

# Life River Dee - Weir Fish Pass Detailed Design

Erbistock Weir  
Appendix B.d - Sediment Sampling note

Natural Resources Wales

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Quality information

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# Erbistock Weir sediment sampling

## 1.1 Purpose

The partial weir removal could potentially result in the release of sediment and other materials that have been impounded behind the weir during its lifetime. The volume, composition and potential contamination of the impounded material is unknown. For this reason, sediment sampling upstream and downstream of the weir was undertaken to inform the potential project risk and inform the detailed design of the project.

The methodology followed on site was developed to provide guidance to NRW and the NRW appointed contractor to undertake bed sediment sampling. Sediment and bed depths were recorded, and superficial bed sediments were also collected and, when feasible, analysed for contaminants within the near surface of any entrained sediments.

## 1.2 Methodology

The recommended sampling methodology was undertaken from a boat both upstream and downstream of the Erbistock Weir, operated by NRW and their appointed supplier, and included:

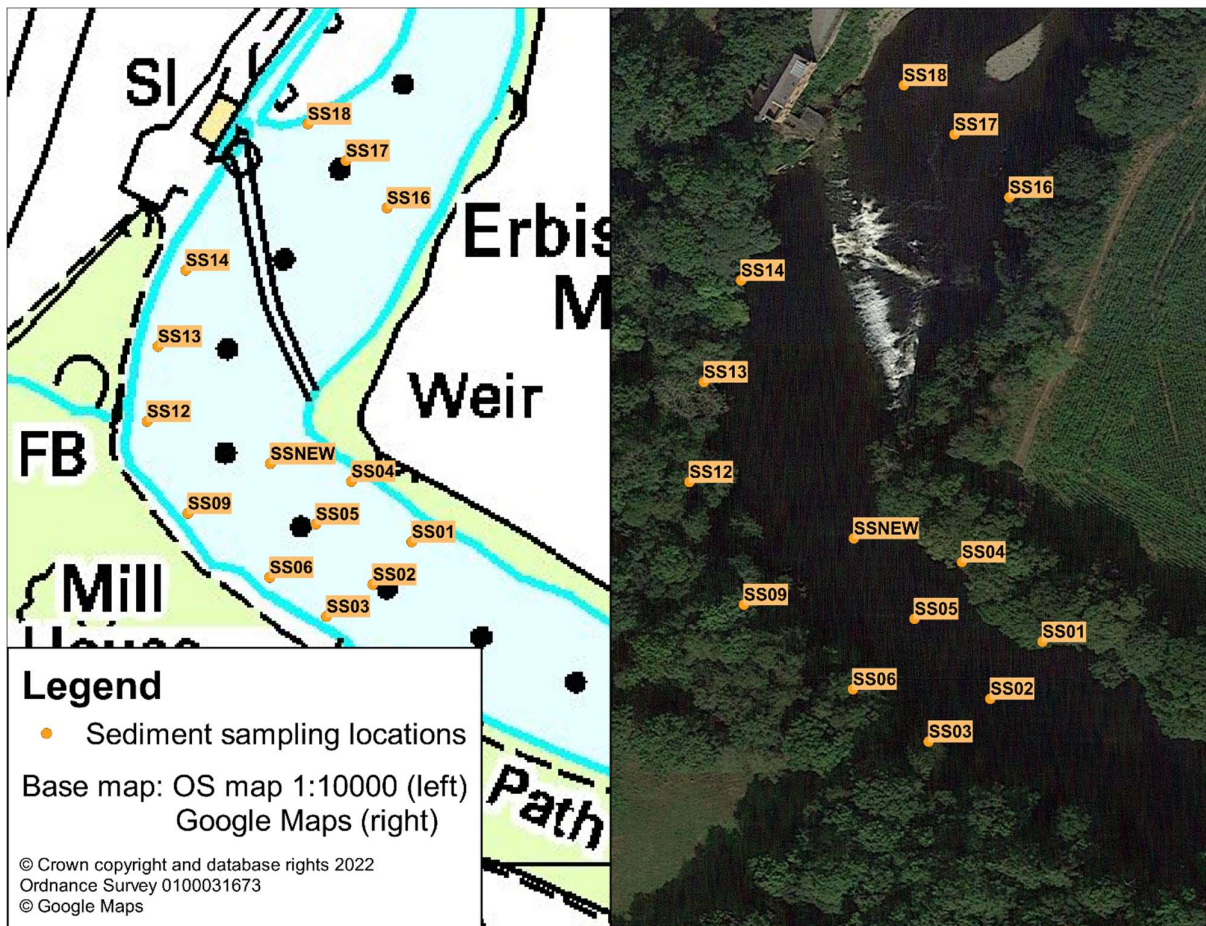
- Monitoring for depth to soft bed sediments, and depth to hard bed; and
- Grab samples of superficial sediments to be collected to jars and analysed in a certified laboratory.

The depth of the soft sediment was monitored to understand whether there are silt and soft clays that are impounded behind the weir. This methodology was required to provide a better understanding of the presence and depth of soft sediments, which could potentially result in environmental impacts to downstream habitats during weir removal. Note that the solid substrate may be bedrock or gravels.

## 1.3 Sediment sampling locations

AECOM, in agreement with NRW, defined a total of 14 locations to be sampled. These are located both upstream and downstream of the weir as shown in Figure 1 (extracted from the most recent sediment sampling methodology).

Note that 18 locations were initially planned, five upstream locations close to the weir were removed for health and safety reasons, as it was not considered safe to undertake sampling in close vicinity of the weir, and one upstream of the weir was added to compensate for this loss.



**Figure 1 Sediment sampling locations**

## 1.4 Sediment sampling results

The sampling work was carried out by an NRW appointed subcontractor, under the supervision of both AECOM and NRW between the 15<sup>th</sup> and 16<sup>th</sup> March 2022. The sampling locations and methodology are outlined in the sections above.

### 1.4.1 Depth to sediment and bedrock

The depth of soft/loose sediment and hard/bedrock is provided in Table 1, as well as further details and notes.

**Table 1 Sediment sampling comments**

| Location ID | Date of sample | NGR            | Depth <sup>1</sup> to bed sediment (m) |                       | Depth of soft/loose sediments (m) | Approximate elevation of bed sediments (m AOD) |                       | Comments                                                                                                                               |
|-------------|----------------|----------------|----------------------------------------|-----------------------|-----------------------------------|------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
|             |                |                | Soft/loose bed sediment                | Bedrock/hard sediment |                                   | Soft/loose bed sediment                        | Bedrock/hard sediment |                                                                                                                                        |
| SS01        | 16/03/2022     | SJ 35484 42091 | 2.00                                   | 2.80                  | 0.80                              | 19.08                                          | 18.28                 | Water sample collected but soil sample was not suitable for soil/leachate analysis. Water sample only sent to laboratory for analysis. |
| SS02        | 16/03/2022     | SJ 35473 42079 | 2.10                                   | 2.36                  | 0.26                              | 18.98                                          | 18.72                 | As per above                                                                                                                           |
| SS03        | 16/03/2022     | SJ 35460 42070 | 2.12                                   | 2.40                  | 0.28                              | 18.96                                          | 18.68                 | As per above                                                                                                                           |
| SS04        | 16/03/2022     | SJ 35467 42108 | 1.77                                   | 2.00                  | 0.23                              | 19.31                                          | 19.08                 | Water and Soil sample collected (both sent to laboratory for analysis)                                                                 |
| SS05        | 16/03/2022     | SJ 35457 42096 | 2.20                                   | 2.35                  | 0.15                              | 18.88                                          | 18.73                 | Water sample collected but soil sample is not suitable for soil/leachate analysis. Water sample only sent to laboratory for analysis.  |
| SS06        | 16/03/2022     | SJ 35444 42081 | 2.79                                   | 2.95                  | 0.16                              | 18.29                                          | 18.13                 | As per above                                                                                                                           |
| SS09        | 16/03/2022     | SJ 35421 42099 | 2.90                                   | 3.00                  | 0.10                              | 18.18                                          | 18.08                 | Water and Soil sample collected (sent to laboratory for analysis)                                                                      |
| SSNEW       | 16/03/2022     | SJ 35444 42113 | 3.30                                   | 3.50                  | 0.20                              | 17.78                                          | 17.58                 | Water sample collected but soil sample was not suitable for soil/leachate analysis. Water sample only sent to laboratory for analysis. |
| SS12        | 16/03/2022     | SJ 35409 42125 | 4.50                                   | 4.60                  | 0.10                              | 16.58                                          | 16.48                 | As per above                                                                                                                           |
| SS13        | 16/03/2022     | SJ 35413 42146 | 3.30                                   | 3.50                  | 0.20                              | 17.78                                          | 17.58                 | As per above                                                                                                                           |
| SS14        | 16/03/2022     | SJ 35420 42167 | Not sampled                            | Not sampled           | -                                 | Not sampled                                    | Not sampled           | As per above                                                                                                                           |
| SS16        | 15/03/2022     | SJ 35477 42185 | 1.29                                   | 1.42                  | 0.13                              | 17.99                                          | 17.86                 | As per above                                                                                                                           |
| SS17        | 15/03/2022     | SJ 35465 42198 | 1.37                                   | 1.60                  | 0.23                              | 17.91                                          | 17.68                 | As per above                                                                                                                           |
| SS18        | 15/03/2022     | SJ 35455 42209 | 1.20                                   | 1.30                  | 0.10                              | 18.08                                          | 17.98                 | As per above                                                                                                                           |

1 - Depth is in relation to the depth reference point

Note that in Table 1 the depth to soft/loose and hard/bedrock sediment were measured on site with respect to a data reference point located in correspondence of a corner of the concrete retaining wall on the left-hand bank (LHB) just upstream of the Erbistock Weir. This is pinpointed in Plate 1 and Plate 2 below.

According to the latest topographic survey (2020), the upper and lower surface of the timber decking (Plate 2 and Plate 4) are respectively at 22.51 and 22.40mAOD. Although the exact elevation of the reference point is unknown, this appears to be between 20-30 cm below the upper surface of the timber decking (Plate 4). For this reason, an elevation of 22.30 mAOD was deemed to be an acceptable ballpark estimation. This elevation has been used to estimate the bed elevations in Table 1.



**Plate 1 Depth data reference point (Erbistock Mill cottage and weir highlighted)**



**Plate 2 View of depth data reference point from Erbistock Mill cottage (16/03/2022)**



**Plate 3 View of Erbistock Mill from RHB**



**Plate 4 Depth data reference point**

During the sampling work, the surface water level with respect to the data reference point were also recorded to understand the elevation of soft/loose and hard sediment bed at the sampling locations. These are reported in Table 2.

**Table 2 Surface water level estimation upstream and downstream of the weir**

| Approximate location <sup>1</sup> | Surface water level difference (m) <sup>2</sup> | Approx. elevation (m AOD) | Flow on day      | Comments                                 |
|-----------------------------------|-------------------------------------------------|---------------------------|------------------|------------------------------------------|
| Downstream of the weir            | -3.02                                           | 19.28                     | Q71 (15/03/2022) | Surface water elevation for SS16 to SS18 |
| Upstream of the weir              | -1.22                                           | 21.08                     | Q74 (16/03/2022) | Surface water elevation for SS01 to SS14 |

1 - One value upstream and one value downstream of the weir only recorded during the survey

2 - Depth is in relation to the depth reference point

## 1.4.2 Flow conditions during sampling

### 1.4.2.1 River Dee flow conditions

Flow statistics<sup>1</sup> at the Erbistock weir were estimated on date and time at which each sample was collected.

Flow conditions on the days of the sediment sampling were estimated using the available long-term (2014-2022) river level data at the NRW flow station of River Dee at Manley Hall (ID: 4176). Figure 2 shows the flow duration curve (FDC) at River Dee at Manley Hall and the main level (flow) statistics.

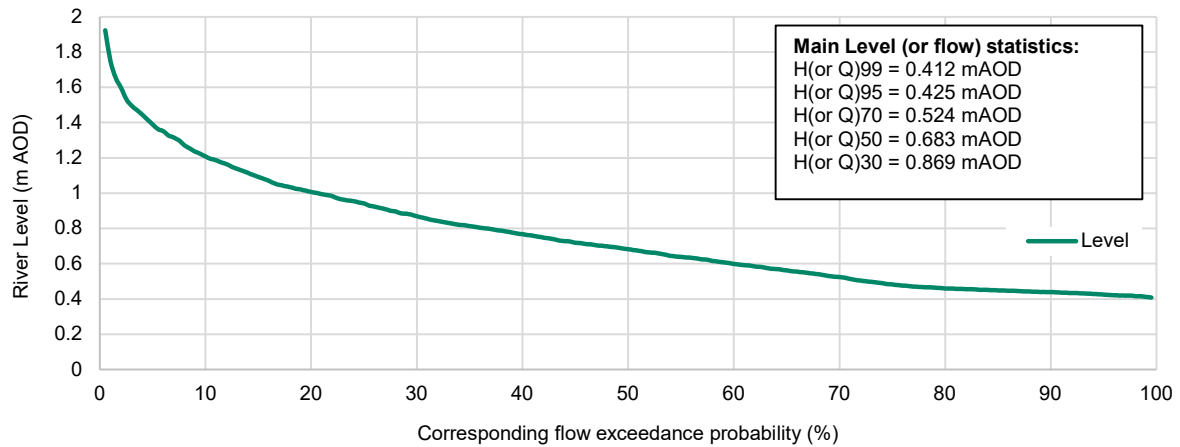


Figure 2 FDC for River Dee at Manley Hall

### 1.4.3 Flow statistics on day

Table 3 lists the estimated level (flow) statistics at the level monitoring station of River Dee at Manley Hall on the date and time of each sediment sample collection. The station records data every 15 minutes<sup>2</sup>. Across the two days, flow oscillated between  $Q_{70}$  and  $Q_{75}$ .

Table 3 Corresponding flow conditions at time of sample collection

| Location ID | Sampling Date-Time | Level at Manley Hall (m) | Corresponding Q stats |
|-------------|--------------------|--------------------------|-----------------------|
| SS18        | 15/03/2022 10:45   | 0.513                    | $Q_{71}$              |
| SS17        | 15/03/2022 11:15   | 0.514                    |                       |
| SS16        | 15/03/2022 11:30   | 0.512                    |                       |
| SS01        | 16/03/2022 11:00   | 0.490                    | $Q_{74}$              |
| SS02        | 16/03/2022 11:15   | 0.489                    | $Q_{74.5}$            |
| SS03        | 16/03/2022 11:15   | 0.489                    |                       |
| SS04        | 16/03/2022 11:30   | 0.489                    |                       |
| SS05        | 16/03/2022 11:45   | 0.489                    |                       |
| SS06        | 16/03/2022 12:00   | 0.488                    |                       |
| SS09        | 16/03/2022 12:15   | 0.488                    |                       |
| SSNEW       | 16/03/2022 12:30   | 0.488                    |                       |
| SS12        | 16/03/2022 13:00   | 0.487                    |                       |
| SS13        | 16/03/2022 13:30   | 0.487                    |                       |
| SS14        | -                  | -                        | -                     |

<sup>1</sup> Q statistics relate to the percentage of time that a specific level or stage is exceed. For example, the  $Q_{70}$  is the flow value which is exceeded for 70% of the time, based on the record used to derive the statistics. When flow and levels or stage are measured at the same location (e.g. typically at a flow gauge), the equivalent flow statistic should correspond to the level or stage statistic if the period used to inform both is the same (e.g. the  $H_{70}$  and  $Q_{70}$  for the same site should be equivalent to one another if derived from the same length of record).

<sup>2</sup> <https://api-portal.naturalresources.wales/>

The flow conditions indicate moderate to low flows across both days and therefore homogenous sediment samples were expected. At these flows, no major change in the sediment substrate is anticipated to have occurred across both survey days. According to the level data recorded at Manley Hall, the latest flood event that could have caused relevant modifications to sediment transport and deposition patterns peaked on February 21<sup>st</sup>, 2022 (with minimum and maximum level on the same day of 1.818 m AOD and 2.410 m AOD respectively). Therefore the sediments encountered are likely to represent normal sediment conditions within the reach.

1.4.4 Samples and general environment

The sediment sampling was challenging due to the nature of the bed of the River Dee at this location. The bed appeared to be characterised by a selection of small to large size gravels downstream of the weir, and mainly gravel (pebbles and cobbles) and bedrock outcrops in the area upstream of the structure.

Upstream of Erbistock Weir, some bedrock was observed outcropping along a tributary that flows down from the left-hand bank into the River Dee (between SS12 and SS13, see Plate 28 and Plate 30). At this location, the river bed seemed to consist of bedrock for a 4-5 meter reach from the riverbank into the channel until a sudden drop in bed channel levels (3-4m). For this reason SS12 and SS13 no sediments were available to be obtained, and the sediments could not be sampled for soil analysis and/or substrate depth measurements.

At all the locations sampled apart from SS04 and SS09, the sampling activity resulted in some gravels with little or no soft fine sediment. Table 4 shows the gravel sample collected and some general environment as observed across both days of site work.

As mentioned in Table 1, SS14 was not sampled, this was due to it being in close proximity with the weir head and therefore not sampled for health and safety reasons.

Table 4 Collected sediment samples and general environment

| SS01                                                                                |                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| Plate 5 SS01                                                                        | Plate 6 SS01                                                                         |

**SS02**

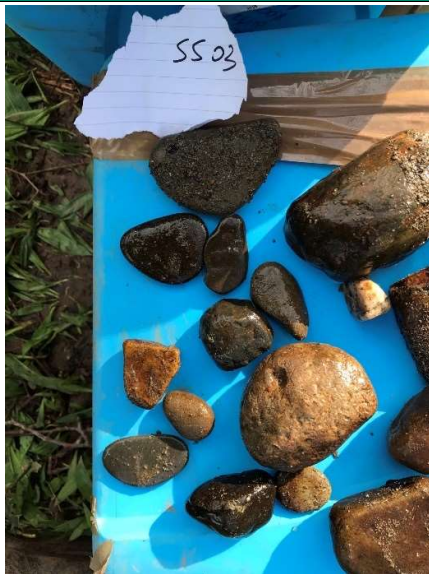


**Plate 7 SS02**



**Plate 8 SS02**

**SS03**



**Plate 9 SS03**



**Plate 10 SS03**

SS05



Plate 11 SS05



Plate 12 SS05

SS06



Plate 13 SS06



Plate 14 SS06



Plate 15 SS06

SSNEW



Plate 16 SSNEW



Plate 17 SSNEW

**SS16**



**Plate 18 SS16**

**SS17**



**Plate 19 SS17**



**Plate 20 SS17**

**SS18**



**Plate 21 SS17**





**Plate 27 Concrete glacis partially wet  
(16/03/2022)**



**Plate 28 Bedrock outcrop on stream on  
River Dee LHB (photo taken on  
January 2022)**



**Plate 29 Flow on bedrock (photo taken on  
January 2022)**



**Plate 30 Stream flowing into River Dee into  
pool upstream of Erbistock weir  
(between SS12 and SS13)**

### 1.4.5 Sediment sample analysis

The sediment samples (where able to be obtained) and water quality samples obtained were analysed in Eurofins Chemtest Ltd laboratory for:

- Soil contamination;
- Leachate water quality;
- Particle size distribution.

Water samples were also taken, and where soil samples were not obtained or not suitable for laboratory testing (gravels and cobbles), then these water samples were analysed in the laboratory.

The water quality and soil contamination data was utilised in the Ground Investigation Report (GIR) to identify potential ground contamination, see the Erbistock GIR<sup>3</sup> for further information.

<sup>3</sup> Erbistock Weir Ground Investigation Report, AECOM, May 2022

The particle size distributions were used to inform the sediment modelling, which utilised the particle size distribution and recorded cobble and pebble sizes.

### **1.4.6 Risks associated with potential sediment immediately upstream of weir**

As stated in the sections above, five sampling locations just upstream of the weir structure were not sampled due to health and safety risks, therefore the exact depth and composition of sediment immediately upstream of the weir is not known.

The sampling work resulted in mainly gravel and rocky samples and very little fine sediment. Therefore, in the event that there is fine sediment located in the area immediately upstream of the weir, it would be limited to a small area and volume. Consequently, the risk of activating fine sediment transport in case of partial removal of the weir is to be considered a minor risk with short term effects on the downstream reaches of the Dee River (i.e. temporary increase in water turbidity between work commencement through to completion but without long term detriment effect on the downstream habitat).

Therefore, although the area immediately upstream of the weir could not be sampled due to health and safety reasons, in the event that there is fine sediment present the risk is minor.

## **1.5 Summary and conclusion**

The sediment sampling work findings and conclusions are shown as follows:

- The collected samples were tested for particle size distribution (PSD), sediment and water quality;
- The water quality laboratory analysis results have been summarised and included GIR;
- The average thickness of the soft sediment layer upstream of the weir structure was estimated to be 0.25m and this value was used to prime the sediment modelling, as well as the PSD;
- The sampling work resulted in gravel and medium-size rock samples with low fine sediment proportion and therefore the risk of activating fine sediments is considered to be a minor risk with short term effects.