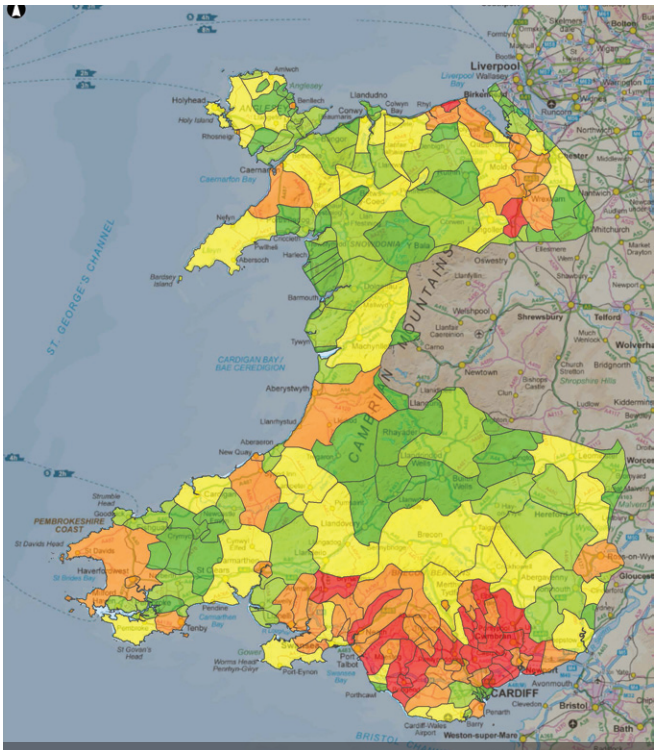
River Rangers

Dŵr Cymru Welsh Water launches a strategy to identify and reduce sewer pollution

by Rosemary Cripps BSc (Hons)

The number of pollution incidents from Dŵr Cymru Welsh Water's infrastructure assets has been consistently above target for the past six years. In order to improve this position, Welsh Water launched the Pollution Reduction Strategy which included the River Rangers project, the *See-it Report-it Stop-it* web-based application and the Predictive Pollution Reduction (PPR) programme. The Rivers Rangers project, managed by Arup, formed a critical part of this proactive approach to both identify and reduce pollution from Welsh Water's assets.



High priority areas for inspection were mapped. Red and orange denote high risk areas, yellow and green lower priority areas - Courtesy of Arup

The See-it Report-it Stop-it web-based application allows the public to report sewage pollution - Courtesy of Dŵr Cymru Welsh Water

Project background

Dŵr Cymru Welsh Water (DCWW) is responsible for approximately 30,000km of sewers across Wales. Approximately 1,650km of these are located in close proximity to watercourses. As these are often in remote and difficult to access locations, problems with the network may go unnoticed and potentially cause pollution and so damage the ecology and water quality within watercourses.

The pollution reduction driver follows on from the proactive long term approach set by Asset Management Period 5 (AMP5) in addition to Natural Resources Wales (NRW, formerly Environment Agency Wales) setting Dŵr Cymru Welsh Water a target to reduce the number of pollution incidents reported from 246 to 155 per year by 2014.

Water Quality is the main driver of AMP5, with a focus on trunk sewer structural deficiencies and catchment-wide solutions to prevent pollution.

As part of DCWW's £12.5m Pollution Reduction Action Plan, Arup were employed to design and manage a project to reduce the number of pollution incidents affecting the watercourses of Wales. DCWW invested over £500,000 in the first stage of the River Rangers project which ran from August 2011 to July 2012.

Targeting pollution hotspots

Firstly, data from the sewerage network was analysed by Arup in order to target areas of the network that were most at risk of polluting a water course should they fail. Survey prioritisation was based on the geographical locations of pollution incidents reported to Dŵr Cymru Welsh Water and the number of DCWW assets within 10m of a watercourse. The density of pollution incidents in each postcode and the number of at risk assets in each area were analysed and this informed a grading scale to prioritise problem areas.

Pollution hotspots were mapped using ArcGIS, with expert advice from DCWW and NRW teams further informing the priority of sites to be visited. This process ensured that the River Rangers were focused on areas that were most at risk of polluting watercourses.

When the high priority areas were mapped, a process had to be designed in order to record the huge volumes of asset data in each of these areas, assess them for pollution risk, structural failure and infiltration, and make that data available to operational teams within the business in order to remedy any issues found. The key requirements for collecting this data were that it must:

- Be efficient.
- Minimise office time processing data.

- Minimise the risk of data loss or photographs being separated from asset condition data.
- Be readily available to the whole business for follow up work.

Managing data collection

To collect the data, six teams, each consisting of two River Rangers walked the high priority areas of the sewer which were within 10m of a watercourse. Each team was instructed to inspect all the manholes and outfalls encountered, checking for defects, lifting the covers to look for evidence of siltation, ragging, debris and fat or previous surcharging of the assets. Survey teams were also asked to report any pipe crossings encountered detailing their location, ease of access, structural condition and warning sign requirements. All findings were photographed. Any ongoing pollution events such as ragging from a manhole or discolouration of the watercourse due to an outfall were reported by the survey teams to Welsh Water's Pollution Incident Advisor directly. The incidents were then dealt with in accordance with Welsh Water's procedures.

Effective data management

Effectively managing the huge volumes of data expected to be received from the 6 (No.) two man teams working full time over 12 months was critical. Approximately 350 photographs and associated data were collected per day from six different geographical areas. Luke Cooper, a GIS mapping and data management specialist at Arup, led the design of an effective process to structure all this data in the most useful format possible.

The Ricoh G700SE GPS camera was identified as having the most relevant features for recording project data. The camera's functionality allowed for a customised pro-forma to be created for capturing information. It automatically geo-tagged each photograph to within ±5m, including the direction of taking the photograph. It was also sturdy, waterproof and impact resistant which fully met the survey teams durability requirements.

The project team designed a pro-forma specific to the sewerage assets that would be encountered on site for teams to fill in, to collect essential serviceability and condition information. The main benefit of this approach was that when the pro-forma was filled in on the camera by the operator, it then attached automatically to each photograph taken, thus eliminating issues with mismatching data and photographs during the download and subsequent analysis of information.

A geodatabase was designed so that the photographs along with their associated data could be uploaded to ArcMap to display the information. The geodatabase includes a Google maps hyperlink for all assets so that users can link the assets to Google street view and forward the location to colleagues and operational teams who may not have ArcMap software.

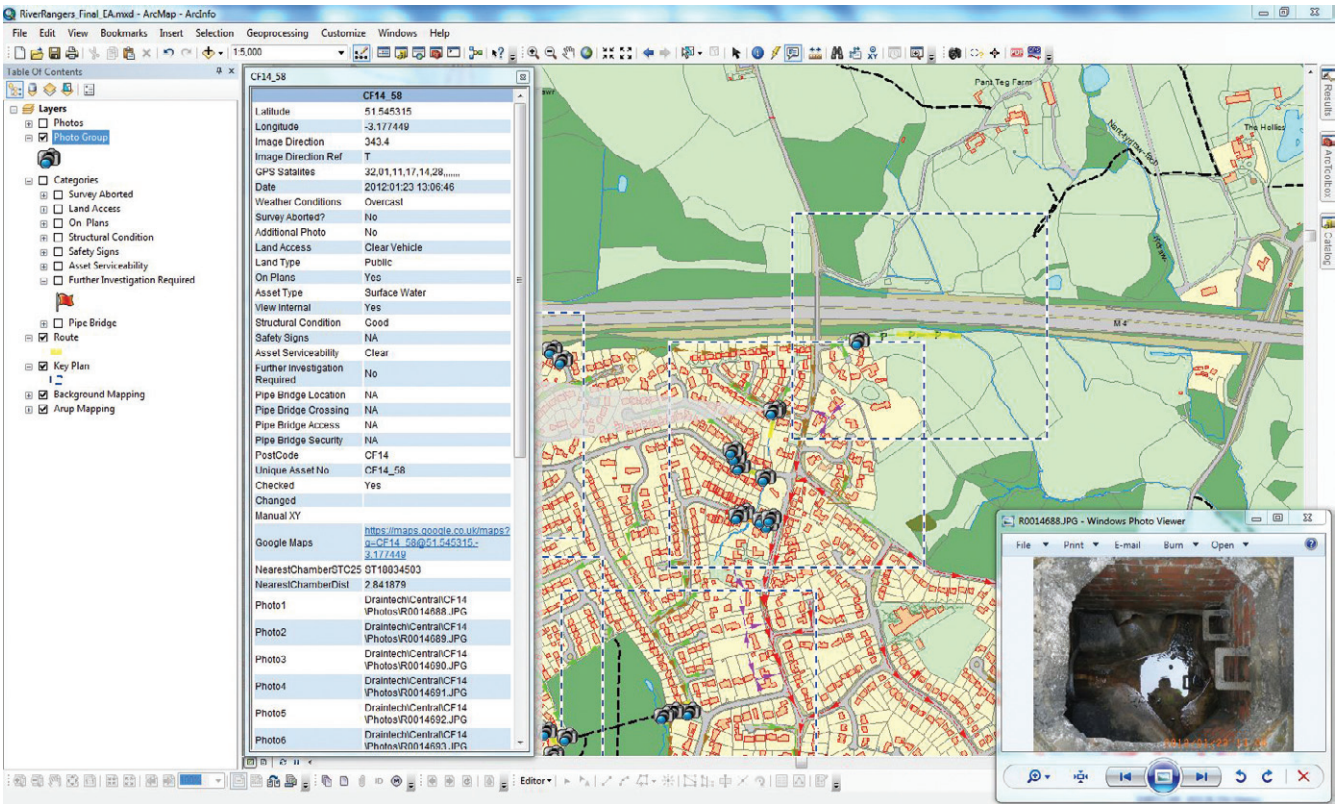
The collected data was regularly uploaded to the master geodatabase and displayed in ArcMap, with the resulting display making incidents easy to interrogate.

Working to improve the environment

During the project lifespan of one year, over 90,000 photos were taken of DCWW assets and all were recorded in the geodatabase. Many operational issues were identified and remedied by River Rangers before they had the potential to cause pollution. River Rangers checked over 1,200km of sewers in close proximity to watercourses on foot, self reporting 185 pollution incidents which were then resolved to prevent further occurrences. The project contributed towards Welsh Water meeting their pollution target set by OFWAT; failure to meet this target could have meant fines of up to £25 million payable by DCWW. Most importantly however, the resolution of these operational issues and sources of pollution will improve the long term water quality and ecology of the rivers of Wales.

Project development

Following this success, River Rangers 2 was commissioned in January 2013. This time the project was focussed more on specific areas; Trinity Horne Statisticians developed a detailed model to predict areas at high risk of polluting should the sewer become blocked. They also undertook a detailed data analysis project



examining the risk factors associated with sewer blockages and the attributes of those sewers that are likely to cause pollution if they do fail. Interestingly, analysis of pollution incidents that occurred during 2011 showed that a significant proportion of pollution incidents are caused by assets that do not have a history of previous pollution.

Trinity Horne used a statistical package to generate "decision trees" to identify the most statistically significant attributes that affect the risk profile of sewers. Each individual sewer on the network was assigned with a blockage and pollution risk to identify those at highest risk. River Rangers were then sent to survey assets at these more specific sites. As the problem areas on the network are further defined, the River Rangers' work becomes more targeted, therefore bringing down project costs and improving efficiency.

Improved technology

A review of the GPS camera and advances in technology resulted in Arup taking the decision to move to tablet devices to replace the GPS cameras, as they offer further advantages for collecting and processing data. As the tablets have both WiFi and 3G connectivity, the data collected on the tablet is uploaded to an Arup hosted Cloud in real time, which both saves the time which was previously used for weekly batch uploading and also allows the data to be reviewed immediately.

This is especially important if a pollution incident is encountered as the data can be sent directly to DCWW for investigation. River Rangers are now using the new tablets to collect data at specific high risk sites identified by the new statistical model.

A web-viewer was also developed in order to allow data to be uploaded more quickly, and to allow easier access to the data for Welsh Water employees.

Utilising available resources - engaging the public

Not only did Welsh Water want to increase the number of customer reported pollution incidents, but they also wanted to ensure that when the project came to an end there was a process in place which made it as easy as possible for the public to report pollution.

Arup came up with an innovative solution to this with the development of the *See-it Report-it Stop-it* web-based application. This allows the public to report pollution incidents, fresh water leaks and odours from their mobile or computer device. Geo-referenced information is sent instantly to Welsh Water for investigation.

River Ranger teams captured GPS tagged data on assets within 10m of watercourses - Courtesy of Dŵr Cymru Welsh Water

Benefits realised

The positive approach, successful data management and continual proactive development and utilisation of technology within this project has lead to:

- An increase in the number of self reported pollution incidents.
- The repair of assets with the potential to pollute in the future.
- The development of an enormously useful databank of assets adjacent to watercourses.
- The reduction in the number of pollution incidents.

It has also built on Welsh Water's understanding of the elements of the sewerage network most at risk of causing pollution incidents, thus enabling them to focus their rehabilitation works on the most at risk assets.

A targeted planned maintenance program is currently being developed though examination of the key data collected by the River Rangers such as pollution indicators (ragging, silt or debris) and the structural condition of the asset.

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