra data loggers at 5 monitoring stations (Figure 22). Logging occurred automatically every 15 mins, and measurements are manually verified by surveyors once a month. The graph below shows groundwater level change per month at all monitoring stations within the project area.

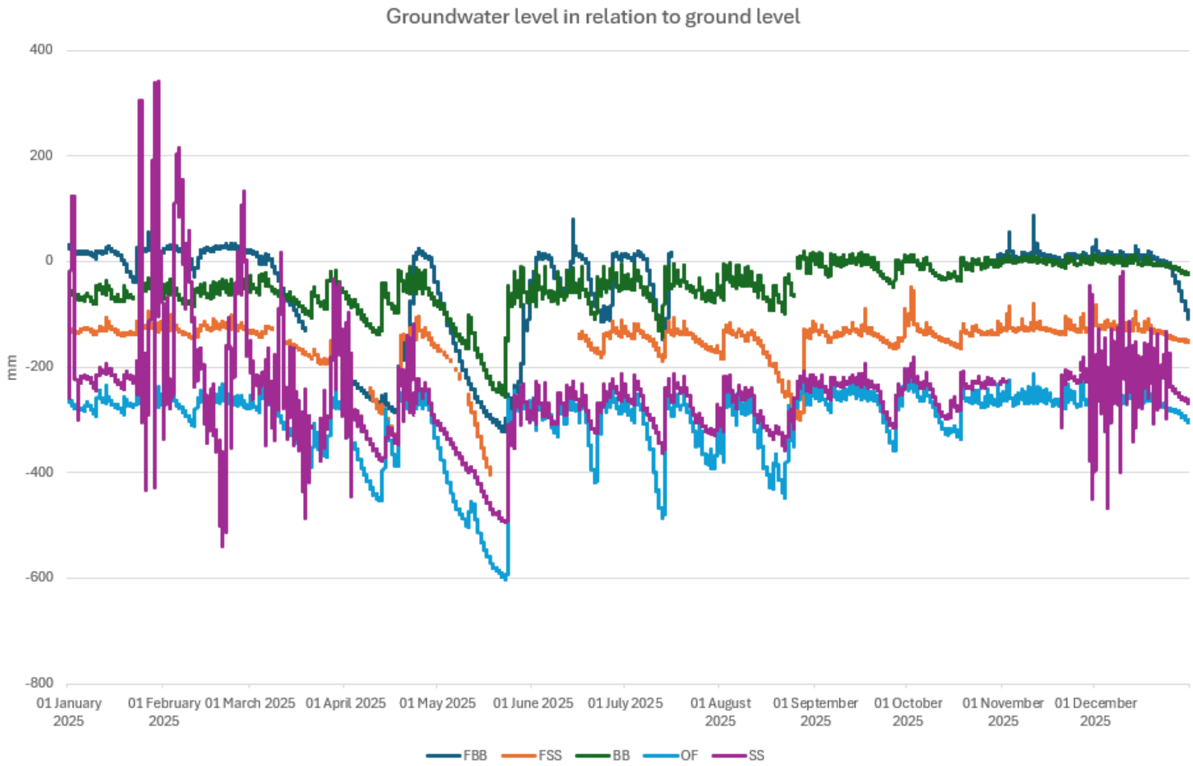


Figure 22: Groundwater level across monitoring stations during the 2025 monitoring period.

4.3.2 *Environmental Parameters*

Light intensity at each ecotope was monitored continuously throughout 2025 with data logged every 15 minutes (Figure 23). At the Sitka Spruce station light intensity for most of the year was much less than other ecotopes, due to shading by the trees. From November light intensity at Sitka Spruce increases due to felling works associated with restoration.

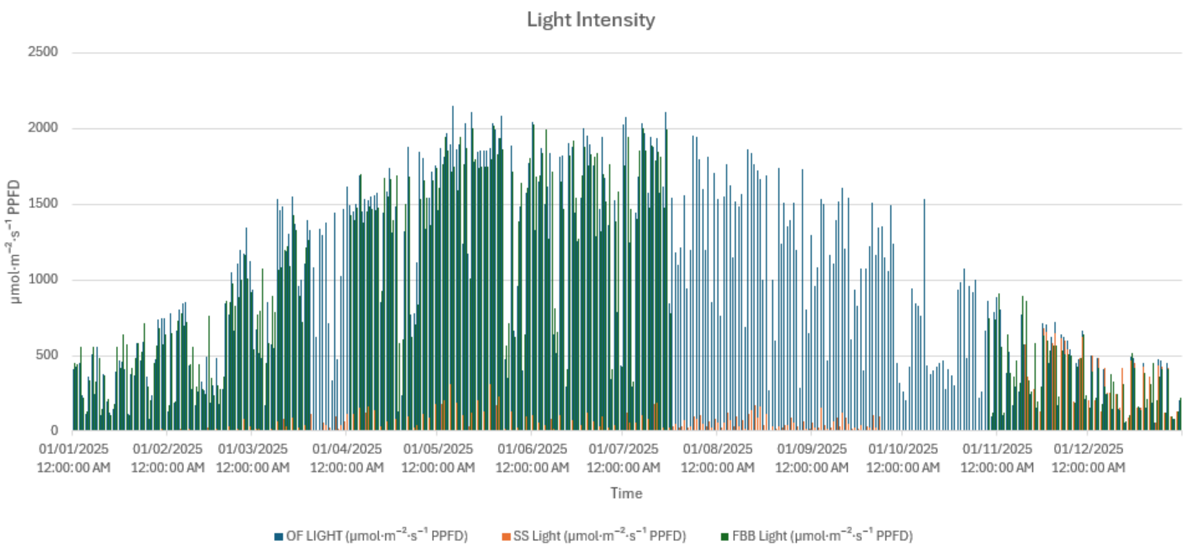


Figure 23: Light intensity measurements at Dore Fhada during the 2025 monitoring period.

4.3.3 GHG-Measurements

Monthly Greenhouse Gas monitoring continued at both sites in 2025, with October, November and December measurements coinciding with restoration works at Doire Fhada. We were successful collecting a complete set of GHG measurements for the year. The fluxes and GHG modeling are still underway at the time of this report.

4.4 Discussion and Challenge

The Zentra Loggers used for data collection occasionally malfunction causing gaps in data. This has been caused by animals eating cables, cables being dislodged from data loggers (possibly by grazing animals), depleted batteries, or malfunctioning sensors.

At the FBB Station, the bracket holding the data logger broke, and the logger fell into a pool of water, irreparably damaging the logger. There is a gap in data, while we waited for a replacement logger. The Sitka Spruce water well logger was faulty giving widely fluctuating data at the start of 2025. This sensor was replaced and readings returned to normal. The sporadic readings from the water level sensor at the end of 2025, is likely due to machinery operating close the water well during restoration works. Data returned to normal in early 2026 when machinery had moved out of that area.

4.5 Communication Indicators

	INDICATORS						
	DIRECT			INDIRECT			
Units	**Economic contribu-tion**	**Ecosystem regulating services** (GHG emissions)	**Awareness raising**	**Ecosystem support-ing services** (habitat for species)	**Ecosystem provision-ing services** (raw materials, freshwater)	**Ecosystem regulating services** (Fire/flood prevention)	**Ecosystem cultural services** (recreation, aesthetic apprecia-tion, and inspiration)
Stakeholder and Duty holder engagement			0				
Information boards/panels			1				
Employment (Individuals/companies hired by the project)	8		2				
Amount spent (€)	621886.02						
Number of jobs (FTE and PTE)	3,5						
Number of events organised or participated			2				
Number of participants in events organised by the beneficiary			0				
Number of hectares restored		27.5					0
GWP reduction (tons of GWP CO_2-eq/ha/yr)		TBD					
Number of Print media			1				
Number of Publications/Reports, promotional material produced			0				
Media coverage (newspaper articles, press releases, radio, podcast)			0				

Website visits – Peatland Policy Portal			2100				
Climate Performance (tons/year CO_2)		To be estimated at project end					
Climate Performance (tons/year CH_4)		To be estimated at project end					
Environmental Performance – resilience to flooding (ha)		To be estimated at project end					
Baseflow con-tribution of receiving water (m^3/s) by percentage		To be estimated at project end					
Average lowest groundwater level on the whole project site (cm below ground level)		-75					
Sustainable land use, agriculture, and forestry (hectares of agricultural land under sustainable management)	0						
Habitats positively affected (ha) and change in percent cover of indicator species associated with their respective target habitat		27.5		58			0

5 Netherlands

5.1 Project Site

In the preparation of the project an extensive eco-hydrological system analysis has been established. This analysis describes the geology, geomorphology, hydrology etcetera. In the present Mid-term Monitoring Report we will only give a short summary. Full details are available in Dutch (Bell & van 't Hullenaar, 2018).

The Witte Veen is a Natura2000 reserve in the east of The Netherlands at the border with Germany (Figure 24). The area is located between two main brooks: the Hege Beek in the north and the Buurser Beek in the south. The main study site in the Witte Veen is the peat bog in the northeast. This peat bog was formed in a lower area in a late Pleistocene sand dune landscape on top of clayloams which originate from the glacial period. During the Holocene the peat bog grew and spread over the landscape. However, since Medieval times human influence started and after drainage, peat cutting and exploitation only a small remnant was left.

The geomorphological setting and the upper geological layers are illustrated in the cross section in Figure 25. In the above mentioned eco-hydrological analysis several of these cross sections are available.

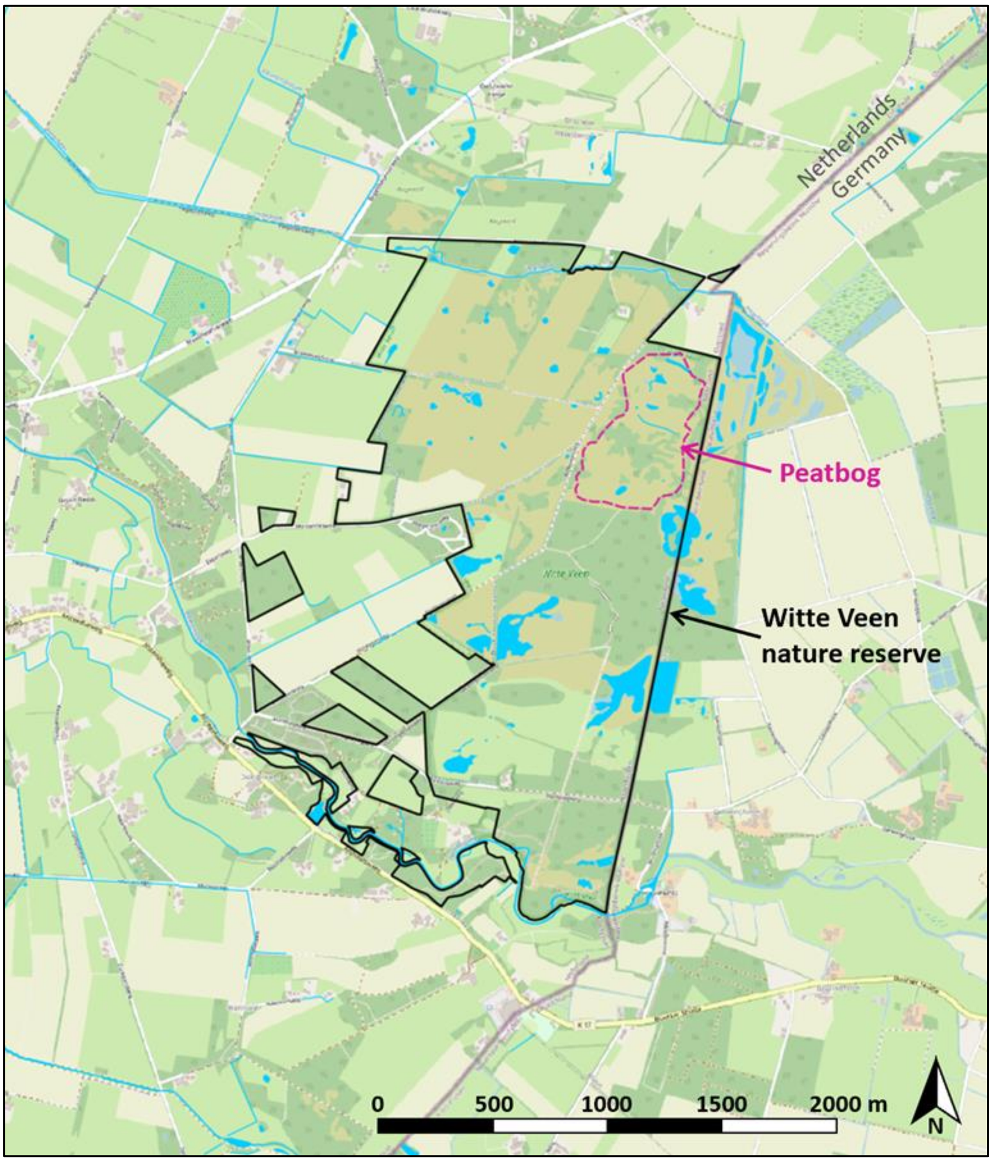


Figure 24: The Witte Veen nature reserve and the location of the peat bog

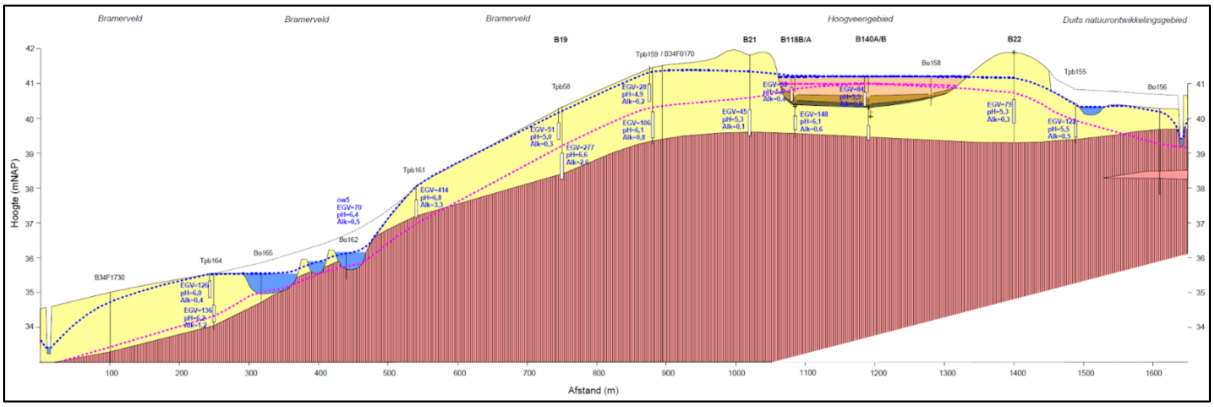


Figure 25 West-east cross section illustrating the geomorphological setting

In the Netherlands a nation-wide DEM is available on both a 0.5 meter and 5 meter resolution. By the end of 2022 the most recent version of that DEM has become available for the Witte Veen (AHN version 4). On the German side of the border we do not have a recent DEM on a fine resolution. Since the project is carried out in The Netherlands the German DEM is only needed for visualisation purposes and does not require a high level of accuracy.

The DEM for the Witte Veen and its surroundings is shown in Figure 26. The elevation decreases from east to west. The peat bog - depicted with the dotted white line - is located on the higher part of the nature area. The valley of the Buurser Beek in the south is clearly visible.

In Figure 27 the DEM of the peat bog is shown in more detail. The late Pleistocene sand dunes are visible as higher parts in the landscape, surrounding the somewhat lower peat bog.

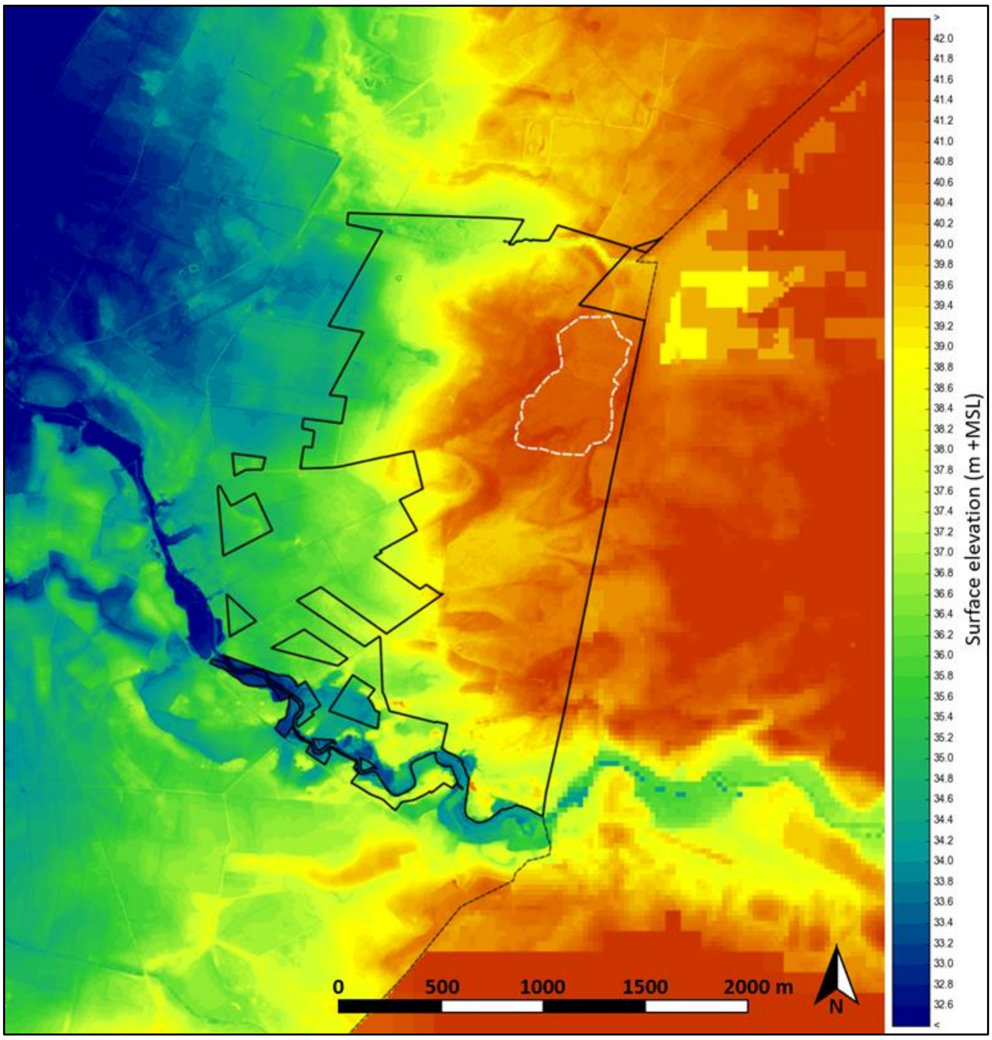


Figure 26: DEM (5x5 meter resolution) of the Witte Veen and its surroundings

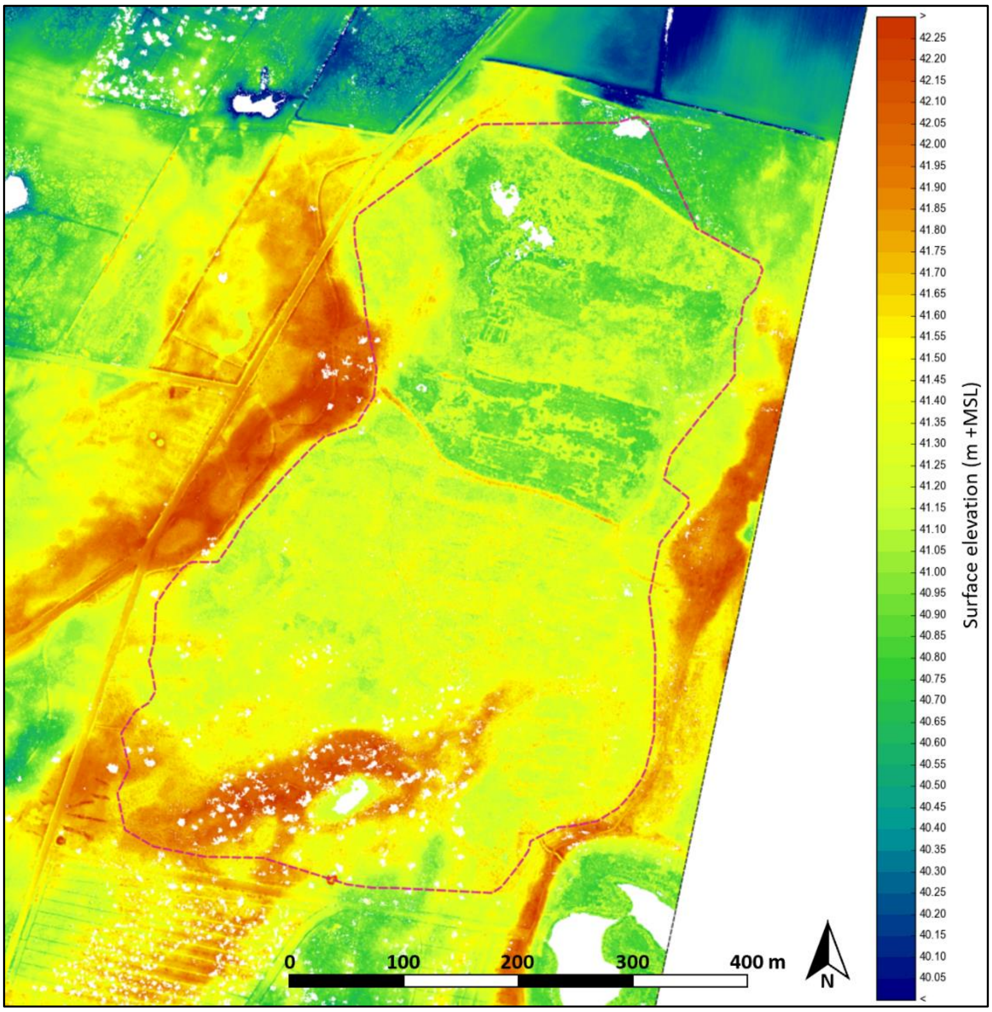


Figure 27: DEM (0.5x0.5 meter resolution) of the peat bog within Witte Veen

Within the peat bog there are no ditches or other streams present. Surface (runoff) and sub-surface water flow from south to north within the peat bog, leaving the bog through a ditch just outside the nature reserve. Water from this ditch flows to the west and north towards the Hege Beek brook in the north. In the nature area outside the bog several (shallow) ditches are present, transporting water to the surroundings in several - mainly westward - directions. These ditches cause water losses from the peat bog area and will therefore be removed in the project. The regional groundwater flow is oriented from the higher parts towards the west.

Reference site

Together with the research partner GEMCE – which measures the GHG fluxes – we have decided that the Engbertsdijksveen in the Netherlands (managed by SBB, the state forestry organization) is the most suitable reference site (see Figure 28). In this peat bog restoration works have been postponed, which give us the possibility to measure at a non-restored site for the entire duration of the LIFE project.

Figure 28: Location of Witte Veen and reference site Engbertsdijksveen in The Netherlands

5.2 Current State

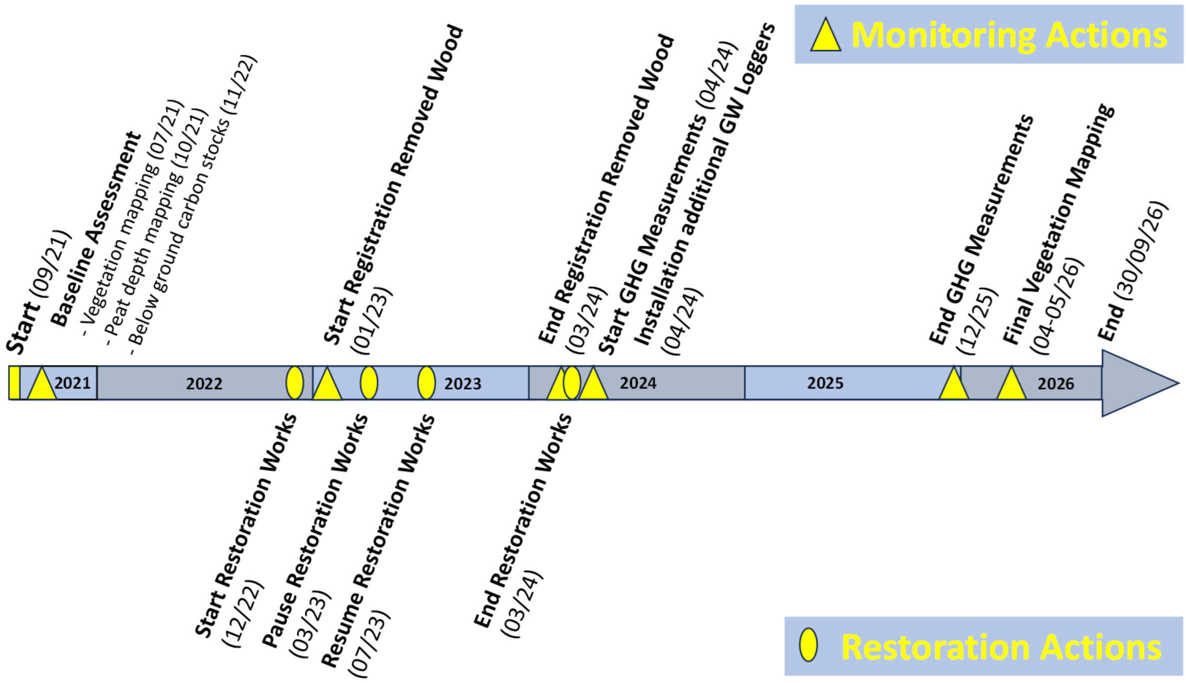


Figure 29: Timeline showing restoration and monitoring progress for The Netherlands.

5.3 Results

5.3.1 Hydrological Monitoring

Monitoring of groundwater and surface water is continued in 2025 at the locations shown in Figure 30 and Figure 31. Additional piezometers were installed in 2024 at the GHG measurement locations and continued in 2025.

Water levels in the two GHG locations are shown in Figure 32. The graph shows the difference between years and between the locations.

Figure 33shows an example timeseries over a longer time period, including a timeseries model (modeled with the Pastas timeseries modeling code). The modeled long-term linear trend is negative. The recent wet period is visible in higher groundwater levels. It is however too early to filter out the rewetting effect of the restoration measures, which may show a deflection to a positive trend.

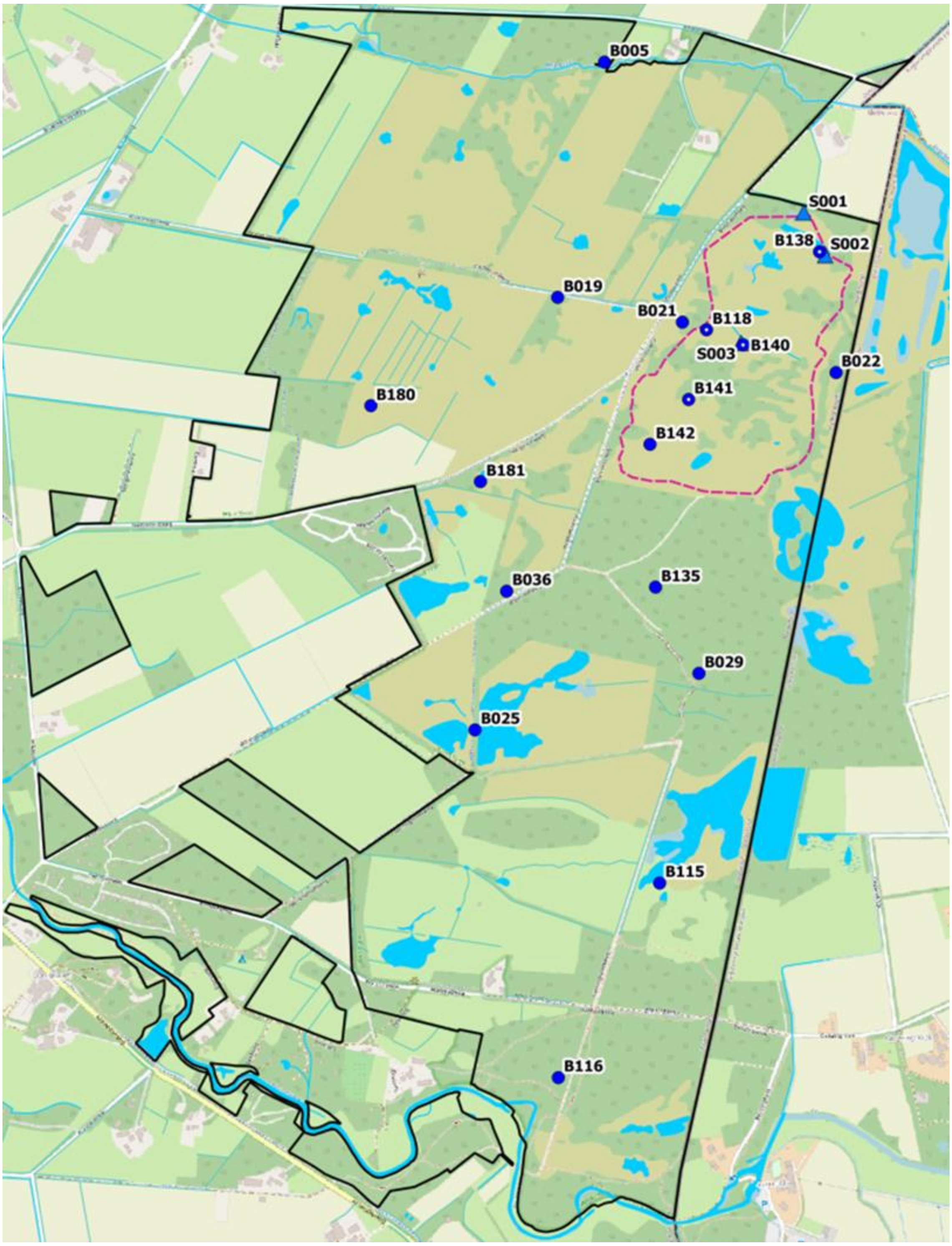


Figure 30: Location of the piezometers in the Witte Veen.

Figure 31: Location of the GHG measurements (center of the plots) and the additional piezometers within the two sites.

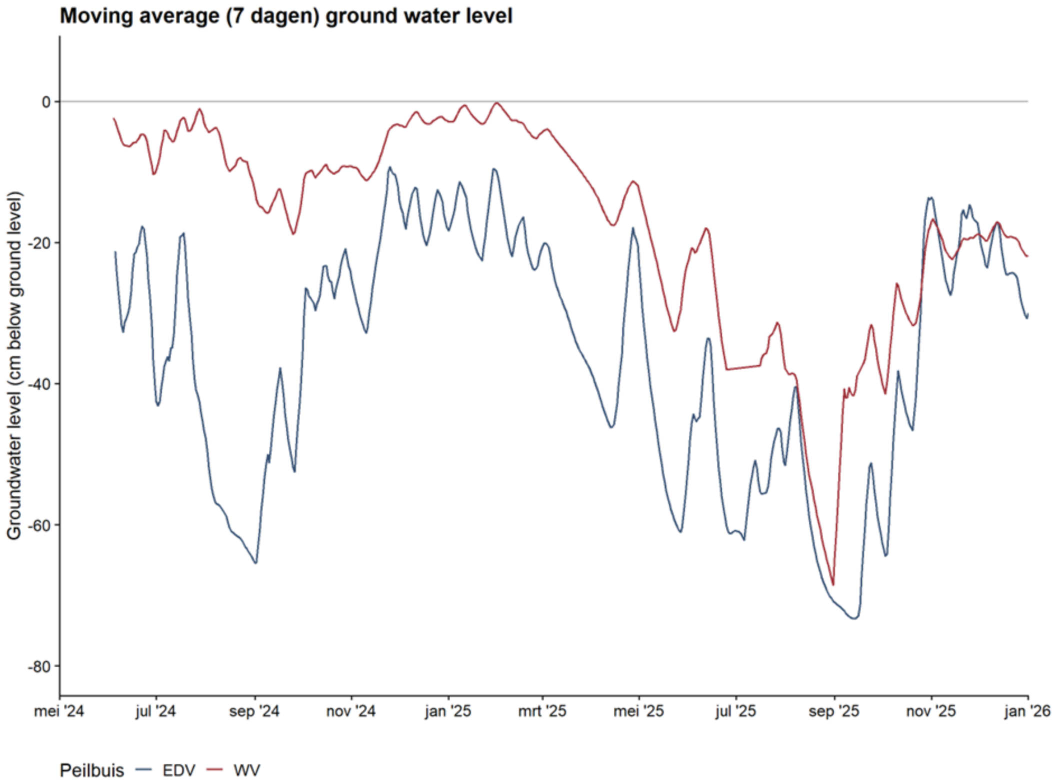


Figure 32: Waterlevels at the GHG sites. WV = Witte Veen, EDV = Engbertsdijksveen.

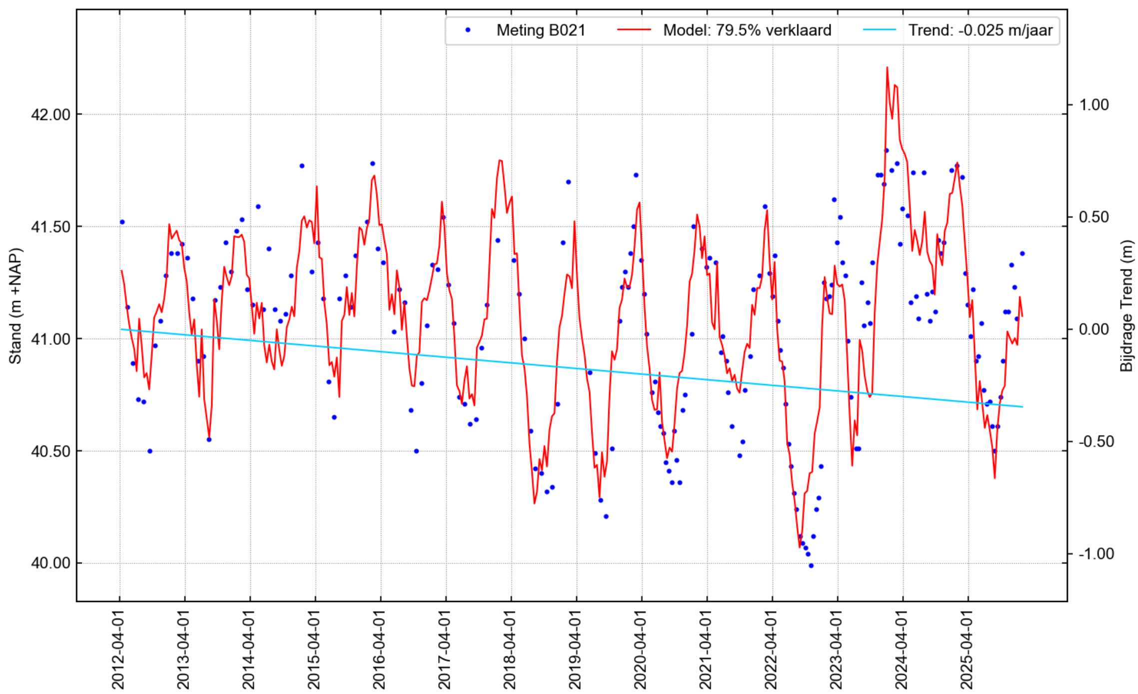


Figure 33: Example groundwater timeseries of piezometer B021: measurements (blue), timeseries model (red). The light blue line is the modeled linear trend.

5.3.2 Environmental Parameters

Meteo data are derived from nearby weather stations of the Royal Dutch Meteorological Survey (KNMI). Monthly numbers over the GHG measurement period (2024 and 2025) are shown in Figure 34.

Timeseries over the whole project period (as from 2021) are shown in Figure 35. The bottom figure clearly shows the wet period from the autumn of 2023 to the end of the summer of 2024: a high cumulative precipitation excess in the winter, followed by a low (to negative) cumulative shortage in the summer. The winter of 2024-2025 was relatively dry. The summer of 2025 was relatively normal.

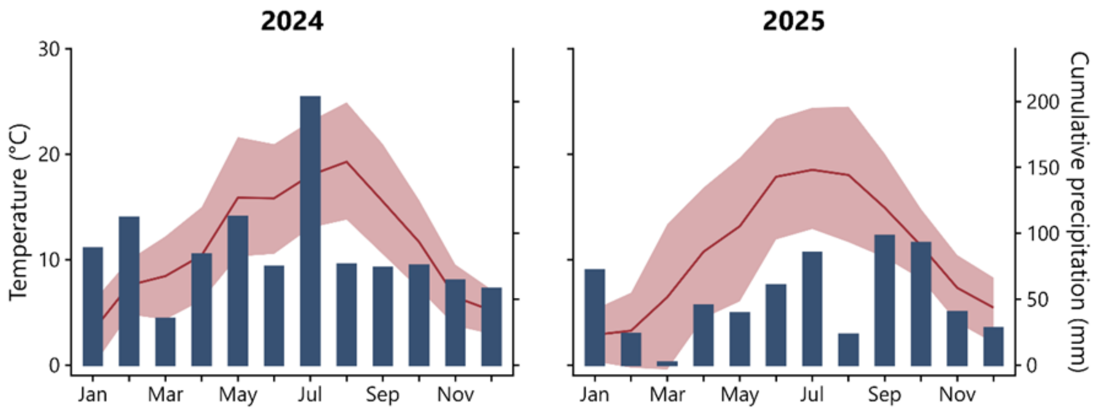


Figure 34: Average monthly air temperature (red line) and cumulative precipitation (blue bars) in 2024 (left) and 2025 (right). The red ribbon shows the monthly average minimum and maximum air temperature.

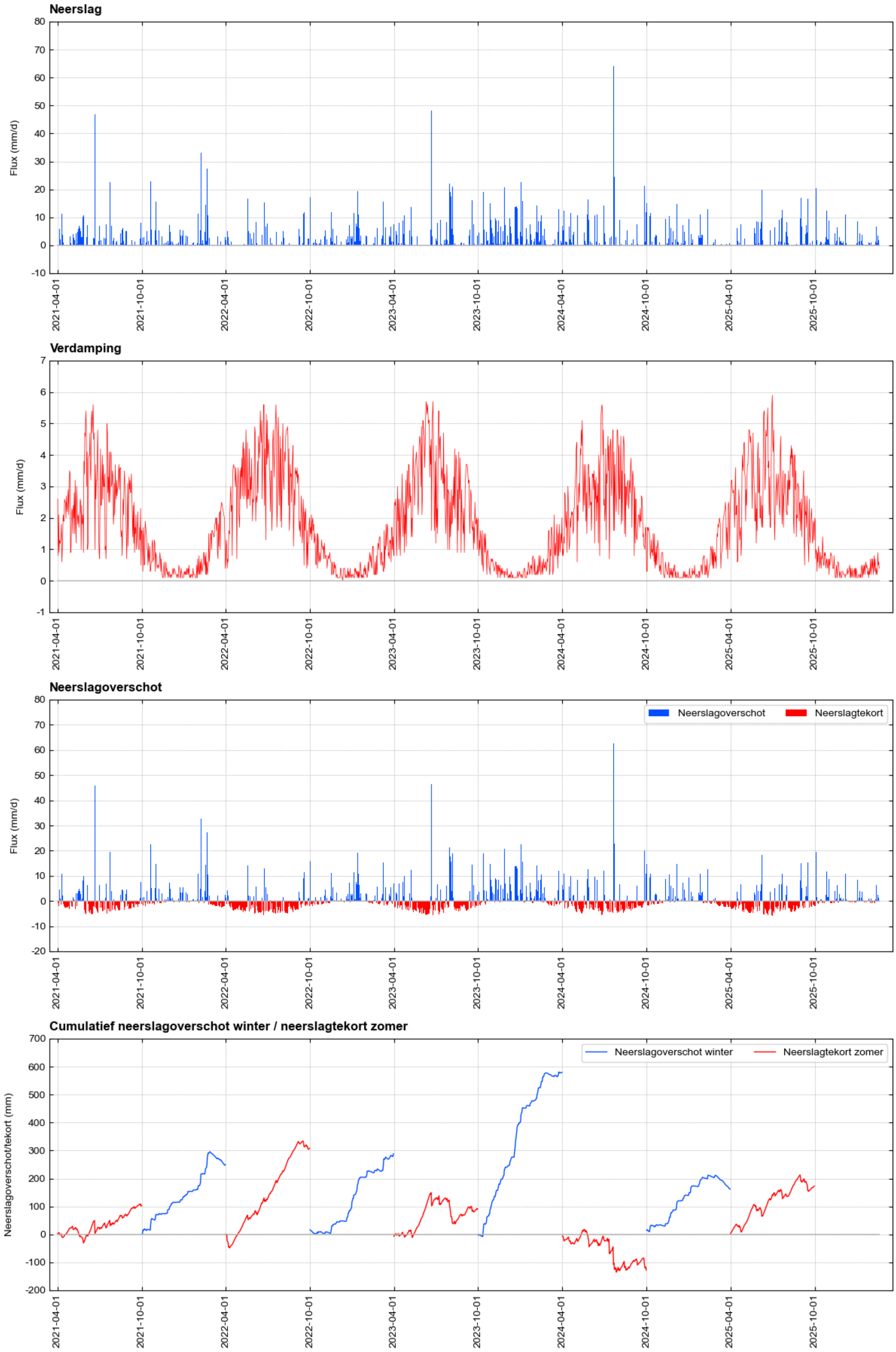


Figure 35: Meteo data for the Witte Veen in period 2021-04-01 to 2025-12-31. Precipitation, evapotranspiration (reference), precipitation excess/shortage and cumulative winter excess and summer shortage.

5.3.3 GHG-Measurements

GHG measurements started in April 2024 in both the Witte Veen and the reference site Engbertsdijksveen (see Figure 31) and ended in December 2025. The measurements were done by the contractor GEMCE (B-WARE and Radboud University) and will be reported in Q2 of 2026.

Measurements were done in 10 plots in the Witte Veen and in 11 plots in the Engbertsdijksveen (see Table 3, Figure 36 & Figure 37) for an overview of the measurement plots). The plots were chosen on a dry to wet gradient and in various vegetation types. A full description of the plots will be given in the end report.

In the period April 2024 to December 2025 there were 18 rounds of measurements in all plots of each site (see Table 4). CO_2 and CH_4 fluxes were measured in light and dark conditions, including a lightresponse curve.

Table 3: Overview of the GHG measurement plots.

Location	Plot	Plant community characterisation
Witte Veen	1	Molinia, Erica
Witte Veen	2	Erica, Sphagnum
Witte Veen	3	Erica, Sphagnum
Witte Veen	4	Molinia, Erica
Witte Veen	5	Molinia, Sphagnum
Witte Veen	6	Molinia, Sphagnum
Witte Veen	7	Molinia
Witte Veen	8	Molinia
Witte Veen	9	Sphagnum
Witte Veen	10	Sphagnum
Witte Veen	11	Open water
Engbertsdijksveen	1	Molinia, Erica
Engbertsdijksveen	2	Molinia
Engbertsdijksveen	3	Molinia, Erica
Engbertsdijksveen	4	Molinia
Engbertsdijksveen	5	Molinia
Engbertsdijksveen	6	Molinia, Erica
Engbertsdijksveen	7	Molinia
Engbertsdijksveen	8	Molinia, Erica
Engbertsdijksveen	9	Sphagnum
Engbertsdijksveen	10	Sphagnum

Table 4: Overview of the GHG measurement dates

2024	2025
April	February
May	March
June	April
July	May
August	June
September	July
October	August
December	September
	October
	December

Figure 36: Overview of the ten measurement plots (excluding the open water plot) at the Witte Veen site, with 1. Molinia & Erica, 2. Erica & Sphagnum, 3. Erica & Sphagnum, 4. Molinia & Erica, 5. Molinia & Sphagnum, 6. Molinia & Sphagnum, 7. Molinia, 8. Molinia, 9. Sphagnum, 10. Sphagnum.

Figure 37: Overview of the ten measurement plots at the EDV site, with 1. Molinia & Erica (dry), 2. Molinia (dry), 3. Molinia & Erica (dry), 4. Molinia (dry), 5. Molinia (wet), 6. Molinia & Erica (wet), 7. Molinia (wet), 8. Molinia & Erica (wet), 9. Sphagnum, 10. Sphagnum.

5.3.4 Vegetation Monitoring

Vegetation was mapped in 2021 just prior to the start of the project. The vegetation map – shown in Figure 38– did not cover the whole of the Natura2000 area, but included the peat bog. A more detailed picture of the vegetation map for the peat bog is given in Figure 39.

In addition to the 'normal' vegetation mapping the distribution and abundance of Sphagnum species was mapped, specifically with the LIFE project goals in mind.

The fieldwork for the next vegetation mapping was carried out in 2025. Results in terms of a validated vegetation map will become available in 2026.

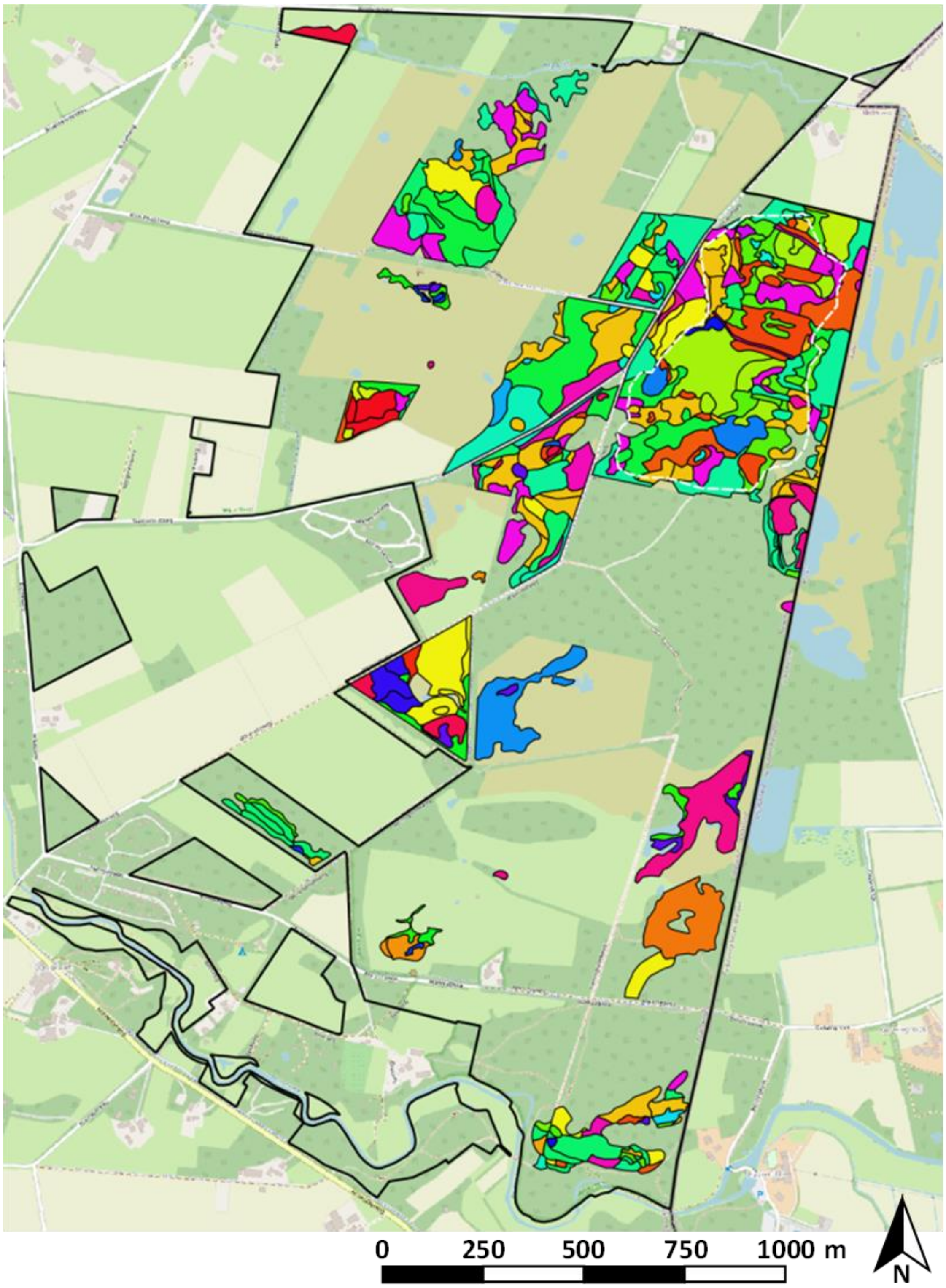


Figure 38: Vegetation mapped in 2021 in the Witte Veen.

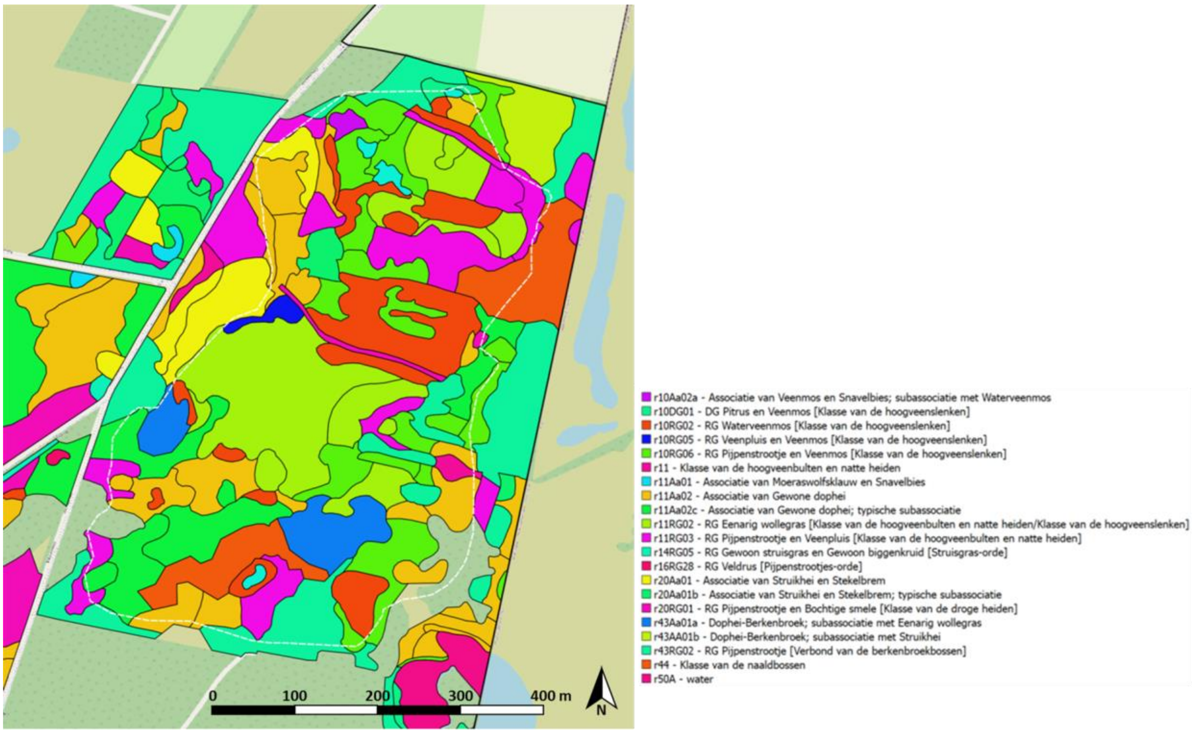


Figure 39: Vegetation map (2021), zoomed in on the peat bog in the Witte Veen.

5.4 Discussion and Challenges

The two measurement years, 2024 and 2025, were quite different in terms of meteorology. The first GHG year started after the very (extremely) wet winter of 2023-2024. The summer of 2024 was also relatively wet. On the contrary, the winter of 2025 was relatively dry and followed by a fairly normal summer.

As a result the field situation and the GHG emissions differed between the two years. This shows that year-to-year variation is important to take into account when drawing conclusions. It also shows the importance of comparing the restoration site to a reference site, in order to separate restoration effects from meteorological variation to a certain extent. In the end report this will be discussed.

Applying the GEST-method to both the pre and post restoration situation may reveal the longer term effects. We think that the vegetation mapping of 2025/2026 may be too early to see clear effects of the restoration. A next vegetation mapping might be done in 12 years in the usual monitoring scheme of Natuurmonumenten.

5.5 *Communication Indicators*

	INDICATORS						
	DIRECT			INDIRECT			
Units	**Economic contribu-tion**	**Ecosystem regulating services** (GHG emissions)	**Awareness raising**	**Ecosystem support-ing services** (habitat for species)	**Ecosystem provision-ing services** (raw materials, freshwater)	**Ecosystem regulating services** (Fire/flood prevention)	**Ecosystem cultural services** (recreation, aesthetic apprecia-tion, and inspiration)
Stakeholder and Duty holder engagement		4	120				50
Information boards/panels	5		5				
Employment (Individuals/companies hired by the project)	15	2	3				
Amount spent (€)	€ 83.644,23 excl. overhead						
Number of jobs (FTE and PTE)	10						
Number of events organised or participated	2	2	10				
Number of participants in events organised by the beneficiary			250				
Number of hectares restored		80 ha (peat)+ 26 ha support. area					
GWP reduction (tons of GWP CO_2-eq/ha/yr)		To be estimated at project end					
Number of Print media			100				
Number of Publications/Reports, promotional material produced			10				

Media coverage (newspaper articles, press releases, radio, podcast)			1 movie 2 articles				
Website visits Witte Veen |			15				
Website visits – LMP-Webiste (Multipeat.org) (Languange)		To be estimated at project end					
Climate Performance (tons/year CO_2)		To be estimated at project end					
Climate Performance (tons/year CH_4)		To be estimated at project end					
Environmental Performance – resilience to flooding (ha)		N/A					
Baseflow con-tribution of receiving water (m^3/s) by percentage		To be estimated at the end of the project					
Average lowest groundwater level on the whole project site (cm below ground level)		To be estimated at the end of the project N/A					
Sustainable land use, agriculture, and forestry (hectares of agricultural land under sustainable management)		N/A					
Habitats positively affected (ha) and change in percent cover of indicator species associated with their respective target habitat		To be estimated at the end of the project					0

6 Poland

6.1 Project Site

Project site is located within Natura 2000 site Torfowiska Orawsko-Nowotarskie (Orawa-Nowy Targ Peat Bogs) PLC120003. The area is situated in southern Poland, in Carpathian Mountains (see Figure 40). It is a part of a mid-mountain basin with a flat terrain relief, where, due to unique geological, geomorphological, hydrographic and climatic conditions, raised peat bogs started to form after the last glaciation. Nowadays they occur here in a mosaic with bog woodlands and meadows, shaping a unique landscape of the region for this part of the Carpathians. The peat bogs, elevated in the form of domes a few metres above the surrounding terrain, are built mainly by mosses *Sphagnum* spp. and dwarf shrubs of the family Ericaceae. They are also partly wooded by pines *Pinus* spp. In the past, the peat bogs were cut by a network of ditches and drained, and their area was also significantly reduced because of peat exploitation. These destructive activities are no longer carried out today, but their effects (drying, peat degradation, vegetation changes, tree expansion) are still visible today. Project activities are being carried out on two of the peat bogs still preserved today.

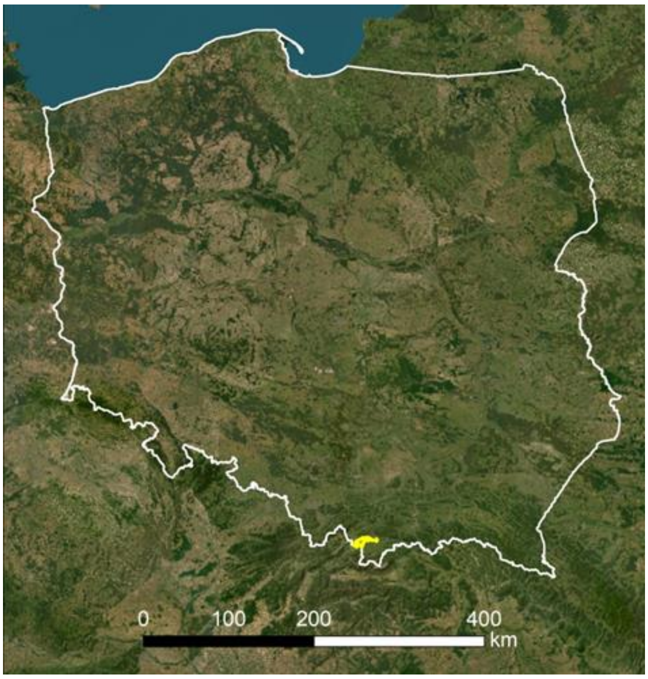


Figure 40: Map of Poland showing the location of the Torfowiska Orawsko-Nowotarskie PLC120003 Natura 2000 site (yellow polygon)

The first is Baligówka (Figure 41, left), one of the largest peat bogs in the region, with an area of ca. 200 ha, and the second is Bór za Lasem and Las Kaczmarka (Figure 41, right), which, as a result of exploitation, has been divided into two parts, currently covering about 40 ha. Both sites are protected inside Natura 2000. A reference function is served by the peat bog Bór na

Czerwonem, located in the same Natura 2000 site, which has been protected as a nature reserve since 1925.

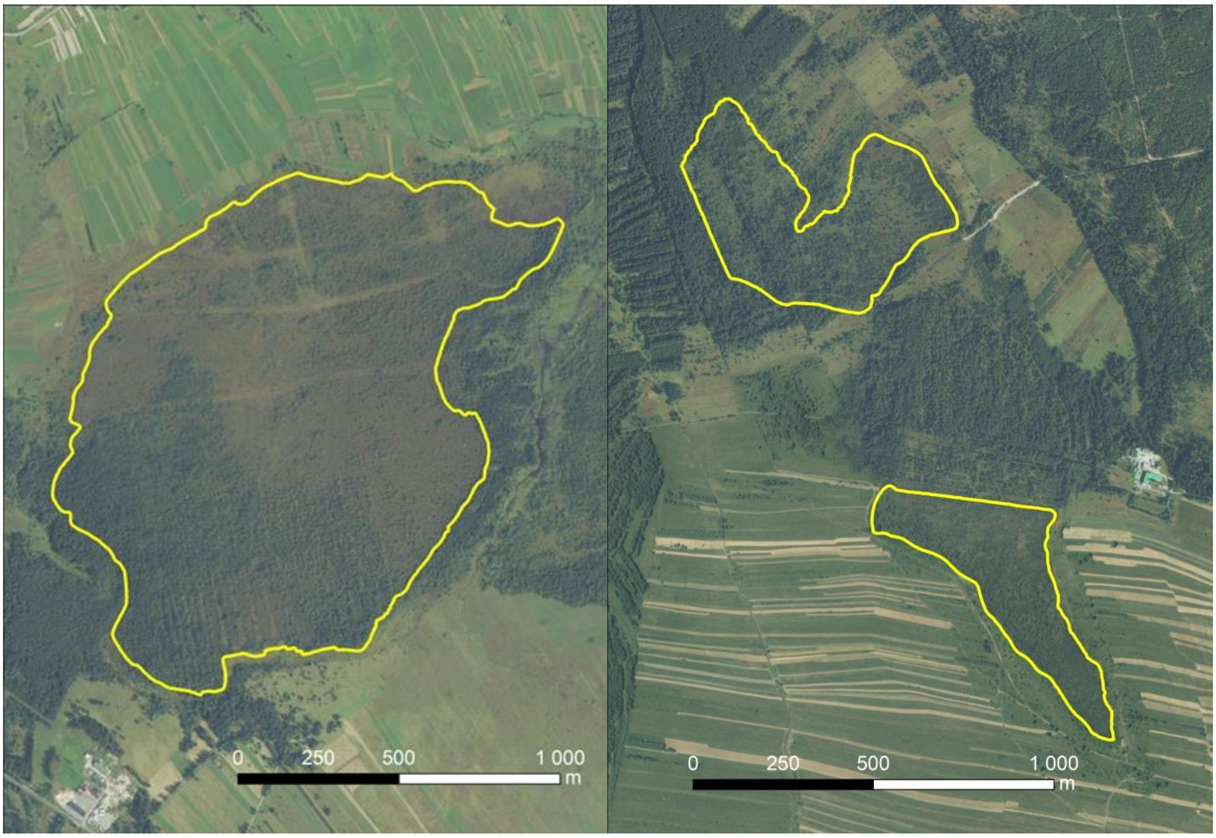


Figure 41: Map showing two project sites: Baligówka (left panel) and Bór za Lasem Kaczmarka (right panel), located within the Torfowiska Orawsko-Nowotarskie PLC120003 Natura 2000 site

6.2 Current State

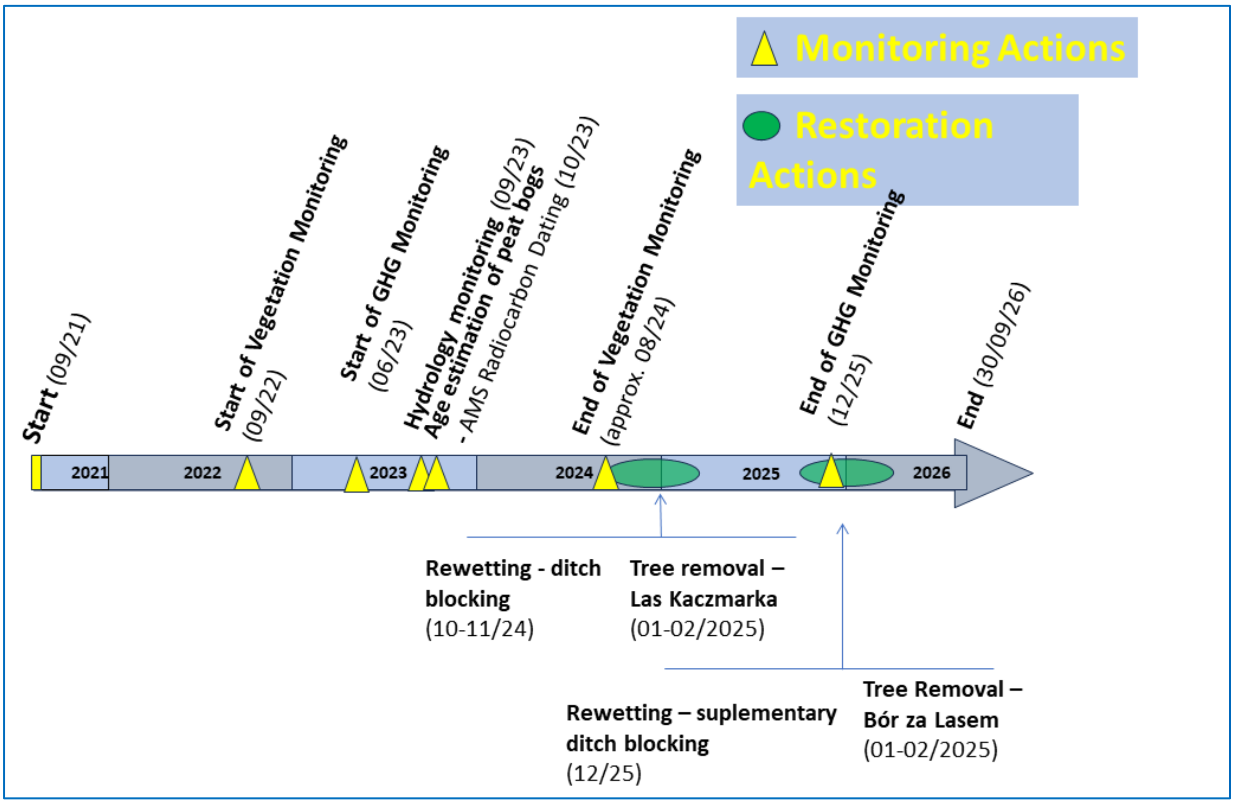


Figure 42: Timeline showing restoration- and monitoring progress for Poland

In the winter of 2025/26, conservation measures were carried out to improve the hydrological conditions of raised bogs in the Natura 2000 site Orawsko-Nowotarskie Bogs PLC120003. Work was carried out on the Baligówka peat bog to reduce water runoff from the bog dome. This involved supplementing the network of water barriers on drainage ditches with an additional 12 facilities. In addition, 14 existing barriers were modified, including 11 that were elongated and 3 that had supporting structures added. Furthermore, in the case of barriers consisting of two walls and a ground filling, in order to limit their overgrowth by ecologically alien herbaceous vegetation, 41 existing barriers were secured by covering their filling with wooden boards. In turn, in the Bór Za Lasem bog, in order to limit water transpiration and uncover the peat bog dome, woody vegetation was removed. Trees and shrubs, mainly Scots pine *Pinus sylvestris*, were cleared from an area of 2.51 ha, and the biomass generated was removed from the peat bog dome. Approximately 250 of the largest trees were not felled, but were killed by bark girdling and left in place.

6.3 Results

6.3.1 Hydrological Monitoring

The water level in the peat has been monitored since autumn 2023 using automatic recorders in piezometers. Results from several points clearly face some technical problems, but the network of monitoring points is intentionally redundant, so the interpretation is still feasible.

The water level changes in various parts of the bogs are different, but generally more stable in central parts. The data for the hydrological years 2024 and 2025 suggest that the water regime of raised bogs in Torfowiska Orawsko-Nowotarskie is somewhat different from the typical water regime of raised bogs in the lowlands - in the well-preserved parts the water level is very stable, not showing the seasonal variability typical of bogs in the lowlands. The effects of ditch drainage are expressed in breaches of this stability and periodic drops in water levels. The response to precipitation varies in different parts of the peatland. Permanent drainage affects the marginal parts of peatlands, especially at edges shaped by peat extraction from the banks. Results of ditches blocking in late autumn 2024 are not yet distinguishable. The results are not immediate water level increase, but rather spring water accumulation, reducing summer fluctuations and depressions. Detailed water level monitoring results are graphically shown below.

<u>Baligówka</u>

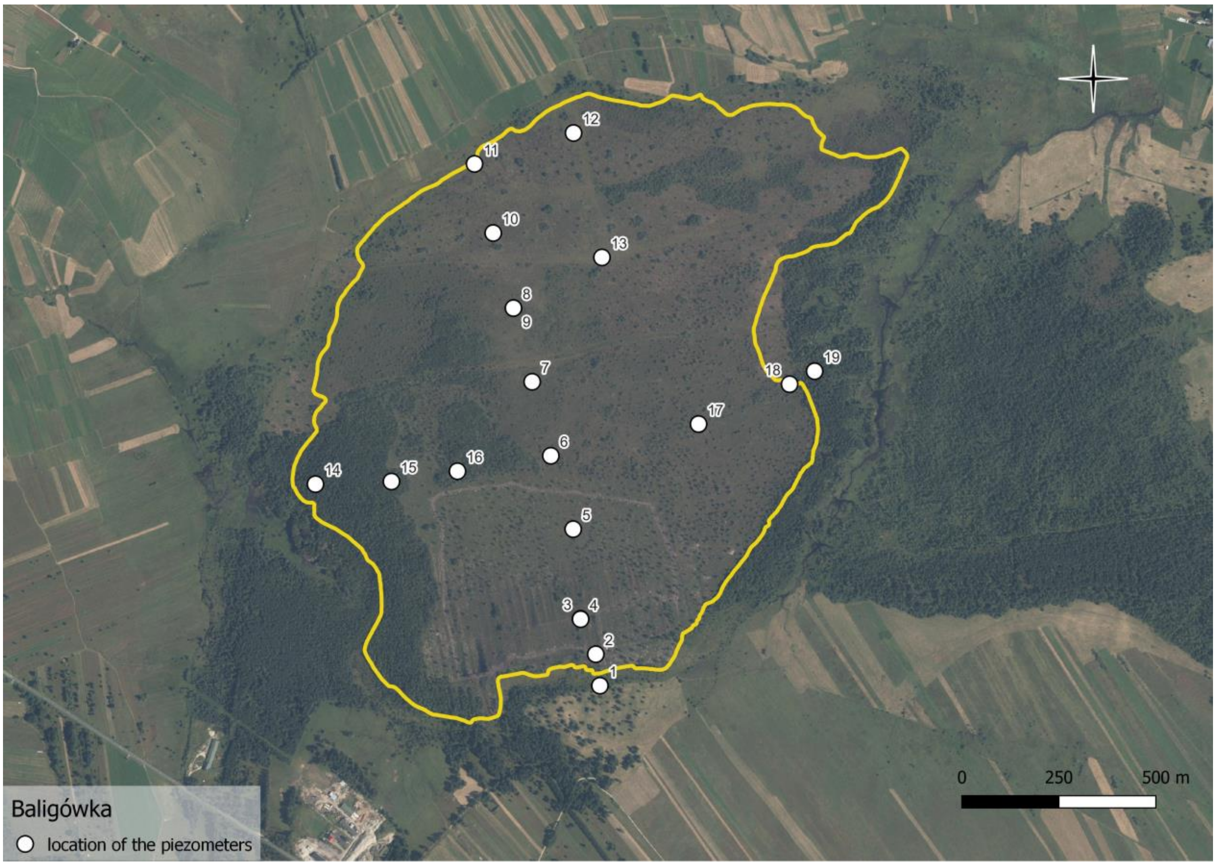
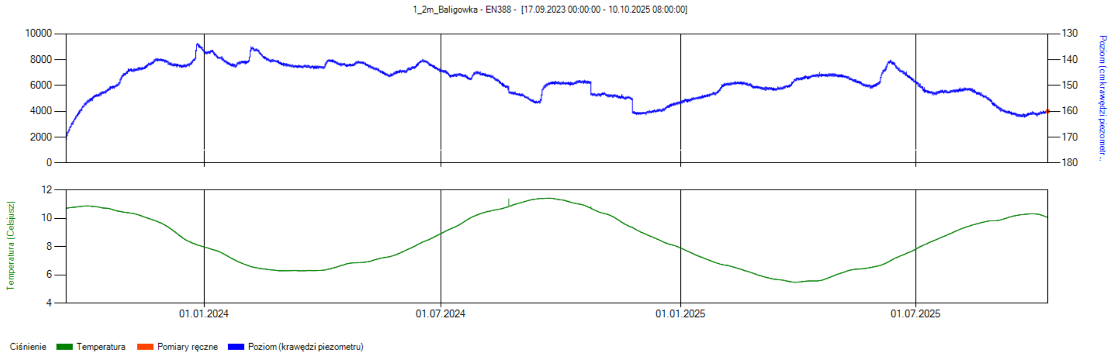


Figure 43: Locations of piezometers at Baligowka Site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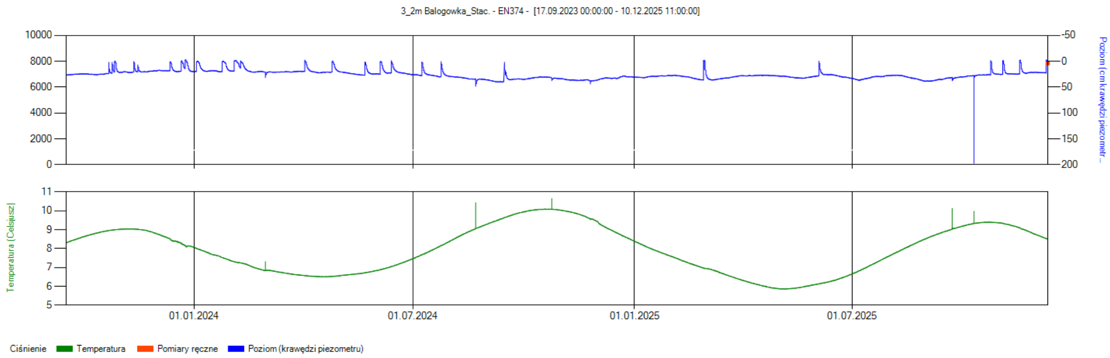
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


3_2m Balogowka_Stac. - EN374 - [17.09.2023 00:00:00 - 10.12.2025 11:00:00]
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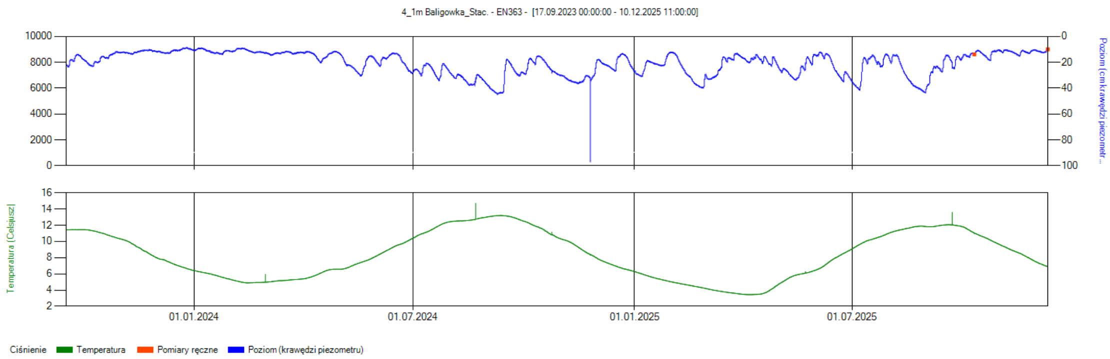
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


4_1m Baligowka_Stac. - EN363 - [17.09.2023 00:00:00 - 10.12.2025 11:00:00]
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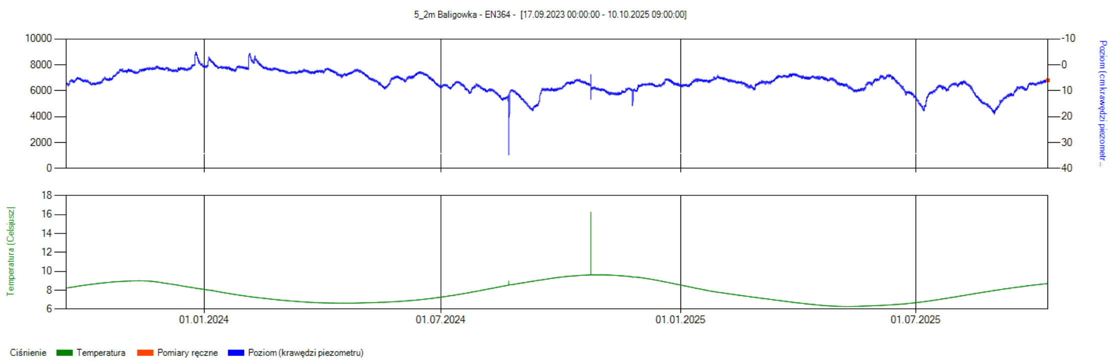
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


5_2m Baligowka - EN364 - [17.09.2023 00:00:00 - 10.10.2025 09:00:00]
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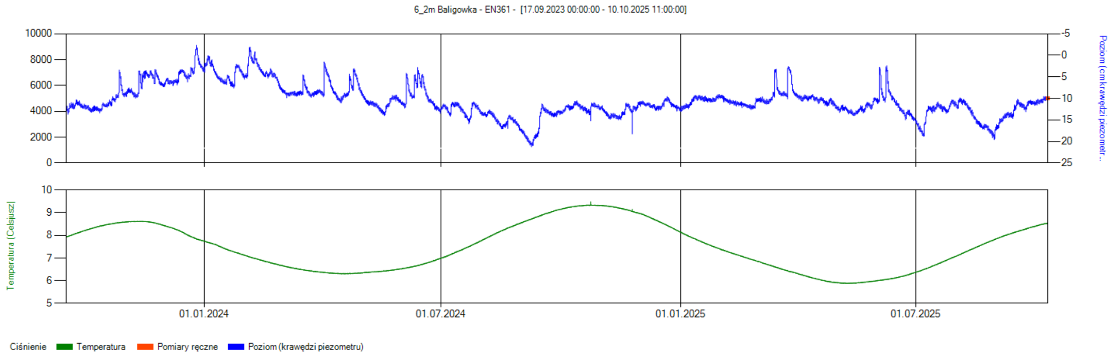
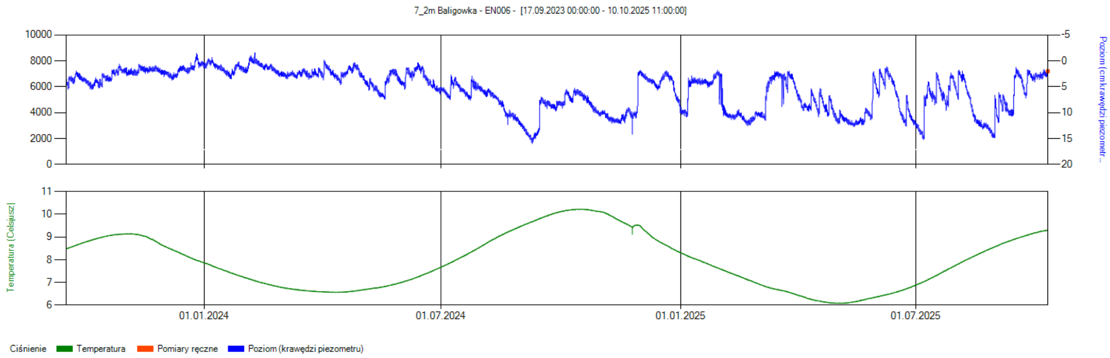
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


6_2m Baligowka - EN361 - [17.09.2023 00:00:00 - 10.10.2025 11:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


7_2m Baligowka - EN006 - [17.09.2023 00:00:00 - 10.10.2025 11:00:00]
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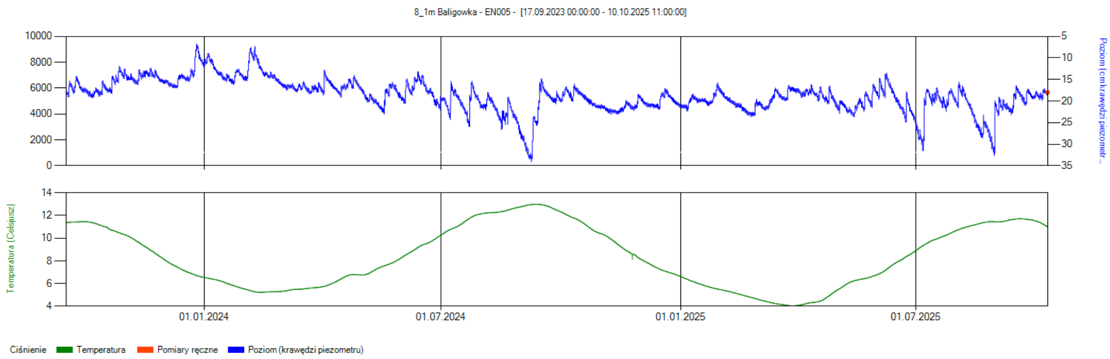
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


8_1m Baligowka - EN005 - [17.09.2023 00:00:00 - 10.10.2025 11:00:00]
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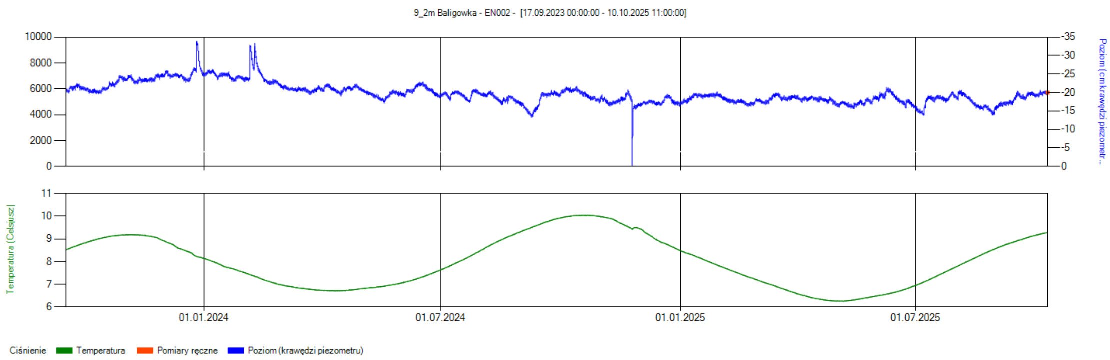
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


9_2m Baligowka - EN002 - [17.09.2023 00:00:00 - 10.10.2025 11:00:00]
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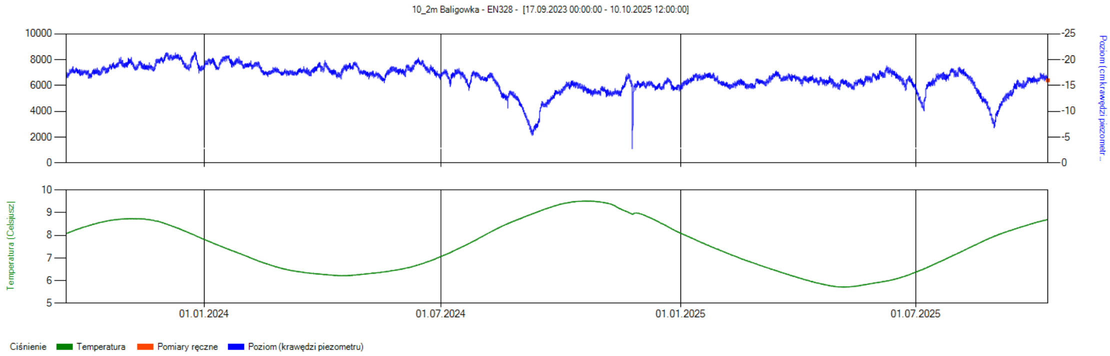
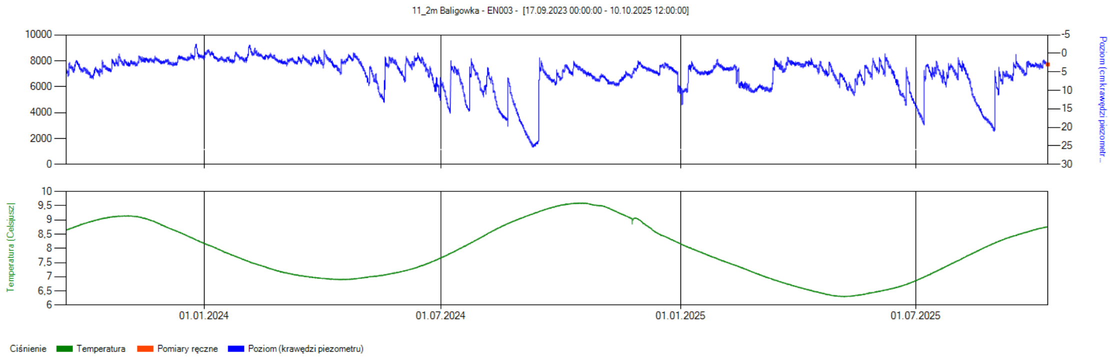
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


10_2m Baligowka - EN328 - [17.09.2023 00:00:00 - 10.10.2025 12:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


11_2m Baligowka - EN003 - [17.09.2023 00:00:00 - 10.10.2025 12:00:00]
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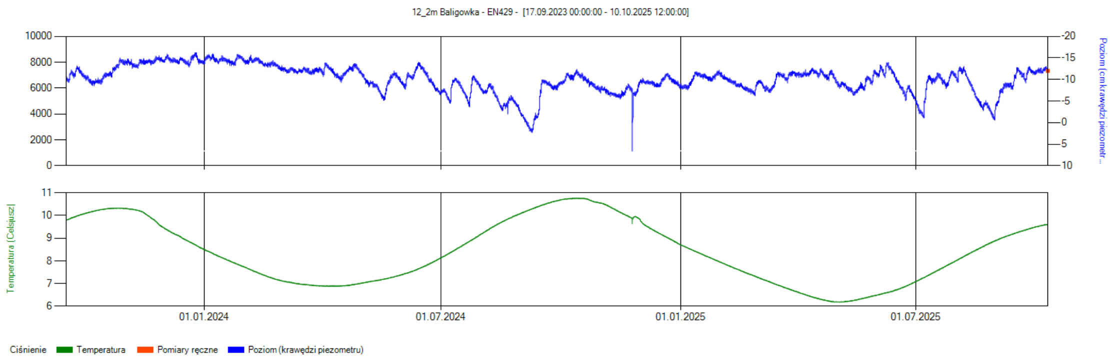
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


12_2m Baligowka - EN429 - [17.09.2023 00:00:00 - 10.10.2025 12:00:00]
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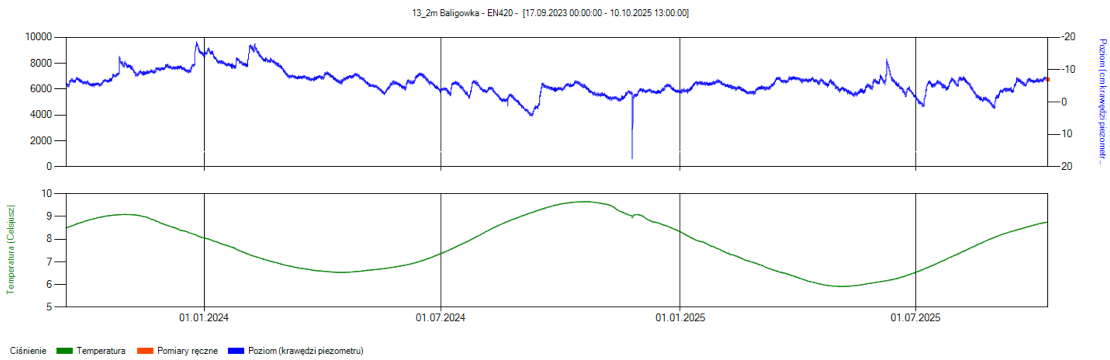
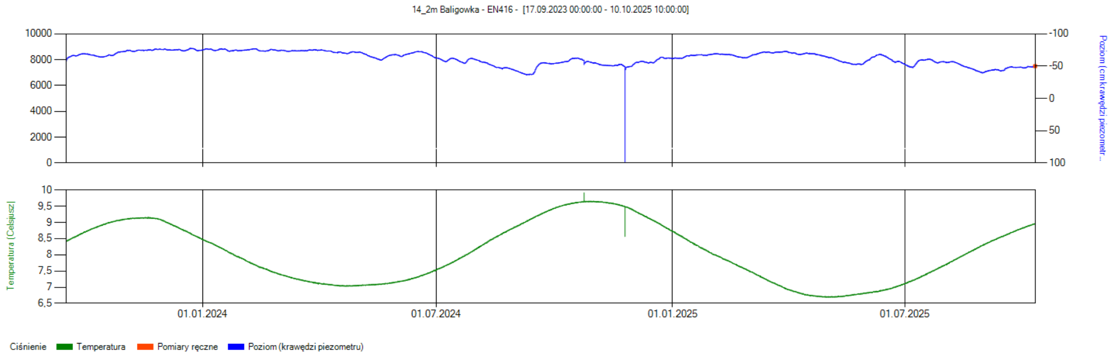
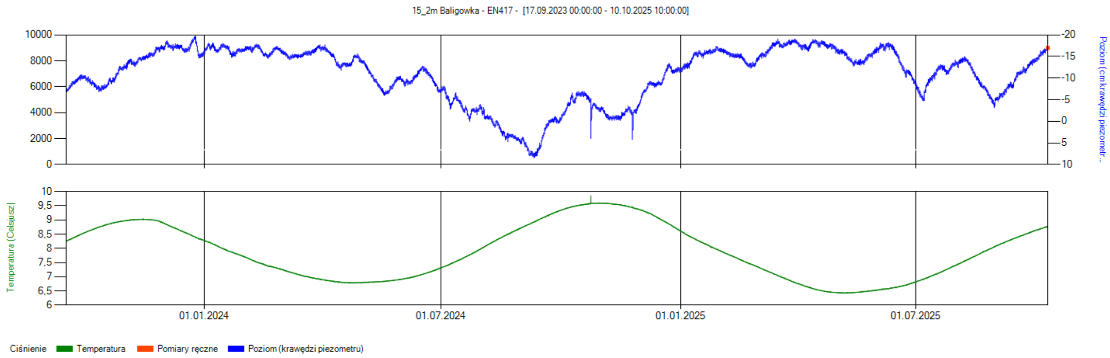
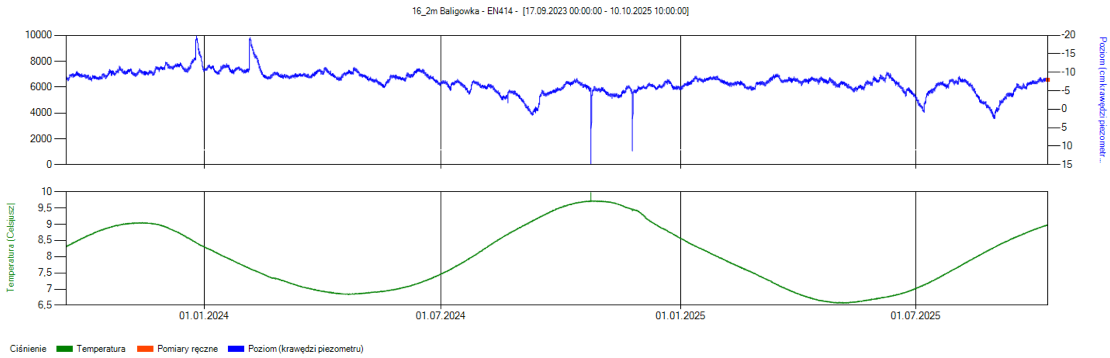
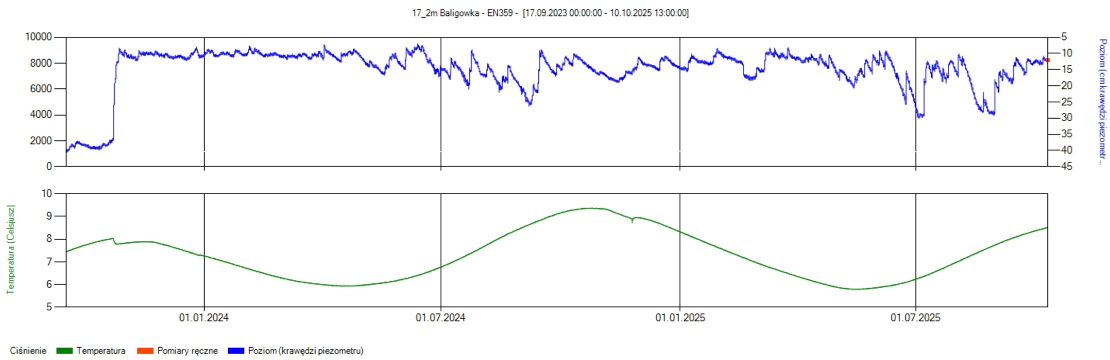
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


13_2m Baligowka - EN420 - [17.09.2023 00:00:00 - 10.10.2025 13:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


14_2m Baligowka - EN416 - [17.09.2023 00:00:00 - 10.10.2025 10:00:00]
Temperatura [Celsjusz]
Poziom [cm krawędzi piezometr
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


15_2m Baligowka - EN417 - [17.09.2023 00:00:00 - 10.10.2025 10:00:00]
Temperatura [Celsjusz]
Poziom [cm krawędzi piezometr
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


16_2m Baligowka - EN414 - [17.09.2023 00:00:00 - 10.10.2025 10:00:00]
Temperatura [Celsjusz]
Poziom [cm krawędzi piezometr
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


17_2m Baligowka - EN359 - [17.09.2023 00:00:00 - 10.10.2025 13:00:00]
Temperatura [Celsjusz]
Poziom [cm krawędzi piezometr
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)

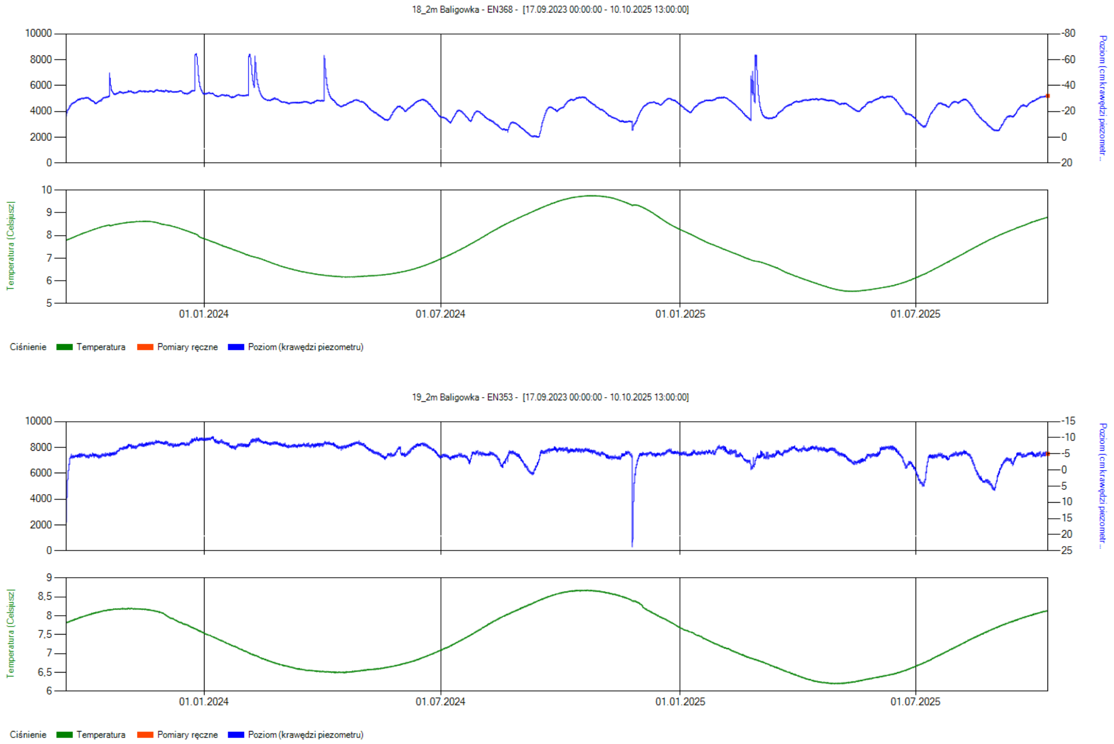


Figure 44: Water table measurements of different piezometers at Baligowka site

Puścizna Mała

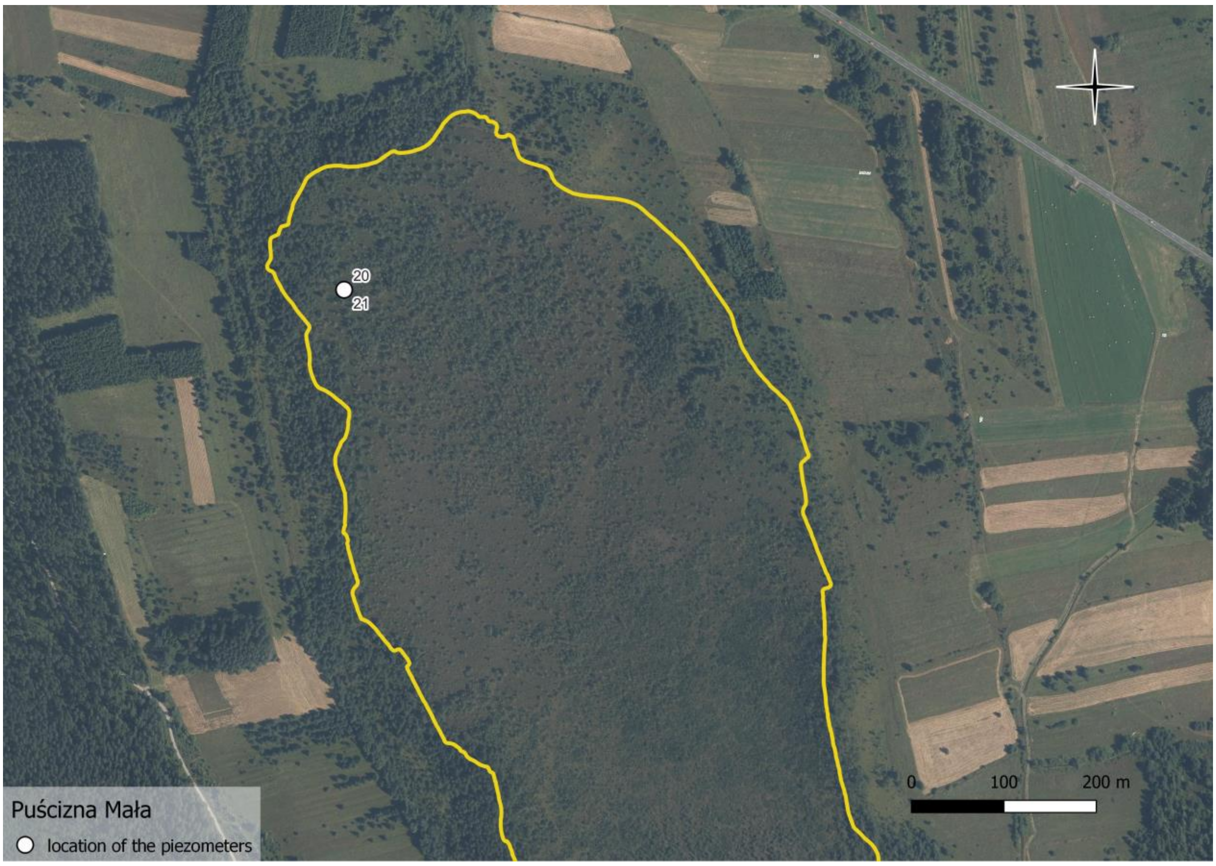


Figure 45: Locations of piezometers at Puścizna Mała site

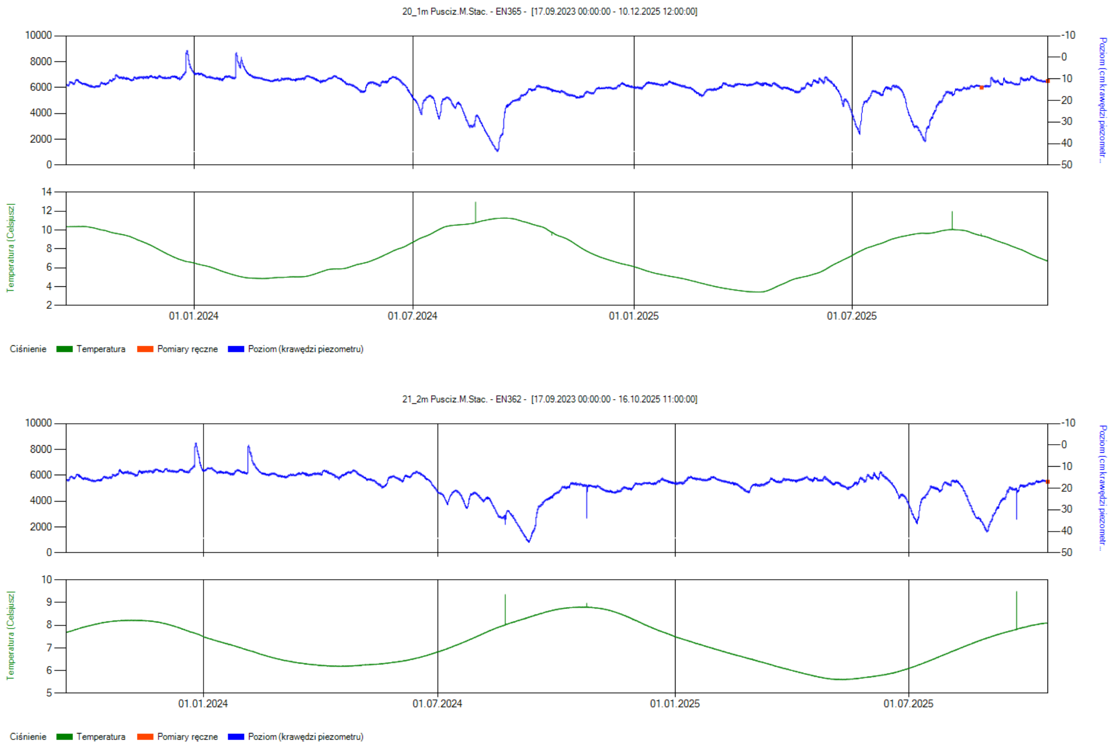


Figure 46: Water table measurements of piezometers at Puścizna Mała site

Las Kaczmarka

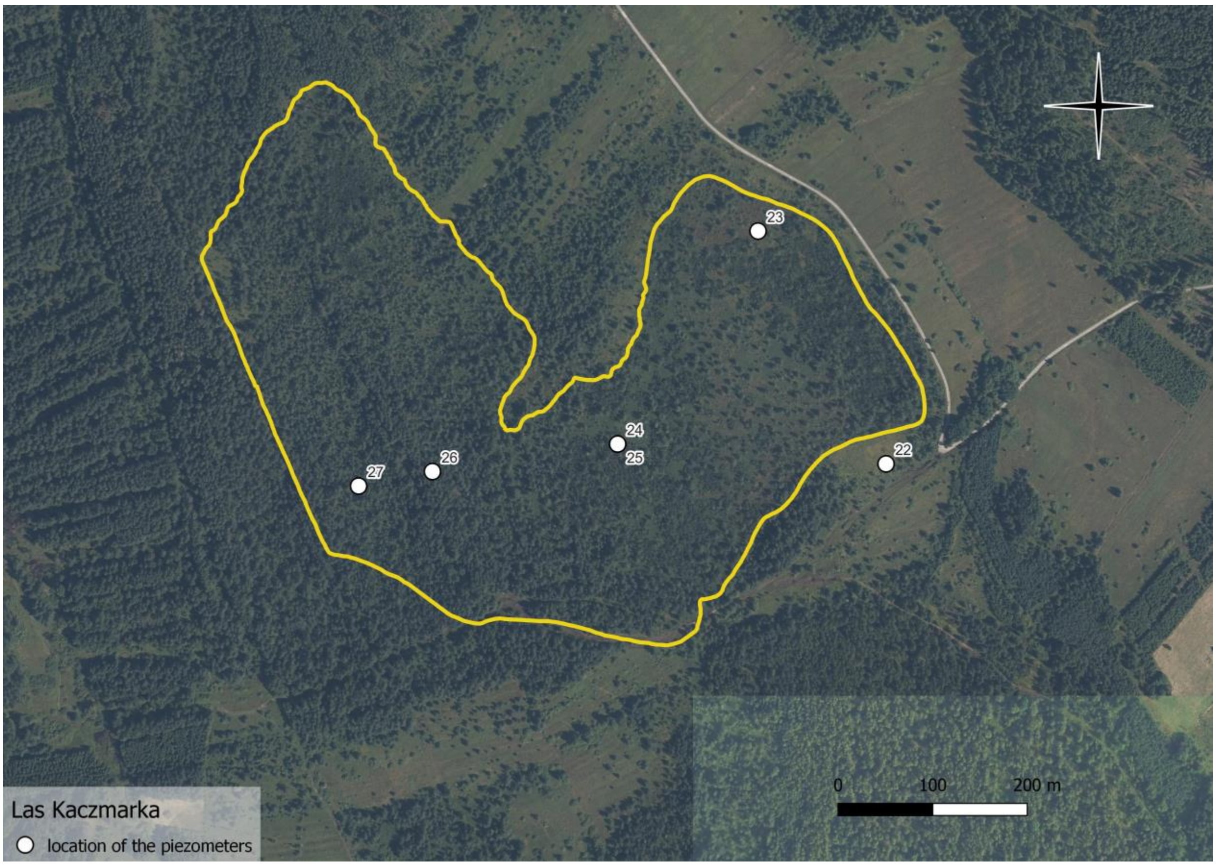
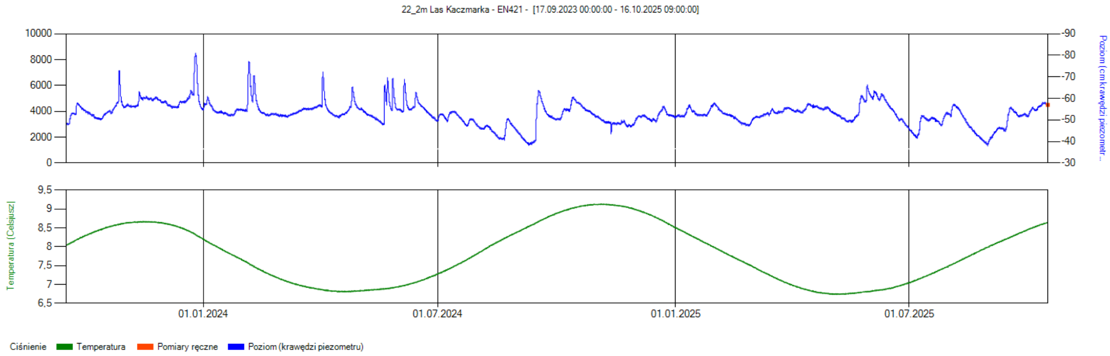
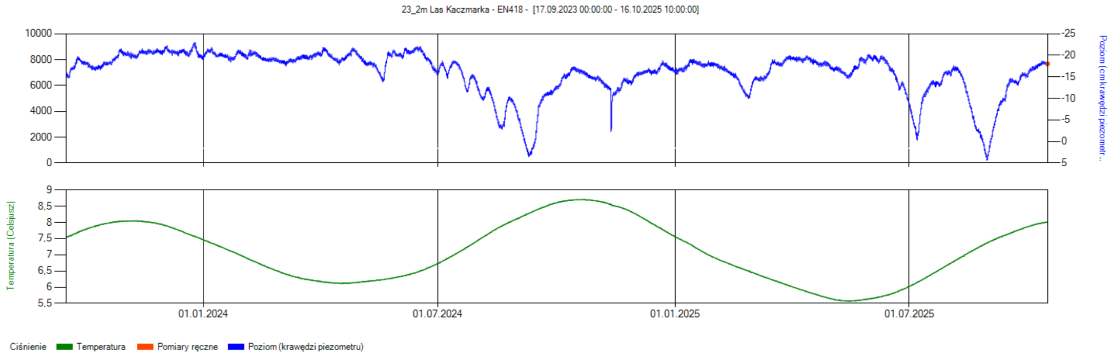
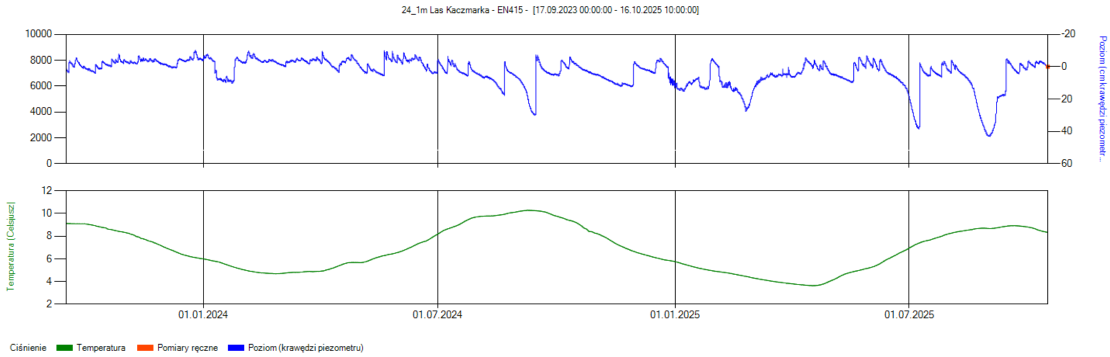
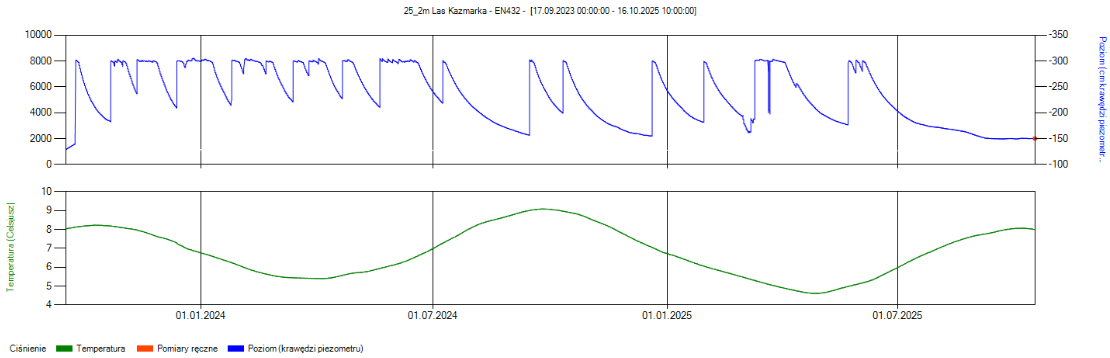


Figure 47: Locations of piezometers at Las Kaczmarka site


22_2m Las Kaczmarka - EN421 - [17.09.2023 00:00:00 - 16.10.2025 09:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


23_2m Las Kaczmarka - EN418 - [17.09.2023 00:00:00 - 16.10.2025 10:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


24_1m Las Kaczmarka - EN415 - [17.09.2023 00:00:00 - 16.10.2025 10:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)


25_2m Las Kazmarka - EN432 - [17.09.2023 00:00:00 - 16.10.2025 10:00:00]
Poziom [cm krawędzi piezometr...
Temperatura [Celsjusz]
01.01.2024
01.07.2024
01.01.2025
01.07.2025
Ciśnienie
Temperatura
Pomiary ręczne
Poziom (krawędzi piezometru)

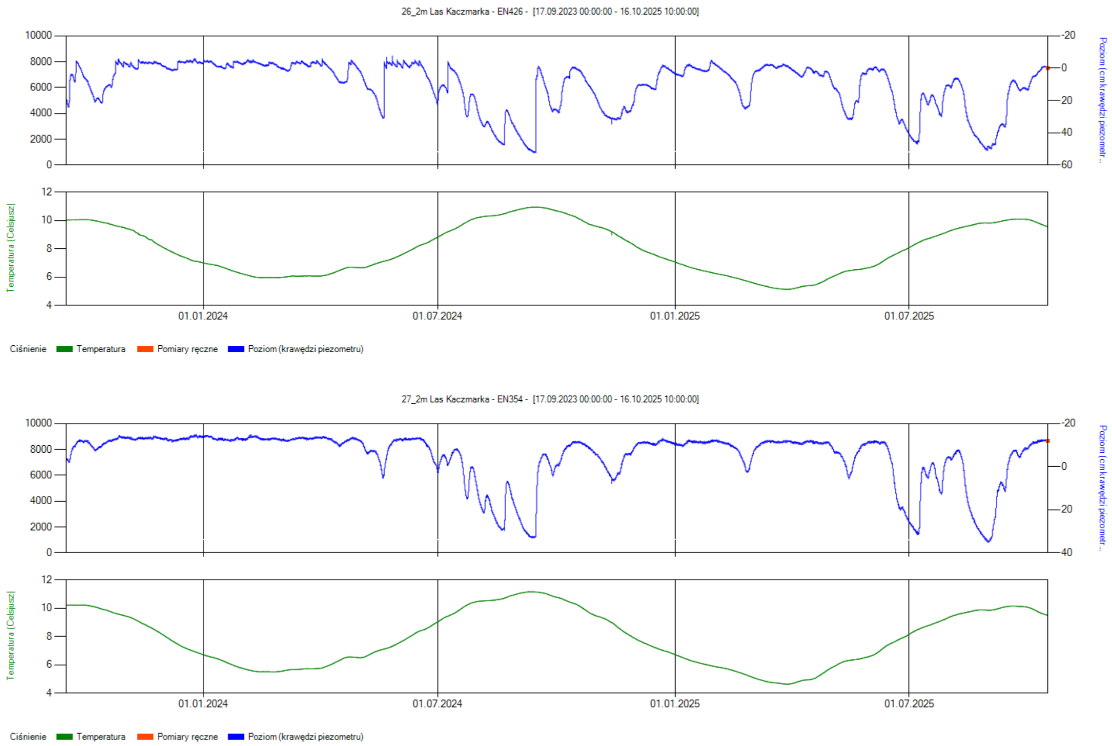


Figure 48: Water table measurements at Las Kaczmarka site

Bór za Lasem

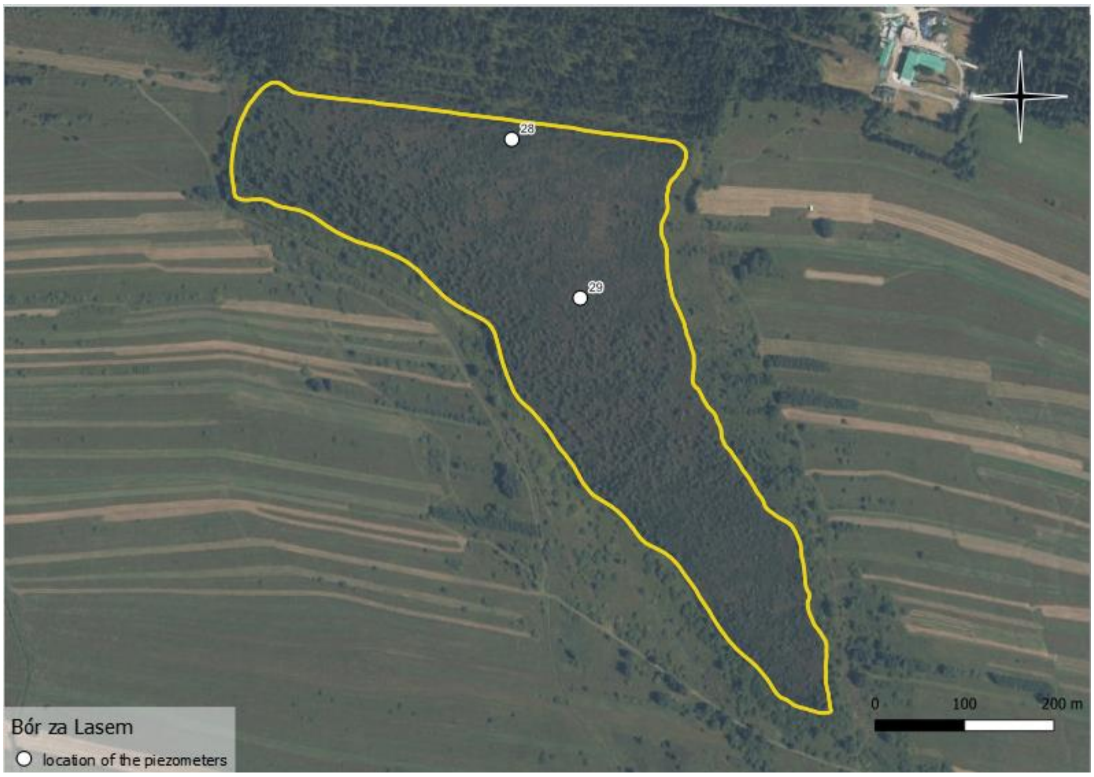


Figure 49: Locations of piezometers at Bór za Lasem site

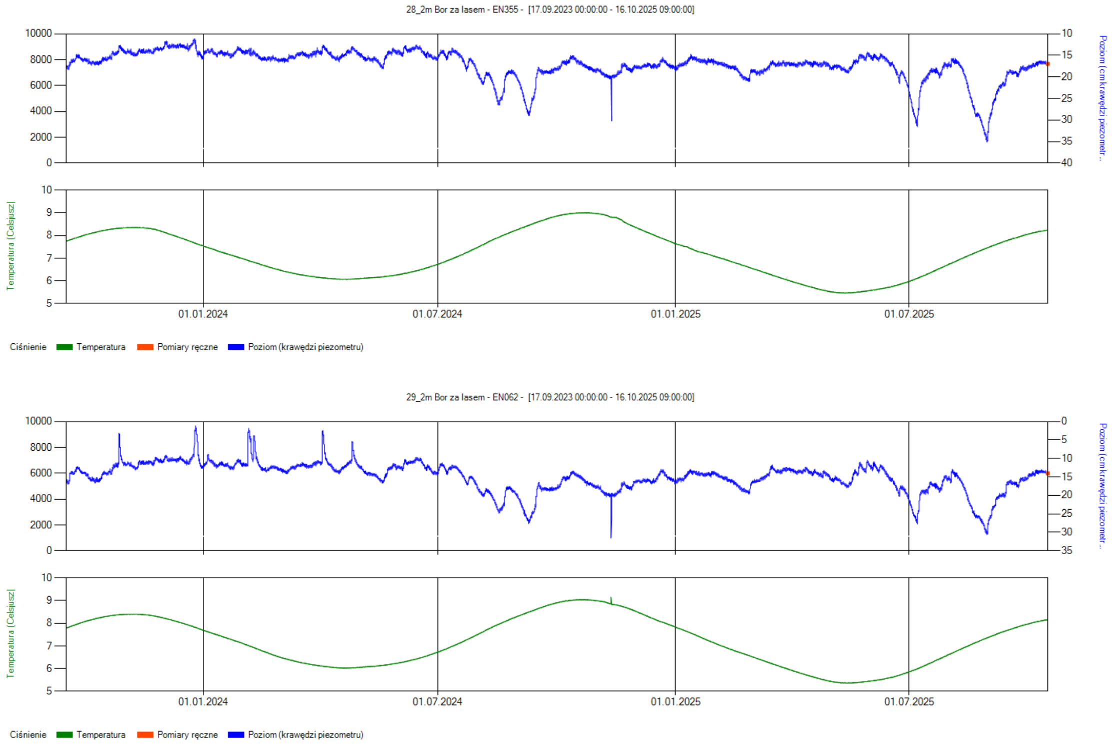


Figure 50: Water table measurements at Bór za Lasem site

Bór na Czerwonem

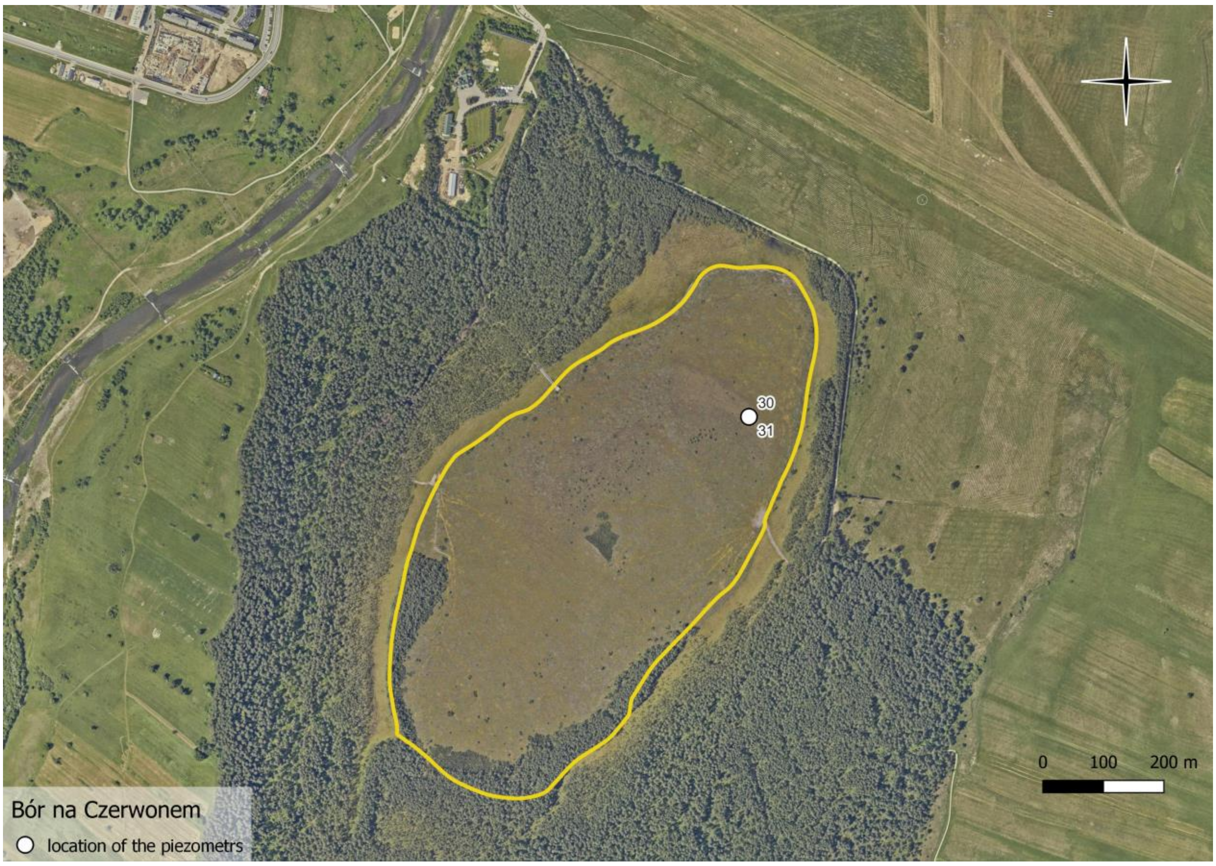


Figure 51: Location of piezometers at Bór na Czerwonem site

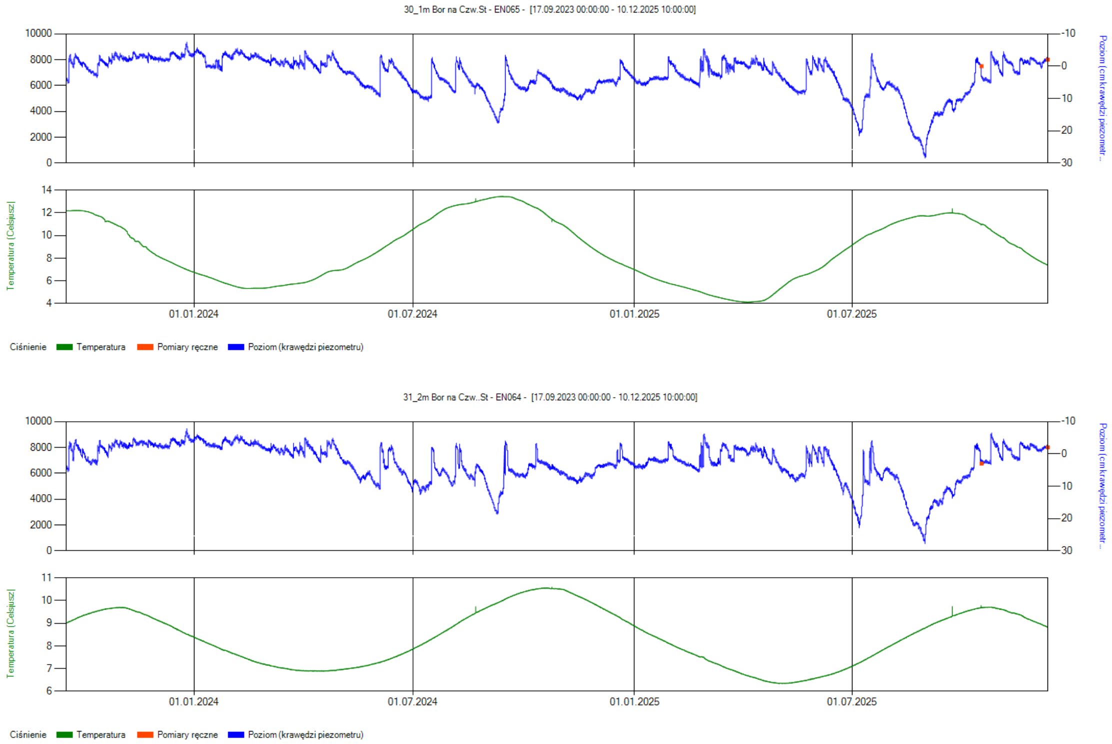


Figure 52: Water table measurements at Bór na Czerwonem site

Figure 53: Field measurements (calibration) of water tables (left); installation of piezometers with lockable caps (right)

6.3.2 Environmental Parameters

At the three sites, where the GHG-measurements were conducted, the following environmental parameters were measured in 2025: Air temperature [°C] (Device: Meter "Atmos 14 Gen 2"), water temperature [°C] (Device: Meter "Hydros 21"), soil temperature [°C] and soil water content [m³/m³] (Device: Meter "Teros 11") in 5-10 cm. Also, the photosynthetically active radiation (PAR) is measured at all sites, but is not included in this report, as this parameter is to be interpreted together with the GHG-measurements, which will be part of the 3rd Monitoring Report. Environmental indices are showing similar patterns of changes throughout the time at all three sites. Also mean values of measured parameters are similar across all sites. All environmental factors will be analysed in detail at later stages of project implementation, when long-term GHG data will be available.

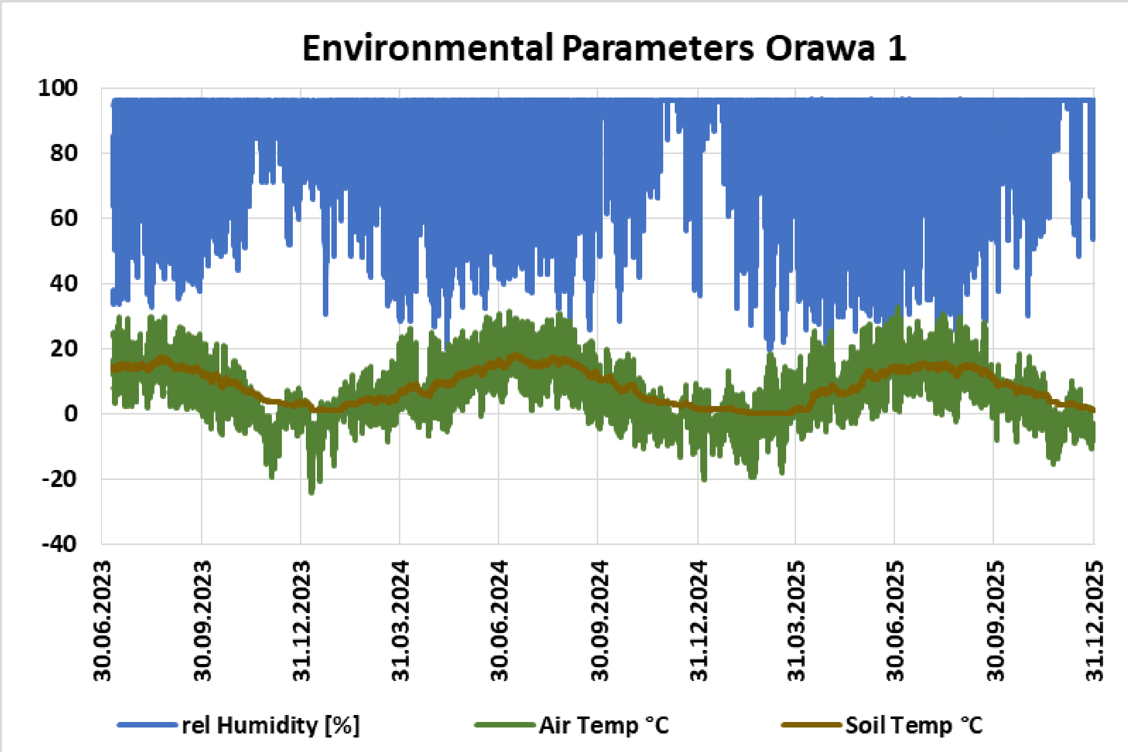


Figure 54: Environmental parameters at site Baligowka (Orawa 1)

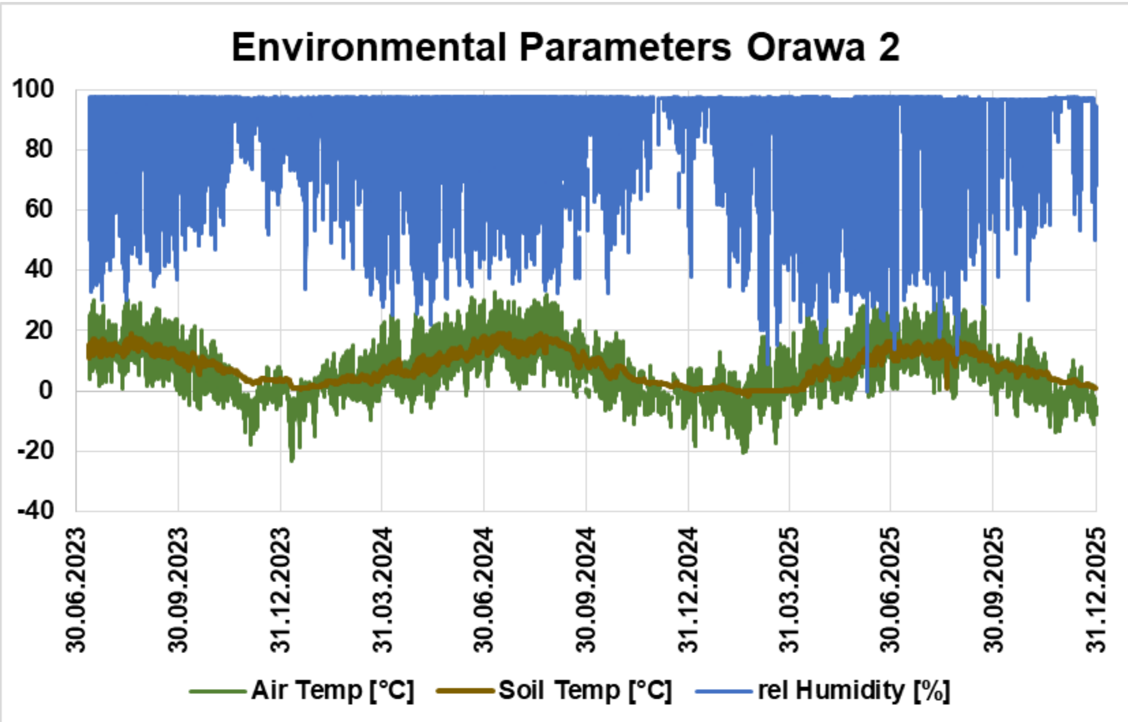


Figure 55: Environmental parameters at Puścizna Mała (Orawa 2)

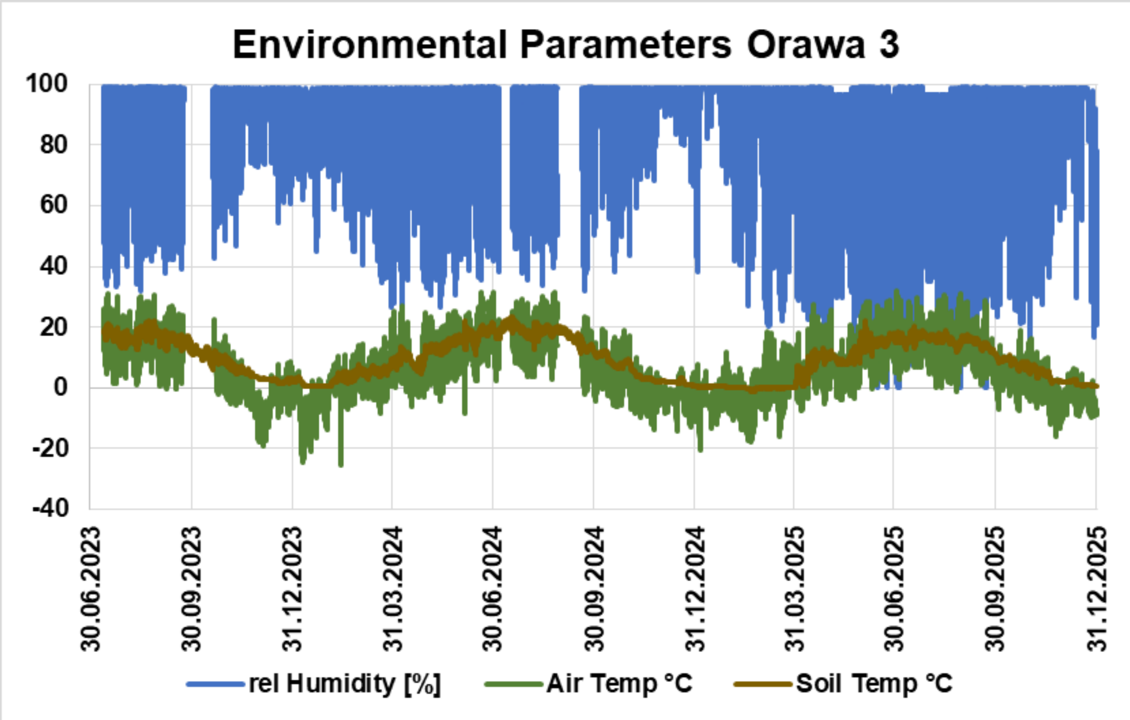


Figure 56: Environmental parameters at Bór na Czerwonem (Orawa 3)

6.3.3 GHG-Measurements

Greenhouse gas measurements started in June 2023, and they have been continued with the same methodology and at the same locations till the end 2025 (last measurements took place in Oct 2025). The measurements have been conducted at three monitoring sites, all of them located in the Natura 2000 site Torfowiska Orawsko-Nowotarskie (see Figure 57). Site Orawa1 (Baligówka) is in the middle of the large raised-bog dome. The vegetation on monitoring plot consists mainly of *Sphagnum* sp., *Vaccinium* sp., *Rhododendron tomentosum* (Figure 58). This dome was also covered by the Scots pines *Pinus sylvestris*, but they have been largely removed in 2023, as a part of restoration measures in another project. This raised bog has been intensively drained in the past. During autumn 2024 (October-November) the Baligówka dome, including the surroundings of the Orawa1 measurement site, was restored by extensive rewetting measures (151 dams on draining ditches, blocking water outflow) implemented within LIFE MultiPeat project. In December 2025 additional, smaller-scale re-wetting measures have been implemented on Baligówka site, including adding 12 additional dams on the draining ditches. Site Orawa2 (Puścizna Mała) is located on a nearby, smaller raised-bog dome. This plot serves as a 'natural state' reference site, as it has not been subject to intensive drainage (though some ditches and peat digging were implemented nearby). The vegetation structure is like the Orawa1 plot, with some scattered Scots pines. Orawa3 (Bór na Czerwonem) site is located at the nature reserve. It serves as a 'restored in the past' reference site, because it has been partly re-wetted around 10 years ago. The vegetation structure is similar to the Orawa1 and Orawa2 plots, with *Sphagnum* sp., and *Vaccinium* sp., as dominant species, but with lower coverage of Scots pines. At the beginning of 2024 restoration measures has been performed at Bór na Czerwonem reserve (as a part of another project), with tree removal and ditch blocking actions implemented, which may have impact on the GHG results from that site. Currently, the data of the first measuring year is processed, and ecosystem respiration (RECO), gross primary product (GPP) and net ecosystem exchange (NEE) are modelled. For a more detailed description of the methods used, see LIFE Multi Peat (2024). The processing of data is ongoing.

Figure 57: GHG measurement at Puscizna Mała (Orawa 2) site, July 2025. Photo: T. Wilk

Figure 58: Vegetation monitoring at GHG measurement: Baligówka (Orawa 1) site, Aug 2025/ Photo: T. Wilk

6.3.4 Vegetation Monitoring

43 permanent vegetation monitoring plots on the Baligówka bog were resurveyed in 2025.

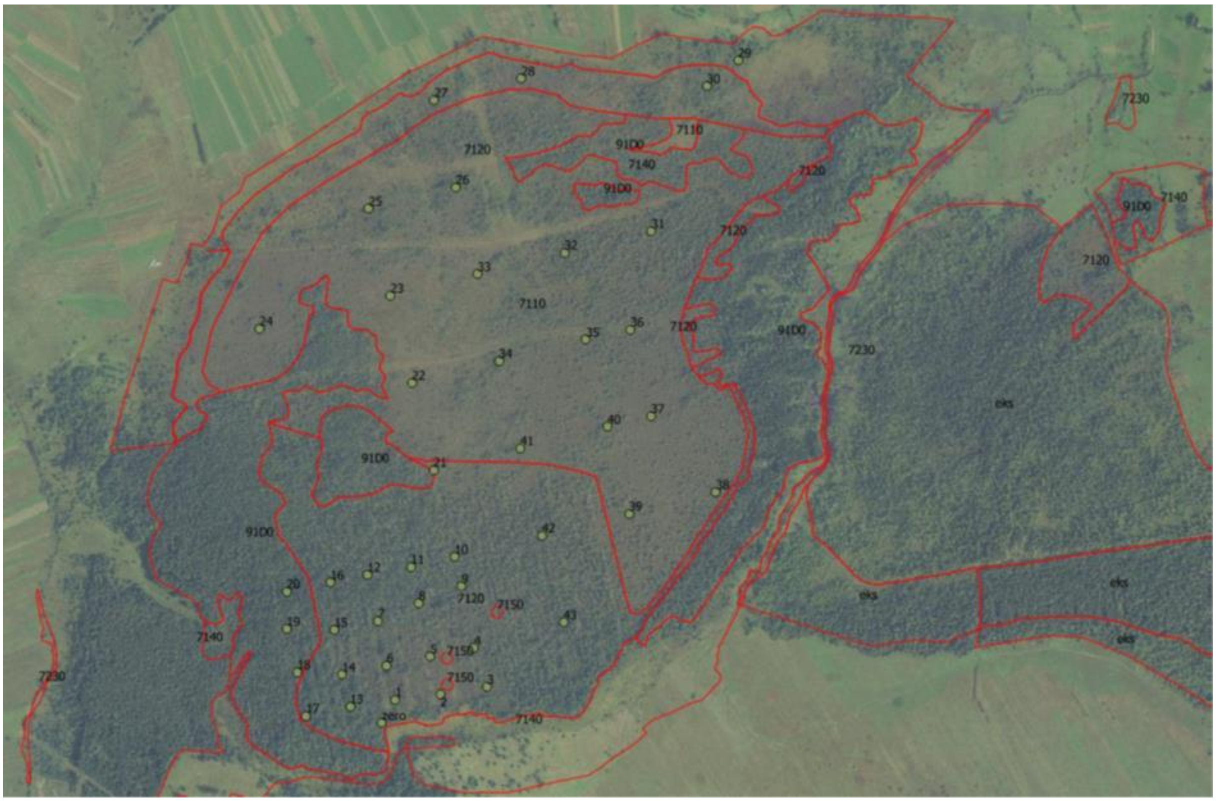


Figure 59: Resurveyed vegetation monitoring plots, Baligówka bog

Significant changes in vegetation were recorded compared to the previous survey conducted in 2023. These changes are primarily attributable to the implementation of conservation measures by the Regional Directorate for Environmental Protection in Kraków (outside the scope of the LIFE MultiPeat project), which coincide with the effects observed following ditch blocking carried out in autumn 2024.

The vegetation of the Baligówka bog comprises a mosaic of raised bog communities belonging to the class Oxycocco-Sphagnetea, order Sphagnetalia magellanici, and alliance Sphagnion magellanici, undergoing succession towards climax forest communities of the class Vaccinio-Piceetea, order Cladonio-Vaccinietalia, alliance Dicrano-Pinion, and suballiance Piceo-Vaccinienion uliginosi.

Significant changes in habitat types were recorded across the monitored plots, with the most pronounced shifts observed for habitats *91D0 (from 20 to 5 plots), 7120 (from 14 to 2), and *7110 (from 9 to 35). The increase in the number of patches of habitat *7110, accompanied by a decrease in habitat *91D0, is attributable to active conservation measures involving the removal of trees and shrubs from the bog surface. A decline in the cover of Calluna vulgaris was recorded across all habitat types, while the cover of Ledum palustre increased consistently. The greatest loss of taxa was observed in habitat 7120 (9 taxa), whereas the largest increase in taxon richness was recorded in habitat *7110 (22 taxa).

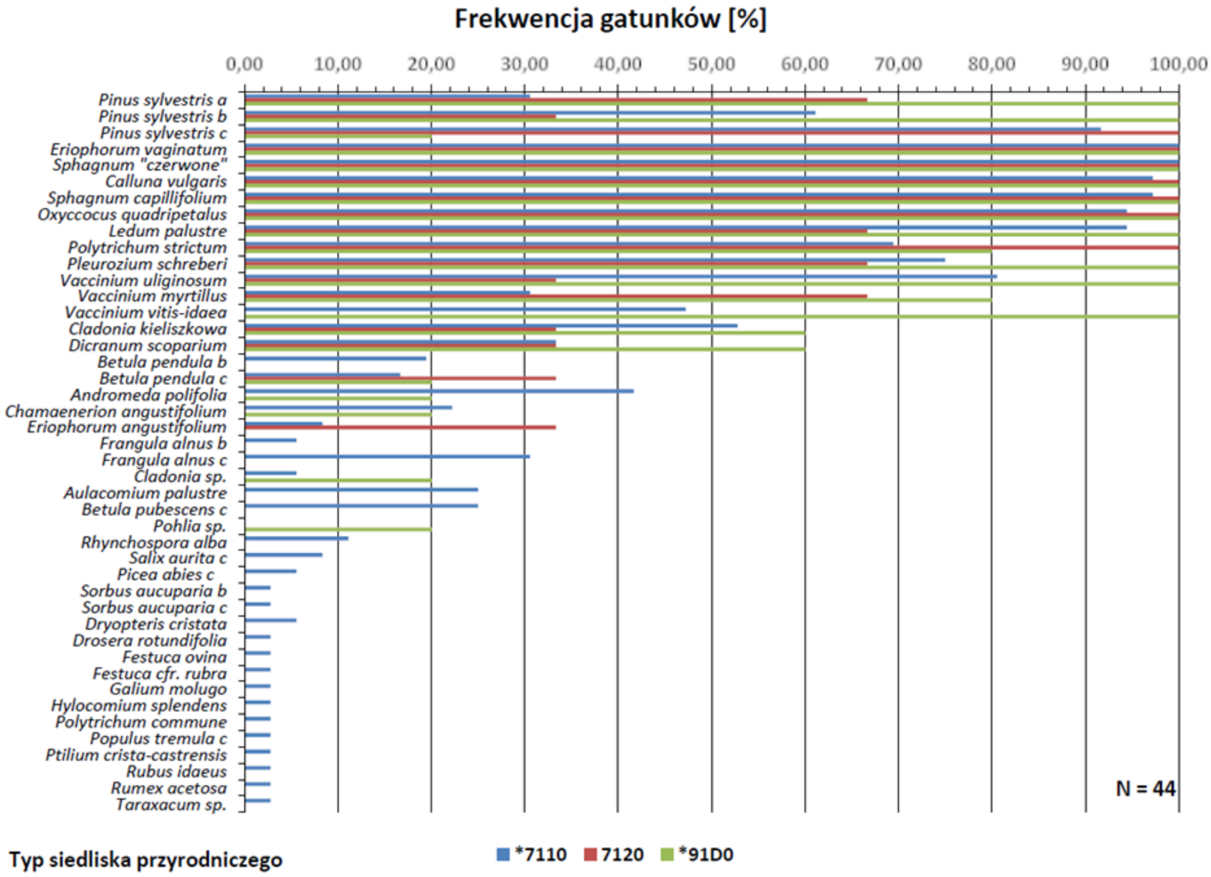


Figure 60: Changes of species frequency, Baligówka bog

Natural habitat *Active raised bogs (7110)* in 2024-2025 was recorded in 35 monitoring plots. The mean cover of the tree layer (a) was 3.29%, shrub layer (b) 2.36%, herb layer (c) 85.28%, and moss layer 56.94%. The tree and shrub layers are composed exclusively of Pinus sylvestris. The herb layer is dominated by Calluna vulgaris (constancy V, cover coefficient 3573), Eriophorum vaginatum (V, 2404), and Ledum palustre (V, 1767). Species occurring consistently but with relatively low cover include Vaccinium uliginosum (V, 712) and Oxycoccus quadripetalus (V, 82). The moss layer is dominated by Sphagnum species, particularly the “red” Sphagnum group (V, 2820) and Sphagnum capillifolium (V, 2352).

Natural habitat D*egraded raised bogs still capable of natural regeneration (712*0) was recorded in 3 monitoring plots, in which phytosociological relevés were carried out. The mean cover of the tree layer (a) was 16.67%, shrub layer (b) 16.67%, herb layer (c) 95.00%, and moss layer 80.00%. The tree and shrub layers are composed exclusively of Pinus sylvestris. The herb layer is dominated by Ledum palustre (constancy IV, cover coefficient 5250), Eriophorum vaginatum (V, 2667), and Calluna vulgaris (V, 1420). Oxycoccus quadripetalus is consistently present but with low cover (V, 10). The moss layer is dominated by Sphagnum species, particularly Sphagnum capillifolium (V, 6250) and the “red” Sphagnum group (V, 1333). Notably, Pleurozium schreberi (IV, 1125) and Polytrichum strictum (V, 173) are also consistently recorded.

Natural habitat *Bog woodland (91D0)* was recorded in 5 monitoring plots, in which phytosociological relevés were carried out. The mean cover of the tree layer (a) was 51.00%, shrub layer (b) 19.00%, herb layer (c) 84.00%, and moss layer 77.00%. The tree and shrub layers are composed exclusively of Pinus sylvestris. The herb layer is dominated by Ledum palustre (constancy V, cover coefficient 5850), Eriophorum vaginatum (V, 1000), Calluna vulgaris (V, 758), and dwarf shrubs, including Vaccinium uliginosum (V, 358), Vaccinium vitis-idaea (V, 206), and Vaccinium myrtillus (IV, 1068). Oxycoccus quadripetalus is consistently present but with low cover (V, 10). The moss layer is dominated by Pleurozium schreberi (V, 3502) and Sphagnum species, particularly Sphagnum capillifolium (V, 3050) and the "red" Sphagnum group (V, 1000).

6.4 Discussion and Challenges

So far, no major problems or methodological challenges have been encountered during the monitoring activities at polish project site. The data collected in 2022, 2023, 2024 and 2025 constitute part of the baseline monitoring information. All planned restoration measures have been implemented: ditch blocking in Oct-Nov 24, and tree removal in Dec 24-Jan25 and Jan-Feb 26. The final analyses of the monitoring data, which will be presented in the final monitoring report, will allow to assess the impact of restoration measures on the environmental parameters of peatlands at project sites.

6.5 Communication Indicators

	INDICATORS						
	DIRECT			INDIRECT			
Units	**Economic contribu-tion**	**Ecosystem regulating services** (GHG emissions)	**Awareness raising**	**Ecosystem support-ing services** (habitat for species)	**Ecosystem provision-ing services** (raw materials, freshwater)	**Ecosystemregulating services** (Fire/flood prevention)	**Ecosystem cultural services** (recreation, aesthetic apprecia-tion, and inspiration)
Stakeholder and Duty holder engagement			6				
Information boards/panels			3				1
Employment (Individuals/companies hired by the project)			12				
Amount spent (€)	OTOP: 106 087,71 € KP: 58 116,35 €						
Number of jobs (FTE and PTE)	OTOP: 6 PTE (=1,5FTE); KP: 4 PTE (=2,7FTE)						
Number of events organised or participated			2				
Number of participants in events organised by the beneficiary			19+9				
Number of hectares restored		252		252		252	252
GWP reduction (tons of GWP CO_2-eq/ha/yr)		To be estimated at project end					
Number of Print media			0				
Number of Publications/Reports, promotional material produced			4 (KP: 2 posts on FB, OTOP: 1 post on FB, 1 news on www)				
Media coverage (newspaper			1				

articles, press releases, radio, podcast)							
Website visits – national website			OTOP: 423 KP: 217 000 (general website)				
Climate Performance (tons/year CO_2)		To be estimated at project end					
Climate Performance (tons/year CH_4)		To be estimated at project end					
Environmental Performance – resilience to flooding (ha)						252	
Baseflow con-tribution of receiving water (m^3/s) by percentage		to be estimated by the end of the project					
Average lowest groundwater level on the whole project site (cm below ground level)		-50					
Sustainable land use, agriculture, and forestry (hectares of agricultural land under sustainable management)		to be estimated by the end of the project					
Habitats positively affected (ha) and change in percent cover of indicator species associated with their respective target habitat				252			0

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