

# Predict, prepare and protect

Smart, sustainable  
solutions to manage  
rivers, mitigate flood  
risk and increase  
climate resilience





# Understanding the challenges you face

Flood events and climate shocks are increasing in frequency and severity as global temperatures continue to rise.

**Cost-effective, practical solutions**

The consequences of extreme weather can be devastating and reported losses are rising. Businesses, governments and organisations worldwide are suffering long-term harm to assets, productivity, service provision and reputation.

Compounding climate change are increasing pressures from population growth, ageing infrastructure and financial constraints. Service providers and asset owners and operators are expected to do more with less, providing greater flood protection to more people, but with proportionally less investment.

Not all floods can be prevented and you can't just keep building higher walls. Clients need solutions that are cost-effective, practical, environmentally sensitive and sustainable, combining soft and hard engineering and addressing the social dimensions of flood risk too.

Our expertise and experience in whole catchment management, natural flood management and infrastructure resilience can help you tackle these challenges.



**Addressing cascade failure**

Disruption in one sector can have diverse, far-reaching consequences if a failure cascades through others. More frequent, intense and enduring extreme weather events, such as flooding, will increase the risk and the level of such failures.

We will identify weak points and, if they cannot be eliminated, develop a contingency plan and build redundancy into the system to limit the extent of cascade failure and maintain continuity of services even during worst-case climate events.

**Close collaboration**

We will work closely with you to gain an in-depth understanding of your specific challenges, the political and business environment you operate in, and the needs of your stakeholders and end users.

As an employee-owned company, we have the freedom and independence of mind to seek out new, innovative ways of solving complex problems.

Smart technologies will extend the working life of existing assets by making systems adaptable and more responsive to weather warnings, and achieve better utilisation of space and storage capacity outside flood events.

Building information modelling (BIM) improves product quality, cuts waste and carbon, and makes it possible to integrate design and construction teams, realising significant savings in time and programme costs. We can also make your investments work harder through value engineering and whole-life cost analysis.

Our teams are equally skilled at developing solutions that work with natural processes to improve the quality and biodiversity of rivers and wetlands.

**End-to-end service**

We collaborate with others in our clients' supply chains, harnessing our collective skills and ingenuity to forge delivery models that provide end-to-end service and support.

The way we work is characterised by seeking continuous improvement, building integrated teams, fostering long-term relationships with clients, developing a sense of shared ownership, and adding value wherever and whenever we can.

Work with us and you will be able to plan and design infrastructure with inbuilt resilience, introduce robust operational and management practices, and prepare effective contingency and disaster plans.

We cover all aspects of river and flood management. Our specialist teams will help you to:

- Predict and prepare for flood events
- Protect critical infrastructure from extreme weather
- Manage flood risks better and more cost-effectively
- Improve emergency planning
- Recover more quickly from climate shocks
- Prolong the effective life of assets
- Achieve greater returns on investment
- Enhance the landscape and preserve natural habitats



# Delivering landmark projects to meet complex challenges



### River engineering skills

Across the globe, in rural and urban areas, and in all kinds of terrain, our multidisciplinary teams have designed and delivered a wide variety of river engineering projects: diversions, river training works, scour protection at bridges, river amenity improvements, river flow gauging stations, flow control structures, flood storage reservoirs and tidal barrages.

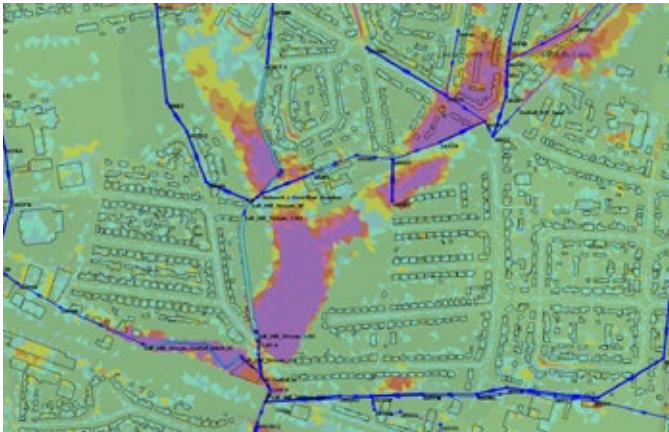
We combine hard engineering skills with expertise in BIM, hydrology, hydraulic modelling and natural flood management (including environmental assessment and landscaping) to provide clients with a fully integrated flood risk management service.



### Coastal protection expertise

Engineering a successful coastal project to protect infrastructure and communities requires an impressive battery of analytical, design and technical skills, covering everything from coastal processes and geomorphology to hydraulics and logistics, and we can provide them all.

Our knowledge of shoreline protection includes beach and dune nourishment, evaluation of sea level rise and storm impacts, ecosystem enhancement, marsh creation, and the optimisation of waterways and harbours.



### Innovative flood modelling

We are a leading developer of improved mapping techniques that better inform our clients of the risks they face from different flooding scenarios. Our work has included depth, velocity and hazard flood mapping under fluvial, surface water and tidal regimes, and complex breach analysis of flood defences and dams.

Flood risk maps can be produced cost-effectively by integrating flooding information with data on land use, population density and economic activity. Such maps enable authorities to make quick decisions, and support a consistent risk-based approach to sustainable development.



### Sustainable drainage systems

Within the water industry we have built up a solid track record for technical excellence in stormwater and wastewater network modelling which supports more effective flood prevention management.

This includes managing the interactions between surface water and sewerage systems, using sustainable urban drainage solutions to hold back rainwater run-off and allow it to soak into the ground, storing it for use, or releasing it slowly to reduce flood risk.

As one of the world's leading consultancies in flood risk management, we can call upon a vast array of specialisms and capabilities.

### We deliver world class engineering solutions by:

- Putting safety, well-being, equality and diversity principles first
- Creating sustainable solutions that provide social, economic and environmental benefits
- Promoting innovations, driving down cost and shortening programmes
- Making efficiencies to achieve more for less
- Ensuring stakeholder engagement throughout
- Providing whole-life asset management facilitated by building information modelling (BIM)
- Packaging projects together to create economies of scale



# Ground-breaking digital solutions

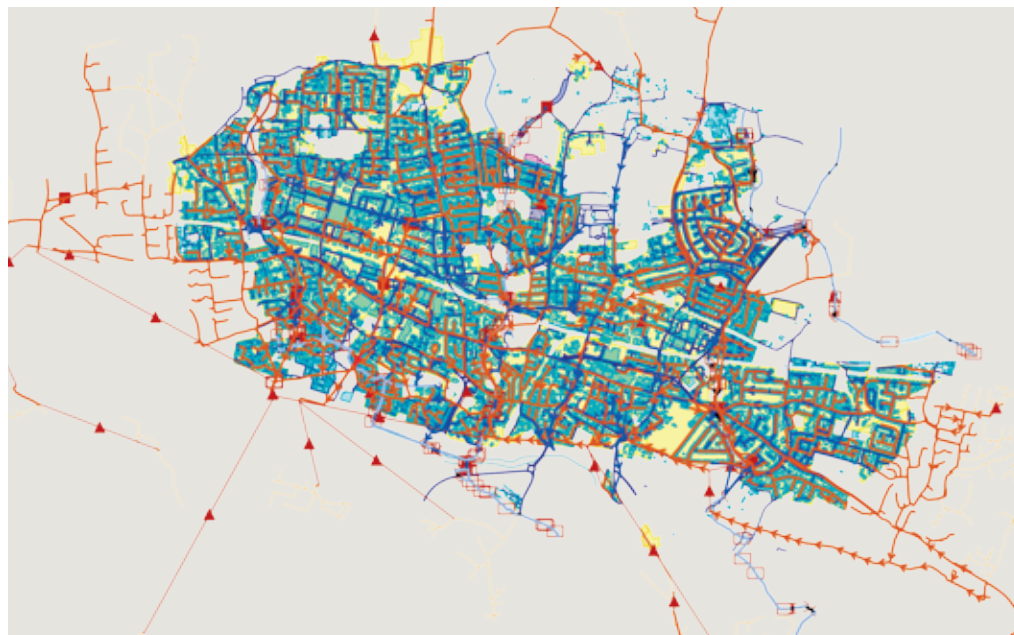
Digital technology has a key part to play in building resilience and we have been pioneering the development of new software tools to mitigate flood risk.

## Fast and accurate forecasting

It is not possible to eliminate the risk from storms, floods and tidal surges, but it is possible to predict and prepare for extreme weather events. We have developed a suite of bespoke digital tools that break new ground in flood forecasting and warning in terms of accuracy, speed and detail.

Our models convert weather forecasts into meaningful visual information that illustrates the potential consequences of flooding and storm surges, making it easier to understand where the impacts would be the most destructive.

By identifying areas at high risk of flooding, and giving time to take necessary preventive measures, our tools offer huge value in flood forecasting, flood warning, flood risk assessments and in flood defence development schemes.



## Our digital product portfolio includes:

### Real Time Coastal Flood Forecasting and Impact Visualisation Tool

Rapidly translates offshore forecast data into information that can show when and where overtopping of coastal defences could occur for a 200km stretch of coastline and the potential flood depth and hazard level.

### Water and Wave Overtopping Tool

Combines data on the type and condition of coastal defences with weather information, such as wind speed and direction, to calculate water and wave overtopping rates for dunes, sea walls, rock revetments and earth embankments for a range of tide and storm surge scenarios over any length of coastline.

### Receptor Analysis Tool

Displays the number of assets, properties and businesses that could be affected by flooding, and can generate a list of the postal addresses of potential flood victims.

### 3D Flood Visualisation Tool

A powerful tool for generating 3D flood visualisations and animations to communicate flood risk information in a format that can be easily understood by the general public.



## Get smart with infrastructure

Our H<sub>2</sub>knOw-how product comprises sensors installed at critical points of the water or wastewater network, collecting real-time information on flow rates, water levels and pressures. This is combined with core asset information and performance data sourced from BIM and geographical information systems (GIS) models, asset management systems, hydraulic models and external sources such as supervisory control and data acquisition (SCADA) systems and CCTV.

A powerful middleware application scrubs, analyses and cross-references data, creating an accurate visualisation of real-time performance. Asset managers are automatically notified of any anomalies in performance, and H<sub>2</sub>knOw-how can facilitate automated responses such as pipe closures or redirection for pre-defined incident scenarios.

H<sub>2</sub>knOw-how was developed to meet our clients' needs, and it can be adapted to meet your needs. Alternatively, we can build new systems specifically to meet your requirements and integrate them with your existing corporate IT systems.

# 10 ways our expertise can help you:

## 1.

### Have confidence that the flood risk is understood

Our industry leading expertise and robust governance maximise the confidence we have in our models and our understanding of the flood mechanism.

## 2.

### Predict how risk may change in future

With continuous improvement to the understanding of future climate predictions, we pride ourselves at leading how this understanding should be applied. We develop mitigation that can be adapted in the future, reducing the need for rebuilds for decades to come.

## 3.

### Improve sustainability

We can help you manage whole river catchments intelligently, developing sophisticated modelling to work out what can be done in each part of the catchment to minimise flooding. Natural flood management has relatively low operating costs compared with more traditional hard engineering schemes that add pressure on future maintenance budgets.

## 4.

### Plan investment wisely

Our models can help you plan infrastructure, ensuring new assets are built in safe locations, are able to withstand the effects of projected flooding events and don't exacerbate the effects of flooding on adjacent assets.

## 6.

### Increase resilience

Owners and operators can identify the vulnerability of their existing infrastructure to flooding, and then strengthen their assets to maintain continuity of services even during worst-case flood events.

## 7.

### Recover quickly

A city that survives climate shocks and achieves continuity of, or quickly restores, essential services will be more competitive and attract greater investment than rival cities. We have experience of building resilient new cities as well as improving the resilience of existing communities.

## 5.

### Build efficiently

We are experienced in delivering large infrastructure projects through BIM, which brings major efficiencies to the design process. You and your contractors will benefit from the reduced risk of redesign during construction.



## 8.

### Communicate effectively

Our modelling and 3D visualisation tools can be used to communicate the effect that flooding could have on a community, making a complex issue accessible to all. You can clearly show the impact your proposals will have both during and following construction, and enable stakeholders to be part of the integrated team.

## 9.

### Work with one supplier

Many river and flood projects require a range of specialists but you may not want to procure numerous contracts to achieve your goals. We can provide a one stop shop that will deliver your vision from one point of contact.

## 10.

### Find more funding

Within 20 years we estimate US\$200bn of investment each year will be needed globally to combat losses from climate impacts and there is a looming annual funding gap of US\$130bn. We have experience of identifying and mobilising additional funding sources and managing investment through a range of private, public, national and international funding systems.



# Tidal barrier will help regenerate region

**Project**  
Boston Barrier

**Location**  
Boston, Lincolnshire, UK

**Client**  
Environment Agency

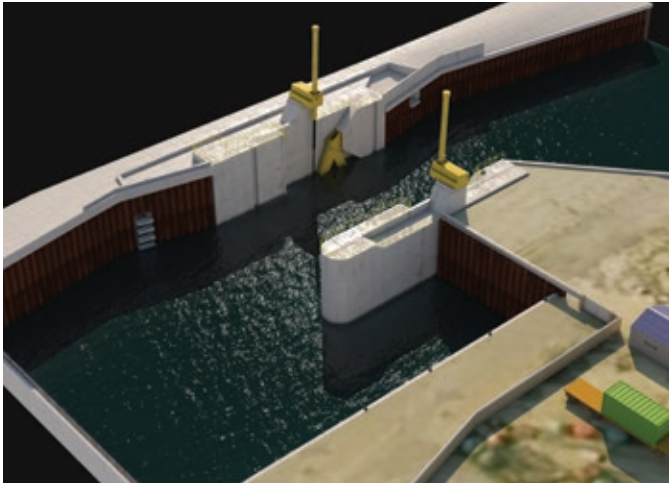
**Expertise**  
Project management, design, environmental impact assessment, hydraulic modelling, stakeholder management

**Opportunity**  
Recent severe flooding in Boston – in December 2013 over 700 homes were flooded – highlighted the need for better protection against tidal surges. Building a multifunctional barrier, a smaller version of the Thames Barrier, across the Haven was identified as the best way of reducing the risk of flooding to more than 14,000 properties. The Environment Agency needed a preliminary design sufficient to provide a robust cost estimate in order to obtain government consent for the project.

**Solution**  
We engineered the design of the 25m sector gate and associated operating machinery. Our hydraulic modelling, including computational fluid dynamics, identified significant cost savings. Our specialist team supported the design further by carrying out surveys which fed into environmental impact assessments. We also created 3D printed models, photomontages and a four minute animation that showed how the scheme would look in operation, which helped with stakeholder engagement and the consultation process.

**Outcome**  
The barrier is scheduled to be completed by December 2019. Boston will then be protected from a 1 in 300 year tidal surge event, even accounting for climate change, and giving the town one of the highest standards of protection against tidal flooding in the country. The barrier will also contribute to the long-term strategic aspiration of local authorities, contributing to economic regeneration in the town and region by aiding the future development of inland waterways, boosting tourism and improving connectivity between cities in the east of England.

14,000  
The number of properties that will be better protected against the risk of flooding



# Think water management is just about water? Think again.

**Project**  
Blue Gold

**Location**  
Bangladesh

**Client**  
Bangladesh Water Development Board and Bangladesh Department of Agricultural Extension

**Expertise**  
Technical advisory services

**Opportunity**  
Almost 40% of people in Bangladesh’s southwestern coastal region live below the poverty line and face food and water insecurity, and poor health. Their hardship is exacerbated by cyclones, storm surges, contamination of land and drinking water by salt water, droughts, river siltation and land erosion. Managing the country’s abundant water resources and fragile land are crucial to long-term development.

**Solution**  
The Blue Gold programme will stabilise an area of 115,000ha and ensure the safety of local people by strengthening dykes and clearing silt from drainage channels. We formed water management organisations (WMOs), a third of whose members are women, to give local people control over the work affecting their lives. These are complemented by Farmer Field Schools which equip people with training in horticulture and aquaculture, leading to better harvests.

**Outcome**  
The WMOs have empowered local people, establishing a democratic approach to water management interventions. The new skills taught to villagers have improved the quality and diversity of their produce, and the project has fostered strong linkages between them and the private sector, creating new streams of income, much of which is reinvested in the development of new farmland. Blue Gold’s greatest legacy will be the self-sufficiency of the area’s communities once the programme closes.





# Flood defence scheme wins over residents

**Project**  
Leeds Flood Alleviation Scheme

**Location**  
Leeds, West Yorkshire, UK

**Client**  
Leeds City Council

**Expertise**  
Civil and structural engineering, BIM, hydraulics, environmental and management services

**Opportunity**  
Leeds is sited in a catchment where river levels can rise rapidly in response to rainfall and the growing risk of fluvial flooding prompted the construction of extensive defences along a 4.3km stretch of the River Aire. Careful planning was needed to ensure residents were not inconvenienced and properties fronting the water, including many thriving businesses, were not needlessly demolished to make way for the new defences.

**Solution**  
Strong engagement with the community, including open days where specially produced videos were shown, helped to convince residents of the necessity of the scheme. We assessed the capability of waterfront buildings to act as part of the defences themselves by establishing whether they could withstand flooding and offer protection to the streets, homes and businesses behind them. The owners of these properties were only too happy to see them saved, and this innovative use of existing assets has cut costs. Besides linear defences, the scheme includes the installation of moveable weirs that can be lowered in flood conditions to reduce river levels, which will be the first of their kind to be used for flood defence in the UK.

**Outcome**  
The scheme will provide 1 in 75 year flood protection for Leeds city centre, 3000 homes, 500 businesses and 120ha of development land. It will give confidence to future investors in the city, opening up key regeneration opportunities in south Leeds, help safeguard 22,000 jobs over the next 10 years, and create 150 jobs and apprenticeships among other community benefits.



# River project makes region safer and more attractive



**Project**  
Room for the River

**Location**  
River Rhine and River IJssel, the Netherlands

**Client**  
Rijkswaterstaat (Ministry of Infrastructure and the Environment)

**Expertise**  
Technical and environmental studies, design and spatial planning, stakeholder management

**Opportunity**  
The Netherlands lie downstream of the major river catchments of the Rhine and Meuse. These rivers are prone to high discharges during the winter, leading to high water levels in Dutch rivers which are confined by increasingly higher dykes. Growing urbanisation means more people are living behind dykes while land behind the defences is subsiding gradually. In addition, rivers are expected to discharge a continually increasing volume of water due to climate change. Convinced that a totally new approach was needed to river management, the Dutch Government developed the Room for the River programme.

**Solution**  
We helped develop solutions to cope with increased river flows without increasing the height of protective dykes by dredging the IJssel and making use of low-lying open land by the Rhine to store and convey water. We supervised works at two sites: at Meinerswijk, which is the floodplain of the Rhine within the City of Arnhem, and along 22km of the lower River IJssel. Our experts were seconded to the executive branch of the Rijkswaterstaat to carry out hydraulic, hydrological and morphological studies, environmental impact assessments, design and spatial planning, and stakeholder management.

**Outcome**  
Completed in 2015, this programme provides flood control by allowing Dutch rivers to expand naturally during periods of high flows at 39 sites. The risk of potential damage and disruption to urban developments as a result of breaches in dyke defences has decreased. A wider benefit is improved environmental quality, increasing the natural and recreational value of the region.

39  
The number of sites where rivers are allowed to expand naturally during periods of high flows



# Sea wall will protect hundreds of homes and businesses

<b>Project</b>	Mantoloking Sea Wall
<b>Location</b>	Mantoloking, New Jersey, USA
<b>Client</b>	New Jersey Department of Environmental Protection
<b>Expertise</b>	Detailed engineering design, project management

**Opportunity**  
Out of adversity comes opportunity. In October 2012, a storm surge from Hurricane Sandy cut through the narrow section of New Jersey’s Barnegat Peninsula and flooded the streets of Mantoloking. All of the Borough’s 521 homes experienced varying degrees of damage, and scores of them were destroyed. Bulldozers were used to create and maintain artificial sand dunes as a temporary measure but residents would remain vulnerable until permanent flood defence infrastructure could be put in place, giving their homes greater protection than ever before.

**Solution**  
We provided assistance with the design, financing and construction of a 5.6km sea wall built from steel sheet piles, the largest of its kind in New Jersey. The project involved in-depth analysis of soil conditions, environmental impacts, anticipated wave conditions and materials to determine the optimum design. We worked closely with stakeholders to meet environmental constraints, provide the cost-benefit analysis needed to acquire funding, and ensure alignment with a long-planned beach replenishment project.

**Outcome**  
What was a particularly vulnerable section of the New Jersey shoreline has greater resilience against future severe weather events. The new sea wall is designed to withstand another storm of the magnitude of Sandy, offering protection to Route 35 and safeguarding hundreds of homes and businesses. The marine-grade steel used in the wall has a minimum lifespan of 75 years. If it stays buried in the sand, it should last for anything between 100 and 150 years.

5.6km  
The length of the sea wall

75 years  
The minimum lifespan of the wall





# A smarter way to manage flood risks



**Opportunity**  
Innovative ideas to unlock new sources of funding are urgently needed to address chronic global underinvestment in flood resilience. In order to generate a return on a major capital investment and attract investors, the central section of the dual-purpose SMART stormwater tunnel in Kuala Lumpur doubles up as a toll motorway, thus providing flood protection and alleviating traffic congestion.

**Solution**  
The 9.5km tunnel diverts floodwaters away from the confluence of the two major rivers running through the city centre while its central 3km section serves as a two-deck motorway to relieve traffic congestion at the main southern gateway into the city. Water can flow under the lower road deck without disrupting traffic flow in most flood conditions. Decks are sealed from the rest of the tunnel by sets of guillotine-style gates. But in the most extreme floods the road decks are shut to traffic and the cut-off gates opened, increasing the tunnel’s storage and conveyance capacity.

**Outcome**  
SMART was the first tunnel of its kind in the world and has saved central Kuala Lumpur from several potentially disastrous flash floods, preventing widespread business and domestic disruption. The landmark project has received international acclaim and numerous accolades for its innovation and ingenious design, including the UN-Habitat Scroll of Honour Award.

**Project**  
Stormwater Management and Road Tunnel (SMART)

**Location**  
Kuala Lumpur, Malaysia

**Client**  
MMC Engineering Group-Gamuda JV

**Expertise**  
Feasibility, detailed design, engineering support, construction supervision, specialist tunnel and hydraulic design services

# Keeping on track in Mozambique

**Opportunity**  
A 1200km heavy railway line was needed to connect the Moatize coal field with the port of Nacala in Mozambique. Our river engineering specialists were tasked with developing the outline design for the cross-drainage of the line.

**Solution**  
To design the cross-drainage structures, the locations of all 2500 watercourses crossing the route of the line were identified using data collated from bathymetric, reconnaissance and other types of surveys. Our engineers carried out studies of the local climate conditions, statistical analysis of rainfall run-off processes, scour analysis and hydraulic modelling to determine peak flood levels for a range of scenarios to optimise crossing sizes. We also sized the main hydraulic structures and floodplain provisions, and identified the requirement of river training works to prevent lateral movement of rivers and protect rail embankments.

**Outcome**  
By optimising the alignment of the railway, we eliminated the need for tunnelling and reduced the number of bridges and viaducts, cutting costs and enabling faster construction. We added value by efficient liaison between the different disciplines in our project team and maximised the efficiency of the river crossings to provide a more cost-effective solution for ENRC.

**Project**  
Nacala Rail and Port

**Location**  
Mozambique

**Client**  
Eurasian Natural Resources Corporation (ENRC)

**Expertise**  
Hydrology and hydraulics (including all aspects of railway, station, port and bulk handling design)







One of the region’s most important transport links will be more robust in the face of extreme weather of increasing severity and frequency.

**Project**  
Western Route Geo-Environmental Resilience Study

**Location**  
Devon, UK

**Client**  
Network Rail

**Expertise**  
Hydrological and hydraulic modelling

# Modelling solutions to keep the trains running

**Opportunity**  
Since 2000 the railway line that connects the south west of England to the rest of the UK has been closed for lengthy periods due to severe flooding, causing widespread travel disruption and costing the regional economy millions of pounds a day. We are delivering a programme of works to improve the line’s resilience in its five most vulnerable locations between Exeter and Newton Abbot in Devon.

**Solution**  
Our multidisciplinary team is developing practical solutions to a diverse array of flooding issues: fast-flowing river flooding, standing water and wave action, rainfall run-off, groundwater flooding combined with overland flow, and overflowing aqueducts. To improve forecasting and warning thresholds, we are evaluating flood prediction systems that maximise the use of Environment Agency river gauges, Met Office rainfall radar and existing lineside cameras. We are also looking for opportunities to improve flood conveyance not just within Network Rail land but across the wider hydrological catchment, co-ordinating with other flood management schemes, for example, to remove weirs and improve culverts.

**Outcome**  
We are developing cost-effective, sustainable flood resilience solutions despite challenges posed by the historic location of the railway line on the floodplain and predicted increases in rainfall and river flow with climate change. One of the region’s most important transport links – essential to connecting communities and economic growth – will be more robust in the face of extreme weather of increasing severity and frequency.



## Engaging with the local community



### Opportunity

The brook that runs through the residential suburb of Rhiwbina in Cardiff is prone to flash flooding during heavy rainfall. A spate of flood events triggered investment in new defence measures and we were engaged to design and supervise construction of a robust, sustainable solution which took into account the sensitive nature of the local conservation area as well as environmental and ecological issues associated with the watercourse.

### Solution

The scheme consists of a range of hard and soft engineering defences along the upstream section of the brook and we have steered the project from the feasibility stage to construction. We used our expertise in hydraulic flood modelling and BIM to optimise the positioning of flood defences, which concentrated works on seven distinct areas, minimising disruption to residents, and leading to an environmentally-conscious design that was aesthetically acceptable to property owners and the local community. There was extensive community engagement throughout the project.

### Outcome

The scheme will contain fluvial flooding up to a 1 in 100 year event (plus allowance for climate change) and increase capacity and flow within the brook. Gravity-fed systems, removing the need for pumps, and construction of earth embankments, instead of retaining walls, reduced costs and lowered the scheme’s carbon footprint.

<b>Project</b>
Rhiwbina Flood Defence Scheme
<b>Location</b>
Cardiff, UK
<b>Client</b>
Cardiff City Council
<b>Expertise</b>
Civil engineering, flood modelling, geotechnical engineering, landscape architecture, ecological services, arboricultural surveys, archaeological assessment

## Better weather forecasts on the radar

### Opportunity

Gathering and analysing information on the timing and location of extreme rainfall is one of the most important aspects of stormwater flood management. In most urban settings in New Zealand, city authorities make use of rain gauges to understand rain events but it is difficult to know if the heaviest rain has fallen on a rain gauge or elsewhere in a catchment. Auckland Council, serving an area with extremely high rainfall variability, identified a need for more accurate short-term rainfall forecasts to support customer requests for service, emergency flood management operations and predictive hydraulic modelling.

### Solution

We further developed our existing operational rainfall radar platform and incorporated a short-term (0-2 hours) nowcasting service for Auckland Council. Nowcasting takes in real observations of approaching rainfall and, by estimating direction and velocity, predicts where rain is likely to occur, allowing more accurate estimates of potential flooding issues. The system will be hosted on our H<sub>2</sub>knOw-how web platform, which will allow easy access for any authenticated stakeholder to all radar data generated both in real time and retrospectively for post-event reporting and planning models.

### Outcome

Access to complete, continuous and consistent rainfall radar data across the region will assist in managing day-to-day operational issues and support Auckland Council’s real-time response to major flooding events, helping it to inform customers and mobilise ground staff as required. In addition, the system’s ability to archive data will provide significant benefit when analysing historic events for long-term strategic flood risk management and prioritising investment in large-scale capital infrastructure projects.

<b>Project</b>
Rainfall Radar
<b>Location</b>
Auckland, New Zealand
<b>Client</b>
Auckland Council
<b>Expertise</b>
Weather nowcasting, smart infrastructure, hydraulic modelling, software development



# 0-2hrs

The lead time of the nowcasting service



# Greening the streets of Philadelphia



## Opportunity

Like many older US cities, more than half of Philadelphia is served by combined sewers that carry both sewage and stormwater. Heavy rain or snow can cause combined sewer overflows to fill basements or discharge into local rivers through the city's 164 outfalls. A sustainable stormwater management plan was launched that would not only improve the city's ailing infrastructure but also support regeneration through green improvements to the urban environment and social fabric.

## Solution

Rather than build multimillion dollar tunnels to store excess stormwater, the Philadelphia Water Department decided to use eco-friendly techniques as part of an ambitious programme to make the city the greenest in America. We prepared final design plans and specifications for several projects including stormwater curb extensions, infiltration trenches that water trees with stored stormwater, and planters that collect drainage from the street. We modelled these and other stormwater devices, resolved constructability issues where new measures were to be built near existing structures, and optimised the designs to improve durability and maintenance.

## Outcome

The programme is reducing flooding, the number and volume of combined sewer overflows in the average rainfall year, and the amount of polluted run-off reaching sewers. In neighbourhoods, air quality is improved and streetscapes are more attractive, improving the quality of life for residents. Making Philadelphia a greener city is also attracting clean tech companies, creating jobs and improving economic prosperity.

## Project

'Green City, Clean Waters'  
Stormwater Management Plan

## Location

Philadelphia, Pennsylvania, USA

## Client

City of Philadelphia  
Water Department

## Expertise

Conceptual planning, field location surveys and mapping, geotechnical engineering, green stormwater design

The programme is reducing flooding, the number and volume of combined sewer overflows in the average rainfall year, and the amount of polluted run-off reaching sewers.



# Need help with a river or flood management project?

**Talk to:**

**Fiona Barbour**

Global water practice leader – Rivers and flooding  
fiona.barbour@mottmac.com

Opening opportunities with connected thinking.

For more information, search 'Mott MacDonald, Rivers and flooding'

**mottmac.com**