



Scour Protection
Project Spotlights



Escob Bridge

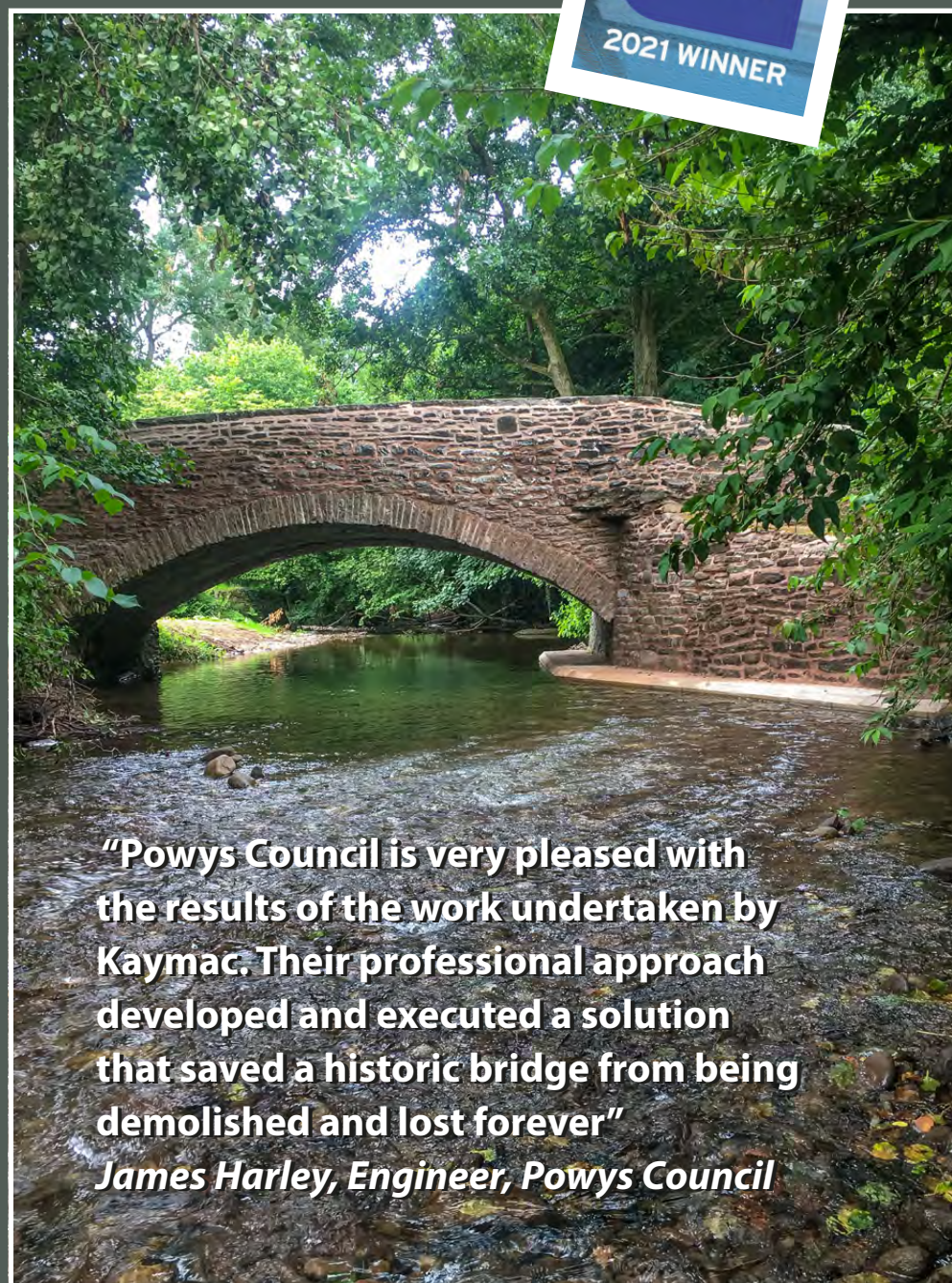
Award Winning Bridge Rehabilitation

Client: Powys County Council

Duration: 10 weeks

Value: £310,000

This Grade II listed structure at Escob West was a structure earmarked for demolition before Kaymac were given another great opportunity to showcase our innovative approach to solving complex in-water engineering problems



“Powys Council is very pleased with the results of the work undertaken by Kaymac. Their professional approach developed and executed a solution that saved a historic bridge from being demolished and lost forever”
James Harley, Engineer, Powys Council

Following the unprecedented flood conditions experienced in early 2020, structures across the UK's watercourses have been left in dilapidated states, with asset owners determining whether repairs can be undertaken safely, or in some cases whether a full structural demolition is required.

Due to the lack of structural stability, all parties were of the opinion that operative access beneath the structure to undertake any remedial works would not be safe. The extent of the flood damage to the structure's abutment was so extreme that it was clearly visible from the opposite river bank, with the arch being almost unsupported for over 50% of the abutment length. The asset owner immediately closed all vehicular and pedestrian use of the bridge.

Kaymac were originally invited to develop a safe method for demolishing and reconstructing the bridge. Not being content with this approach and being confident that we could offer an innovative solution to the client, our engineers began brainstorming possible solutions and determined that through careful control of the watercourse, a temporary composite propping system could be floated beneath the structure without the need for any operatives to be put at risk during its installation. The solution would also allow water to pass through the structure if future flooding events were to occur during the planned repair programme.

The solution would require temporary RC bases capable of withstanding the bearing pressures exerted by the propping system, being installed upstream and downstream of the structure. We consulted with our suppliers, namely RMD Kwikform and Pebble Engineering Ltd to confirm that our proposal would satisfy a detailed design, before presenting our proposal to the client. Through a stringent interview process, the proposal details were questioned and

checked so that the client could satisfy themselves that the approach could not only stabilise the structure but also offer a value engineering solution, with substantial savings compared to the original demolition and reconstruction option.

Upon being awarded the works, Kaymac carried out all of the necessary steps in line with our Temporary Works Management Policy to ensure that a detailed and rigorous design was undertaken.

The method of constructing and positioning the RC bases, floating the temporary propping system beneath the bridge and essentially using hydraulic jacks to raise the whole system to ensure continuous contact of the temporary works with the existing structure was achieved to ensure that under no circumstances, operatives were required to work beneath the structure and risk being injured through structural collapse during the temporary works installation.

The work was planned through close consultation with Natural Resources Wales, the Heritage & Conservation Dept. of the Brecon Beacons National Park Authority and our client. With the structure being situated within the Brecon Beacons National Park and within a watercourse known to be frequented by various marine life and small mammals, Kaymac needed to ensure that the works could be undertaken with no detriment to the local eco-system. Environmental measures including conservational surveys, fish rescues, the use of silt curtains to encapsulate the works, using specific in-water environmentally sensitive concrete admixtures and ensuring all plant near to the watercourse would be fitted with bio-degradable hydraulic oils were undertaken on site.

Upon the successful installation of the temporary propping system, a detailed survey of the damaged abutment could

be safely undertaken by Kaymac. Being a Grade II listed structure, Kaymac liaised with the local Heritage & Conservation Dept. of the Brecon Beacons National Park Authority to develop a suitable repair method that would not only stabilise the structure but also maintain the historic complexion of the bridge. It was agreed that a composite repair entailing in-situ concrete and masonry would be adopted in this instance. Kaymac's commercial divers safely removed the misplaced masonry from the river bed before erecting formwork to encapsulate the repair area. The concrete was installed in 3 vertical lifts from the invert to the arch springing and offset horizontally from the face of the existing abutment so that the recovered masonry could be reinstalled and tied in with the existing details. Once the structure had been stabilised and the concrete test cubes proven to be in excess of the required design strength, the formwork was dis-assembled. The temporary propping system was then safely removed to allow the safe inspection of the arch barrel and other structural elements of the bridge.

Following the successful completion of the works and subsequent removal of the temporary propping system, the bridge was re-opened to the public.

Kaymac are extremely proud to have played their part in developing and implementing an innovative engineering solution that has not only saved the bridge from collapse but has also provided our client with substantial cost savings.

We look forward to the next opportunity to showcase our innovative approach to solving complex in-water engineering problems for our clients. ●

Llanbrynmair Railway Bridge

Scour Repairs

Client: AMCO
Duration: 8 weeks
Value: £330,000

Following inspection of the under-bridge of the Afon Pandy single span masonry bridge carrying the railway line over the river Cwm from Newtown to Machynleth, it was identified that masonry repairs and improved scour protection works were required to ensure the safety of the structure

“It was a challenging project that was time critical, putting passengers first, we were able to stabilise the bridge without causing any disruptions to the services”

Jeff Lippiett, Operations Manager, Kaymac



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During the winter months, the river flows had damaged the various scour protection system installed by others previously. Kaymac were commissioned by Amco Rail to install a new thick reinforced concrete invert throughout the structure to protect from scour. Re-pointing and stitch drilling works were also required to the abutments and archway of the structure.

As the works involved disturbing the existing bed material and pumping concrete into the watercourse, there was a danger of harming the surrounding environment. Kaymac worked closely with Natural Resources Wales to plan the works to ensure minimal impact on the environment. The river is also abundant with wildlife and as the works were carried out near the spawning season, there had to be a pass constantly open to migratory fish.

It was planned for the river to be over-pumped to ensure a dry working area for the works. A temporary sand bag bund was installed at the upstream face of the structure, with 3 No. 12" submersible pumps used to channel the flow through the structure downstream. A 12" flume was incorporated into the bund to ensure an open pass for any migratory fish.

Once installed and the working area had been de-watered, the excavation works began to remove the bed material to the formation level. The works were carried out in two halves to ensure adequate access for the excavators and dumpers. Kaymac had two teams working 12 hour shifts per day (day and night working)

to ensure that the tight programme was met. The formation level was checked by the engineer and the steel reinforcement and timber shuttering was installed to the design requirements.

The concrete was pumped into the shuttering to create the first half of the invert. As an NRW requirement, stone was placed by hand into the concrete with the aim of it helping to reduce the flows when the river was re-opened. Once the first half had cured, the above was repeated to complete the scour protection works. Plinths were also installed both upstream and downstream to protect the foundations of the structure's wing walls. The project was completed successfully during a period of very poor weather and high river flows. ●



Janes Creek Bridge Strengthening

Client: Birse Rail
Duration: 24 weeks
Value: £840,000

The bridge structure was deemed unsafe following investigation due to rotation and movement; the structure required stabilisation. The works comprised of Bridge Strengthening works including insitu concrete to the invert, 42m long ground anchors and all associated temporary works



“Kaymac’s temporary works design was able to hold back a 5m head of water, allowing operatives to stabilise the bridge within a dry working area. This was a great project and a fantastic opportunity to showcase Kaymac’s expertise, seamless collaboration and innovation at its finest”
Jeff Lippiett, Operations Manager, Kaymac

Jane's Creek Bridge is a five span underbridge located on the Strood Junction to Maidstone West line between Strood and Cuxton. The structure spans a tidal creek of the River Medway and two minor roads: a Marina access road and the local Civic Centre and ambulance depot access road. The two roads are not adopted highways. The bridge carries two tracks with electrified 3rd rail. The railway runs on embankment either side of the bridge. The bridge comprises five simply supported decks spanning between mass brickwork abutments and intermediate brick piers founded on timber piles. The wrought iron main girders support transverse cross girders which in turn support longitudinal rail bearers and deck plates.

The total bridge length is 57 metres, with four spans of 10 metres and a longer centre span of 17 metres. The total width is 8 metres. The substructure is believed to date from 1856, with the superstructure being a later deck replacement circa 1900. The substructure had a history of movement and appeared to have been repaired on several occasions. The piers adjacent to the creek had rotated and Pier 1 had been propped by a brick supporting wall which had subsequently cracked. The substructure therefore required stabilization.

The substructure stabilisation works involved restricting further piers (Piers 1 and 4) comprised of the installation of 5 no ground anchors per pier. These anchors were driven down from horizontal to the design level and angle.

The purpose of the anchors was to restrain further movement of the piers and not designed to jack them to their original alignment.

The second stage of the works was to stabilise the two central piers (Piers 2 and 3). This was achieved by excavating at the toe of the existing piers, and installing a concrete slab that prevented further movement of the pier bases inwards.

Due to the lack of head room under the bridge we were unable to install a temporary sheet piled cofferdam as proposed, instead we opted to use 1 tonne dumpy sand bags stacked up to create a temporary bund. An excavator was used to place the 1T dumpy bags at low water to the upstream and downstream ends of the structure. Once positioned, polythene sheeting was placed over the bund and held tight using smaller sand bags to create as dry working area as possible.

Suitably sized submersible pumps were placed on the upstream end of the bund, with the hoses laid to over pump the water over the working area. Smaller pumps were necessary to dewater the area between the bunds and the working area.

Waling beams spanned between the inner faces of Piers 2 and 3 and at intermediate points, RMD Megashore struts were used to provide temporary support to the piers prior to the excavation of the creek material.



Following the installation of the waling beams; excavation, formwork, steelwork and concrete works could take place safely.

To summarise, Piers 1 and 4 were stabilized by the installation of ground anchors with nominal tensioning. These were designed to resist further movement, however did not jack the piers back to their original orientation. The foundations of Piers 2 and 3 were stabilised, this involved the installation of a reinforced lightweight concrete, cast in-situ slab at the base of the piers which spanned under the existing creek bed. The slab is 750mm deep and placed on a 500mm deep stone bed, and connected to the base of the piers with stainless steel dowels.

The project was delivered on program and within budget. ●

Guerning Dog Road Bridge

Scour Protection Works

Client: Calderdale Council

Duration: 4 weeks

Value: £170,000

Lack of headroom due to a build up of bed materials, and the potential for scour damage during flood conditions required flood alleviation works for our Client, Calderdale Metropolitan Borough Council



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Guerning Dog Road Bridge is located 0.5 miles west of Todmorden, Calderdale, West Yorkshire, and carries Knowlwood Road at a junction with Rochdale Road over the River Calder. Due to the susceptibility of the River Calder to respond quickly to rainfall and consequently rise in river level, it was imperative that the weather conditions were checked and monitored prior to and during any activities where personnel are working in the watercourse.

To allow semi-dry access below the bridge structure, the river was flumed through two twin wall pipes. A dam of bulk bags of sand was then constructed upstream and downstream of the bridge to divert the flow through the flume pipes.

Due to the high flood protection walls on either side of the river, it was necessary to lower the 3t excavator and micro excavator into the river using a 10 hydraulic crawler crane. Two-way temporary traffic management was put in place to achieve this

With the river flows were diverted, the bed materials were excavated down to formation level beneath the bridge and 6m upstream and downstream of the structure to allow placement of the Proserve scour protection Mattresses. Care had to be taken not to undermine the bridge foundations or the footings of the adjacent retaining walls. A total of 120t of mobile bed material was moved from below the bridge to increase the headroom and achieve the formation levels as per the design.

“Fantastic workforce, professional approach to every aspect of the scheme, very impressed with their H & S, communication and performance on site. This was a challenging project with particularly difficult access; Kaymac delivered successfully with no issues”
*Program Manager,
Calderdale Council*

Once the levels had been reduced, the scour protection could be installed onto the prepared river bed. The scour protection consisted of 220mm thick Proserve constant thickness mattresses, which were filled with a 2:1 sand/ cement ratio C35 micro-concrete. An underwater additive was mixed with the micro-concrete to prevent wash out and consequential pollution to the river. Environmental protection mitigation filter screens were placed downstream of the works to reduce the impact of pollution entering the river.

Scour protection was achieved and the project was delivered on program and within budget. ●



Rastrick Bridge

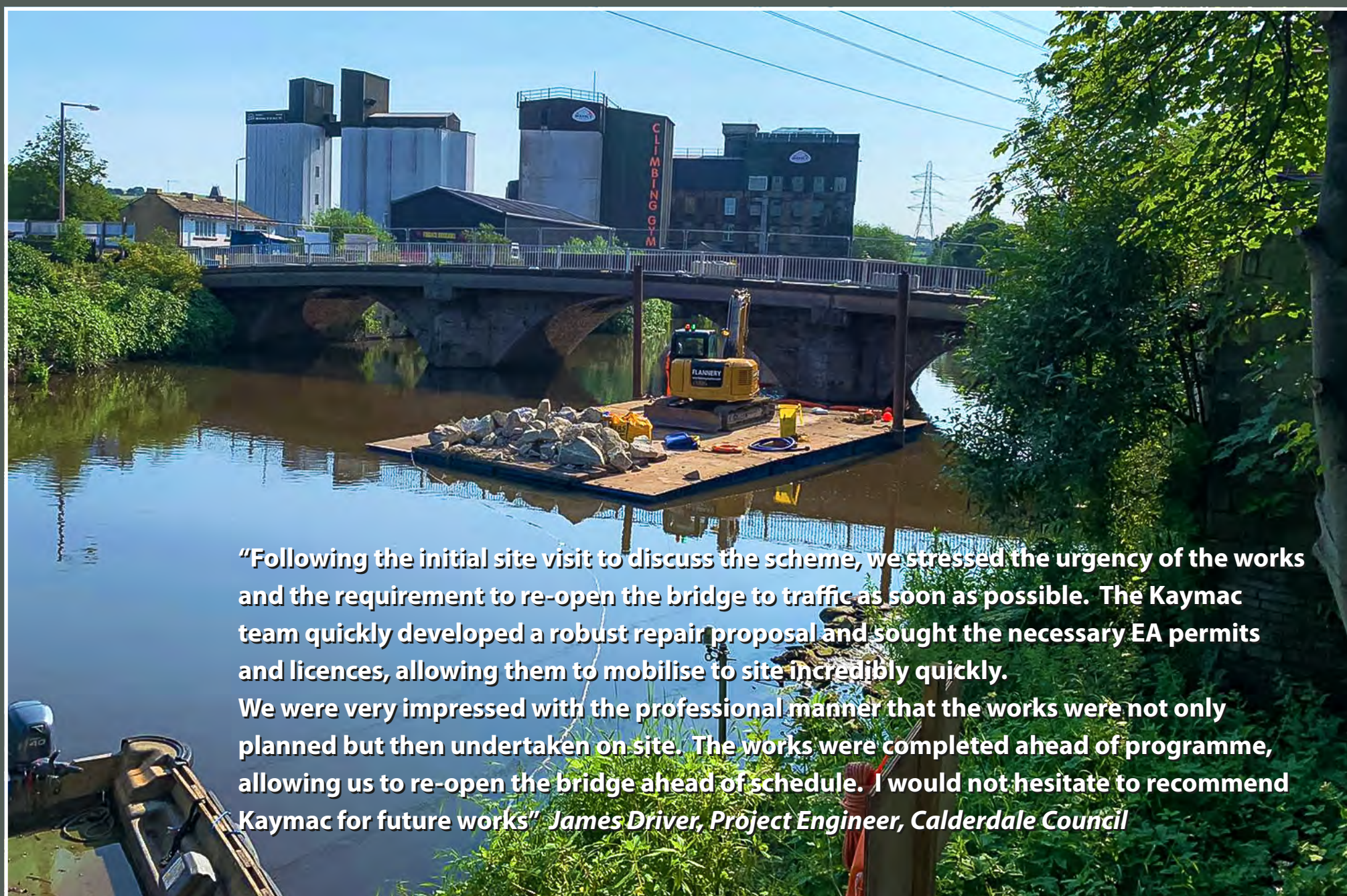
Emergency Scour Repairs

Client: Calderdale Council

Duration: 4 weeks

Value: £115,000

Rastrick Bridge is a three-span underbridge which carries the A643 over the River Calder. The structure is constructed from bonded masonry abutments and piers that support bonded masonry arches



“Following the initial site visit to discuss the scheme, we stressed the urgency of the works and the requirement to re-open the bridge to traffic as soon as possible. The Kaymac team quickly developed a robust repair proposal and sought the necessary EA permits and licences, allowing them to mobilise to site incredibly quickly. We were very impressed with the professional manner that the works were not only planned but then undertaken on site. The works were completed ahead of programme, allowing us to re-open the bridge ahead of schedule. I would not hesitate to recommend Kaymac for future works” James Driver, Project Engineer, Calderdale Council

Following the severe flood conditions experienced across the U.K in early 2020, critical safety checks to infrastructure have been of paramount importance. In this particular case, the flooding had transported a shipping container causing it to become wedged against the upstream face of the bridge structure which could not be removed until the river levels had subsided. Its wedged position had caused severe scouring to occur to the affected pier.

Following its removal, the asset owners undertook an underwater inspection which identified a number of areas of concern and resulted in the immediate closure of the structure until it could be fully assessed and any structural concerns rectified.

The road closure was causing heavy congestion and traffic issues, with the asset owners under considerable increasing pressure from the public to rectify the situation and re-open the bridge. The scour survey was undertaken by another diving contractor and once the client had received the findings, they were left to then try and determine an appropriate method of repair. It was at this time that Kaymac were invited to interpretative the survey results, develop a proposal and further, give the client the confidence that they could deliver a bespoke underwater repair solution in a manner that would allow the bridge to be reopened with due haste.

Following a site visit, Kaymac's engineers developed the proposal which would permit the works to be undertaken through diving operations, making use of Kaymac's own steel modular pontoon system. Kaymac also had to assure both the client and the

Environment Agency that the proposed construction methodology would ensure that no pollution or suspended particulates (as a result of the works being undertaken in wet conditions), from entering the watercourse and being dispersed downstream.

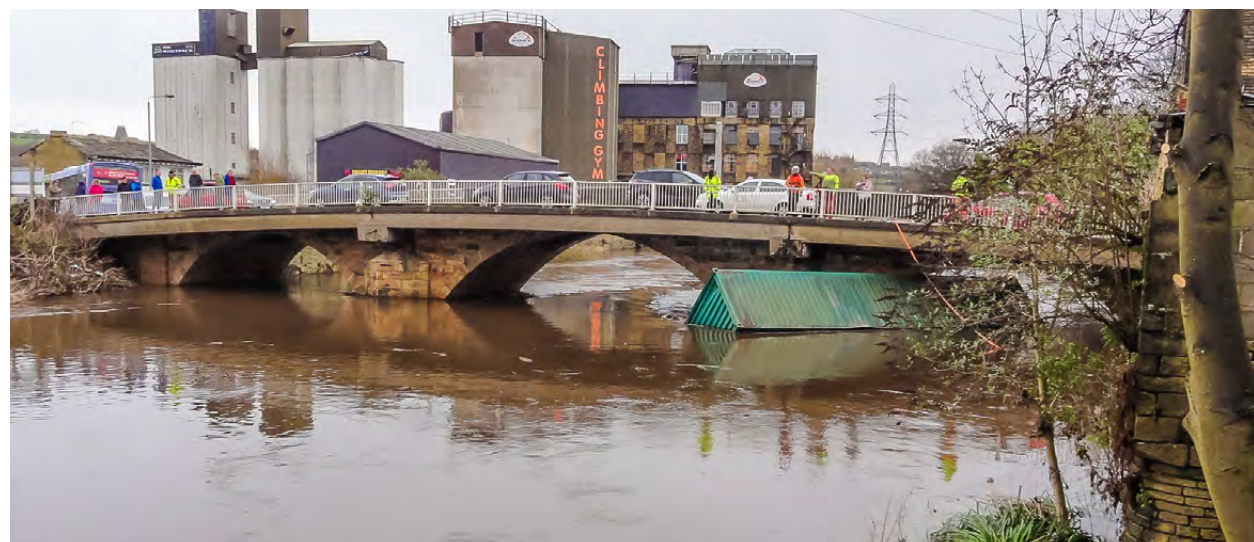
Through close and open liaison with the Environment Agency, Kaymac were able to obtain the relative flood risk activity permits quickly, allowing the works to be undertaken within a week of the initial applications. Concurrently, Kaymac sourced the required materials and obtained the relative buoyancy calculation checks for the intended floating plant, ensuring that once the EA permit was received, works could immediately commence, thus limiting the overall road closure duration.

Upon mobilising to site, Kaymac installed a temporary access ramp to safely construct the pontoon system within the watercourse. Through diving operations and with the assistance of the excavator, the loose bed material around the pier was excavated

to the required formation level, before formwork was erected by our divers.

A concrete boom pump positioned off the bridge (to ensure no additional loading was applied) was used to place an approved underwater concrete mix, essentially filling the scour hole and stabilising the structure. The excavator was then used to place rock armour around the cutwater of the pier to offer further protection against future scour. All elements of the works, including the installation of the temporary and permanent works through diving operations were undertaken by Kaymac's directly employed workforce.

We understand that undertaking the works below water can also introduces a host of testing and quality concerns for our clients, however, with Kaymac's vast experience in undertaking these types of projects across the UK, a detailed Inspection & Test Plan was documented and further, adhered to on site to ensure compliance at every phase of the works. ●

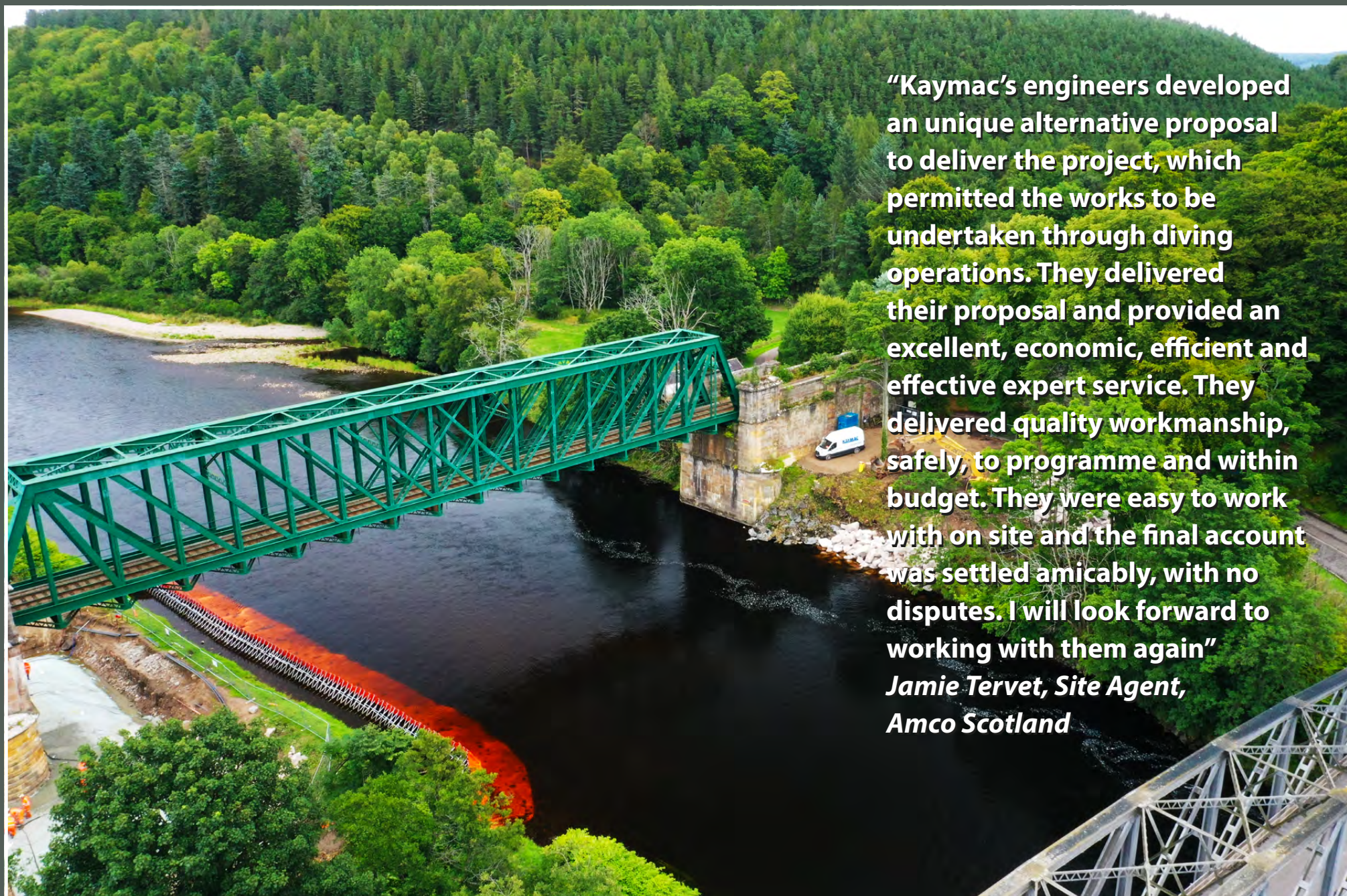


Spey Viaduct

Scour Protection Works

Client: AMCO
Duration: 5 weeks
Value: £360,000

In late July 2020, Kaymac were contacted by our client to assist with developing a proposal that would permit the safe installation of a fabric formwork scour protection system to the abutment of a railway bridge near Inverness, Scotland



“Kaymac’s engineers developed an unique alternative proposal to deliver the project, which permitted the works to be undertaken through diving operations. They delivered their proposal and provided an excellent, economic, efficient and effective expert service. They delivered quality workmanship, safely, to programme and within budget. They were easy to work with on site and the final account was settled amicably, with no disputes. I will look forward to working with them again”
Jamie Tervet, Site Agent, Amco Scotland

Rhys Colcombe, CEng MICE,
MSc, BEng (Hons),
Senior Project Manager.
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The client had secured the scheme and planned to undertake the works in dry conditions using a portable frame dam system; however, it became evident that this would not be feasible given the approximate river depth of 3.0m in certain sections. Following the site visit, Kaymac's engineers developed an alternative proposal which would permit the undertaking of the works through diving operations, without adapting the detailed permanent works design which would have likely resulted in the works being delayed until the following Spring, 2021.

Kaymac were confident that they could deliver a bespoke underwater solution and further developed the proposal through close liaison with the client's permanent works designer and the manufacturer of the fabric formwork mattress system. Kaymac were able to illustrate to the client that a number of value engineering principles could be implemented, including utilising the existing rock armour material that was on site and due to be used for the permanent works, into forming a temporary bund that would protect our diving operatives from the river flows during installation.

Through assessing and interpreting the historic river level data, Kaymac developed the temporary works solution so that it would be set at a height that would offer maximum working opportunities with minimum down time due to adverse weather; whilst also ensuring that it would not cause an obstruction resulting in a heightened flood risk upstream of the works.

Kaymac also had to assure both the client and SEPA that the proposed construction methodology would be adequate in preventing any pollution or suspended particulates (as a result of the works being undertaken in wet conditions), from entering the watercourse and being dispersed downstream. The construction proposal together with our detailed pollution mitigation methodology were documented and issued to SEPA as an amendment to the client's original environmental permit application before being duly approved.

All elements of the works, including the installation of the temporary and permanent works through diving operations were undertaken by Kaymac's directly employed workforce. Our delivery management team included a qualified and experienced on-site project agent, together with regular visits from one of our project engineers to ensure that the works were undertaken in accordance with the detailed design.

Undertaking the works below water also introduces a host of testing and quality concerns, however, with Kaymac's vast experience in undertaking these projects across the UK, a detailed Inspection & Test Plan was documented and further, adhered to on site to ensure compliance at every phase of the works. Following the successful completion of the permanent works and subsequent removal of the temporary measures, the worksite was handed back to the client, two weeks ahead of programme. ●



KAYMAC