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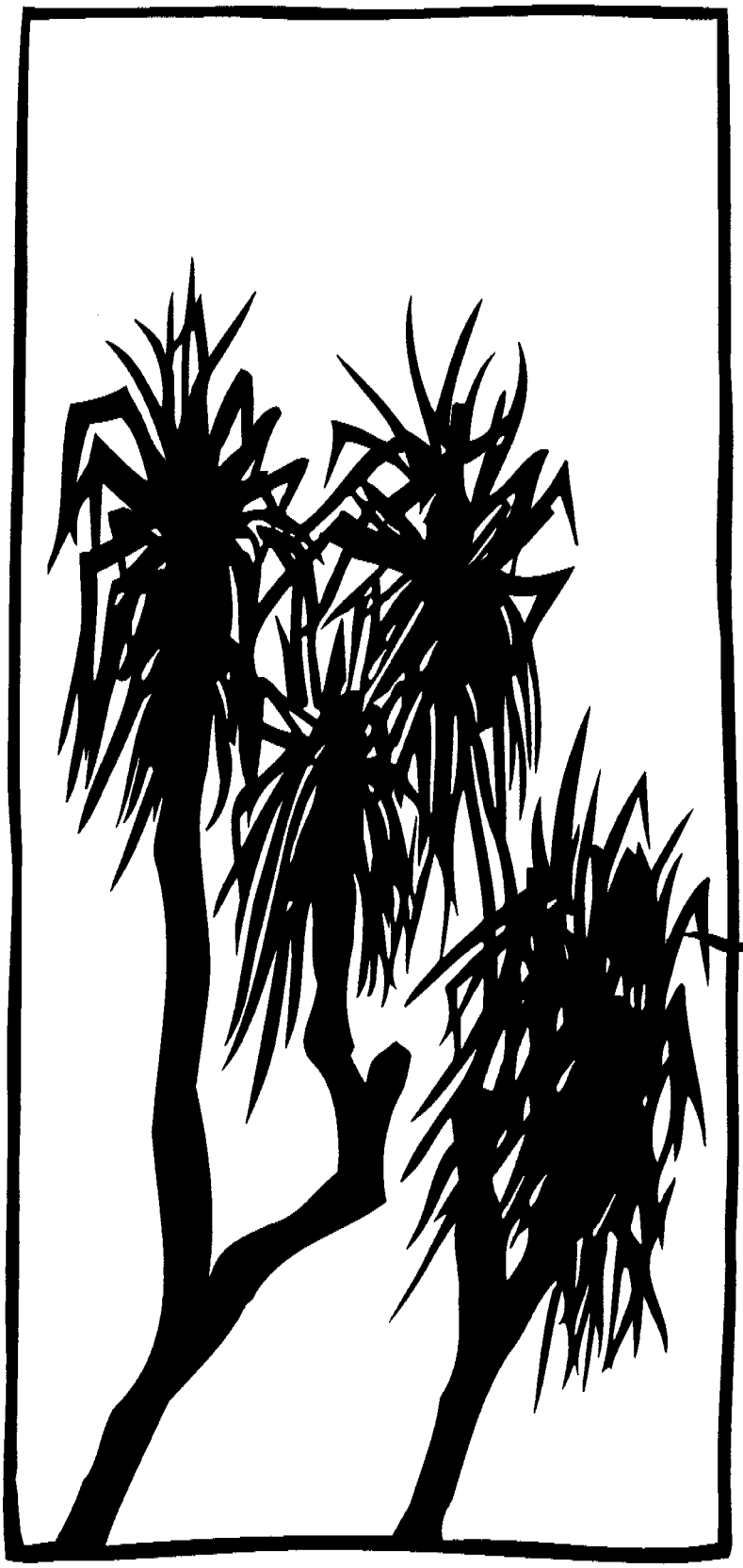

Past, present and future development of GIS at the Environmental Research Institute of the Supervising Scientist and the Office of the Supervising Scientist

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1.0 Background

eriss and ***oss*** have been developing GIS capability for several years, and a number of papers and internal reports have been published detailing the aims, objectives and requirements for the system (Devonport, 1992, Riley, 1992, Devonport & Riley, 1993). Over the intervening years, some of the recommendations and objectives of these reports have been taken up and developed, however there is still some way to go in terms of ***eriss/oss*** achieving an integrated system which addresses the needs of all potential GIS users.

The structure of the Darwin Office and its relationship with ***eriss*** is currently being reviewed, and it would seem sensible to revisit the issues at this time. The present situation is that ***eriss*** has an operational GIS and a staff member responsible for the GIS database, and ***oss*** has a separate GIS database in the Darwin office and a staff member who is responsible for GIS as part of their duties. The reasons that this situation has arisen include a low level of resourcing, some technical difficulties with networking between the two offices and different software being adopted by the Darwin office when setting up their system. This situation is not ideal, and the obvious solution is that there should be a single GIS database, particularly in terms of data storage. Different software is not an insurmountable problem and may be justified in certain circumstances. This particular issue will be discussed later in more detail.

Another reason to revisit the issue of GIS is that there is now a much wider awareness of what GIS and remote sensing technology can be used for among ***eriss/oss*** staff. Although the original papers discuss the use of GIS for many of the functions of the Supervising Scientist as a whole, circumstances have dictated, until recently, that the GIS focus has been in the wetlands section. It is now becoming clear that both Environmental Radiation and Geomorphology are incorporating GIS/RS technologies into their project planning and are beginning to consider the resources necessary to develop these technologies. Now that the interest is present and people are becoming more aware of the possibilities, there is an opportunity to take advantage of this, and it is vital to further develop an integrated approach to GIS and RS for both ***eriss*** and ***oss***. This approach must also take into account what is occurring within Environment Australia and should be developed as far as possible in conjunction with relevant groups within EA.

2.0 Original aims and objectives for ARRGIS

The original ARRGIS project was set up with the aim of providing OSS(i.e. ***eriss*** and ***oss***) management with a tool which could be used to store retrieve and manipulate environmental data to aid in the decision-making process (Riley and Devonport, 1993). The information required by management was divided into two types: monitoring (what is happening at present) and modelling (what might happen in the future).

Objectives were listed as: to identify relevant and available data, select the hardware and software, and assess the potential of GIS in achieving the aims of OSS. These objectives were said to have been largely met with the implementation of a prototype system.

Further objectives include "putting forward concepts" for "improvement of the prototype" which were to be evaluated during a review which I have been informed never actually occurred. The paper discusses problems with data acquisition and the need for collaboration with other groups such as NTU and ANCA (now PAN). There is also discussion of the need for quality statements and the eventual need for a metadata system. Environmental models are discussed – the need to incorporate them into the GIS if it is to be more than a storage and

presentation medium and the problems with this including the lack of relevant models and the technical problems with incorporation into GIS software.

3.0 Current status of ARRGIS

eriss has had the software and hardware required for GIS operations since the initial development work in the early 1990s, however has only had a person employed full time to work on GIS development since mid 1996. GIS capability has also been developed at the ***oss*** office in Darwin since 1997.

When I arrived at eriss the ARRGIS system had not been in use for some time and the first task was to update equipment, including hardware, software and software licenses. Following this, basic datasets were obtained and loaded, and efforts were directed at integration of the datasets in terms of projections and formats. It has also been necessary to set up methods of incorporating data from the differential GPS into the database. Most of this work is now complete, with the most major future task being to integrate the GIS database into the network and ensure that it is available to users, and set up a metadatabase to hold information about the GIS datasets such as that relating to quality and attributes.

3.1 Hardware

eriss hardware includes a Sun Ultra 1 Unix workstation, which is connected to the network but which is not readily accessible by users on the network. All data and software is stored on this workstation. Data is continually transferred between the workstation and the PC network, however users cannot access the GIS database except through the GIS operator. This situation is partly the result of having only one GIS trained user/administrator, and partly the result that it has been technically very difficult to grant access to other users on the system. The technical problems relate to the fact that the GIS is running on a Unix operating system and there is a lack of Unix systems administration experience (in particular integration of Unix and PC systems) on site since the departure of the IT staff member with this experience.

3.2 Software

GIS software used at ***eriss*** ArcInfo and ArcView. This platform was chosen on the basis of compatibility with Environment Australia and in particular with ERIN, the lead GIS agency within the Department, and the main data provider for basic thematic coverages. At this time there was no official policy on choice of GIS software within EA, and this eventually resulted in a number of different software packages being purchased by different sections in Canberra. Recently, however, the trend has been to consolidate towards using ArcView as the major software for GIS users. ArcInfo and ArcView are widely used by both Commonwealth and State Government agencies, although some agencies also use programs such as MapInfo and drawing and cartographic software such as AutoCad.

oss is also running a GIS in Darwin, and has a MapInfo license on a PC platform. I understand the decision to purchase MapInfo was made on the basis that it is purported to be more user friendly and require less expertise to use than ESRI (ArcInfo/ArcView) software, and in view of the fact that there are still difficulties in access and exchange of data between Darwin and Jabiru. According to sources within the NT Department of Mines and Energy, MapInfo is the default industry standard software for the mining industry (at least in the NT), due to its reputation for ease of use. From an ***eriss*** point of view this would appear to be at odds with the policy within Environment Australia in which most groups are moving towards using ArcView (plus ArcInfo for specialist GIS

groups). Further consideration of these issues may need to be undertaken, as the existence of two types of GIS software within a single organisation is not an ideal situation. As mentioned previously, however, this may be necessary in certain circumstances. This issue should be considered in the rationalisation process.

In terms of the NT Government, Lands, Planning and Environment uses ArcView and ArcInfo, but possibly MapInfo in some sections. I understand Parks and Wildlife also use both Arcview and MapInfo. The Department of Mines and Energy uses MapInfo but also has some ArcView licenses. Parks Australia North is now following the EA lead and is using ArcView. Personally, I believe that ArcView is now considered user friendly and most users would be able to use it for most required operations after a two day course which is fairly standard for most specialist software packages.

3.3. Data

The GIS database in Jabiru includes approximately 12Gbytes of data including thematic coverages, aerial photography, satellite imagery and DEM data. In addition to data stored in Jabiru we have access to a comprehensive satellite imagery archive stored at ERIN in Canberra. Details of this imagery are available through the WWW. The base GIS consists of the 250k digital data product produced by AUSLIG. This database includes layers of drainage, waterbodies, roads, aeronautical features, built up areas and elevation points. Future editions will contain a vegetation coverage. In addition some of the data is at 100K scale, including the coastline. Parks Australia North is investigating an agreement with AUSLIG to obtain access to digital 50K data for the park area at a reasonable cost.

Additional data layers are related to individual projects and have been obtained in the field or from aerial photography or other imagery. For example, some projects have their sampling sites and/or mapped areas (such as water bodies or vegetation) documented in the GIS database. Other projects and work areas have large amounts of data which could be in the GIS system but are not at present.

4.0 User requirements

Until recently the GIS at ***eriss*** has been more or less a "one person" operation, with the data and software being connected to the network but not readily accessible to anyone other than the GIS administrator. ***oss*** has been in a similar situation, and the resourcing has not been constant, making it difficult to consolidate and develop the database.

Given the increased interest in and level of training in GIS occurring within the organisation, I am anticipating that the demand for and use of GIS and remote sensing resources will undergo a steady increase. In addition to the Wetlands section, EnRad and Geomorphology are beginning to undertake projects which will be enhanced by the use of remote sensing and GIS. For example, GIS and remote sensing could be invaluable for long term monitoring of minesites. These systems can also be used for detection of radiation in the environment using radiometric data obtained from aircraft and/or satellites.

After talking to potential users in Wetlands and Impact of Mining section at eriss, and staff from oss it appears that there are a number of requirements which staff have for the GIS system, including:

- Desktop access to software and data
- Data access control i.e. other users have read only access
- Ability to easily enter data into the system, e.g. from ascii files and spreadsheets

- Flexibility to use data at several different scales
- Integration of collected field data with aerial photography, topographic data and radiometric data
- Ability to quickly and accurately map sampling sites and attach data to these sites
- Ability to map local areas and mine sites, for example to overlay infrastructure data (roads, buildings) onto remotely sensed data, contours etc
- Ability to quickly and easily conduct simple analyses, for example area and distance calculations
- Embedded linkage of modelling and other packages (graphing, statistics) into the GIS to allow visualisation of temporal and other data at different geographic locations
- Monitoring of areas (large scale and small scale) using remotely sensed data including aerial photography, satellite data and digital photography
- Modelling (rehabilitation outcomes and very long term modelling of groundwater contamination/contaminant movement etc)
- Ability to model the effects of any incidents at the mine/s

Other issues which I believe will become critical once multiple users begin accessing the GIS but which are not so obvious to new users include:

- Software and data access issues i.e. who has access to which data and what levels of access do they have
- Network speed at eriss– I believe this may be a problem, particularly since most of the data is stored inside the wetlands building
- Storage and archiving of data – where, how and for how long will data be stored
- Metadata – so users can easily source datasets and obtain quality and attribute information
- ***eriss/oss*** network – will this support data access from both sites?
- User support – users must have access to increased IT support and also have access to persons with experience in remote sensing and GIS

Some of these requirements are relatively simple and easily achieved, others are much more long term and will require significant resources to develop. Solutions for some will depend on when and if the Institute is relocated to Darwin. The evolution of the GIS system will therefore happen gradually and in stages.

5.0 Future development of ARRGIS

The major objective of the GIS system has not changed, in that it is expressed as:

That the GIS should support the activities of the Supervising Scientist in carrying out his responsibilities in the Alligator Rivers Region; and it follows that:

the GIS database should be a useful, useable and accessible resource for all staff at both the Jabiru and Darwin offices (***eriss*** and ***oss***). The previous section documents what the users wish to get out of the GIS. The requests fall into a few categories which can be seen in terms of stages of the development of the system:

Stage 1. Access to and ability to perform simple GIS functions on the desktop

Stage 2. Entry of and access to user generated and "local" and large scale data in the GIS

Stage 3. Integration of remote sensing and GIS databases

Stage 4. Development of modelling facilities and visualisation tools to be used in conjunction with the GIS

These stages will develop at different rates depending on a number of factors. Following is a discussion of each of the stages and a description of progress towards each one.

Stage 1. Access to and ability to perform simple GIS functions on the desktop

Ability of users to access the GIS on their desks and perform simple functions depends on achievement of a number of goals, listed here with the status of each :

Availability of data

Development of initial base GIS is complete in terms of containing much of the available topographic and continental scale data. This data requires maintenance and updating, for example the datum conversion which will need to be completed in the near future, as well as purchase of improved datasets as they become available.

Access to software and data

Until recently this has been a major problem due to an inability to overcome Unix/PC interface problems on site. Previously a Unix workstation was the best and only practical computer on which to run a sizeable GIS. Now that this is no longer the case, the decision has been taken to move the GIS to a PC/Windows NT platform in order that it is compatible with all other eriss/oss systems and to allow full networking of the data and software.

To achieve this the software licenses have been transferred from NTU to eriss, the back maintenance (which had lapsed because of confusion with NTU) has been paid, the software has been upgraded to Windows NT versions, and two additional ArcView licenses have been obtained at no extra cost from the ERIN pool.

This will result in most people having desktop access to ArcView, and the GIS data being available on the network, as well as all GIS/RS data being able to be stored in a single location. The PC has been purchased, the network software is being loaded and the data is in the process of being transferred to the network.

A further issue is how to ensure access to data for ***oss*** staff. This is a technical issue and the solution will depend on the future location of the institute. I will be meeting with Peter Waggitt in the near future to discuss the ***oss*** database. I have been unable to find out much information about what is actually contained in the database as yet.

Training

It is important that users have sufficient training to be able to perform basic GIS analysis and produce map products for themselves. A number of users have undergone training in GIS and remote sensing software and I have encouraged this for anyone who wishes to use the GIS themselves. Staff trained in basic ArcView functions include Ken Evans, Bruce Ryan, Ben Bayliss, James Boyden, Dene Moliere, Guy Boggs and Michael Saynor. Guy Boggs also has experience with ArcInfo. Some staff have also undergone training in the use of ER Mapper image processing software.

Support for users

People who have basic training in GIS will require a certain level of support and help at various times. This will be both from IT staff and from GIS staff. The types and sizes of data files for GIS and remote sensing tends to ensure that there is an increased need for IT advice and support from users of GIS. The somewhat complex nature of GIS also means that users will require support in terms of technical aspects of GIS data and analysis. I am prepared to provide this wherever possible but it should be recognised that an increase in the number of GIS users will result in an increase in the requests for advice and assistance.

Network speed and function

The adequacy or otherwise of the network for GIS operations can only really be judged once people start using the data over the network. I suspect there are going to be some problems, however, and these may need to be addressed quickly in order to prevent users becoming frustrated with the system and discouraged from using it.

Summary

This stage is well underway and in fact I can perform all of these functions and have been able to do this for some time. The next step is to obtain access for other users, and this is well advanced and should be available within a few weeks.

Stage 2. Entry of and access to user generated and "local" and large scale data in the GIS

Data entry

Entry of and access to user generated and large scale data into the GIS will take some time, depending on amounts of historical and past data which needs to be formatted and entered, and priorities for data entry. The mindset shift in which users see the potential of storing and using their data in a GIS has started, and it is important to keep the momentum going by ensuring that they have easy access to the GIS and are able to enter their data easily. This may require development of some automation techniques or writing of programs to enable fast and efficient data entry. Even users who have had training are likely to require some initial assistance with this.

Storage, archiving and metadata

These issues are pertinent for all computer users and all organisations, however they take on a particular significance when dealing with GIS and RS data due to the amount of storage space they consume and the potential to produce large amounts of derived datasets very rapidly. These issues have the potential to consume considerable time and energy and have already done so at ***eriss***. Numerous documents have been produced on these topics at the organisational, departmental, national and international levels. The scope of this document does not include a detailed discussion of these issues, just to discuss what steps have been taken in this direction with regard to GIS and related data. At some point in the future it will be necessary to take these issues up (again) at an organisational level.

Basically, entry of large amounts of data with multiple users will reinforce the need to address data storage and archiving issues, and the issue of metadata. I cannot stress strongly enough the importance of the availability of accurate metadata once you have a number of GIS users. The metadata must be accurate, up to date and the responsibility of everyone.

In terms of a metadatabase to store GIS dataset information, I have trialled various available databases and not found any which are immediately suitable for our use. This includes the ANZLIC metadata entry tool which is inflexible and not particularly user-friendly. I have begun developing a database in Microsoft Access which I hope will be suitable for GIS