

## **Implementing a Corporate GIS to protect England's Heritage**

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### **Abstract**

In 2002 a GIS strategy was agreed for English Heritage to meet its modernisation targets. Four years on, the organisation has reached its aim of a Corporate GIS with *webGIS* (ArcIMS), *deskGIS* (ArcGIS) and corporate spatial database (ArcSDE).

*webGIS* gives all staff access to the textual and spatial data and analytical tools required for their work. Over 750,000 records, based in 6 databases are now accessible through a single gateway, along with modern and historical Ordnance Survey data. *deskGIS* is used for editing the data and performing advanced queries, whilst record creation and deletion is managed through the textual databases coupled with web services to *deskGIS*.

A significant program of training in system usage and GIS theory was implemented to ensure staff were maximising usage of the systems and data.

This paper explores the systems, their integration and the peaks and troughs throughout the implementation period.

## Introduction

English Heritage is a public body with responsibility for all aspects of protecting and promoting the historic environment. By the very nature of the environment in which we live almost all of the data English Heritage collect, manage and curate has a spatial attribute associated with it.

In 2002 a geographical information strategic review identified the need to implement a corporate GIS system rather than continue the piecemeal approach which was in place. Typically copies of datasets were being maintained in a variety of locations, to a variety of standards and data was retained by those who created it rather than by those who needed it.

This paper describes the processes involved in implementing English Heritage's Corporate Geographical Information system, explores the systems themselves in more detail and the peaks and troughs during the 3 year implementation period.

A PRINCE2<sup>1</sup> project was set up to manage the implementation. The English Heritage project team consisted of the newly created Corporate GIS team of four and a dedicated full time PRINCE2 practitioner qualified project manager seconded from the EH Information Systems Group, a factor which definitely attributed to the successful implementation.

The corporate project was split into 2 projects, each with their own products. The first was the creation of a system called *webGIS* and the second *deskGIS*.

## **webGIS**

The project formed a key element of the Chief Executive's 2002 "Coming of Age" modernising agenda by-lined: "giving staff the right tools for the right job".

Four main objectives were identified:

- a) Enable staff to quickly and easily obtain and combine a wide range of accurate and definitive casework, planning and research information about the historic environment.
- b) Provide all staff with national seamless coverage of Ordnance Survey maps and the ability to regressively compare modern and historic mapping dating back to the Victorian era.
- c) Migrate over 750,000 spatial records from 2 legacy GIS databases and dynamically link them with textual records held in 6 legacy Oracle databases.
- d) Implement an architecture to support EH's longer term strategic objectives which includes the addition of an even greater range of internal and third party data, field based data capture and public-facing web GIS access to all EH's heritage data.

Following extensive consultation with a wide range of users a business case was written and funding approved by the EH Information Systems Project

Board. A specification was then produced and went out to tender through OJEC<sup>ii</sup>. 46 tenders were received and following a rigorous tender process ESRI (UK) were awarded the contract through S-CAT<sup>iii</sup>.

The specification had to carefully balance the needs of the users to those of the organisation and business analysis was required to split out the “it would be nice to have” from the “must have”.

The development period involved an extremely close and excellent working relationship between the EH Corporate GI Unit and the ESRI (UK) development teams. In addition a large and enthusiastic User Group was set up to ensure engagement with the users continued throughout development. The ability to see a prototype at an early stage was extremely beneficial to both parties.

A project board was established to provide governance to the project. A senior director in the Planning and Development directorate took the role of senior responsible owner and the Resources director was the projects Executive Board representative. The project board has responsibility to sign off all major milestones of the project, as well as signing off change requests. Having director level representation from across the organisation also helped to ensure extra staff resource was deployed to the project when required.

The first step was to create a centralised spatial database using Oracle 9i and ArcSDE 8.3. This stores the full range of mapping EH is licensed to use through the Ordnance Survey Pan Government Agreement. Previous GIS systems at EH were only capable of holding 10% of large scale mapping at any once, so one of the challenges in implementing the system was to store a full seamless national coverage of OS MasterMap. This was loaded using ESRI (UK)'s bulk supply service. The organisation is still investigating options for its MasterMap maintenance strategy.

In addition pre-war historical mapping for the whole country needed to be stored. Four epochs (time periods) are available for both 1:2500 and 1:10560 scale mapping, in addition to the Town Plan data. Due to the historical nature of the data there were a number of problems associated with loading the data. In particular it was difficult to know if missing coverage was due to a tile not being loaded or due to the fact that no data was available. There were also problems with data format and supply (corrupt tiles supplied, duplicate and inconsistent tile names) which caused delays. Initially the data was bulk loaded (in a similar approach to the modern mapping) but due to overlaps at county boundaries each county had to be loaded as a separate layer. English Heritage is the first government organisation to store this data at a national scale.

The EH business data was loaded into ArcSDE using a weekly cut of the six main spatial datasets taken from the desktop GIS application, known internally as HSIS (an Intergraph system). Materialised views were established in Oracle to allow links between the textual information, stored in 6 legacy databases, to be retrieved about a spatial feature. The corporate

spatial database is now in the region of 700GB and new datasets are added in response to staff requests.

The next step was to provide a means of providing access to all the data stored in ArcSDE. ESRI (UK)'s solution, originally using ArcIMS 8.3, provides access to a system called "webGIS". This is available to every member of staff (approximately 1900) who are based in 12 offices or at home through the EH intranet.

The system contains the standard GIS browser tools such as zoom, pan and identify. However the main method of navigation is through a quick search tool. This is built using ESRI (UK)'s GazOps service and utilises OS Address Point data as well as the 1:50,000 gazetteer. The user can enter a place or street name as well as postcode or grid reference. There is also a more comprehensive gazetteer allowing staff to zoom to a particular EH feature based on its unique identifier. *webGIS* acts a "one stop" shop for access to the main EH databases. The identify tool allows the user to retrieve basic summary information, such as name, grade and address of a listed building but also allows them to retrieve the full list description from the textual system (see figure 1).

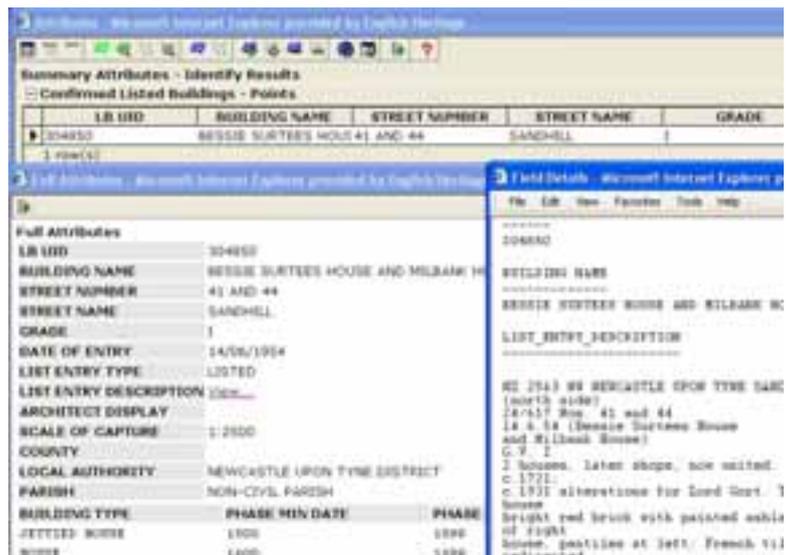


Figure 1: Screenshot of webGIS showing summary view, full attribute view and list description accessible through the identify button.

Due to the range of user requirements a collection of generic spatial tools were produced to allow users to select and buffer a range of geometries. Key to the spatial querying power that *webGIS* provides is the ability to have multiple active layers. The scheduled monument dataset for example is stored in two separate layers so to select all scheduled monuments in a particular parish you need to make both layers active. Similarly a common basic query is "What heritage is within area Y", so the user needs to be able to make all EH layers active. This speeds up querying as the user doesn't have to run lots of repetitive searches.

In addition to spatial querying a simple user interface is provided to allow the user to perform textual queries. The range of research and casework conducted within in the organisation meant this tool had to be flexible rather than limiting the user to a number of set queries. Early prototypes of the system identified the need to be able perform cumulative selections; that is to allow a number of textual queries to be run in succession and each time adding (or removing) records from the selection set. A change request was therefore issued to add this to the specification.

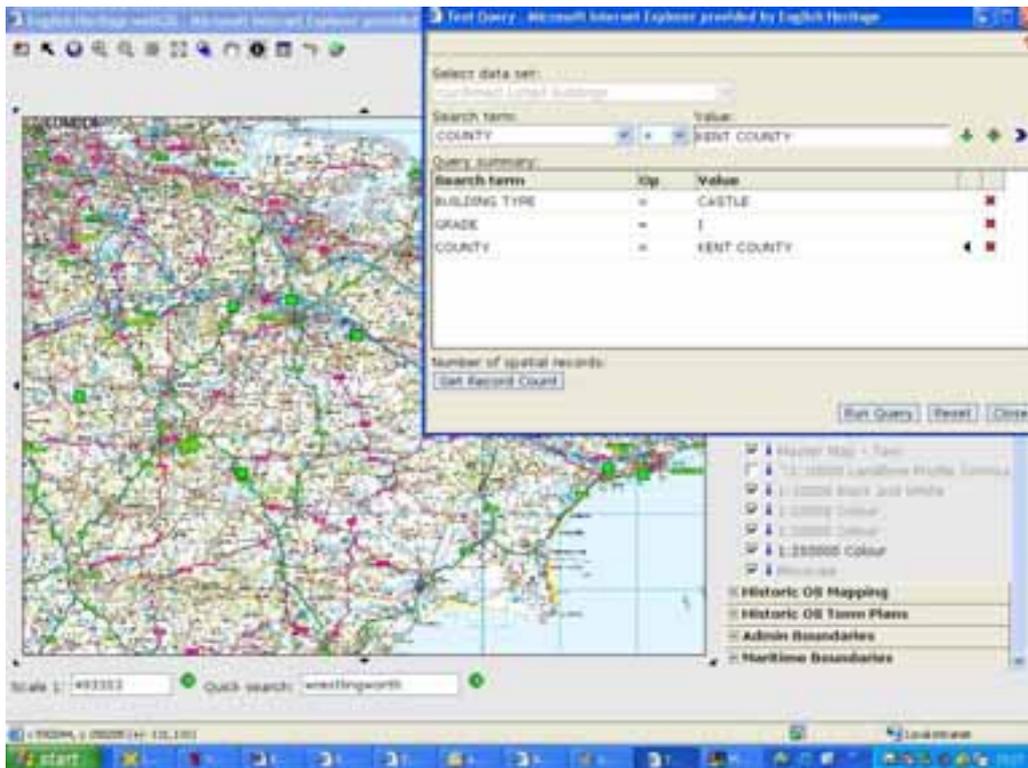


Figure 2: Screenshot of webGIS showing textual query tool which has queried all Grade I Listed Buildings in Kent with a building type of castle. These are highlighted on the map as green squares. © Crown Copyright. All rights reserved. English Heritage 100019088. 2006.

One of the challenges was in creating a simple GUI (graphical user interface) to the historical mapping. The user needs to be able to quickly switch layers on and off, but on occasion would need to switch off particular counties within a layer to compensate for overlap at county boundaries. The system was designed to switch all counties on by default, but calculate which layers are visible in the map extent and give the user the option to switch counties off if required (see figure 3).

A key benefit for the user is the ability to print off maps from their desk, rather than requesting them from a central team. A number of templates were created to allow staff to print off a “statutory map” (the official map which accompanies the textual designation record) or an “in context” map (what is on the screen). The printing routine uses html templates and then the user uses standard browser printing functions to print the map. The range of printer models across the EH estate has meant that different settings are required to get a print fitting on one page and often it has been a matter of user trial and

error to find out the required settings. There is currently no means of saving maps electronically which is a limitation. This is likely to be the subject of a future round of system enhancements.

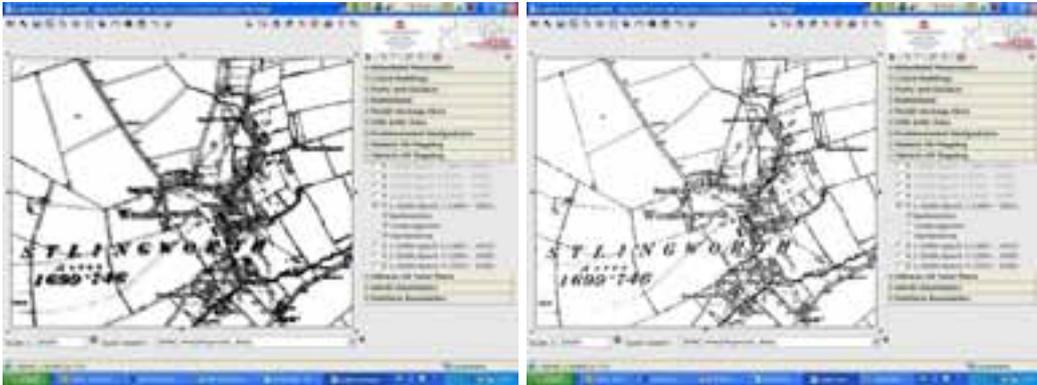


Figure 3: Screenshots of webGIS showing 1:10560 Epoch 1 historical mapping for Wrestlingworth with all counties switched on (left picture) and with just Bedfordshire switched on (right picture). © and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2006) 00394 and TP0024.

The range of tools available within the system (and not all tools have been described) in addition to the fact that access to spatial data and spatial querying tools, for most staff, was a new experience provided a significant challenge for the Corporate GIS team in terms of creating and implementing a training plan.

To begin with the corporate GIS co-ordinator undertook a regional road show a few months before the system went live to show staff what was coming to their desktops, what their appetite and also to ensure user expectations were realistic – emphasising the fact, for example, that they could not add or edit their own data within the system. This was positively received.

Due to the regional structure of English Heritage it was decided to hold training in each regional office. Super Users were nominated within most business areas and received training first. They now act as a point of communication between the business area and the Corporate GIS team. Each regional office belongs to one of four territories, and the territory data co-ordinators, responsible for providing education, advice and training about EH's data (spatial and non-spatial) are now responsible for running GIS training for their territory. They were provided with advanced GIS training and those who had little or no experience of being a trainer attended an externally run "Training to be a trainer" course. A set of laptops are couriered around the country between regional offices. Getting seven networked laptops in some of our offices meeting rooms can be a bit of a challenge (e.g. Bessie Surtees office, Newcastle on the fifth floor of a Grade I listed building).

The training consists of a three hour "Introduction to webGIS" course designed to include some basic theoretical principles, such as why the scale of capture is important, as well as a number of exercises which allowed staff to become familiar with the system and its main functions. To date we have

trained over 650 staff, including the chairman. As well as continuing to run the introductory course we are now looking to run a more advanced course in some of the more complex querying functions in addition to workshop style training sessions whereby staff can bring along their problems. The GIS team provide ad-hoc support to staff and as a result of staff enquiries have produced a number of "how to" fact sheets which answer the most frequently asked questions.

*webGIS* went live in April 2005 and has been extremely well received by the organisation. Following suggestions from staff and reviews of the system by the corporate GIS team a number of enhancements have been made to the system and we look to continue to make enhancements to meet the ever increasing demands and changing needs of the organisation.

### **deskGIS**

Leading up to *webGIS* going live the second project was initiated. The project remit was to upgrade the current Intergraph data capture system (known as HSIS) to ESRI products by December 2005. The time deadline was critical as the service contract for the HSIS contract expired then.

Since the *webGIS* project had started the ESRI product range had upgraded so included in scope was upgrading the recently gone live system from ArcIMS 8.3 and ArcSDE 8.3 to the 9.1 versions.

Some changes to *webGIS* were also required as the weekly exports from HSIS were stopped and all the spatial data (over 750,000 spatial records) had to be migrated into ArcSDE. Due to some of the stringent spatial rules in ArcSDE a significant amount of data cleaning had to take place, which required the data capture teams to allocate additional resource to the project. Additionally the data was being migrated from six databases each with their own data schema and model. There are a large number of "oddities" associated with these databases, which were found to have little to no documentation; creating a single database schema for all the databases to fit together was a major challenge.

The new desktop system (*deskGIS*) uses ArcGIS 9.1 running on CITRIX. A CITRIX platform was chosen, to minimise the impact of running the thick client application across EH's distributed network and also to allow upgrades etc to be easily handled. We initially had a problem with the application freezing when switching between ArcMap and another application but this was solved by upgrading the CITRIX client to version 9.1.

The system makes use of the wide range of standard tools available within ArcGIS although a number of customisations were required to meet EH's business needs. There are two main teams using the system. Firstly for data capture and secondly for more advanced querying which is beyond the capabilities of *webGIS*.

A number of business rules were established which affected the design of the system. Standard ArcSDE versioning is used but it was decided that no-one can edit the default version as this was the version being used by *webGIS*. Each data capturer therefore creates their own version and it is only when they decide to post back to the default version that the data changes would be made available to the rest of the organisation. This provides data capturers with an excellent range of flexibility, particularly for long term data capture projects.

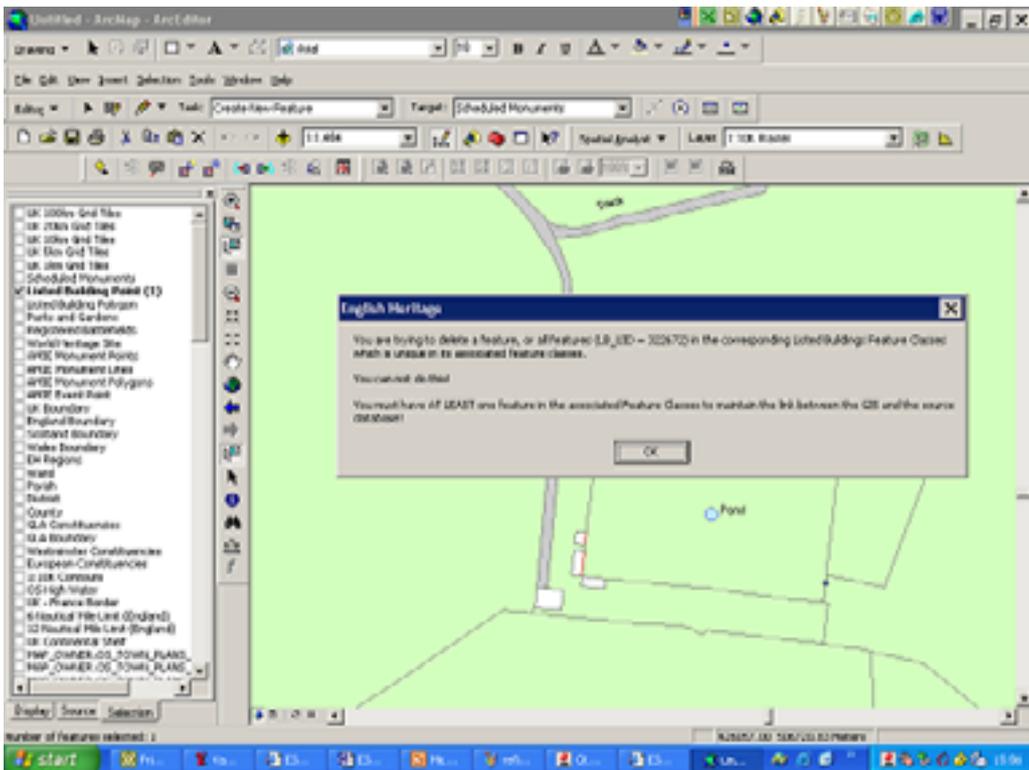


Figure 4: Screenshot of deskGIS, showing how database rules do not allow data editors to delete all features of a record to ensure referential integrity is preserved. © Crown Copyright. All rights reserved. English Heritage 100019088. 2006.

It was also agreed, in order to preserve referential integrity between the textual and spatial systems that only the textual systems can create or delete a record. When a record is created or deleted a web service is triggered to create or delete a record in the GIS. In addition if a feature is enhanced within the GIS another web service is triggered to pass the new centroid national grid reference to the textual system. When data editors are spatially enhancing a record they need to ensure the same attributes are assigned to each part of the feature. To enable this, a “clone” tool was created, which copies attributes to new features automatically. A user is also unable to delete all features of a record to ensure that there is always a corresponding spatial record for every textual record.

Quality assurance is provided by both the textual and spatial systems capturing the data editors' name. Shortly after going live a listed building record was found in Wales (outside the remit of English Heritage), the appropriate building inspector was contacted and training provided to show them how to capture accurate grid references within *webGIS*.

Whilst *webGIS* provides the ability to search on a refined list of textual terms it does not provide access to all the textual fields and does not use the thesaurus structure EH's data is indexed on. Our enquiry and research service team, who provide data to the public, therefore had the requirement to perform spatial queries in *deskGIS* and then pass the selection set to the textual system (or vice versa) to refine the enquiry or run reports. This was achieved by allowing the user to save the query (selection set) which passed the unique identifiers of the selected record to the textual system.

Additionally some tools were created to allow data created by field survey teams in AutoCAD to be bulk loaded into the spatial database. It is hoped that in the future this data will be used to enhance the Ordnance Survey MasterMap heritage layer. It also allows survey teams to update the depiction of AMIE monuments without requiring access to *deskGIS* and therefore also do not require training and support for the GIS systems.

As part of investigating options for training a number of users attended an Introduction to ArcGIS part 1 course but feedback suggested this was inappropriate for most users as staff need to learn and understand workflows rather than generic ArcGIS tools. It was therefore decided to provide training in house.

Unfortunately the corporate GIS team were unable to dial into ESRI's network due to internal infrastructure problems and so they only had three weeks to assess how work flows transposed to the new system and prepare training material. The system was only available in house 3 weeks before the go-live date so arranging training was problematic, particularly for those on leave for most of this period. A 2 day course was written with the first day covering the basics of ArcGIS and the second day covering either data capture or data querying depending on the user. All the users were based in one office so training was run on site in a dedicated IT training suite which consists of six computers.

Users were worried about the system change and the corporate GIS team were concerned that a large amount of support would be required when the system went live. However go-live went ahead as planned and the amount of support required was minimal suggesting the training had been successful. Approximately one month after going live a meeting took place with the users to discuss problems and potential enhancement requirements. A list of over 50 issues was produced, of which 45 were training issues. A training plan was then created and additional training, often 1 to 1 has been organised. Day to day support is provided by the *deskGIS* manager and is relatively low. We are now training other users in different business areas how to use the system.

## Conclusion

There have of course been technical hurdles on the way but it has been widely acknowledged that the implementation of Corporate GIS is one of the most successful IT projects at English Heritage. Some of the critical factors for success have been the excellent working relationship with ESRI (UK), a keen committed and knowledgeable project team, having senior director governance for the project and a thorough communication strategy.

The problem the Corporate GIS team now face is that GIS is so popular that everyone wants GIS functionality in other IT systems as well as further functionality within the current systems and they want it tomorrow. It is hard to balance the requirements and developments of new systems with supporting existing users. As a result a GIS board has been established to provide governance and ensure the priorities of the business are addressed.

The ultimate aim of EH's GIS strategy is to ensure that all staff have the correct tools to make best use of its spatial data assets in carrying out their work. Future projects are planned including mobile working, GIS functionality in marketing systems and providing spatial data and tools to EH's partners and the public. The infrastructure is in place to enable these projects and the lessons learnt from this project will help to ensure that future work is as successful.

## References

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- <sup>i</sup> <http://www.ogc.gov.uk/prince2/>
  - <sup>ii</sup> <http://www.ojec.com/>
  - <sup>iii</sup> <http://www.s-cat.gov.uk/>

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