

Llannerch Bridge Newsletter



The purpose of this newsletter

This newsletter is published by Denbighshire County Council. Its aim is to ensure that local residents, businesses and other interested parties are kept up-to-date on the progress with our project to replace Llannerch Bridge. Our intention is to publish a newsletter on a quarterly basis so that you know what we have done, what we are aiming to do next, and opportunities for you to get involved in the development of this project.

In this edition, we will be letting you know what has happened since the last newsletter we sent in Winter/November 2022, as well as what we're hoping to achieve before our next newsletter in Summer 2023.

Project update: what's been happening?

Since we issued our last newsletter:

Flood modelling works have been completed.

In the last newsletter, we explained that the River Clwyd flows in a completely different way and the patterns of flooding are very different to how they would have been since the original bridge was built, approximately two hundred years ago. It is important to understand the impact of any works to the bridge and approaching roads on the flood plain.

The risks of not doing so include:

- Potential to increase the flood risk upstream of the bridge site
- Potential to increase the flood risk downstream of the bridge site
- Potential for any new bridge to be washed away, if not designed appropriately

We have also been in discussions with Dŵr Cymru Welsh Water, to ensure the replacement works have no adverse impact on the local water aquifer, which runs underneath the River Clwyd.

Successful community meeting

Officers from Denbighshire County Council were pleased to be able to attend and deliver a presentation at a community meeting, organised by local County Councillors Chris Evans and James Elson for residents of the areas in and around Trefnant, Tremeirchion, Cwm and Waen on 15th February 2023. Over 70 residents were in attendance.

Highlights from the community meeting presentation:

In the community meeting on 15th February, the Council's senior bridge engineer, Jim Hall, delivered a presentation explaining in more depth some of the complexities around the Llannerch Bridge site. Many attendees found this helpful and asked for copies, so we have dedicated the bulk of this newsletter to sharing the information that was included in the presentation:

How and why the bridge collapsed

Jim Hall, the Council's senior bridge engineer, has provided the following explanation for how and why Llannerch Bridge collapsed:



Figure 1 (above) - Photograph of Llannerch Bridge prior to collapse

1. Evidence of a flattened arch on the Trefnant side of the bridge. This means the abutment (supporting structure the bridge sits on) has likely moved since the bridge was first built. Arch bridges rely on compression forces squeezing the rocks together to enable the bridge to carry its own weight, and that of the traffic that crosses it. A flattened arch means that the ability to carry compressive loads will be reduced.
2. Evidence of scour (removal of river sediment around the abutments) under the bridge. The depth of the river 50 metres either side of the bridge allows for the bridge to be crossed in Wellington boots most of the year. Under the bridge, the river depth was recorded between 2.5 metres and 4 metres deep. A recent scour assessment suggested that the theoretical scour depth (the amount of material that can be washed away before the river is running over bedrock) is 9.5 metres. If this was to happen then any new bridge foundations would be under severe stress.

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Figure 2 (below left) - Map showing river Clwyd between 1904-1939

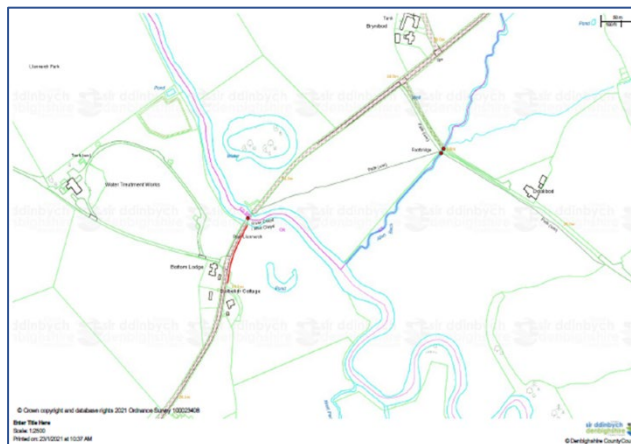
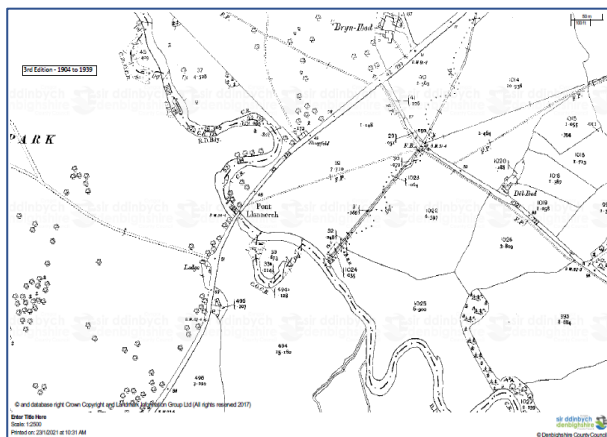


Figure 3 (above right) - Map showing the flow of the river Clwyd today



Figure 4 (above) - overlay of pre-WWII map (red) against a recent Google Earth satellite image (yellow)

It is possible to see that even within the last century the flow of the River Clwyd has changed significantly. The meanders are highly active, with the meander downstream of Llannerch bridge having been lost, whilst the meander upstream has moved up to the road.

We have highlighted this on the left by overlaying the pre-WWII map (with the river highlighted in red) against a Google Earth satellite image taken in April 2015 (with the river highlighted in yellow).

This change to the river flow will affect how water interacts with the bridge structure, and – as explained, has impacted the scour and potentially undermined the bridge foundations.



Figure 5 (above) - map showing the current flood plain for the River Clwyd



In Denbighshire, the Llanerch Bridge between Trefnant and Tremeirchion collapsed
CHRISTOPHER FURLONG/GETTY IMAGES

Figure 6 (above) showing the impact of the raised road on the flood plain

The flood plain for the River Clwyd is significant. However, because the road is raised, all water from the river must pass through the bridge hole until the water level reaches significant height to flood the road. This is visible in the overhead image shown here, as much of the ground that theoretically belongs to the flood plain

downriver of the bridge, remains dry. It is also possible to see the velocity (speed) and force with which the water is flowing through the gap where the bridge once stood.

A rising or lowering flood is a problem because the velocity (speed) at which the river passes the road changes dramatically. It also changes dramatically at various depths, hence the flows of water can become very complex.

Whilst the factors described may have contributed to weakening or undermining the bridge structure, the reason the bridge ultimately failed was due to the loss of a tree.

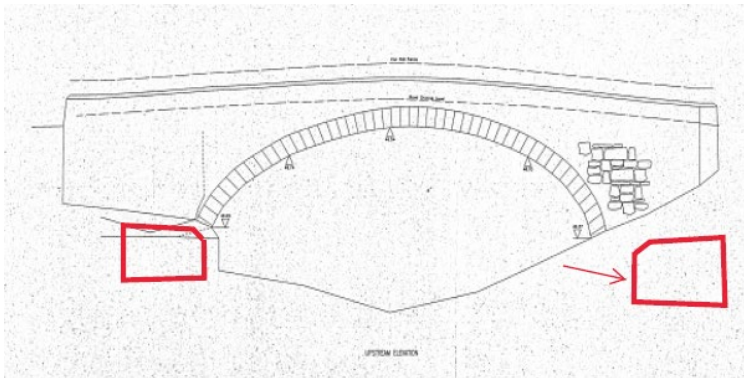


Figure 7 (above) - diagram showing the span of Llannerch Bridge with the springing highlighted in red

The tree was sited upstream of the bridge, on the Tremeirchion side, behind the 'springing' element of the bridge.

The springing is the part of the bridge that separates the arch of the bridge from the bridge foundation. This passes forces

from the arch down into the ground, but also keeps the arch under compression by the sheer weight of material behind the springing, pushing back *up* on the arch.

When the tree fell, flood water rushed into the space where the tree's root ball had been, and quickly eroded the softer ground material behind the tree root. With no material behind the springing element, the weight of the arch would have pushed the springing away from the bridge, and the arch then collapsed, filling the once-deep scour hole in the river. The abutment structure then rolled on top, pinning it in place.

In the summer months when the water is lower, it is possible to see the arch, beneath the protruding abutment section of the old bridge. It is also possible to see the exposed timber frame that would have once formed the basis of the bridge foundations, upon which the arch was built, however this timber is now quickly deteriorating as it has been exposed to oxygen for the first time since the bridge was built.

In summary, then, a number of factors led to a possible weakening of the structure, and the loss of the tree meant that the bridge lost compression and suffered a catastrophic failure.

Why haven't we built a new bridge yet?

1. We are working on it. We have entered into a contract with Balfour Beatty to develop a costed solution together with a plausible programme of works that is likely to receive planning permission. This is called 'optioneering'. As hopefully

evidenced by the previous section, the site itself is very complex. The original bridge was Grade II listed, which means that – in theory – we should be aiming to replace as closely as possible, a like-for-like structure. Since we have evidence that this type of structure may not exactly be suitable for modern pressures of the flood plain and river flow, we have needed to undertake significant flood modelling to understand the impact of a huge range of different flood scenarios at the site. The new bridge will still need to satisfy Cadw that the heritage of this important rural Denbighshire locality is preserved for future generations.

2. The bridge site sits above a freshwater aquifer that provides a crucial fresh drinking water to tens of thousands of homes across North Wales, including all residents of Trefnant, Tremeirchion, Waen and the surrounding areas. The depth of the aquifer is between 36 metres and 112 metres beneath field level.
3. Between the aquifer and river gravels sits a sandstone seam which can be found about 12 metres below ground level. The thickness of the rock seam is about 24 metres, however it is full of fissures (channels). Some of these fissures are very large and they carry more flowing fresh water, which interacts with the freshwater aquifer. The 9.5 metre river bed scour prediction (the amount of material that can be washed away before the river is running over bedrock) and a 12 metre depth to the highly fissured sandstone seam means that the river could become perilously close to the sandstone seam (and therefore the water supply) if we simply replicate the existing bridge; as there would only be 2.5 metres of scour potential left. Hence the new bridge is likely to be larger in span, much larger.
4. We would ideally like to found the new bridge on the rock seam, below the scour level. However because this rock seam is only 24 metres thick and highly fissured, it means that the selection of the foundation type is very complex as we must not pollute the aquifer below.
5. The bridge side is immediately next to the Dŵr Cymru Welsh Water abstraction facility. This is both a difficulty and an opportunity as Dŵr Cymru Welsh Water have very kindly given the optioneering team their ground investigation data for their site,

which is proving immensely important in informing the design options for the replacement bridge.

In summary, therefore, a new bridge design will require careful and thorough research. We have to be sure that the new bridge does not replace the old bridge exactly like-for-like, as that would be liable to collapse in future flooding events. We also have to be sure that we do not negatively impact the flood plain or potentially further alter the course of the river immediately upstream or downstream of the bridge side. Finally, we have to be sure we don't affect the drinking water supply for a large chunk of the county of Denbighshire.

Why can't we build a temporary bridge?



Figure 8 (above) - example image of a Bailey bridge

Temporary bridges such as bailey bridges still require permanent foundations. Since we now have no foundations on one side of the Llannerch bridge site, and very poor foundations on the other side, it would be as expensive (if not more expensive) to create foundations suitable for a Bailey bridge at the Llannerch Bridge site, and additionally these would almost certainly then be in the wrong place for allowing the replacement of it with a permanent bridge further into the future. The

research required to support the placement of Bailey bridge foundations would be almost the same as that required to install a permanent bridge foundation, and therefore it would not significantly speed up the replacement process to install a Bailey bridge.

Additionally, Bailey bridges are also costly to maintain as they require constant maintenance (and can often be closed for days or weeks at a time to allow this). In addition, they usually have weight limits and width limits, meaning that they would require traffic control and additionally a large bulk of traffic that used the road before (including agricultural traffic such as tractors, horse boxes etc) would be unable to use such a bridge, rendering it impractical for such a rural, agricultural community. From the community engagement we carried out between November and December 2021, we understand that

approximately 17.5% of all traffic over the bridge amongst respondents was agricultural traffic, that wouldn't be able to use a temporary bridge.

We noted as part of the community engagement (and continue to see on social media) asking for us to “call in the Army” – these, we believe, may have been reference to floating pontoon type bridges.

Pontoon bridges require the approaching sides to be flat, which at Llannerch bridge, they are not. Pontoon bridges are useful for moving a known set of equipment over a river quickly, but are not usually designed for repeated use.

Pontoon bridges themselves float, so the actual bridge wouldn't need foundations, however the approach structures do and since the approach to Llannerch Bridge is not flat, making good this area to allow for the safe installation of a pontoon bridge would come with similar (or possibly even greater) requirements in terms of cost and time as installing the foundations for a permanent bridge solution. Finally, the fact that the river levels are so variable at this location would mean that the pontoons would be settled on the river bed or adjacent flood plain for the majority of their operational life. This would leave them liable to puncture and risk them sinking, or requiring regular replacement.

We fully appreciate the frustration of residents and other road users that there continues to be no bridge at the Llannerch Bridge site, however we hope these updates go some way to explaining that the most cost effective (and, probably, the quickest) solution is for us to continue to work towards securing a permanent replacement for Llannerch Bridge.

What's happening next?

Finalising preferred design options for the new bridge

Based on our conversations so far with Natural Resources Wales, Denbighshire County Council's own planning department, heritage body Cadw, Welsh Government, and Dŵr Cymru Welsh Water we have appointed Balfour Beatty as the project managers to develop an 'optioneering' document that considers all of the complex (and often conflicting) issues, before recommending a preferred solution in the summer of this year.

On 7th February 2023, Denbighshire County Council submitted an application to Welsh Government asking for them to fund the design and construction of the new bridge under

their *Resilient Roads* funding grant. Welsh Government's current position is that they will need to assess **all** applications made under the *Resilient Roads* funding scheme before determining how to allocate the funding.

Collecting feedback from the community on our final designs

Once we are confident that the design (or designs) of the bridge/bridges we have proposed are safe, appropriate, and flood resilient, we will be taking this our proposal(s) back to the community for feedback before submitting a planning application to replace the bridge. We are not quite ready yet, however we hope to use our Summer newsletter to share these with you.

We also intend to carry out a road safety review of the approaching roads from both sides of the bridge, as our previous community engagement carried out between September and November 2021 raised a number of concerns. Again, we intend to use our Summer newsletter to launch this road safety review and we will be asking you for your thoughts.

Date of the next newsletter

The next newsletter will be published in Summer 2023 (approximately late June/early July).

Could this newsletter have been an email?

If you've picked up a paper copy of this newsletter and would prefer to receive copies of the Llannerch Bridge newsletter electronically in future, please email public.engagement@denbighshire.gov.uk. If you have previously received Llannerch Bridge newsletters via email, you do not need to contact us again to ask to receive future newsletters. You only need to contact us if you wish to unsubscribe.

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