

Case Study – Hydrospatial

Charting the tidal Thames: Cadcorp SIS at the Port of London Authority

If you were responsible for seeing a 272 metre ship safely navigate the Thames Estuary and then dock at its berth several miles upriver, knowing that in places there is a mere 900mm between the ship's keel and the river bed, you would want to be pretty sure that your navigation charts were accurate and up to date.

That's precisely what the 90 or so Port of London Authority pilots have to cope with every day. They rely on charts produced by the Port of London Authority Hydrographic Service with the aid of the latest digital mapping and GIS (geographic information system) software to help them do it.

While everyone is familiar with the River Thames as a tourist attraction, fewer people are as familiar with it as a major commercial port.

In fact, the Port of London is the second largest port in the UK. It handles more than 52 million tonnes of cargo each year, including around 18 million tonnes of oil and oil products. Port activity comprises around 25,000 ship movements per year from over 70 operating wharves and cargo terminals along the river.

In addition to this massive cargo business, there is a growing requirement from the tourist industry for cruise liners to be able to navigate the Thames into Central London. To this end there are moorings in the Pool of London and at Greenwich.

The Port of London itself comprises the entire tidal Thames, from Teddington in west London, eastwards to an imaginary line across the Thames estuary between Margate and Clacton-on-Sea. Responsibility for public right of navigation and for conservancy of the river over this entire distance - some 140km - falls to the Port of London Authority (PLA), which owns most of the river bed from mean high water mark between both banks of the river. The PLA is the pilotage authority within this area and is also responsible for securing safety of navigation, oil pollution matters and structures and moorings placed in the river.

Going digital

To ensure that the Port of London retains its position as a leading UK port, the PLA continues to invest in services for its customers - i.e. everyone who uses the tidal reaches of the Thames. Key to these services is the on-going surveying and charting of the river bed and navigation channels to ensure the safety of vessels of all sizes which use the river for both



business and pleasure. This activity is the responsibility of the PLA's Hydrographic Service, which is based alongside the Thames to the east of London at Gravesend in Kent.

From here, the Hydrographic Service operates three survey craft. The 21m aluminium monohull "Verifier", and the 14m GRP construction, twin water-jet catamaran "Yantlet", cover the Thames Estuary and the river, while the new 8m launch "Galloper" is used for work close in-shore and in associated waterways.

During surveying, depth measurement is carried out by multi-beam echosounders (Reson 8101, 8125 and 7125) with 450 and 200KHz transducers, giving total coverage of the river bed. Positioning is almost exclusively by Differential Global Positioning System (DGPS), with the corrections being broadcast from an in-house reference station by VHF radio. All the data is logged and processed by Hypack® software, with tide reductions based on any of the 14 automatic tide gauges in the area. The reduced sounding data is then sorted for the appropriate scale and output as ASCII x, y, z data

Other data on real-world, physical objects, such as piers, jetties, moorings and buoys, and non-physical objects, like the navigation channel edges, is included in order to produce the navigation charts required by the PLA user community (pilots, harbour masters and licensing managers, etc).

While the production of navigation charts constitutes the main activity of the Hydrographic Service, it also undertakes engineering and environmental surveys and provides information to support the PLA's role in river conservancy (for example, details on the erosion and shoaling of mud flats and banks).

Before the digital system was put in place, all of the charts and maps produced by the Hydrographic Service were produced manually by tracing OS Land Line map features onto acetate overlays and then drawing the survey data onto these to produce the required charts. With over 40 large scale charts of the river plus numerous individual plans required to cover the reaches of the Thames and berths covered by the PLA, it was a major task keeping them up to date. It was also very time-consuming and costly.



Following a feasibility study, the decision was made to replace manual methods of chart production with a computer-based system. The software chosen by the Hydrographic Service for this was Cadcorp SIS - Spatial Information System, from UK digital mapping and GIS software developer, Cadcorp. As a result, today survey data and other data on physical and non-physical objects is merged with Ordnance Survey (OS) MasterMap® digital maps using Cadcorp SIS.

Keeping up-to-date

John Pinder, the PLA's port hydrographer, who is responsible for developing and supporting the system, says, "Having looked at the different digital mapping and GIS software products available, we chose Cadcorp SIS because it was the one product that enabled us to easily zoom into an area of map, place a grid and a title block on it and print it out at the required scale. That seems a simple enough task but at the time there were very few products that could do it easily, and there still aren't that many".

"Furthermore", he adds, "a standard facility in Cadcorp SIS is the ability to read and display Ordnance Survey GML data in its native form, as well as a very wide range of other GIS, CAD and graphic data and database formats, without translation. Other products require the purchase of a translator."

With the Hydrographic Service holding sufficient OS MasterMap data to cover its area of the Thames, this facility brings major benefits when it comes to keeping the map database up to date. Through its maintenance contract with OS, every three months the Service receives its change-only update (COU) files. With the MasterMap data held in a spatially enabled database, all that is required is to use Cadcorp's simple MasterMap Manager application to load the COU files directly into the database and to automatically update existing data. All updated data is immediately available within Cadcorp SIS.

Today, the vast majority of the 350 or more revised charts and maps produced by the PLA's Hydrographic Service each year are produced with Cadcorp SIS. These not only include navigation charts - which form the great majority - but also maps relating to river conservancy and to foreshore clean-up operations under the Thames 21 project, in which the PLA is a partner.

Data, be it sonar soundings, GPS, maps or other geographic or non-geographic data, is input to the GIS in the form of native contour data, DXF, TIFF or ASCII files, depending on the nature and source of the data. In addition, because a great deal of essential but non-OS data, such as channel edges and licences, only exists on the original acetate overlays, these are scanned as required and imported into Cadcorp SIS as raster files which are given a geo-reference.

This data is assigned within the GIS to one of five layers which go to make up a PLA chart. These layers are for topography, i.e. OS MasterMap data; channel edges and anchorage areas etc.; moorings, wrecks and buoys (imported from existing PLA databases); contours; and depths. These layers can then be viewed individually and combined within a print template comprising grid, north point and title block etc. for final output. Specialised navigational notation symbols and line-styles required for navigation charts have been developed internally by the Hydrographic Service using the programming facilities within Cadcorp SIS.

Charts and maps for all

For the internal PLA user community, small quantities of final charts are output on an ink jet plotter in the quantities required. However, for use by mariners in general, where the quantities required are likely to be in the thousands, the information is sent to the UK Hydrographic Office in Taunton for incorporation into British Admiralty charts and subsequent publication.

The frequency with which these charts need to be updated depends to a large extent on the nature of the part of the river in question. For example, areas which are prone to shoaling need to be surveyed every month and new charts produced on a regular basis; more usually though, each segment is surveyed every four months. In addition to this requirement to survey for navigation charts however, the whole river is re-surveyed and re-charted from bank to bank, for river conservation purposes, every eight to ten years.

In the future, the PLA's Hydrographic Service plans to move to the production of electronic navigation charts (ENCs) derived from the Cadcorp SIS database. To this end, the Service has purchased SevenC's ENC Tools and has started prototype production of International Hydrographic Organisation (IHO) S57 data. This will eventually replace the current paper charts on ships, with the information being downloaded digitally over radio, enabling charts and other information to be automatically updated in a timely manner where it is most needed - on the ship. S57 is the IHO Transfer Standard for Digital Hydrographic Data and as such will be the preferred method of exchanging data with the UKHO, this being the subject of a pilot study between the two organisations.

With all chart revision and production work now being undertaken with Cadcorp SIS, John Pinder and his team are looking to expand the use of the system to other areas of the PLA's responsibilities. This has been largely achieved with the delivery of a number of applications via the Authority intranet through continued development using a Cadcorp SIS web-based GIS. One of these applications relates to pollution of the Thames from oil and other hazardous materials.

Following serious oil pollution accidents elsewhere, legislation was put in place requiring authorities like the PLA to have an approved pollution plan. The PLA's Hydrographic Service has used Cadcorp SIS to build a database to support the PLA's responsibilities in this area. Data from Natural England on areas of environmental sensitivity and environmental vulnerability, as

well as sites of special scientific interest (SSSIs), have been collated and merged with the Hydrographic Service's own data to create a unified database for use in pollution control and remedial action planning.

This enables the PLA to readily update the information as the situation on the river changes but also to use the spatial query and analysis facilities in Cadcorp SIS to instantly and easily search for and to output specific pollution-related information, whenever required.

Further uses of GIS data within other PLA departments include making the Hydrographic Service data available in the Vessel Traffic Management system. This enables information such as the depth of water on a berth and other berth details, including photographs and berthing instructions, to be instantly accessed and displayed simply by selecting a berth on a digital map displayed via the Cadcorp web-based system.

The PLA is now in the process of updating its web-based GIS to Cadcorp's dynamic, web-based GIS server, Cadcorp GeognoSIS. This will include an overhaul and redesign of all applications currently served via the Authority intranet. The first application close to going live, contributed to by relevant organisations and available over a corporate extranet, has been developed to exchange information and support the decision-making process in relation to dredging licence applications on the River Thames.

Major benefits

The benefits which GIS has already brought to the task of revising and producing navigation charts and other maps at the PLA's Hydrographic Service are clear. They include the ability to revise and update more charts in less time and to attach other relevant data to the map database for other related applications within the Port of London Authority.

Overall, the system has provided the PLA a good return on investment and has enabled it to improve the level of service it gives to its customers - the users of the tidal River Thames - in terms of the information they need. With its plans for increased use of Cadcorp SIS in other aspects of the authority's areas of responsibility, the PLA's Hydrographic Service is confident that yet more benefits will flow in the future.



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