

New legislation has created a vision of a flood-resilient UK. But first we need to fill in a detailed picture of our drainage assets and flood risk problems. Simon Brightwell, a divisional technical head at geophysical investigations specialist, Fugro Aperio, looks at some of the tools helping to meet the data collection challenge.

Getting ahead in the data race

The need to collect and report data on drainage infrastructure and assets at risk of flooding to a national register was a key recommendation of the Pitt Review.

Now, this huge data-building exercise has been taken forward in The Flood and Water Management Act 2010. Flood management agencies, local authorities and operators of critical national infrastructure face huge challenges in tackling and funding it.

Nevertheless, judicious investment in geophysical surveys for informing flood risk assessment will be vital to the success of future improvements. By building a detailed picture of drainage networks, flood defences, coastal erosion, drainage networks, vulnerable structures, surface water run-off and flood mechanisms, we can identify priorities, design solutions that are right first time and make best use of funds.

The scale of data acquisition is tough enough, but there are also deadlines. The Flood and Water Management Act requires local authorities to submit risk management strategies by June 2011. In addition, under the European Union Floods Directive, they must complete a preliminary flood risk assessment by the same time.

In anticipation, geoscience specialists like Fugro have been honing their substantial global survey capabilities to provide flexible, multi-layered data solutions for mapping, monitoring and assessing flood risk, surface water hydrology and drainage networks.

Fugro's approach to data-building is based on a 'funnel' principle, starting with high level remote sensing techniques covering whole regions, and cascading down to targeted geophysical and geotechnical investigation on the ground. The broader view at the top gives the chance to identify crucial assets and weaknesses in the overall flood risk map for unitary territories – a county or substantial tranche of coastline. Working down the survey funnel, techniques can be deployed giving increasingly detailed layers of information for specific 'local' sites flagged as priorities – highway flooding, dike move-

ment, sea wall strengthening.

Providing the broadest view at the top of the 'funnel', Fugro uses satellite imagery to monitor movement of flood defences and other structures. Further definition is provided by airborne surveys either from fixed wing or helicopter platforms. With more than 50 aircraft equipped with a wide range of cameras and sensing technologies, the company has completed photographic, mapping, Lidar (laser imaging) and geophysical surveys in flood prone areas around the world.

As part of the Environment Agency's Strategic Regional Coastal Monitoring Programme for the South-East, Fugro-BKS is undertaking annual airborne photographic surveys of some 900km of coastline. The project is benefiting from the latest digital techniques to provide high resolution aerial photography and map-accurate orthophotography that can be overlaid on existing map information to monitor coastal changes. Modern digital aerial cameras also capture near infrared data simultaneously. This presents opportunities to apply the infrared band imagery for habitat and ecological mapping or to identify impermeable areas, thus helping to evaluate urban water run-off, key information for surface water management plans (SWMP).

Since 2006, Fugro-BKS has also acquired low level Lidar data for in excess of 3,500km of linear flood defences to help the Environment Agency to assess potential overtopping of river embankments. The data assists in the evaluation of the condition and height of the embankment and its ability to defend in the event of flooding.

When airborne Lidar was first accepted by the Environment Agency as a tool for generating embankment modelling data, resolution was in the order of 15 points per sq/m. Definition below 10 points could potentially miss a single thickness wall that may be acting as a water barrier. Now, at the same flying height, resolution in excess of 100 points per sq/m is possible – some 6 to 7 times better – achieving much greater modelling accuracy.

New technology will supply data with a vertical accuracy in



the range of +/- 3.5cm RMSE (root mean square error), crucial for determining, for example, if urban water run-off is likely to breach shallow structures such as a kerb. Traditionally 3D Lidar point clouds have been difficult to interpret. However, the Lidar data is now acquired using an integrated RGB colour line scanner that produces virtual

colour Lidar point clouds to facilitate interpretation by end users.

Surveys from the air provide only part of the picture.

Surveys at ground level, using ground penetrating radar (GPR), electromagnetic techniques or camera inspection, will be needed to fill in the gaps. These can yield inventory and condition data for drainage



assets, or will map moisture within road pavements or in unbound materials such as earth dams and levees.

A recent pilot drainage survey by Fugro Aperio for Devon County Council has highlighted the value of an integrated survey approach. The survey was commissioned to provide data to help identify the cause of localised flooding on the A377, to help the council's design team to evaluate remedial options.

Electromagnetic cable location (ECL) was used to map the drainage system and a CCTV inspection to report on its condition. A GPR survey of the carriageway was carried out to determine pavement construction and condition, and to map sub-base moisture. Topographic data were also supplied to enable planners to easily predict rainwater run-off patterns in relation to stormwater gully positions.

At the cutting edge of 3D mapping is a new 360 degrees, 3D laser scanning system from Fugro. Vehicle mounted, it travels at traffic speed recording high resolution photographic and 3D laser images, invaluable to the design of surface water drainage improvements.

The unintended presence of water within a structure can weaken materials, such as road or seawall foundations, or can be symptomatic of a problem such as leakage or failed drains. Fugro Aperio has invested considerable effort in rapid scanning, non-destructive technologies for mapping variations in subsurface moisture using a suite of electromagnetic methods. These can be towed behind a survey van and the results can enable cost-effective targeting of remedial measures.

The shift in focus under AMP 5 from new build to repair and maintenance is likely to prompt demand for geophysical condition surveys of existing assets, with flood risk among considerations.

Geophysical methods like ground radar could play a key role. These reduce the need for exploratory drilling and excavation in sensitive, water-retaining or listed structures, or in multi-functional structures, such as

coastal rail embankments acting as flood defence walls.

Compared to intrusive investigations, geophysical methods are simpler and quicker to establish on site and require less complicated access arrangements. They also reduce the risks associated with excavating unrecorded structures where buried services may be present.

The Pitt Review revealed that a significant proportion of recorded flood defence structures are owned by third parties, such as embankments or walls in private gardens. The logistics of access to these assets for inspection may well be difficult, making remote mapping from the air and non-destructive radar investigations attractive options.

While feeling is unified over the need to act on the gathering threat of floods, the agencies, council teams and infrastructure operators tackling the issues will have disparate data needs.

Specialists with broad, joined-up resources – integrating geospatial, geotechnical and geophysical capability allied to expertise in flood risk and water related investigations – can bring a valuable extra dimension to the national and local data reporting process that is building momentum.

Firstly, they are better equipped to undertake the daunting size of data collection – something few, if any, agencies or authorities could take on in-house. They also have a holistic understanding of how data sought by different project teams may interconnect, spotting opportunities to save cost, time and consultancy duplication by piggybacking surveys to meet wider needs. A well planned survey strategy that thinks outside boundaries for synergies with other flood-interested disciplines will deliver more accurate, meaningful and cost-effective data, and less waste.

Ultimately, timely investment in robust data will inform the design of effective flood risk mitigation and help reduce the crippling cost of repairs, insurance and liability claims that follow flood events.

Tel: 0870 6008050
www.fugro-aperio.com

Alternative funding sources needed

Future investment in flood defences will require greater contributions from communities and businesses, Environment Agency Chief Executive Dr Paul Leinster said recently.

Speaking at the Defra/Environment Agency Flood and Coastal Risk Management conference in Telford, Dr Leinster said that local contributions to the funding of flood defences will have to play a greater role in reducing the risk of flood and coastal erosion. His comments echo calls made by Sir Michael Pitt in his independent review of the summer 2007 floods.

Environment Agency spending on flood and coastal risk management is currently at record levels (£629m for 2010-11). However, other sources of funding will need to be found to protect communities from increasing risk of flooding and coastal erosion including from changes in climate in future.

Some communities have already adopted this approach and, with the assistance of the Environment Agency and Defra, increased levels of protection against flooding and coastal erosion. These include:

Hereford (Midlands region): Asda contributed £2m

as part of the planning conditions for a supermarket in the town, in addition to constructing 440m of flood defence. The total cost of the scheme was £7.5m and it provides protection to 196 properties including 25 listed buildings.

East Hanney (Thames region): Volunteers cleared weeds from a local brook, increasing the brook's capacity, and also constructed a flood defence bank and footpath. The Environment Agency provided soil, the hire of two mini-excavators and two dump trucks. The local authority paid for coir rolls used to help stabilise the new bank.

Bawsey (Anglian region): In 2007 a group of local landowners and residents formed the East Lane Trust to raise £2.2m to implement a coastal protection and flood defence scheme for a 250m section of coast. The money was raised by selling plots of land in nearby villages. In 2007, the government granted special permission to allow 26 homes to be built on the plots which were not previously available for residential development. The money raised was given to the District Council to commission a sustainable coast protection scheme which was completed in summer 2009.

Dr Paul Leinster said: "The Environment Agency has been given £629m by Defra to reduce flood and coastal risk this year, £21m more than last year. We are on track to reduce flood risk to 160,000 properties in England between April 2008 and March 2011 – exceeding our Government target for the period by 15,000.

"Whilst continued government investment in managing the risk of flooding is important, we must now also look at alternative funding streams, including increased contributions from those who will benefit from future

defence schemes."

Online service

A new service that allows householders and businesses to monitor rising river levels during a potential flood has been launched by the Environment Agency.

The service at <http://www.environment-agency.gov.uk/riverlevels> enables the public to monitor river and sea levels at over 1,700 locations across England and Wales. The data will complement personalised phone and text message alerts from the organisation's free flood warning service.