Natural Resources Wales

Salmon for Tomorrow 2

Llanwrda Design Philosophy

277161 - ARP - 04 - XX - RP - CX - 1006

I01 | 1 March 2021

Job number 277161

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Document verification

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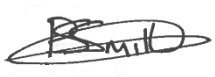
Job title		Salmon for Tomorrow 2		**Job number** 277161
Document title		Llanwrda Design Philosophy		**File reference** 4-50
Document ref		277161 - ARP - 04 - XX - RP - CX - 1006		
Revision	**Date**	**Filename**	Llanwrda Design Philosophy.docx	
Draft 1	25 Jan 2021	**Description**	Final draft for client review	
			Prepared by	Checked by	Approved by
		Name	Holly Webster	Philip Smith	Robin Campbell
		Signature			
Issue 1	01 Mar 2021	**Filename**	Llanwrda Design Philosophy_v2.docx	
		Description	Final version following client comments	
			Prepared by	Checked by	Approved by
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		Signature			
		Filename		
		Description		
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		Signature			

Contents

1 Introduction

Natural Resources Wales (NRW) have appointed Ove Arup and Partners (Arup) to appraise and design fish passage improvements as part of the Salmon for Tomorrow 2 programme. This report sets out the chosen design for one of these sites: Llanwrda.

1.1 Background

The Salmon for Tomorrow 2 programme includes six sites located across south Wales. These are Canaston, Green Park, Honddu Forge, Llanwrda, Pantglas and Pontdolgoch (Figure 1). The works comprise of a mix of new fish pass installations, modification of existing fish passage or in some cases weir removal. Arup are supported by subcontract specialist partner fish pass designers Fishtek to provide design advice and prepare the applications for the fish pass panel in relation to these works.

Figure 1: Map indicating locations of Salmon for Tomorrow 2 sites

1.2 Client Brief

The project brief provided by NRW is as per the extract below:

'*The project aims to improve fish passage beyond the weir on the Afon Dulais, Llanwrda, Carmarthenshire. This will provide access to 20km of suitable spawning and juvenile salmonid habitat. We will aim for these works to progress to construction in 2021/22 dependent on wider programme and further funding.*' (NRW, 2020)

1.3 Site

The site is located at Llanwrda a small village in Carmarthenshire (grid reference SN 71396 31616) on the Afon Dulais. The site is just off the A40 road and then accessed over a small bridge.

The weir is broad crested, with a central low flow notch. This has concrete side walls, topped with wood around the top of the low flow notch. It is fitted with eel tiles and is at approximately 45 degrees; too steep to permit fish passage.

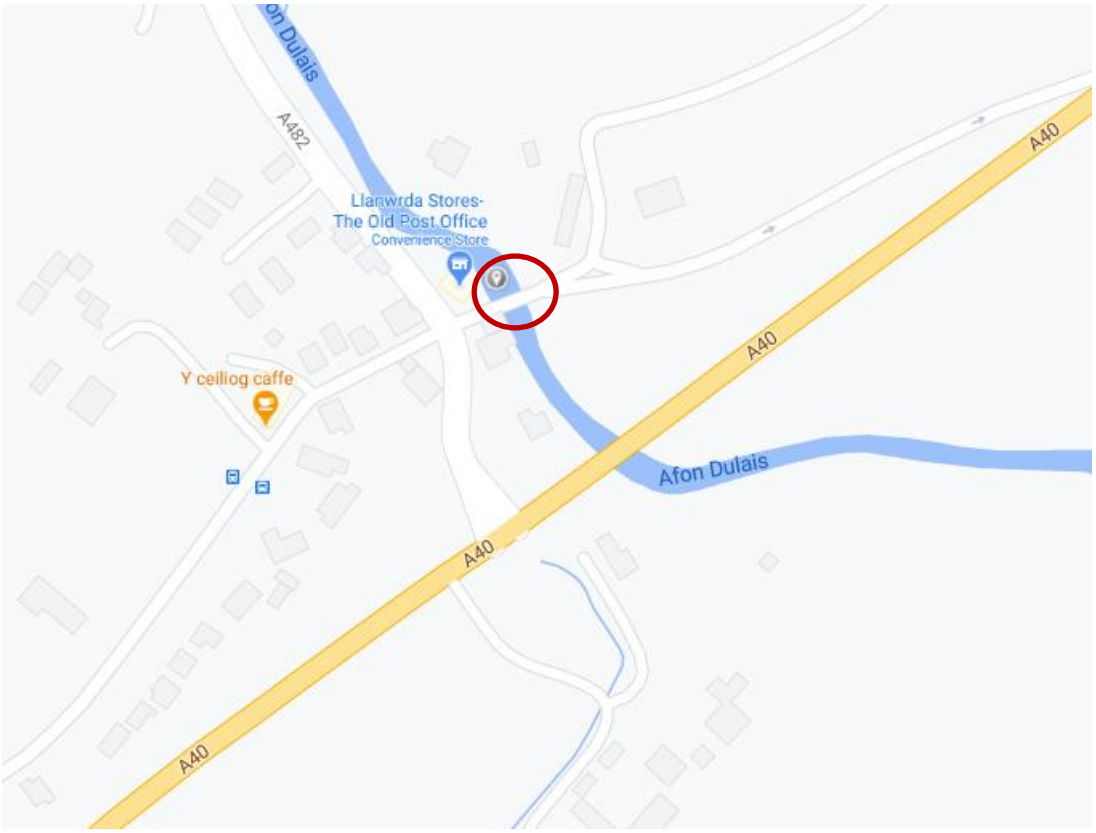


Figure 2: Site location (Google maps, 2020)

Figure 3: Existing weir and pass at Llanwrda (Arup, July 2020)

Figure 4: Entrance to location (Google Maps, 2020)

2 Baseline Information

Information from Project Brief provided by NRW (NRW, 2020):

'There is no available information on the existing weir construction or central low flow notch beyond what can be gained from visual inspection.'

To help inform the design topographic surveys, flow survey, site visits and ecology surveys have been conducted.

2.1 Flow Inputs

According to the National River Flow Archive (NRFA), there are no flow gauging stations on the River Dulais. As such a CEH Low Flows analysis was to derive a representative flow duration curve, and these results were later verified with flow information provided by NRW.

Percentile Exceedance Values	Annual Discharge (m3/s)
5	2.76
10	1.96
50	0.47
90	0.09
95	0.06
ADF (Annual Daily Mean Flow)	0.83

2.2 Topographic

The site was surveyed topographically in September 2020. The survey indicated that the weir structure is approximately 2m deep on the downstream side from the highest level of the concrete to the base of the structure. This means the water level downstream of the weir is 1.2m at Q99 flows. Construction either in water or utilising overpumping will require careful planning.

2.3 Flood Risk

The river and adjacent land fall within flood zones 2 and 3 (Figure 5). The predicted probability of flooding is 1% (1 in 100) chance or greater in any given year in Flood Zone 3. Therefore, the construction Risk Assessments and Method Statements should implement safe systems of work to include consideration of flood forecasts, inclement weather and local river levels (available for Llanwrda gauge via NRW's website) warning during construction.

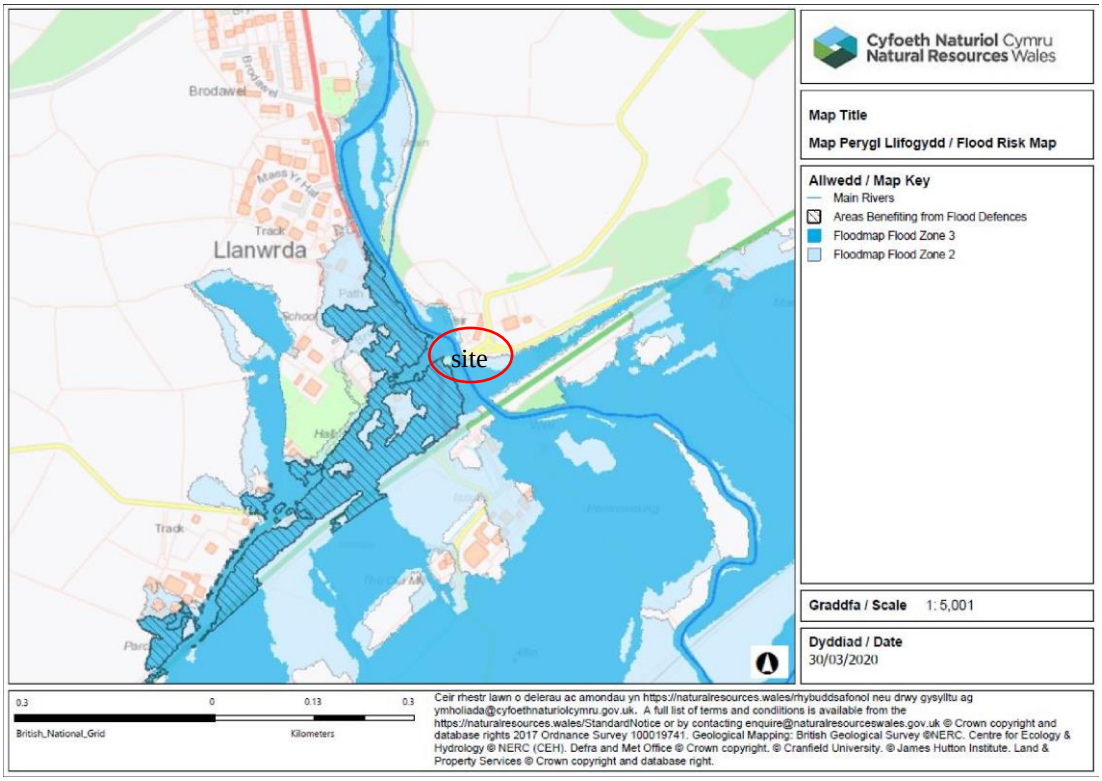


Figure 5: Flood risk map for the site (NRW, 2020)

2.4 Environmental Constraints

A Preliminary Ecological Appraisal has been conducted for the site informed by desk study and a site visit by an ecologist. Key conclusions from the report are noted below:

- Himalayan balsam and Japanese knotweed have been identified adjacent to the Site and must be considered in an Invasive Species Management Plan which should also include giant rhubarb as a precaution.
- Less than 1km downstream of the weir the Afon Dulais joins the Afon Tywi which is a site of Special Scientific Interest and Special Area of Conservation. An HRA screening exercise should be undertaken to fully assess any likely significant effect of the proposed works on the nearby Afon Tywi SAC.
- Any vegetation clearance should be limited to scrub and grassland habitats, which should be reinstated post works. If vegetation clearance is required during the nesting bird season, a nesting bird check by a SQE will be required and any nesting birds protected from disturbance during construction. Any vegetation that is removed to enable the works should be reinstated on at least a like-for-like basis.
- Standard pollution control measures should be implemented during construction to protect habitat on/adjacent to the Site, to be implemented for all in-river works.

- Any lighting required should avoid sensitive habitats, and any open excavations should be covered at night.
- Measures to enhance the value of the Site for biodiversity such as including bird and bat boxes should be considered.

2.5 Utilities

A services search was carried out as part of the preliminary investigations. This identified water supply and sewerage lines crossing the river upstream and downstream of the weir respectively. These should not be impacted by the works (Figure 6).

There are also electricity cables overhead on the approach to the site, these are low voltage lines (

Figure 7). Further details illustrating services will be shown in the Site Information pack.

In addition to these mapped services there is a leat which provides an unlicensed extraction from the river which is taken directly from the location of the weir. The route of this is shown in Figure 8. It is believed that the water abstracted is now used for livestock by a local farmer. It has been noted on site visits that the penstock at the upstream end of the abstraction is occasionally shut, presumably to reduce flooding in the fields, but the landowner has not confirmed this. Due to the ongoing uncertainty around the status of the abstraction, it has been agreed with NRW that any proposed fish passage should maintain the availability of water at the abstraction at Q95 and above.

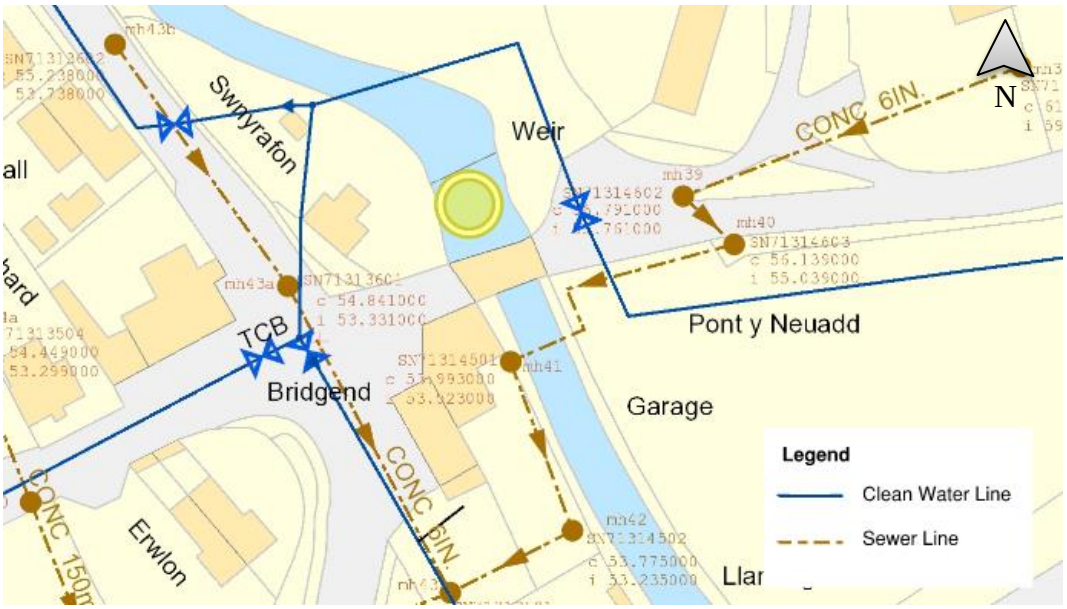


Figure 6: Extract from DCWW Service Return. (DCWW, 2020)

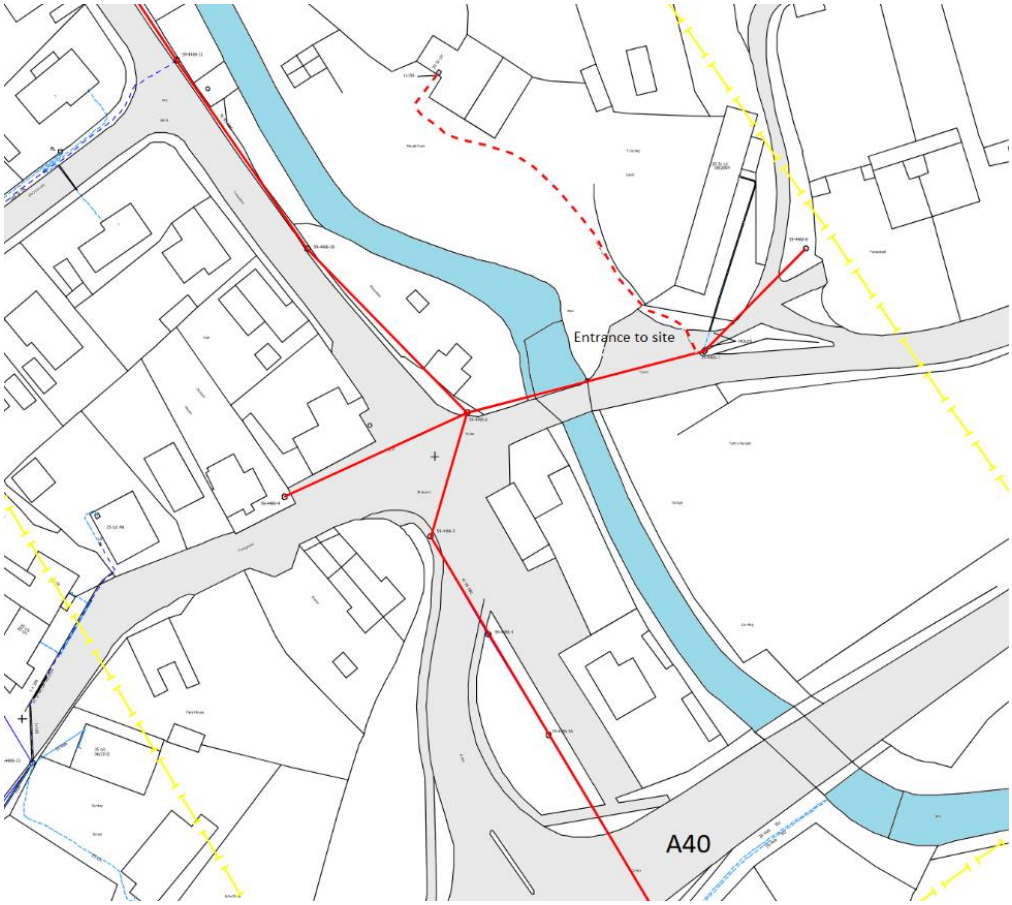


Figure 7: Electricity lines near the site, low voltage overhead lines in solid red, low voltage underground lines in dashed red.

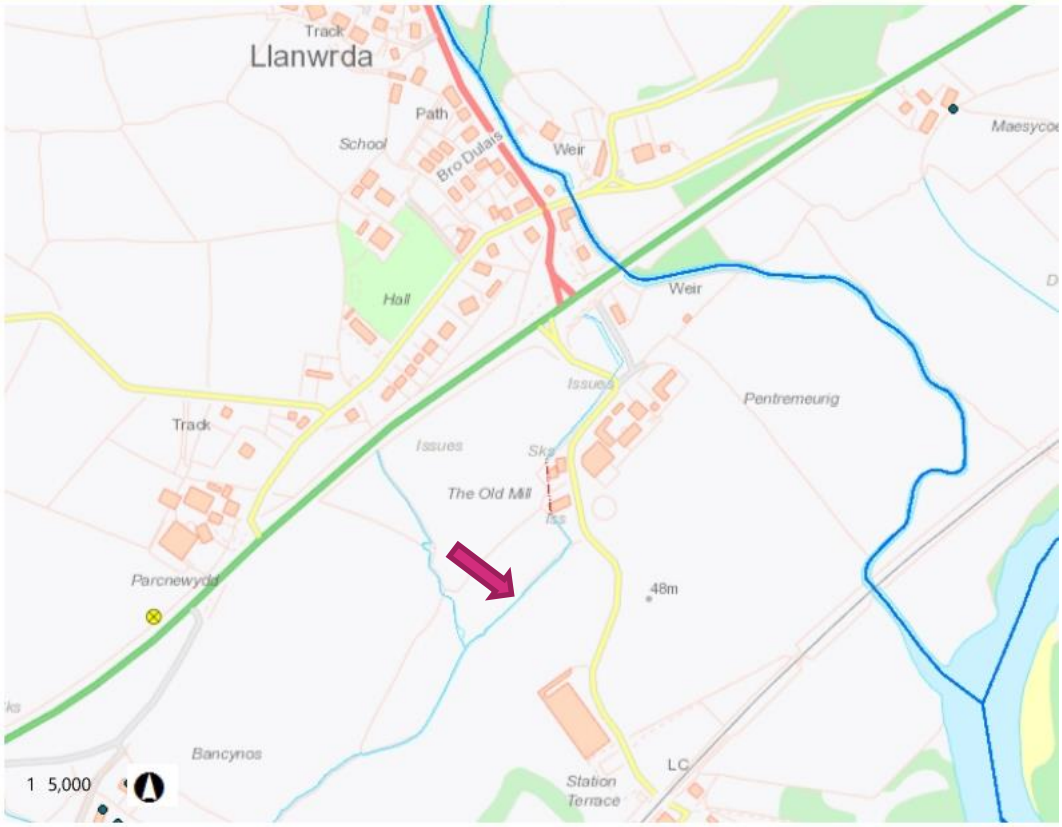


Figure 8: Route of abstraction (light blue line) (OS Maps, 2020)

Figure 9: Leat coming off from Weir, wooden edge of low flow channel also shown. (Arup, 2020)

2.6 Interfaces

NRW have provided a land ownership map which is shown in Figure 10, the landowner at the proposed site location adjacent to the river is Mr Clive Roberts who is the chair of the West Wales rivers trust.

Mr Roberts and others in the area were part of an informal consultation carried out by NRW in December 2020 to raise awareness of the project and obtain their views on the best location for a fish pass.

It is also noted that on the opposite (right) bank, the houses have existing flood defence walls.

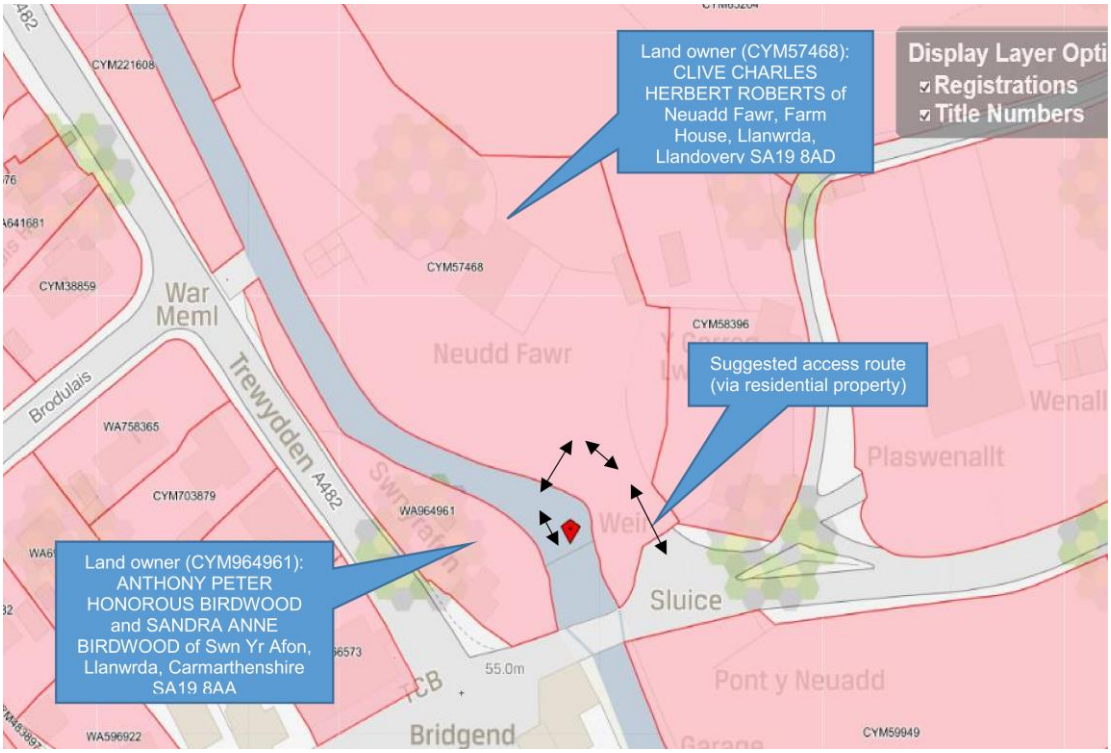


Figure 10: Land Ownership Map (NRW, 2020)

3 Option Development

Natural Resources Wales' initial project brief requested three possible option be considered (Larinier, Denil and crest lowering). These were expanded upon with a full options appraisal conducted by Fishtek. Using a multicriteria analysis of function, buildability, aesthetics, maintenance, cost, and impact to other structures it was determined that a larinier pass was the most appropriate option for the site. Other shortlisted options were weir removal and creating a rock ramp.

The larinier design was developed in consultation between Arup, Fishtek and NRW to determine levels which would enable it to operate for the maximum range of flow whilst not preventing flow to the abstraction in low flows (Options Selection Meeting, 9th Nov 2020). It was agreed that a 0.6m wide larinier with upper invert of 53.84 mAOD was optimal. Fish passage over the larinier would operate at flows greater than Q77, with flows to the abstraction maintained until Q95.

Two locations for the fish pass were considered; at the centre (where the low flow notch is located) and to the true left-hand bank which would allow easier and safer maintenance but may require greater changes to the riverbank. Through consultation with the local community, including the landowner on the left bank who is chair of the Canals and River Trust, it has been decided to have the centralised pass option. This is shown in the visualisation below (**Error! Reference source not found.**).

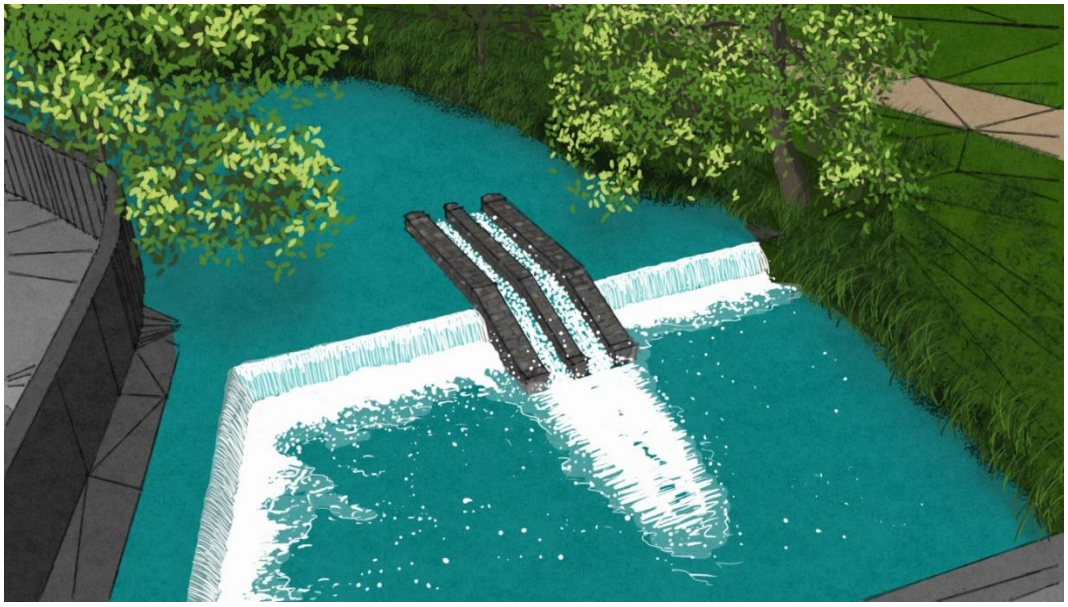


Figure 11: Visualisation of proposed larinier and eel pass.

4 Design

The pass will consist of a 600mm wide Larinier channel with an adjacent 300mm eel channel separated by a central wall (as shown in

Figure 12). The fish pass is set with a gradient of 15% with 100mm aluminium baffles, and eel pass gradient of 17% with Berry and Escott tiles fixed onto the surface. Eel tiles mounted on a 1:1 slope from the exit of the eel pass to the bed are also included. A cross section through the weir and eel pass is shown in Figure 13. It is suggested that the pass could be topped with coping stones to provide a more natural aesthetic. Outline design drawings are appended to this report for full details.

The design has been influenced by comments from the National Fish Pass Panel which were received in January 2021. These centred around the position of the pass relative to the weir (it was subsequently moved upstream) and possibility of debris accumulation.

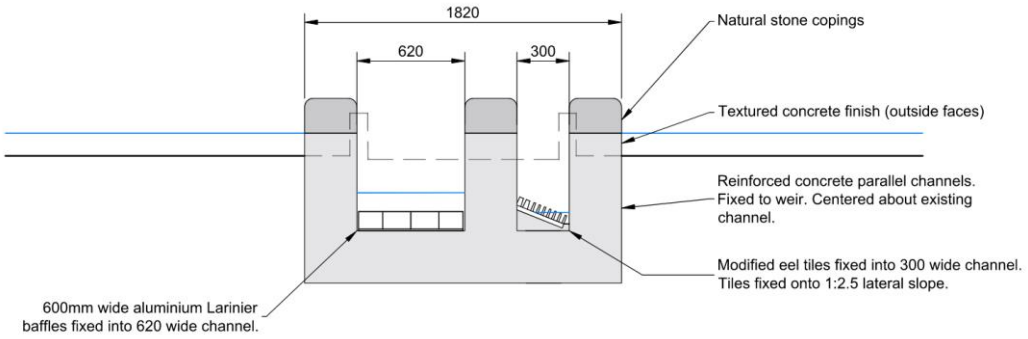


Figure 12: Cross Section through proposed fish and eel pass with the existing low flow notch shown by a dashed line.

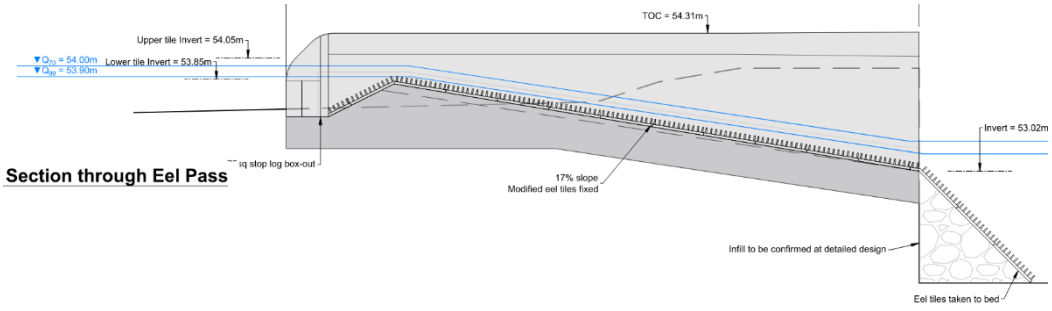


Figure 13: Long section through Eel Pass. Existing weir profile shown by dashed line.

4.1 Buildability

It is recommended to get early contractor involvement on this project to consider the optimal method of construction which will minimise H&S hazards and carbon. This could include pre-casting elements of the design or may require overpumping. Another design choice influenced by the construction methodology is the block supporting the downstream end of the pass. This could be cast hollow

and infilled with low carbon fill. Determining the most appropriate methods would be best achieved through discussion with a contractor prior to any concrete design.

The village of Llanwrda and the site is easily accessed via the A40. Space for a compound has not yet been confirmed. There is a strip of land adjacent to the area of construction, however, this is not thought to be big enough or suitable to allow the landowner access to their home (Figure 14). Instead, a small field on the opposite side of the road to the construction entrance might be suitable (See Figure 15). This land is used for sheep grazing and is in Flood Zone 2 and 3. A third option, 300m away at SN 71192 31454 is a large area of disused land/car park.

Figure 14: Entrance to land on left bank owned by Clive Roberts (Google Maps, 2020)

Figure 15: Potential site for compound on area of land on the opposite side of the road to the entrance shown in Figure 14. This filed is in flood zone 2 and 3. (Google Maps, 2021)

Topographic Survey suggests that there is an approximate 3m change in height between the riverbank and riverbed on the downstream side of the weir (partially due to scour), and approximately 2m change in height on the upstream side. Getting materials into the river will need to be carefully considered especially in conjunction with the Preliminary Ecological Appraisal which advises on minimising disruption to the local ecology. It is likely that a small ramp will need to be constructed upstream of the weir. The approximately 8m gap between trees in this location is considered wide enough not to require tree removal for access.

4.2 Design criteria

The design life for the pass is to be a minimum of 50 years unless otherwise specified by NRW. The pass will be designed to include the loading from water pressures and flows caused by river flows, including the effects of scour.

For the concrete specification it is assumed that the structure is normally submerged but occasionally exposed to air (this is a more severe classification than always submerged), it will also be designed to resist occasional periods of freezing and thawing. It is assumed that hand mixing is not required as the site is accessible. Concrete finishes and the appearance of any stonework or masonry are to be agreed with NRW.

4.3 Maintenance

Maintenance access is to be from the left bank down to the river upstream of the weir, where a set of steps have been allowed for to reduce the risks of slips, trips and falls. Operatives will then walk through the shallow part of the river having assessed the flow conditions as being safe to do so. Stop logs can be placed at the upstream section of either the fish or eel pass to dry them out.

It is anticipated that most maintenance will relate to the removal of debris from the pass and some minor repairs to the baffles or eel tiles. For the upstream section of the pass this can be carried out standing next to it due to the shallow depths – this has been agreed with the local NRW team.

More significant maintenance activities may require temporary works to dry out the structure. This will require a more significant risk assessment and method statement.

4.4 Relevant standards and guidance

CESWI 7th Edition

BS EN 1992-1-1:2004 Eurocode 2 – Design of concrete structures

BS 8500-1:2015 - Part 1: Method of specifying concrete and guidance for the specifier

5 Key risks and opportunities

5.1 Risks

Key construction risks are summarised below. A designer's hazard log will be produced as part of the works information, as well as pre-construction information.

- Access into the river
- The existing weir may be reinforced, making construction (e.g. breaking out a section) particularly challenging.
- Locating a site compound agreed with landowners
- Potential for high flows during construction
- Managing required vegetation clearance outside of bird nesting window.

5.2 Opportunities

- Environmental enhancement could be considered such as replacing removed vegetation and putting up bat and bird boxes in the area. Suitable trees for bird and bat boxes to be installed on will be shown on the drawings.

- Access to the weir, including for fish pass access, can be improved by the addition of access steps.

6 References

DCWW. (2020). Services Return. Newport: Dwr Cymru Welsh Water.
NRW. (2020). *Llanwrda Project Brief.* Cardiff: Natural Resources Wales.

Appendix 1: Llanwrda Outline Design

SAFETY HEALTH & ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the type of work detailed on this drawing, note the following risks and information.

Risks listed here are not exhaustive. Refer to Designer's Risk Assessment and pre-construction phase plan.

CONSTRUCTION

C1 **Managing flow & stage levels in Afon Dulais**
- Monitor flow levels & flood warnings.
- Check adequacy of cut-off & stability of cofferdams.

C2 **Managing seepage flows through weir**
- Monitor seepage
- Check stability of cut face in weir and assess permeability of formation material.
- Check adequacy of cut-off & stability of cofferdams

C3 **Working near water**
- Avoid working near water where possible
- Allow provision for fixed edge protection to eliminate falls into water
- Allow provision for systems for work positioning and fall arrest
- Assess bank stability / conditions considering access for personnel and machinery
- Wear appropriate PPE

C4 **Risk of falls from height**
- Allow provision for fixed guard rails to eliminate falls from height and appropriate means of access not involving ladders
- Allow provision for systems for work positioning and fall arrest

C5 **Lifting**
- Check cranage lifting facilities & constraints
- Check access weight & size restrictions for cranage at bridge crossings along access route to site

C6 **Services**
- Low voltage overhead electrified cable identified.
- Over-river pipe dn/s of bridge (source unknown)
- Check for identified & unidentified services. Clearly highlight and services that may affect works

C7 **Interface with public & other site operations**
- Assess risk to public on site
- Liaise with landowners
- Check adequate warning signs and fencing in place

ENVIRONMENTAL

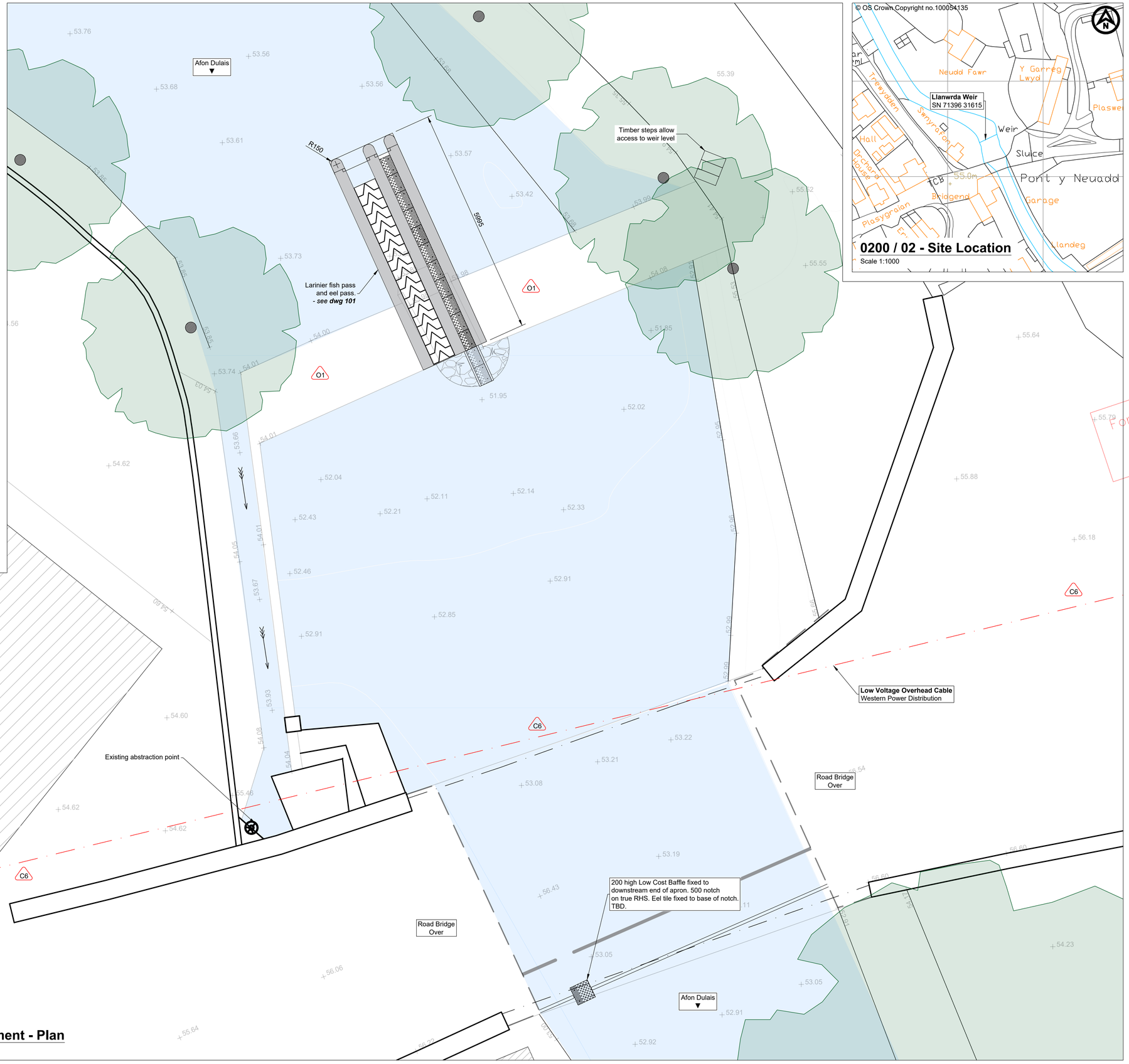
E1 **Pollution of Watercourse**
- Create a suitable dry working area
- Refer to 'Guidance for Pollution Prevention 2018'
- Produce a Site Waste Management Plan
- Produce a a Site Environmental Emergency Plan
- Have a suitable incident Response Plan in place

OPERATION & MAINTENANCE

O1 **Access for Debris Clearance**
- Asset owner to have suitable regime for accessing Larinier in center of river. To cover (min): working in water; slip, trips, falls; falls from height; emergency response plan.

For information relating to Use, Cleaning and Maintenance see the Health and Safety File

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement



0200 / 01 - General Arrangement - Plan

Scale 1:50

0200 / 02 - Site Location

Scale 1:1000

NOTES:

1. DIMENSIONS:
- Are in millimetres unless otherwise stated.
- Marked thus (*) are approximate.
- All levels are in metres to Ordnance Datum. Contractor to cross-reference to Site Datum to confirm critical levels.

2. SPECIFICATION:

All works to be carried out in accordance with the Works Information and Specification and in line with the Civil Engineering Specification for the Water Industry (CESWI)

For Information Purposes only

Not for construction

Rev.	Date	Description	Auth.	Chkd.	Appr.
B04	16/02/21	For Information	MTG	GB	TC
B03	09/12/20	For Information	MTG	GB	TC
B02	07/12/20	For Information	MTG	GB	TC
B01	30/11/20	For Information	MTG	GB	TC

Status: Outline Design

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Original Size	A1	Checker G. Bilotta	
Datum	N/A	Approver T.Coe	
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Client: Cyfoeth Naturiol Cymru Natural Resources Wales

ARUP

FISHTEK CONSULTING

PROJECT: Salmon for Tomorrow Llanwrda Weir

TITLE: Fish and Eel Pass General Arrangement Central Option

Drawing No.	Project No.	Revision
0200	- 02828 -	B04

SAFETY HEALTH & ENVIRONMENTAL INFORMATION

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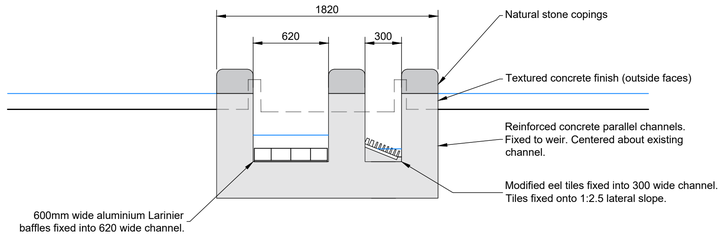

0201 / 03 - Cross Section - crest

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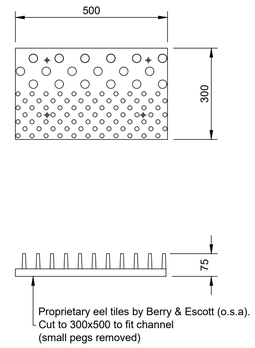

0201 / 05 - Modified Eel Tile - Detail

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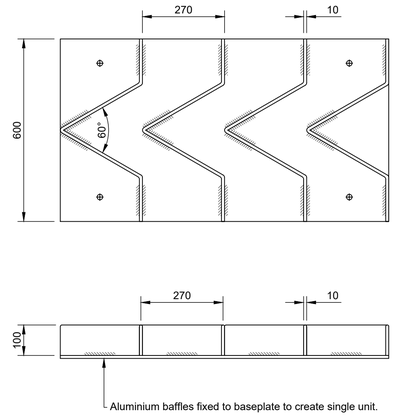

0201 / 06 - Larinier Baffle Plate - Detail

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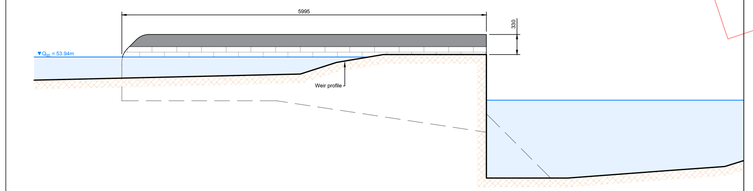

0201 / 04 - Sectional Elevation through Weir

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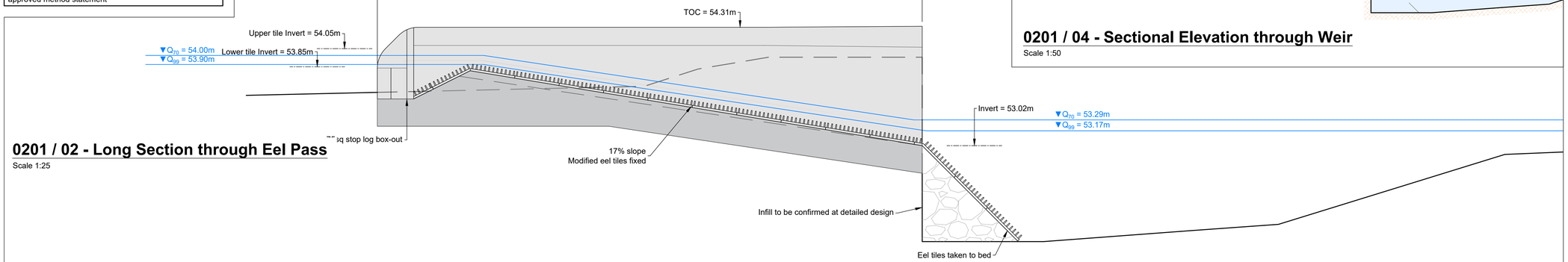
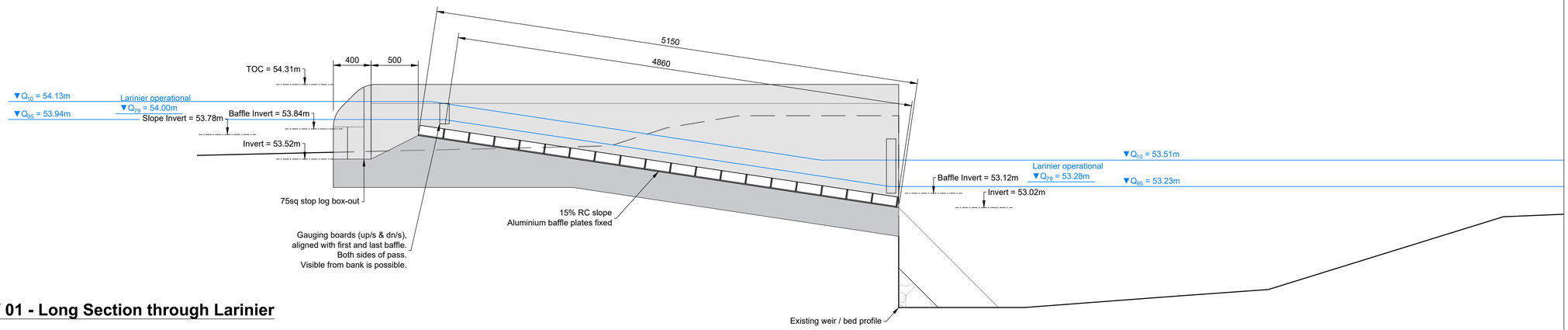


0201 / 02 - Long Section through Eel Pass

Scale 1:25



0201 / 01 - Long Section through Larinier

Scale 1:25

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Client: Cyfoeth Naturiol Cymru Natural Resources Wales

ARUP

FISHTEK CONSULTING

PROJECT

Salmon for Tomorrow
Llanwrda Weir

TITLE

Fish and Eel Pass
Sections and Details
Central Option

Drawing No.	Project No.	Revision
0201	- 02828 -	B04