

Bridge by bridge

In the aftermath of Storm Desmond, Cumbria County Council faced a herculean task to rebuild its shattered infrastructure. The scale and urgency of the recovery programme called for a radical new approach to project and contractor management.

Project
Infrastructure Recovery
Programme

Location
Cumbria, UK

Client
Cumbria County Council

Expertise
Project, programme and
commercial management

In partnership with



Before and after
The original Pooley Bridge (below) stood for 250 years before it was completely destroyed by Storm Desmond



Reconnecting communities, rebuilding livelihoods

Unprecedented rainfall

The name 'Desmond' will forever be etched in the memories of the people of Cumbria. In December 2015, Storm Desmond brought unprecedented rainfall to the north-west of England. It was a 1 in 200-year flood event and Cumbria bore the brunt. In just 48 hours the county was deluged with 1.15 trillion litres of rainfall, enough to fill Wembley Stadium 290 times over.

Almost 8000 homes were flooded. The storm also impacted 2000 businesses, more than 600 farms and 300km of carriageways.

Nearly 800 bridges were damaged. Several stone-built river crossings, some of which had stood for hundreds of years, were swept away. In the storm's aftermath, businesses and livelihoods were badly affected and there was an urgent need to restore vital road links, reconnect cut-off communities and get the county moving again as fast as possible.

Given the scale and severity of the devastation, Cumbria County Council required support and increased capacity to plan and manage the rebuilding of Cumbria's shattered infrastructure.

This was not just because of the huge number of individual works needed – more than 1200 in total, ranging from patch repairs to full reconstruction of highways, slopes, retaining walls and structures, culverts and bridges. Other

challenges included building temporary structures, restoring listed bridges of historical importance, dealing with the expanse and remote terrain of England's third-largest county, and restricting in-river construction activities to just 15 weeks of the year (in keeping with legislation to safeguard fish passage).

"The recovery programme was not beyond us in terms of engineering ability but its size, scale and complexity was," says Nick Raymond, head of

infrastructure recovery and major programmes, Cumbria County Council.

"The programme would more than double the size of our capital programme and our business as usual resource model just couldn't absorb such an increase in scale. We knew we would need additional project, programme and commercial management capacity and skillsets."

Cumbria County Council joined forces with Mott MacDonald to plan and deliver what would

become known as the Infrastructure Recovery Programme (IRP).

The objective for this four-year £123.6M programme was "to provide resilient reinstatement of Cumbria's infrastructure back to full functionality in the most efficient and effective manner".

Integrated team

“The first task was the creation of an integrated team, working out of a single hub, to deliver the programme,” says Mott MacDonald’s David Brown, IRP programme director. “All the IRP’s personnel were appointed on a ‘best athlete’ basis, regardless of whether they worked for Cumbria County Council or Mott MacDonald.

He adds: “We knitted together into a seamless team working as one unit. If you walked around our office, you wouldn’t know who worked for who.”

Nick Raymond says: “The 36-strong IRP team is split more or less equally between the two and combines the council’s intimate knowledge of its assets, communities and stakeholders with

Mott MacDonald’s rigour and fresh thinking on programme management and project delivery.

“The council has also played an ‘intelligent client’ role, providing strong leadership, not only in the command and control sense, but in terms of ensuring the behaviours of everybody in the team are aligned with delivering the programme’s outcomes.”

Nick adds: “The level of commitment from everybody on the team has been absolutely phenomenal. I was a victim of the flooding, so were many other council staff. For us it was personal.

“The non-Cumbrian members of the team from Mott MacDonald also displayed that personal level of commitment, and this really drove the programme forward.”

The programme was divided into five portfolios: core surfacing; major civils; major bridges; minor bridges; and other works.

Each portfolio is managed by a dedicated commercial team who are supported by key support services and cross-functional capabilities that run across the whole of the programme.

784
bridges damaged
or swept away

“The 36-strong IRP team combines the council’s intimate knowledge of its assets, communities and stakeholders with Mott MacDonald’s rigour and fresh thinking on programme management and project delivery.”

Nick Raymond
Cumbria County Council

Stopgap solution
A temporary Bailey bridge was erected at Pooley Bridge to keep communities connected



Bridge inspections

Members of the IRP team assigned to bridge repairs compiled a list of all the bridges that had been damaged by Storm Desmond. This included bridges that had either collapsed, been closed, or remained open but had sustained damage requiring remediation. The work involved 1600 individual surveys and inspections of roads and structures.

Each bridge was visited by suitably qualified and experienced bridge engineers who ranked each asset's priority, based on engineering assessments, on a scale from one to five:

Priority 1 Red assets – structures closed or lost during the flooding.

Priority 2 Amber assets – structures that following inspection required works to structural elements within three months.

Priority 3 Amber assets – structures that could either not be fully inspected or required works to structural elements within six months.

Priority 4 Amber assets – structures that required minor repairs.

Priority 5 Green assets – structures unaffected by the floods.

Crucially, the scoring took into account the socio-economic impact on towns and villages left isolated by the loss of transport links.

“We understood what was important to the connectivity of Cumbria,” says Nick Raymond.

“The closure of the A591, an important link road for local traffic and for tourists travelling to the Lake District, was alone costing the regional economy an estimated £1M a day. Reopening this link was clearly a high priority.

“The closure of Hall Beck Bridge in the south of the county only affected the residents of 12 remote properties. But the loss of the crossing had such an adverse effect on this rural community that repairing it was deemed a priority too.”

Each asset, or group of assets, was scoped and budgets allocated, with an agreed level of contingency and risk monies to deal with any changes, such as the discovery of damage not evident from the site inspections, which were conducted in early 2016 when river levels were still high.

Structural inspection
Engineers checking for scouring damage at Lazonby Bridge



1600

individual site surveys and inspections conducted of roads and bridges

Delivery community

David Brown says: "The scale and urgency of the programme prompted us to conclude that there was no place for traditional contracting and procurement methods.

"We drew up a blueprint for working with the local supply chain which would move us away from a conventional client-supplier transactional relationship to a more collaborative one based on common goals and aligned behaviours."

To date more than 70% of contracts have been awarded to Cumbrian suppliers, providing a valuable boost to the county's economy and increasing the programme's added value.

394
total jobs

305
direct

89
indirect and induced

£18M
total GVA

£14M
direct

£4M
indirect and induced

£71M
spent in the first 2.5 years of the Infrastructure Recovery Programme

£44M
worth of contracts awarded to local suppliers

70%
of contracts awarded to local suppliers

How IRP is contributing to Cumbria's economy and supporting jobs and businesses in the local and regional supply chain

Local supply chain

Having a predominantly in-county supply chain has helped win over hearts and minds. The IRP team has made the most of this emotional commitment to build a 'delivery community' that not just works together but learns together.

"Regular supply chain events and workshops are used to share learning, innovation and best practice," adds David. "Contractors are happy to share ideas with each other, for example, on how to improve worksite health and safety."

Mott MacDonald's Ian Rowley, IRP programme delivery manager, says: "The IRP's project managers have broken with convention and embedded themselves within the supply chain. They consult suppliers on key decisions and encourage them to put forward their own suggestions of how best to deliver the programme.

"They have embraced thinking from the supply chain that has ultimately led to greater alignment between themselves and contractors, streamlining processes and creating efficiencies."

An example of this is the bundling of assets and schemes into work packages. With a fast-track programme, the IRP team knew they would have to think of an innovative way to bundle schemes together; the traditional approach of awarding contracts individually to different contractors would simply have taken too long.

Awarding one contract for multiple projects, covering as many as 70 assets in some cases, has made the procurement process more efficient. It also provides the supply chain with a larger, more meaningful scope of work, allowing them to plan and deliver projects more efficiently and effectively compared to undertaking them one by one.

Another area of innovation is the use of geographic information system (GIS) based planning. Schemes that were similar in terms of complexity, geography, scope and scale were clustered using GiGi, Mott MacDonald's cloud-based GIS asset management system.

Rebuilding Cumbria, bridge by bridge

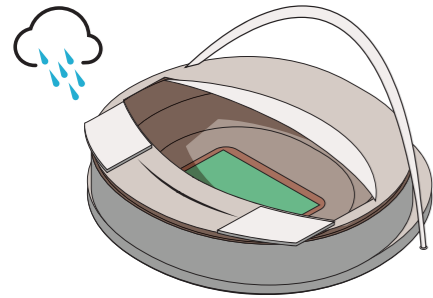
Storm Desmond

In December 2015, Storm Desmond brought exceptional rainfall to the north-west of England. In Cumbria thousands of homes and businesses were flooded. Across the county 784 bridges were damaged or swept away.

Infrastructure Recovery Programme

Four-year £123.6M programme headquartered in Carlisle and co-managed by Mott MacDonald and Cumbria County Council.

1 in 200-year flood event



1.15 trillion litres of water fell over 48 hours, enough to fill Wembley Stadium 290 times over.

1 Brougham Old Bridge



- Near total loss of Grade I listed structure built in 1812
- Returned to 17.5t loading and reopened in December 2017
- Long-term resilience added to structure
- Reconstruction sympathetic to historic design

Fast-flowing rivers

The biggest risk to Cumbria's bridges is scouring caused by fast-flowing water in its rivers. The River Caldew falls some 600m in just 64km from source to sea. River flows increase rapidly after heavy rainfall.

Record rainfall

During Storm Desmond, 34.1cm of rain fell in 24 hours at Honister Pass in the Lake District – the highest rainfall ever recorded in the UK.



Reconnecting communities

The reopening of economically important transport links such as the A591, a key route for local traffic and tourists, was a high priority for the recovery programme.

2 Bell Bridge



- Total loss of Grade I listed structure built in 1772
- New bridge opened in December 2017
- Advanced design improves river flows
- Significant use of reclaimed stone

Yorkshire Dales National Park

3 Pooley Bridge

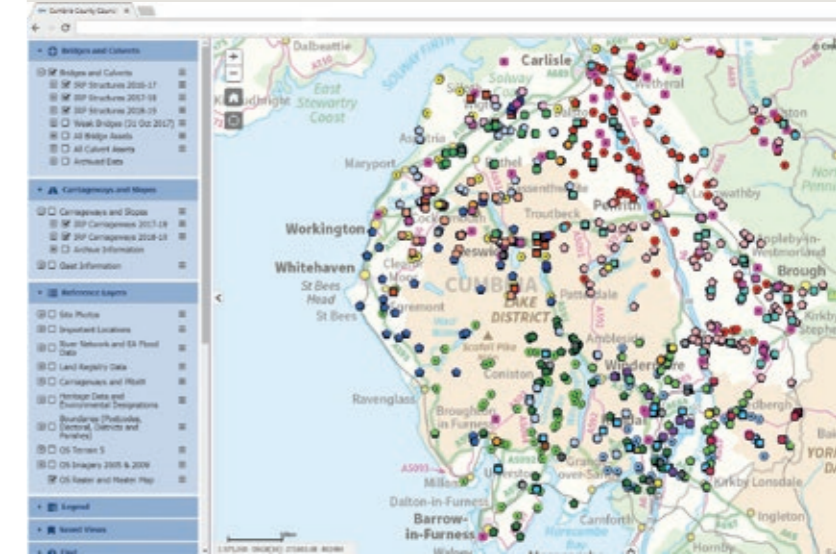


- Total loss of Grade II listed structure built in 1764
- Temporary bridge erected to maintain vital road link
- Wide-ranging stakeholder consultation on new design
- Single-span bridge due to open in 2020



Resilient design
The new Bell Bridge has a designed working life of 120+ years

The truth and nothing but...



GiGi enables multidisciplinary teams working on infrastructure projects to view, edit and interrogate the same real-time information.

Information is maintained and retained over time, so during the lifecycle of the project a single source of truth is created that can be accessed, referenced and audited as required.

The system ensures collaborative working through access to data covering every project discipline through each phase of the project lifecycle.

For IRP, GiGi brings together multiple data sources – including from surveys and inspections, and on land ownership, river levels and temporary traffic regulation orders – to aid co-operation and communication.

Information can be accessed anywhere, anytime and by anyone with clearance and internet access, making it possible for IRP personnel and contractors to access and record data when out in the field.

Cumbria County Council is one of the first public authorities in the UK to benefit from a GIS tool with this capability.

Contracting strategy

The IRP team devised a contracting strategy based predominantly on design and build, and the NEC3 suite of contracts.

NEC3 is the third edition of a family of standard contracts unique in offering a complete end-to-end project management solution for the entire project lifecycle, from planning, defining legal relationships and procurement of works, all the way through to project completion, management

and beyond. Originally created by the Institution of Civil Engineers, the first 'New Engineering Contract' or NEC was published in 1993. The core principle of NEC contracts is that collaboration is the key to successful project delivery.

"The design and build approach was a new way of working for those members of the supply chain who had only previously worked as subcontractors to main

contractors," says Ian. "They were asked to manage the design because it would unlock opportunities for them to get involved in projects at an early stage, reducing the risk of over-engineering, and promote the collaborative ethos which is such an important element of the IRP."

In the first year of the programme, the focus was on cost-reimbursable contracts (NEC3 ECC Option E), which were more appropriate as

the maturity of the engineering information was both technically and commercially inadequate. "This was considered key to getting on site in the first year and starting work without delay by creating an environment for the supply chain to really drive delivery, be creative with their solutions and accelerate the number of assets returned to service," continues Ian.

Later works had more definitive design and build scopes, and so it

was appropriate to switch to Option C contracts, and subsequently Option A contracts.

Option C is a target-cost contract where the financial risks are shared between the client and the contractor. Under Option A, the risk of carrying out the work at the agreed price is largely borne by the contractor.

1234

individual repair works identified

Procurement strategy

The programme pioneered a new procurement strategy, known as progressive asset release (PAR). This involves the procurement of packages of work where a large volume of the work still has to be fully scoped to make it commercially acceptable to the supply chain.

“An entire works package would be put out to tender, making allowances for individual asset scopes that were not fully designed and engineered,” explains David Brown.

“These assets would be progressively released into the resulting contracts via compensation events or new contracts as appropriate when they were at a suitable level of maturity.

“This process used the existing contract mechanics, meaning there were no heavy legal amendments or redrafting to be undertaken. This saved time and ensured our supply chain readily understood how to operate the contract.

“By enabling contractors to tender for complete packages in this way, we cut tendering and procurement costs, obtaining better value for money.

“PAR has not only generated time and resource savings of up to 30% during both pre- and post-contract stages, but also provided a greater platform for the supply chain to grow organically, something we are keen to support.”

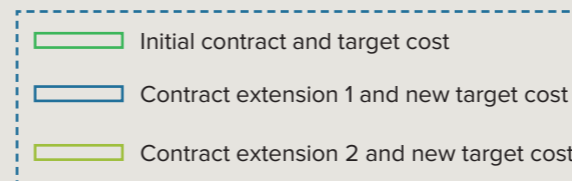
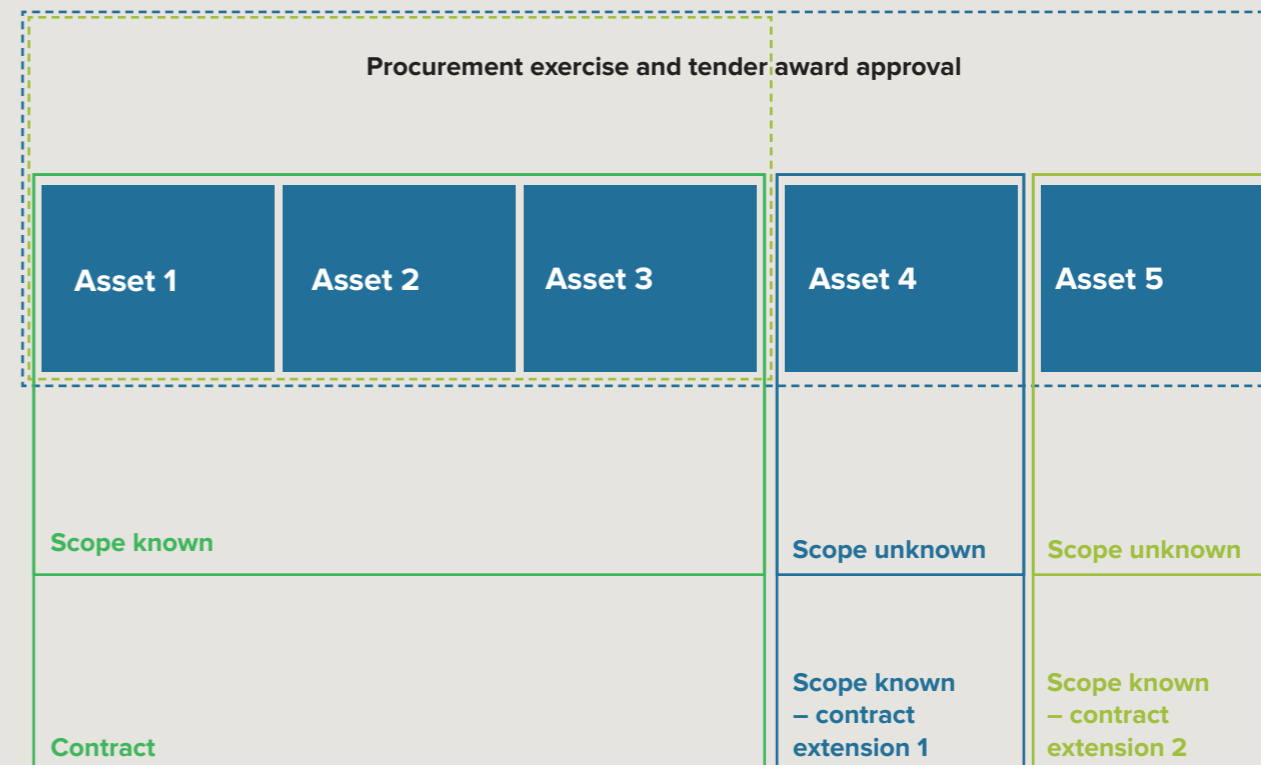
“PAR has not only generated time and resource savings of up to 30% during both pre- and post-contract stages, but also provided a greater platform for the supply chain to grow organically.”

David Brown
IRP programme director

4%

of Cumbria’s 7900km highway network, around 300km, will be resurfaced under the IRP programme

Progressive asset release – how it works



Progressive asset release (PAR) significantly reduces the volume of procurement activity for schemes within a works package that are not all at the same level of design/engineering and/or commercial maturity.

How PAR works:

- Works package for multiple assets put out to tender
- Includes works not fully designed and engineered
- These assets are released as they are scoped
- Original works package seamlessly incorporates contract extensions and new target cost

The PAR strategy, along with design and build and NEC3 contracts, represented a steep learning curve for the supply chain.

“During the first live projects, the IRP’s commercial team would sit down with contractors to explain their thinking and methods, ask them where any stresses and strains were, and offer close support and guidance,” says Ian Rowley.

“All parties were open and honest with each other and this has created stronger working relationships.”

David Brown adds: “This story isn’t one of revolution. Rather, it’s been an evolutionary step-by-step shift in thinking that has captured hearts and minds.

“In most project or programme delivery environments, you can use formulas and tools to calculate risks; the same cannot be applied to behaviours.

“Our actions and planning have been well-thought through, but the anticipated response from the supply chain was largely a moral leap of faith on our part.

“They did respond as we hoped and I believe the IRP has broken new ground with this level of behavioural engagement, which runs like a golden thread throughout the whole programme.

“This behaviour-based approach has generated a high level of industry interest and we have been asked to speak at conferences and write technical articles about it, which we are happy to do to promote shared learning.”

Restored to glory
The reconstruction of Brougham Old Bridge was in keeping with its historical importance

Increased resilience

The emergency funding Cumbria County Council received from the UK government was essentially to cover the cost of like-for-like replacements. Where possible, however, opportunities have been taken to improve the long-term-resilience of bridges and introduce flood alleviation measures.

The biggest risk to Cumbria's bridges is scouring caused by fast-flowing water in its rivers. The River Caldew, for example, is 64km long but falls some 600m; the Thames, by contrast, is 329km long and falls 106m from source to sea.

Training walls were introduced at some locations to alter river flow behaviours, thus improving scour protection to the foundations of abutments. At other sites, a combination of scour bags and rock rolls have been used to 'fill' scour gaps and provide added protection.

Other resilience measures include improved drainage and strengthening arches with concrete saddling, as with Brougham Old Bridge, a Grade II listed structure, built in 1812, which came close to collapse.

Improvements were subject to value engineering, examining, for example, whether rock armour could provide the same level of protection to abutments as a full concrete invert.

On complete bridge replacements, project managers worked closely with stakeholders, such as the Environment Agency and lead local flood authorities, to include flood modelling in the design process.

Pooley Bridge, a total loss and one of the gateways to the Lake District, had held back water entering Ullswater, England's second-largest lake. The need for a structure with an improved hydraulic performance informed the choice of designs for the new bridge.

Similarly, the replacement for Bell Bridge, a hump back bridge built in 1772 that collapsed in the storm's wake, has a 17% larger under-bridge area to improve river flows.



Lasting legacy

At the time of writing (September 2018), the Infrastructure Recovery Programme was more than halfway to its objective. Essential infrastructure, vital to the economic and social wellbeing of the county's predominantly rural communities, is being restored and returned to service quickly and cost-effectively.

Out of 784 bridge repairs needed, from pointing to total rebuilds, 278 have been completed and 264 are in progress, leaving 242 still to do. Among other works, 4% of Cumbria's roads will be completely resurfaced by the programme's end.

Stephen Hall, assistant director for highways, transport and fleet at Cumbria County Council, comments: "The Infrastructure Recovery Programme would have taken at least five years instead of four if we had not brought Mott MacDonald on board.

"Their experts devised the contracting strategy which enabled us to get repair works started quickly while still meeting our financial due diligence requirements.

"This strategy will be one of the programme's lasting legacies, along with an upskilled local supply chain with which we have established an intrinsic level of trust and co-operation.

"The IRP will also serve as model for rigorous, collaborative and cost-effective project management across the whole of the council.

"We are a better, more capable authority as a result of the programme, which has improved the resilience of Cumbria to withstand and recover from future extreme weather events."



Design consensus
The form of the new Pooley Bridge was chosen after extensive consultation with the local community

"The Infrastructure Recovery Programme would have taken at least five years instead of four if we had not brought Mott MacDonald on board."

Stephen Hall
Cumbria County Council



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Cumbria Sub-regional Project of the Year



North West Regional Construction Awards
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