Castell Sett (GR SN 78590 82382)

This project focuses on one waterbody (GB110063041580: Castell - headwaters to confluence with Rheidol) that makes up the mid part of the Afon Rheidol catchment. The Afon Rheidol rises on the western slopes of Plynlimon in the headwaters of Nant y Moch Reservoir, which is primarily fed by the Afon Llechwedd Mawr and the Afon Hengwm. The river flows southerly, passing through Dinas Reservoir and Ponterwyd, to Devil's Bridge where it turns westerly, passing Cwm Rheidol Reservoir before entering Cardigan Bay at Aberystwyth.

The 2012 Water Framework Directive Abandoned Mines Project for the Afon Rheidol catchment splits the Afon Rheidol river system into seven waterbodies however this project will focus on only one; GB110063041580: Castell - headwaters to confluence with Rheidol. The report classified the waterbody as being of 'Moderate' quality with failures for zinc and copper at the WFD sampling point in the Afon Castell at Ponterwyd (490012). Two of the Agency's 'Top 50' mines are found in this waterbody: Esgairlle (with Esgairlle Old) and Castell. As well as these three 'Red' classified mines, there are an additional six 'Amber' mine sites with the Afon Castell waterbody which require additional data to classify as 'Red' or 'Green'.

There is a hydroelectric power (HEP) abstraction on the Afon Castell downstream of the mines at NGR SN7669381177 which takes water to Dinas Reservoir. The licence authorises a maximum abstraction of 31,000,000 cubic metres per year.

The Afon Castell upstream of Esgairlle Old Mine (location 81424 – see schematic below for sample locations) marginally exceeds zinc (Zn) and cadmium (Cd) EQS while copper (Cu) and lead (Pb) are below their Environmental Quality Standards (EQS) targets. Approximately 300m downstream of Esgairlle Old Mine (location 81241), below large spoil tips, concentrations of Zn, Pb and Cd significantly increase. Cu also increases, subsequently exceeding its EQS.

Approximately 2.2km downstream of Esgairlle Old Mine and 1.4km downstream of Esgairlle Mine at location 81221, concentrations of all four metals decrease, however Zn, Pb and Cd remain in excess of EQS targets. Cu reduces below EQS. A further 1.2km downstream, below Castell Mine at 35269, Zn and Cd again increase, Pb continues to decrease but remains above EQS and there is no significant change in Cu levels.

The WFD classification point for the Castell (490012) is just upstream of the Rheidol confluence at Ponterwyd, approximately 2.5km downstream of Castell Mine and below the HEP abstraction, therefore on a stretch of river with significantly depleted flows. Concentrations of Zn and Cd have decreased by this point but remain elevated above EQS, whilst Pb has decreased sufficiently that it is now below EQS. Cu has seen a fairly significant increase surpassing its EQS.

Figure 1 Schematic diagram of the Afon Castell waterbody including water quality and flow summary statistics (taken from the WFD 2012 report).



Flow in I/s, metal concentrations in µg/I (number of samples). *dissolved zinc. Red figures represent EQS failures.

In June 2022, Arup completed desk studies at Castell, Esgairlle and Esgairlle Old, as part of the NRW Catchments & Mines project. The objective was to gather information in order to improve the understanding of the site conditions and potential issues. The following is taken from the 2022 report.

The Castell, Esgairlle and Esgairlle Old sites are located 21km due east of Aberystwyth and are adjacent to the A44 and the B4343 at the eastern extent of Castell. The Castell site is located National Grid Reference (NGR) SN 77387 81269 and Esgairlle and Esgairlle Old at NGR SN 79084 82717 and SN 79573 82961 respectively.

The Afon Castell headwaters are located within the Esgairlle Old site and pass to the south of the Esgairlle site. The Afon Castell is joined by the Nant Cwyn, Nant Coch Mawr, Nant Rhys and some other small unnamed watercourses before passing to the immediate north of the Castell site. The Nant Meirch runs through a portion of the Castell site from southeast to northwest, and discharges into the Afon Castell.

Zinc and cadmium, noted for driving the overall classification status, were recorded to be 4.876kg/yr and 1376kg/yr respectively downstream of Castell Mine. Lead, a WFD Priority Substance, was measured at 146 kg/yr.

Castell: There was limited evidence of contamination/water influx into watercourses from point sources at Castell Mine, with the exception of one adit at Castell East Mine. Much of the workings are anticipated to be flooded and there was a series of flooded open stopes with no obvious exit. Whilst there was no direct evidence of water discharging from the Castell mine into local watercourses, there is evidence of surface

water migrating across the site and particularly across the areas of open spoil and eventually leading into the Afon Castell. The surface water quality assessment indicated that the area of greatest metal loading was associated with the small streams within spoil at the interface between spoil and the Afon Castell.

Esgairlle: Water is actively exiting the mine workings via a drainage adit during times of heavier rainfall which is associated with the greatest metal loading at Esgairlle. This water can freely enter the adjacent watercourse. A collapse of this adit was also noted, and anecdotal evidence was supplied stating that water exits through this collapse, again during periods of heavy rainfall. The other adits on site are noted to be closed or collapsed/blocked. Any of these adits may present a risk from blowout and could potentially discharge mine waters and waste across the landscape and into local watercourses. The proximity of spoil the Esgairlle site, particularly fines, to the local small watercourse may contribute to metals or fines within the watercourse which joins the Afon Castell.

Esgairlle Old: The proximity of spoil to watercourses at Esgairlle Old is notable. The headwaters of the Afon Castell gather in and around much of the spoil and former processing areas. The desk study considers that the adits at Esgairlle Old may present a risk from blowout and could potentially discharge mine waters and waste across the landscape and into local watercourses.

Loadings indicate that there is greater inputs of metals into the Afon Castell from the Castell Mine as opposed to the Esgairlle and Esgairlle Old Mines (see Figure 2).



Designations at the site:

 Mwyngloddfa Castell Site of Special Scientific Interest (SSSI) lies within the Castell Mine site boundary and is of interest for both its geological and biological features. This includes the classic demonstration of breccia produced by hydraulic fracturing processes, a characteristic feature of the Central Wales Orefield and it also supports a notable assemblage of lichen species associated with a range of metal-rich habitats.

To address the identified pollution and hazards, it is proposed that the following works are undertaken as part of this Project, with the primary objective of reducing metal loadings in the Afon Castell and ultimately the Afon Rhediol:

- Design and construction of up to three permanent flow gauging structures (FGSs) including at the adit at Castell East Mine and Esgairlle adit portal. A site walkover will determine the location of the third proposed flow structure. These structures could be fitted with automated and telemetered (dependant on signal assessment) level sensors to allow continuous data collection and remote monitoring;
- A water quality monitoring programme to include the FGSs, mine water and surface waters. This programme will also seek to improve the water quality monitoring data within the waterbody and consider if any of the six 'Amber' sites within the water body can be reclassified as either 'Green' or 'Red';
- Undertake blow out risk assessment, with supporting tracer testing if required;
- Investigations at the spoil heaps at Castell, Esgairlle and Esgairlle Old;
- Optioneering, design and plan a preferred remedial intervention strategy which may include surface water management interventions and a mine water treatment facility (MWTS), to manage and mitigate the pollution from the site and potentially treat the mine water discharge(s), resulting in water quality improvements downstream.



Location plans



Castell Environmental Constraints Plan





Esgairlle and Esgairlle Old Environmental Constraints Plan