Department of Conservation and Land Management in Western Australia

Improving information management within CALM

The results of a study tour in March, 2005 of five other conservation agencies within mainland Australia

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Contents

1 Executive Summary

This report presents the results of a study tour in March, 2005 of selected Australian conservation agencies. The study tour focused on how information was managed within agencies, particularly biodiversity research information, with a view to helping identify best practice from both organisational and technological perspectives. The study focused specifically on the management of biodiversity data within a scientific context, to provide a strategic direction for progressing the *NatureBank* vision. However, many of the key findings and recommendations apply across the Department.

Rather than providing piecemeal suggestions, an attempt is made to provide a cohesive set of recommendations covering many related aspects of information management within the Department. Taken together over the medium term, these recommendations provide an opportunity for the Department to become a leader in demonstrating best practice, and providing the State with the best possible basis for supporting conservation with the right information, in the right place, at the right time.

The agencies visited were:

Jurisdiction	**Agency**
New South Wales	Department of Environment and Conservation
South Australia	Department for Environment and Heritage
Queensland	Environmental Protection Agency
Victoria	Department of Sustainability and Environment
Australian Capital Territory	Federal Department of Environment and Heritage

Discussions were held with senior managers and organised within a specific framework:

- **Organisational context**: Core business; structural and political history; obligations to, and expectations of, clients; required outputs
- **Data generating activities:** Projects and activities; data gathering policies, procedures and standards
- **Information systems:** Supporting information systems; infrastructure; systems policies and procedures; technology

1.1 Key findings

This section summarises key findings of the study tour.

- Agency staff were helpful and candid in discussing their organisational context, describing both the strengths and weaknesses of their internal operations. Each agency had limited resources, a complex and demanding political landscape, and no one agency represented best practice across its operations. However, each site had specific strengths that contributed to an overall picture of how CALM might proceed forward.

- In almost every agency visited, there was a stated recognition from Government of the need to base conservation planning and land management decisions on the best available scientific information. There was, concurrently, a high demand for biodiversity information, not just from Government but community groups, NRM bodies and internally within an agency. Agencies responded to that demand with a variety of information systems, with the intention of providing comprehensive and relevant information, subject to available resources. In most agencies there was a strong philosophical commitment to corporatise their information and make it as widely available as possible.

- A major issue affecting the ability of an agency to integrate and deliver biodiversity information was the degree of fragmentation within the organisation ie the cultural silos or power bases within an organisation that frustrated the movement of information around the agency.

  Contributors to fragmentation included:

- Geographic separation of staff
- Agency restructures
- The *purchaser / provider* model

- In many agencies, there were particular issues associated with science staff treating their information corporately. Despite a recognised need to allow sufficient time for findings to be published, attempts to incorporate original research data into a shared, corporate environment often failed. Reasons cited included:
    - Concern about relaxing control of datasets
    - Lack of available resource for maintaining data beyond project funding
    - Contractual limitations with funding
    - Lack of an adequate corporate environment in which to lodge data
    - Lack of interaction between science staff and information management staff.

- For an effective conduit between activities and outputs there needed to be a policy and standards-driven environment for gathering data in a consistent manner, and a suite of integrated information systems that fully supported and recognised the kinds of data being collected.

  In the agencies visited, this environment included a range of high-level committees comprised of science or business staff, and senior technical personnel. These provided an essential function in vetting projects on the basis of relevance to core business, relationship to existing systems, and impact on IT infrastructure. Policies and standards were applied to every part of the process from activity to output, including data collection, organisation, distribution, archival and maintenance; application approval, development and deployment; knowledge management; and technology and infrastructure.

- In discussions with agencies, it was argued that data collection projects and information systems should not be implemented without a clear definition of required outputs. Information systems were a determining factor in achieving client expectations. Project design therefore needed input from output purchasers, data collectors and systems designers from the beginning. Historically, many projects were designed with little forethought of how data would (or should) be used after the traditional paper publication process. Many systems were developed without regard for existing systems. Strategies for improving the delivery of outputs included:
    - High level support from executive management encouraging strategic use of information systems, particularly integrated systems
    - Multi-skilled staff with a detailed understanding of both core business and information technology acting as a bridge between clients and GIS / IT sections, so that systems delivered required outputs
    - Focussing GIS / IT sections on agency core business ie managing biodiversity and estate information

- Agencies had implemented a range of different information systems that both relied on and encouraged an integrated approach to information. These included:
    - General provision of databases and maps over the web
    - Atlas systems displaying species point distribution data from Herbarium and Museum records, survey and other biodiversity databases
    - Standardised ecosystem administrative boundaries
    - Sites of significance – monitored sites, research plots

1.2 Implications for CALM

The following discussion has been substantially summarised from the main body of the report. This section lists only the key recommendations (referred to in square brackets and listed separately on

page 8). A number of other recommendations are also presented below that relate to detailed processes and functions within the Department. The full report provides context, examples and discussion.

1.2.1 Strategic support for, and use of, information systems

After visiting and reviewing five other conservation agencies at both State and Federal level, the view was reached that CALM needs to use its information systems in a more strategic manner, particularly to improve its support for biodiversity information systems

While there has been progress, increased support from senior management is needed to continue the process of re-assessing current funding priorities, reviewing the role of information management across the whole Department and promoting the benefits of supporting and integrating CALM's knowledge base [R1].

1.2.2 The Executive Information Management Committee

The Executive Information Management Committee (EIMC) is a high-level committee with the role of overseeing Departmental activity relating to information management, providing guidelines and policies and informing and advising Corporate Executive on strategic matters. Part of the committee's role is to ensure that information projects promote the core business and objectives of the Department.

However, the EIMC does not appear to have adequately assumed this role in a consistent manner. Most discussion is concerned with technical issues such as network infrastructure, equipment replacement programs, and desktop infrastructure. As important as these issues are, it is equally important to discuss agency business at a strategic level, assess the implications for information management, and have an opportunity to assess or comment on business plans for new initiatives.

It is essential that a strategically focussed group contributes to all major corporate projects by assessing the implications of projects across the Department, providing advice and ensuring that projects are integrated with each other, and a separate, technically focussed, group ensures projects are supported by the existing IT environment, in terms of a hardware / communications perspective and from a data management perspective [R2].

1.2.3 Putting people in the right place

A key strategy to implementing and maintaining integrated information systems is to have better integrated processes and functions. Having people within the same branch physically located together facilitates better processes. However, with a geographically decentralised agency like CALM, this can be hard to achieve and requires high-level support [R3].

The GIS section within CALM has a responsibility for managing biodiversity data. It interacts with Science Division staff on a daily basis yet no GIS section staff member possesses a formal qualification in the biological sciences. This leaves GIS section staff without the capacity to properly interpret or validate biological datasets [R4].

With the absence of on-site GIS specialists, and the increasing availability of desktop GIS capability, there is the potential for GIS activity to proliferate across the Department with little integration, duplication of effort, multiplicity of software environments and staff working outside their strengths or job description [R5, R6].

Another key strategy in helping to integrate information are *bridging positions* – staff with a clear understanding of core business as well as information technology. These positions provide a means for clients to articulate their requirements and translate these into the information systems and infrastructure needed to support the client's proposal [R7].

1.2.4 Supporting core business

IT sections in many agencies lacked adequate capability for supporting GIS software or biodiversity data management. The datasets were not understood, and the infrastructure and

software used were often outside their skill base. Reasons for this included a lack of resources, inadequate recruitment policies and a misunderstanding of core business.

Important as they are, financials and human resources information systems are *not* the core business of CALM, though they overlap with and support core business. The core business of this agency is conserving WA's biodiversity and managing our entrusted lands and waters (CALM, 2002). It is therefore essential that ISS be adequately resourced, and adopt appropriate recruitment policies, to provide better support for those applications directly relating to biodiversity data and managing our estate. *Note that the argument is not to reduce resources for essential corporate services, but to provide more resources supporting applications directly relating to our core business* [R8].

In this author's view, the GIS section has a primary responsibility for compiling and providing spatial and other information supporting conservation and estate management, particularly biodiversity information. While not a data gatherer *per se*, it must nevertheless provide expertise in data content. The alignment of GIS activity with science and biodiversity was reflected in almost every agency visited, where sections were named with words to the effect of "Biodiversity Information Management", and aligned within the science or NRM sections of the agency [R9].

1.2.5 Improving data standards and protocols

While certain standards have been developed relating to application development, there has been, until recently, no process or forum for the comprehensive and systematic development of standards and procedures covering spatial applications or data, across all aspects of this agency's data gathering activities and information systems. The most effective way of doing this is for an ongoing technical group to develop a set of proposed standards and protocols covering as wide a range of information management activities as is practical, focusing in the short term on high priority business needs [R10].

CALM employs scientists with nationally and internationally recognised expertise in conducting surveys. In collaboration with other scientists, both internal and external, and with other agencies, CALM could provide leadership by defining a set of common standards for collecting and organising species and community data. This should include both survey and opportunistic data, both vouchered and sight observation data [R11, R12].

1.2.6 Project life cycle

Every modern survey project uses information management technology. If projects are not costed adequately, or if there is inadequate database design, the capacity to integrate the project's results into a corporate knowledge base may be impeded. There is an underlying presumption that a project is complete once the results are published. Unfortunately this rarely happens in practice. There is an ongoing demand for the data to be used in other applications, or for statutory archival purposes. Over time, data accessibility and archiving become an issue as storage media become obsolete. If the primary output was a paper publication, the original data may become difficult to access, or even lost.

With online systems and increased data scrutiny, data compilation and validation, and possibly even data collection, are an ongoing activity. In other words publication is not the end of the project cycle. The current project approval process within the Science Division and elsewhere does not adequately take this into account. Every new project funded through a one-off grant invariably saddles the Department either with the choice of the project ceasing when funding runs out, or bearing the cost of system maintenance. This cost is rarely factored into project budgets and, as a result, the true cost to the Department is understated [R17].

1.2.7 Application development standards

The design of software applications, particularly database applications, can significantly impact on the capacity of an organisation to integrate information. If an application uses local data rather than corporately stored data, then versioning or backup problems will arise. If an application does not use the correct data tables for a given knowledge area, then data integrity may be compromised.

Of particular note is the proliferation within CALM of corporate database applications written in Microsoft Access. Because of the wide availability and low cost of Access, many staff have developed single-user database applications that have expanded into essentially corporate applications, yet are still managed as single-user desktop databases [R18].

1.2.8 NatureBank

The NatureBank proposal (Science Division, 2002) contains a vision for providing a single point of entry into the Division's knowledge base. The key findings and recommendations of this report support and affirm the aspirations of that initial proposal. In particular, the proposal recommends the creation of a number of positions that would undertake data management, GIS analysis and specialised biological modelling, as well as acquiring GIS hardware and software [R27].

1.2.9 Risk assessment

This report makes suggestions and recommendations involving attitudinal changes, appropriately skilled positions, and a funding increase for information management. In an environment of limited available funds, this presents a major challenge. An important consideration, therefore, is the consequence of doing nothing i.e. continuing with the same budgeting process, the same apportioning of financial and human resources, and the same information policy environment. Two particular risks are:

1. Loss of credibility: many agencies are transforming how core business is done, and there is an increasing expectation that agencies will interact with one another using industry-standard methods for sharing information. One current example is CALM's participation in the joint SLIP project. If CALM does not appear to be moving forward in a similar manner, CALM's credibility may be affected.

2. Loss of opportunities: there are a number of Federal funding opportunities either directly to State agencies, or through NRM and other local groups. Agencies are competing against each another to provide services. If an agency is not competitive because it lacks capability, those opportunities may be lost.

1.3 Key recommendations

R1: Corporate Executive actively promotes and encourages the strategic use of integrated information systems as a mechanism for achieving our core business goals.

Ways of achieving this include:

- R1a Implementing CALM policies that support and affirm the strategic role of information systems, and mandating standards and procedures developed by EIMC and other relevant groups
- R1b Affirming the need for a strategic group to advise on policies, and a separate technical group to focus on procedures and standards for information management and application development across CALM
- R1c Providing, via output purchasers and corporately, increased financial support for specific, high profile projects that benefit the Department as a whole
- R1d Encouraging and recognising staff who develop innovative solutions for integrating our information systems
- R1e Publicising the need for integrated systems through the standard channels of internal and external CALM publications

R2: Corporate Executive reviews the current role and terms of reference of EIMC, and implements a process for developing two new groups, one focussing on strategic issues and the other on technology and data organisation.

R3: Corporate Executive continues to advocate, promote and resource initiatives for consolidating Branch and Divisional structures so that, where possible, staff within a branch are co-located.

R4: Divisional managers facilitate and, where necessary, resource the placement of appropriate skilled information specialists within GIS section. Options include:

- R4a: GIS section modifies its recruitment policies to favour applicants with a formal background in biology and with a specific interest and capability in GIS data management and analysis.
- R4b: Science Division collocates further science positions with GIS section

R5: Each remote centre should have on-site, specialist capability to undertake GIS data management and mapping activities, application of relevant data standards, and, where possible, basic LAN and desktop support.

R6: Managers at remote centres consider the option of converting existing field-based positions to specialist information management positions.

R7: Corporate Executive supports the creation of (or upgrading of existing) positions to function as business development managers within both ISS and GIS sections, and that Divisional managers convert or recruit existing positions to business development managers as deemed appropriate.

R8: Information Services Section is assigned increased resources, and adopt appropriate recruitment policies, to better support specialised information applications such as providing data and web services over the web, and to better support other sections in managing spatial applications and biodiversity data.

- R8a: DBA availability should be doubled to two FTE positions, with one position having specific experience in administering spatial databases.
- R8b: A new Data Administrator position should be created within ISS, with responsibility for developing and maintaining the CALM corporate data model

R9: Corporate Services Division explores ways of renaming or realigning GIS section so that its core business is more self-evident. Options include:

- R9a: Merging GIS section with the Science Division to produce a new entity concerned with both science and spatial information
- R9b: Renaming GIS Section to include words reflecting biodiversity information management

R10: Under the aegis of the strategic group, and the relevant and supporting policies from Corporate Executive, a technical group is assigned the responsibility of developing standards and protocols for all aspects of data gathering and information management within the Department. This group should work in conjunction with Divisions to develop relevant, applicable and workable standards and procedures. The resultant standards should be referred to the strategic group for comment and endorsement, and finally referred to Corporate Executive for approval.

R11: Science Division facilitates and promotes the development and use of data collection and management standards for field survey projects. In collaboration with other agencies, workshops and working groups should be set up that will, in the first instance, develop a specification for how general-purpose flora and fauna survey project databases should be designed. These standards should be published and distributed widely.

R12: New data collection projects should be scrutinised and endorsed by a high-level committee with both business and information technology expertise to draw from. This committee should ensure that the project has received specialist data advice and input and that it has also met the conditions described in R17 (page 40).

R17: All Departmental Divisions endorse the principle that new data collection projects should factor in the expectation they will have an ongoing life, that the underlying data will be ultimately archived or warehoused in an online environment with access by a range of clients. This will bring with it ongoing custodial responsibilities, and ongoing maintenance costs. New projects should not be approved by the relevant body (see R12 and R12a on page 37) unless these considerations have been adequately acknowledged and addressed.

R18: All corporate application development is to adhere to Departmental standards and be assessed and approved at a project level by senior Divisional management, ISS and EIMC.

R27 Corporate Executive endorses and support the recommendations contained within the NatureBank proposal and provide resources for the new positions outlined within the proposal.

2 Introduction

This report presents the results of a study tour in March, 2005 of selected Australian conservation agencies. The study tour focused on how information, particularly biodiversity research information, was managed within agencies with a view to helping identify best practice from both organisational and technological perspectives.

The demand for information has greatly increased in recent years. Internally to this agency, there is a greater requirement for supporting decision-making and operational activities through the provision of timely, accurate and relevant information. Externally, there is an increased expectation from natural resource management groups, community groups and the general public for information on a host of different, often complex, topics. Again, timeliness, accuracy, relevance, and especially, internal consistency, are important characteristics of how we should provide that information. In addition, advances in Internet technology have increased community expectation for access to that information.

To date, the Department of Conservation and Land Management (CALM) has made a substantial investment in purchasing hardware and software for storing large quantities of data, particularly spatial data. However, these purchases alone do not ensure that data will be managed and integrated appropriately across the Department, or that this information will achieve the purpose for which it was collected.

If there are unhelpful or faulty processes, increased resource might even make matters worse. This could cause managers and decision makers to view the existing investment negatively and appoint future resources elsewhere, further hampering the Department's ability to respond to requests for information in a timely and accurate manner.

Other conservation agencies across Australia have also been addressing the need to manage and publish information more effectively. In some cases, their progress is clearly visible through online access to a wide range of information sets. In many cases, though, progress is hidden within Departmental Intranets. It was thought that the most effective way to understand how other agencies have addressed these issues was through face-to-face contact.

Their experience in managing similar kinds of information, and with similar policy drivers, would be extremely useful in helping to identify best practice. A comparison with these agencies would help identify our existing strengths, clarify which organisational processes needed improvement, and indicate how information could be better organised. No such comprehensive comparison with other agencies had previously been undertaken within CALM.

Thus the concept of a tour was devised and potential participants contacted. The initial plan was to visit South Australia, Queensland, Victoria, New South Wales, the ACT (Federal DEH), Tasmania and Christchurch, New Zealand. For various reasons it was not possible to visit Tasmania and Christchurch. This was unfortunate, as both these jurisdictions have contributed significantly in managing and publishing biodiversity information. It is hoped to visit both these sites at a later stage, as they should provide further useful information for CALM in moving towards best practice.

Part of the background to this tour was the *NatureBank* proposal initiated by the Science Division (Science Division, 2002). This proposal entailed the development of a single entry point, or 'one-stop-shop', into the knowledge generated within the Division. This was driven partly through the need to make research data available to a wider range of clients but also to centrally archive the data in the event of staff retiring or leaving the Department.

As part of a recent internal restructure of the Science Division, a new program, Science Applications, was created with the intention, amongst other things, of progressing the vision for NatureBank. Science Division staff with a demonstrated capacity for managing biodiversity information were recruited to the new program, with the immediate task of assessing the current situation and developing a business plan.

At first glance it appeared the plan would primarily focus on technological issues. Solutions would probably involve investment in further, or improved, infrastructure, the development of new applications and the immediate warehousing of key datasets. However, after some consideration it was apparent that organisational and structural issues were as significant as the technological ones, and a step backwards was required to see the bigger picture.

The review of information management within sister agencies was therefore timely and useful in providing valuable input to the plan. It affirmed the observation that information systems are a reflection of agency business and processes, which are themselves enshrined within a specific organisational context. While the focus of this report is on improving our systems integration and furthering the NatureBank vision of a one-stop-shop for biodiversity knowledge, it is impossible to talk of improving systems integration without reflecting on those underlying business systems and processes.

This report intentionally focuses on information systems integration. While it discusses, or alludes to, high-level organisational matters, these may be the subjects of other review processes more appropriately dealt with elsewhere. Nevertheless, the goal of achieving systems integration is dependant on those matters being dealt with effectively.

3 Methods

Rather than focusing immediately on technological details, such as applications and solutions, a framework was required to provide a broader context. This framework consisted of:

1. Briefly reviewing the organisational and political context of each conservation agency. This provides an insight into the obligations and expectations placed on each agency for relevant information by government, or its various clients, whether internal (eg management, operations) or external (eg consultants, academia, general public). These obligations and expectations give rise to a number of desired or required outputs (eg activities, processes, databases) and expected outcomes (eg whether the output actually achieves what was intended).

2. Briefly reviewing the structural and political history of the agency. This could indicate how internal groupings might influence the movement of information within the agency.

3. Reviewing the various data-generating activities and systems, and the different kinds of data that were ultimately collected, and their relationship to the expected outputs described above. Included as part of data gathering were the various policies, procedures and standards that guided and regulated those activities.

4. Looking at specific information systems and the associated standards, policies and procedures put in place to guide and regulate system development.

This framework can be summarised as that shown in Fig. 1. Required outputs and outcomes give rise to a set of projects or activities that collect data. These data are managed and summarised through information systems, which are intended to generate, or contribute to, the expected outputs and outcomes. A set of standards, policies and procedures guides and regulates activities and system development. All of this happens within a specific organisational context.

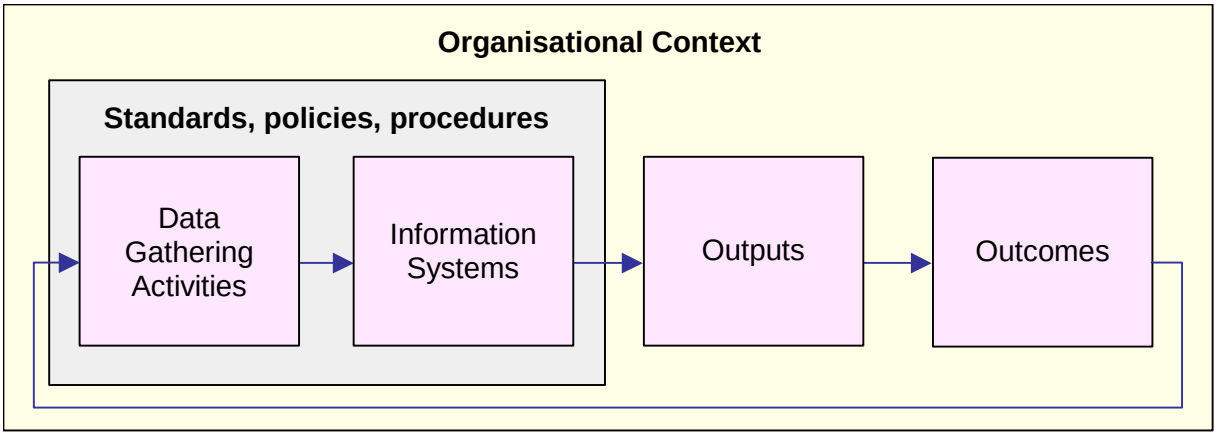

Figure 1. From activities to outcomes

Using the above framework, a set of questions was designed to facilitate discussion (see Appendix 1, page 48 for further details). Due to the need to scope the tour within a reasonable timeframe, questions focused primarily on improving the management and integration of biodiversity research data within the Science Division. However, it was recognised that feedback would be relevant across many areas of CALM.

Through existing networks and prior contacts with other States, senior managers were invited to either participate directly or nominate key staff members with a detailed knowledge of biodiversity information management in their agency. In every case, there was a clear willingness to cooperate with the study, and staff from each agency were nominated to discuss specific aspects of their work within the general framework described above.

Visits were arranged to workplaces for both detailed discussion and demonstration of a wide range of information applications and products.

4 Key findings

This section summarises key findings of the study tour, organised according to the framework described above.

Throughout the process of discussion, agency staff were candid in discussing their organisational context, describing both the strengths and weaknesses of their internal operations. Each agency struggled with limited resources, a complex and demanding political landscape, and no one agency represented best practice across its operations. However, each site had specific strengths that contributed to an overall picture of how CALM might proceed forward.

The purpose of the report is not to highlight weakness, but to build a picture of best (or at least better) practice across a range of information management issues. Findings are therefore generalised when it comes to discussing specific problems in a given agency. However, where there was a particular strength or innovation, this is specifically mentioned.

4.1 Organisational context

In examining the organisational context of each agency, a number of common threads were identified relating to, or affecting, how information was managed.

One thread initially explored was a comparison of the relative importance of information management across and within agencies. This might give a more objective indication of how well CALM fared in its support for biodiversity research and also its commitment to supporting information systems.

However, it became obvious that meaningful comparison was difficult, if not impossible. The scope of each conservation agency varied widely. Furthermore, the science and information management effort was not always located in one program and the FTE and budget figures were not equally available in publicly available documents such as annual reports.

To complicate matters, it was not the whole Information Technology (IT) budget that was relevant, but that spent strategically on applications directly supporting core business (see the section *Affirming core business*, page 34). Thus, figures for overheads such as financials, human resources and records management would need to be excluded. Another possible exclusion might be systems that were initiated and funded externally. This would leave just internally funded applications, where agency prioritisation had a more direct impact in determining successful proposals.

Another approach would be to assess the *number and scope* of internally funded applications, particularly those with direct relevance to both high-level decision-making and major operational activities. Again, it was hard to quantify this without expending a significant effort in each agency as well as our own and such an activity was beyond the initial scope of this report.

Some conclusions were drawn, however, and are discussed in the section *Strategic use of information technology*, page 28.

Some of the other common threads are discussed below.

4.1.1 Demand for information

In almost every agency visited, there was a stated recognition from Government of the need to base conservation planning and land management decisions on the best available scientific information. There was, concurrently, a high demand for biodiversity information, not just from Government but from community groups, NRM bodies and internally within an agency. Agencies responded to that demand with a variety of systems, with the intention of providing comprehensive and relevant information, subject to available resources.

In most agencies these systems were visible over the Internet. In one, live data were available only over the Intranet, but with a commitment to convert that to Internet availability. Thus, in most agencies there was a strong philosophical commitment to corporatise information and make it as widely available as possible. In two particular agencies, this was accompanied by strong support from executive management for business plans promoting corporate, integrated biodiversity information systems, as well as the underlying infrastructure required to support them.

In one particularly illuminating discussion, a manager noted a demonstrable increase in the demand by Government in that State for information from their agency to assist in decision-making. This increase in demand was directly attributable to a relatively high level of expertise and awareness of information technology at senior and executive management level. Because senior managers were aware of efficiencies possible through the use of information systems, greater support was provided for improving internal business systems, processes and procedures. This led to qualitative and quantitative improvements in how information was supplied to clients.

On the other hand, where senior or executive management had a lower understanding or regard for information systems, staff generally paid less attention to internal integration, even though expectations for results may have been just the same. In other words, leadership was essential in motivating an agency to improve its core business through better information systems.

Factors influencing this approach included obligations through the relevant Freedom of Information and record keeping Acts.

The importance of information management is particularly emphasised in the Queensland EPA Science Program 2005/06, which has an explicit focus on *applied* research and the recognition that research was a small part of the total science effort, where the greater effort is "…in the application of science to gathering information, monitoring and modelling the environment, environmental planning, and preparing and implementing management actions." (EPA Qld, 2005).

Given the limited resources agencies had to contend with, innovative recruitment strategies were required to provide the above support. Historically, conservation managers had recruited on the expectation that most staff would have been primarily occupied with fieldwork and that other activities were less important. However, in the agencies visited, there appeared a recognition that information-based positions were equally important in delivering conservation outcomes.

It is difficult to quantify how much relative resource was applied to information management versus field-based science staff within the agencies visited. However, based on limited experience and anecdotal information, there appeared to be a higher commitment to information management, relative to fieldwork, in other States than in Western Australia.

4.1.1.1 Corporate web site

Another issue affecting the ability to respond to demand for information was the Departmental policy on its corporate web site. Most agencies revealed tensions between the corporate relations arm and the other content-producing Divisions. Put crudely, the corporate relations approach was described as a 'brochure approach' to content, and characterised by well-designed but highly controlled, static web pages. In some cases control was maintained by the corporate relations arm itself, while in others it was delegated to an executive within the Division providing content.

However, with the demand for live information (ie dynamic, data-base driven content) a different approach was required that accommodated a greater need for control outside of the corporate relations purview whilst still maintaining Departmental guidelines and standards. While a reasonable balance had been achieved in some agencies, in others the result was to stifle innovation and content.

4.1.2 Fragmentation

A major issue affecting the ability of an agency to integrate and deliver biodiversity information was the degree of fragmentation within the organisation. In this context fragmentation refers to the

cultural silos or power bases within an organisation that frustrate the movement of information around the agency, often resulting in duplication of systems and services, or suboptimal system performance.

Geographic separation of staff was seen as a major contributor to fragmentation, particularly where resources were not equitably distributed between centres. Over time, idiosyncratic practices and methodologies developed in the absence of standards, adequate communications or resources.

Departmental restructures were also a factor in the ability of an agency to maintain its level of information integration. However, the actual impact was not always proportional to the degree of change.

In one case, an agency had been restructured a number of times, resulting in an exacerbation of existing silos to the point of duplicate systems, version control issues and a narrow regional focus. In another case, however, despite recent changes at high levels, and despite one or two major sites of dislocation, the agency as a whole still showed a reasonable degree of information integration. This may have been for a number of reasons. Firstly, key groups within the agency had remained together. Secondly, a number of key corporate information systems had already been implemented, which helped establish and perpetuate a corporate ethos, and a need to communicate across sections.

There are other contributors to fragmentation. In one agency the *purchaser / provider model*, which it had discarded in recent years, was cited by some managers as contributing to fragmentation through its arbitrary distinction between purchaser and provider, creating an environment of haves and have-nots, and reducing buy-in from individual purchasers on whole-of-Department projects.

Within the context of information management, the purchaser / provider model, while designed to (theoretically) help align activity with output, had had unintended consequences that frustrated systems integration. Unless both purchasers and providers were equally committed to good information systems, the negotiation process would inevitably under-resource that activity. Unless the purchaser saw the value of information systems, providers would opt to minimise expenditure in that area (often by under-costing projects) so that resource for fieldwork or other activities was not jeopardised.

Furthermore, where information systems required infrastructure support from an agency's Information Technology (IT) section, it was hard to categorise the purchase in terms of a specific Division's requirements.

4.1.3 Role and reputation of science-based research

As a generalisation, there are substantial gaps in our knowledge of the natural environment, and that more information is required to address those gaps. Research into key areas such as threatened species and communities, and salinity was considered important. However, a number of factors influenced the capacity for an agency to deliver high-quality scientific information.

In some States the word 'research' has had negative connotations, presumably from an inference that it equates to pure research, which should be performed by academic institutions rather than a conservation agency. In some cases this resulted in the removal of 'research' from organisational charts and substituted with 'science', which seemed more acceptable.

However, with the emergence of contemporary issues such as vegetation clearing and salinity, there appears to be a renewed acknowledgement from Governments of the need for high quality science to inform decision-making in contentious issues. This has been associated with an increased investment in information management. In Queensland, for example, the Smart State initiative has seen a renewed support from Government for the sciences, particularly health, agriculture, natural resource management and biodiversity (QLD, 2005). (Western Australia also has a particular commitment to the sciences as demonstrated through the Premier's Science

Council (WA, 2005) and through recent initiatives inviting expressions of interest into a major research facility for the State.)

In some agencies, the scientific and information management effort was centralised into a single branch, while in others it was fragmented across different parts of the agency. In these situations, data management and integration issues were prominent.

4.1.3.1 Science staff and corporate data

In many of the agencies visited, there were particular issues associated with science staff. While there was a recognised need to allow sufficient time for findings to be published, it seemed difficult for some scientists to treat their information corporately. Subsequent attempts to incorporate original research data into a shared, corporate environment often failed. Reasons cited included a concern about relaxing control of datasets (see the section *Data maintenance and custodianship*, page 21), and a lack of available resource for maintaining data beyond project funding (see related discussion in section *Project life cycle*, page 39).

Other contributing factors included funding contractual limitations, the lack of an adequate corporate environment in which to lodge data, and a lack of interaction between science staff and information management staff.

4.1.4 Rare and endangered species and communities

Each agency paid specific attention to rare and endangered species and, in most cases, communities, and a number of systems and processes were in place to collect, assess and manage the data as well as mechanisms for providing information to clients. However, the mechanisms for assessing the degree of threat, and the information systems and activities to support them, varied from State to State.

In one example, the Federal Department of Environment and Heritage maintains the SPRAT (Species Profiles and Threats) database of threatened flora and fauna species and communities of national significance (DEH Canb, 2004) listed under the Environment Protection and Biodiversity Conservation Act (1999).

Other examples include Queensland and Victoria: the use of Regional Ecosystem (Sattler & Williams, 1999) and Ecological Vegetation Class (DSE, 2004) boundaries play a key role in many information systems in assessing threat to species and communities. In the case of Queensland, the Vegetation Management Act (1999) dictates a specific percentage of remaining area of a regional ecosystem for it to be classed as threatened. In this situation, the Act effectively dictates a range of activities and supporting information systems to comply with the terms of the Act.

4.1.5 Natural resource management

The Natural Resource Management (NRM) process currently plays a major role in the management and acquisition of biodiversity information within Australia, and all conservation agencies visited had specific programs and systems in place to address NRM requirements. NRM groups are generally net users of information, and are reliant on agencies to provide that information.

As an illustration of the impact of NRM requirements on agency systems, one of the key spatial layers required was vegetation. Although vegetation might be considered a biodiversity layer, responsibility for its mapping varies from State to State. In some States this function was undertaken by a primary production agency. Where this occurred, significant problems and challenges had arisen. Different policy drivers within each agency result in data and systems integration issues, reflecting the fact that NRM also had a range of drivers relating to sustainability and production. This contributed to a degree of agency overlap that had significant implications for how information systems were implemented and managed.

4.2 Gathering and managing data

Given the array of drivers described above for conducting research and gathering biodiversity information, agencies typically implemented a range of programs designed to provide baseline data that could be summarised and transferred into either operational activity or stored in knowledge bases for informing a range of clients.

However, there was a wide disparity in the effectiveness of the pathway between information gathering and information dissemination. Some factors were more significant than others in determining the effectiveness of that pathway. These are described below.

4.2.1 An integrated information environment

One of the most important requirements for an effective conduit between activities and outputs is a policy and standards-driven environment for gathering data in a consistent manner, and a suite of integrated information systems that fully support and recognise the kinds of data being collected. These systems should answer the kinds of questions that prompted the data gathering in the first place. Such information systems should be able to reuse data in a variety of contexts, and the answers provided to specific questions should be repeatable and consistent.

In the agencies visited there were a number of components to such an environment. Firstly, there was usually a range of high-level committees comprised of science or business staff, and senior technical personnel. These provided an essential function in vetting projects on the basis of relevance to core business, relationship to existing systems, and impact on IT infrastructure. In Victoria, the recent appointment of a Chief Information Officer was seen as a key position in coordinating the development of new information systems, with a specific emphasis on anticipating future business information needs and the systems that would be required to support them.

Secondly, there was an essential mix of standards, policies and procedures that covered the project development cycle, from data gathering activities through to decision support systems.

4.2.2 Standards and policies

Integration cannot be achieved without standards. Those agencies that had a well-developed set of standards were also the ones with the most integrated environments. This, in turn, enabled them to develop a wide range of applications that could more effectively satisfy a wider range of clients with more timely and consistent information.

Standards and policies were applied to a whole range of activities, from survey methods to application development to information dissemination. In the agencies visited certain standards and policies were particularly effective in helping achieve an integrated environment.

4.2.2.1 Data collection

Some agencies had a well-defined and explicit set of standards for capturing survey data, whether for vouchered specimen data or sight observations. Those standards applied to agency staff as well as consultants and the general public. In addition, some States had developed data collection tools that enshrined those standards. This resulted in data consistency across a wide range of activities and facilitated the merging of data into a single repository.

While national standards exist for various aspects of survey data, there is no one standard covering everything and each agency appeared to have developed its own. However, there was significant pressure coming from environmental regulatory agencies for data collected as part of environment impact assessments to be provided in a consistent format (and, where possible, vouchered).

In a couple of agencies there was a well-developed concept of “sites of significance”. In recognising sites that might contain permanent quadrats, research plots, or other features that required ongoing site visitation, a set of standards was developed for managing these sites on a State basis. These standards were used by both agency staff and consultants alike to identify and manage sites of significance. In agencies where no such standard existed there was no way to

explicitly register that collections or observations made at the same site were, in fact, the same physical site, except by inference.

4.2.2.2 Data storage and distribution

Data storage was regarded as a major issue by the various IT sections within each agency. Data volume affected the ability of data to be adequately protected and distributed. As legislative and client demands for information increased, so did the volume of data to be stored, backed up, and distributed to various regional centres. A number of technological solutions now presented themselves that provided increased data capacities by orders of magnitude, but the logistics involved in managing the logical organisation of the data, and the distribution of large datasets over limited bandwidth, presented major challenges.

For many agencies, part of the answer lay in the adoption of industry-standard Storage Area Networks and the implementation of fast wide-area network connections between centres. In one agency, the adoption of one megabit or higher connectivity between central and regional sites was regarded as a high priority and a corporate project affecting all parts of the agency rather than just those sections willing to spend the money.

In South Australia the implementation of terminal services provided an alternative to high bandwidth requirements by largely centralising desktop functions on a central set of servers. Even regional nodes were connected to the same central servers. In this model, PCs effectively acted as dumb terminals, and bandwidth was only required to update screens. While the South Australian model does have a number of advantages through centralising file storage and desktop applications, this model will not suit all agencies as the initial investment is considerable, and there are many situations where staff legitimately require localised, individual processing.

4.2.2.3 File and data organisation

Even with sophisticated and high-capacity storage facilities, without adequate data organisation access to relevant information could become worse rather than better. While it is feasible to create more folders, more databases, more tables, if the location and content of information is disorganised then that information is effectively lost.

In response to this, some agencies have invested much effort in developing solutions at both a file and table level. One particular exemplar was Queensland, which had implemented a project called *Enterprise GIS*. This project was effectively a multi-faceted system for naming and organising spatial objects according to international standards, and a methodology for mirroring (or copying) those objects in a transparent and automated manner to regional locations. This resulted in a standardised map symbolisation and naming convention that all parts of the Department adhered to.

The meaning of fields within data tables is yet another level of detail that requires consistency if integration is to be achieved. Fields that referred to the same entity should be called the same thing. Codes used to classify the values of an entity should be standardised for consistency.

One agency had started the complex task of developing a corporate data model to document the relationships between key datasets. This was regarded as a difficult but essential task so that future projects might avoid creating datasets that duplicated or clashed with related existing datasets.

4.2.2.4 Data documentation

In every agency visited there was a clear recognition of the need to maintain descriptive information about data (ie metadata), including data quality, genealogy, purpose, etc. However, each agency seemed to implement a different solution for how metadata should be managed and published. Contributing factors to this situation were a lack of standard tools for capturing metadata and a lack of integration between those tools and commonly used spatial data softwares.

Interestingly, despite the attention paid to developing standards for directory structures, with the exception of DSE in Victoria no agency appeared to have yet developed a corporate data register,

documenting what datasets the agency owned or where they were stored, nor a data dictionary documenting individual table columns.

4.2.2.5 Data analysis

A corollary of an integrated environment is that there should be a single point of truth for any given dataset. Rather than having uncoordinated duplicates of the same data table, there should be one corporate and official version of the table used for analyses, distribution, etc.

The Environmental Protection Agency (EPA) in Queensland has built on this approach with respect to data analyses. To avoid situations where disparate answers resulted from different parts of the organisation analysing the same (or related) datasets, the EPA provided a standard, online set of analyses for commonly requested questions (eg the number of plant species in a national park).

4.2.2.6 Application development

A major impediment to maintaining a single point of truth and an integrated corporate data environment was the unregulated development of applications. On the one hand, agencies typically had capable staff who could develop applications to fulfil a particular function. On the other hand those applications were invariably implemented in ways that did not comply with corporate application standards.

The result was that applications did not receive appropriate scrutiny and endorsement from senior management via a business plan or relevant committees; non-optimal solutions were implemented that required substantial maintenance; versioning problems arose; and technologies were implemented that were not supported by Departmental infrastructure. The unregulated development of applications resulted in staff contributing increased and unsustainable resource to an activity that was not necessarily their strength or core business. Furthermore, there were potential liability issues if incorrect data were presented, or the application failed through inadequate approval and development procedures.

As an example, most agencies reported a proliferation of Microsoft Access databases and applications being distributed over the network. These applications were often developed as a localised response to a specific need, and written within a single user, desktop environment. However, where there was a demand for that database from other staff, or where the application supplied particular functionality not already catered for, it developed a life of its own, crossing the divide between a single-user project database and a multi-user, corporate database application. Unfortunately, the distribution / update process was often *ad hoc* and uncoordinated, potentially resulting in data loss or inconsistency.

In response to this, a number of agencies had implemented policies expressly forbidding application development except through standard protocols. Additionally, some agencies had implemented firewall rules to prevent Access databases being copied both internally and externally over the network. In other cases, strong discouragements, such as fines, were implemented to prevent applications being copied.

In most States it is now a legislative requirement to maintain adequate records. Thus it was essential that applications go through standard change control processes so that changes could be managed and adequate records kept.

Unfortunately, one of the main reasons staff took up application development was the lack of funds to develop applications through normal corporate processes. This was partly a resourcing issue that needed to be addressed at a senior or executive level within the agency.

4.2.3 Data maintenance and custodianship

One issue of concern, expressed by all agencies, was data maintenance. While the nature of some applications clearly factored in an ongoing data update and maintenance cycle, there were many situations where the need to maintain data was not recognised. For example, species-based datasets used the species name as a means of identifying records. However, improved taxonomic

knowledge invariably changed the usage of names, and this affected data currency. Also, no dataset is free from errors. Where source data were published, scrutiny of the data would inevitably result in user feedback. This was particularly the case with spatial data and the proliferation of online mapping systems. In some cases this feedback could be ignored. In many cases it could not.

Conceptualisation and funding of data gathering projects rarely took into account the cost of data maintenance over the long term, or left that responsibility to another part of the agency. Scientists involved in major funded survey projects generally ceased any commitment to data maintenance on project completion. To some extent this was understandable if the funding conditions specifically excluded ongoing data maintenance, or presumed that ongoing costs would be borne by the agency.

In many agency discussions, views were repeatedly expressed to the effect that taxpayers expected better value for money from major survey projects, given that data collection was expensive and often unrepeatable, and that a component for data maintenance should be a standard part of any funding arrangement to help preserve that investment. Concomitant with this, the agency should also be prepared to support the data maintenance process by having suitable systems for storing and managing the data. Secondly, data maintenance was one of the key responsibilities of a data custodian. Without adequate custodianship, datasets inevitably lose reliability and scientific value.

In Victoria, the notion of ongoing custodianship was built into data collection activities. Firstly there was an expectation that data maintenance was the responsibility of the custodian. When consultants undertook survey projects, they had access to a complete copy of the Flora Online database, a comprehensive atlas of Victorian flora records, as part of the survey project. In this way they could benefit from existing knowledge whilst at the same time targeting gaps. Secondly, conditions for data access included a commitment to provide the Department with a copy of all records collected *and* a commitment to maintaining data. This arrangement benefited both the State and the consultant.

In other agencies, a somewhat cynical view was expressed that, prior to the implementation of online systems, scientists had relied on the lack of systems to avoid data scrutiny and consequent data maintenance effort. With the advent of wider scrutiny through new online systems, a new approach to custodianship was required.

4.2.4 Data archiving

One of the key drivers for initiating this study was the need to ensure that data collected through research activities were properly lodged, archived or warehoused in an appropriate environment. Surprisingly, none of the agencies visited had any specific arrangements in place to ensure the capture of data into a corporate environment on the retirement or departure of research staff.

In some cases this was a recognised problem that needed to be addressed. In others this was not considered to be a problem because of the explicit arrangements in place when research staff undertook data collection projects. In these cases, there was an understood obligation and commitment from research staff to provide their data to centralised information management staff upon completion of the project and publishing of results. Of course, this presumed an already established repository or Atlas-like system for data to be warehoused or published in.

4.2.5 Knowledge management

The term ‘knowledge management’ produced a variety of responses when brought up in discussion. In some cases it was interpreted as being synonymous with information management. In other cases it was interpreted as a *Knowledge Management System*, a specific class of software that indexes a range of different document types over the agency Intranet (and possibly beyond). In some cases this was associated with a controlled vocabulary search, while in others a simpler keyword search akin to Google.

None of these interpretations was actually the intended meaning of the term when brought up in discussion - it was clearly an analogous term needing clarification. In the context of this study, 'knowledge management' was used simply as a way of assembling all that was known about a particular topic eg what do we know about species X? That knowledge may be held in a number of different areas – in databases, in Word documents, in people's heads. The intent of the question was to elicit what attempts agencies had made to bring together all the relevant knowledge on specific topics or themes. Yet it appeared that most of the answers related to *document management*. Document management systems (DMS) help find documents (possibly even database records) through sophisticated searching mechanisms. It is not clear to what extent DMS were used in each agency – presumably each had some kind of electronic document and records management system (EDRMS) that supported that function - but there was no discussion to what extent there was any integrated system for gathering knowledge on a topic across the different areas mentioned above.

DMS or EDRMS are one way of assembling knowledge. Another mechanism is a library. It appears that in every agency, the libraries were seen (and saw themselves) as a separate entity to the information and knowledge processes of an agency. This was despite the fact that libraries documented and archived research results, and used information systems to manage their data.

Other tools used to assist in the knowledge management process included *content management systems*, which helped facilitate and regulate the publishing of content on a corporate web site. There was, however, a wide disparity in the use on content management systems, both across and within agencies.

4.3 Information systems

In response to the outputs and outcomes required from an Agency, a number of projects or activities are undertaken that are intended to provide those output and outcomes. Where information and decision making is required, raw data must be collected and compiled. It is the role of information systems to support the transition from raw data to relevant information and knowledge.

In discussions with agencies, it was argued that projects and activities should not be implemented without a clear definition of what outputs were required. Because of the increasing demand for information and expectations of clients, information systems were the determining factor in achieving those expectations. Project design therefore needed advice from output purchasers, data collectors and systems designers at the project start. This was rarely the case. Research staff often lacked sufficient understanding of information systems and minimised that part of the project, using traditional methods for disseminating research findings (eg journal articles, books). Many projects were designed with little or no forethought about how the data would (or should) be used after the traditional paper publication process.

Given the underestimated importance of information systems to the success of a project, many agencies had developed some key principles in assisting the development and implementation of information systems. In particular they focused on the relationships between clients and information specialists, and ways in which bridges could be built.

In addition, some particular information systems were reviewed for their strategic value to the agency.

4.3.1 Bridging the gap between business requirements and IT solutions

In most agencies there were at least two groups involved in developing information systems to support outputs: clients and IT sections. In the first instance, a client proponent would conceptualise a project. Depending on the agency's corporate policy on application development, the client might directly approach a developer to provide a solution. This was often the case for smaller projects.

However, for larger scale projects that depended on agency infrastructure, the corporate IT section was generally required to participate, sometimes to assist in developing project specifications, and perhaps some project management, and occasionally some application development (though this was more often outsourced to a private consultant).

Because small, desktop projects invariably grew to providing a corporate function, many agencies encouraged staff to submit projects through a standard corporate development process, again involving the IT section.

In every agency visited, however, there was a difficult, and sometimes tense, relationship between clients proposing a specific project, particularly those involving biodiversity data or some kind of spatial application, and IT staff. Invariably, clients would have a partially developed idea of what they wanted, but were unclear as to what was possible and how their project might (or should) fit within the agency as a whole.

On the other hand IT staff, while conversant with standard business applications, generally had limited business knowledge, and limited experience with spatial systems and the peculiarities of managing or analysing biological data. IT Staff were generally recruited to maintain standard or generic functions such as LAN/WAN maintenance, email, file and print services, and some support for corporate administrative applications such as financials or human resources. Thus, they tended to mould projects into a commercial business paradigm rather than the more complex biodiversity information / GIS environment. This left little resource available to service the proposal, and inevitably saw the priority of non-generic projects downgraded.

Complicating the situation further, IT staff tended to be itinerant, partly because of the nature of the industry and the high demand for generic skills across many businesses, and partly because of deliberate recruitment practices. Each IT section tended to have a relatively small number of permanent staff, and a larger number of outsourced positions. This was partly due to the need for IT specialists to be aware of, and implement, best-practice industry standards. It was difficult, and possibly unreasonable, to expect permanent staff to have that same currency of specialist skills. Using consultants was therefore a way of utilising current knowledge and skills.

However, this led to some undesirable outcomes:

- IT positions lacked a detailed business knowledge of the agency
- Training of, and investment in, IT personnel to understand core business was often wasted
- Clients did not always get the product they wanted
- A lack of IT support or expertise in maintaining GIS infrastructure or publishing spatial data
- A duplication of resources by GIS or science sections performing their own maintenance functions
- A lack of change control standards within applications that were not standard commercial business ones
- A lack of continuity because of rapid turnover of IT staff

Two or three agencies had recognised and partially addressed this problem through deliberately cultivating staff positions with specific experience and understanding of the agency's core business *as well as* a detailed and strategic understanding of information technology.

Such positions would typically involve staff with a commitment to, and at least five to ten years (ideally ten to fifteen) experience across different aspects of, the organisation. These positions were senior (at least level 7 in WA public service terms), to help retain staff. The positions were typically entitled 'client services manager', or 'business development manager', and their role was to facilitate client satisfaction by helping them clarify what they wanted, translating their requirements into a comprehensive project specification that met industry standards, and liaising with the IT section to ensure that resultant systems would actually work.

4.3.2 Role and placement of GIS capability

The role and placement of an agency's GIS capability varied across agencies. In some cases, that capability was largely centralised within a single branch. In others there was a central capability and a number of smaller loci within other branches. In some cases, GIS staff, while administratively part of the central capability, were physically located within regions. Sometimes these different centres duplicated effort, sometimes they worked collaboratively, but always a degree of incompatibility in how data were managed.

By virtue of its organisational placement, most GIS capability was branded with the nature of the work – primarily biodiversity and estate management, analysis and publishing. In only one agency visited was the GIS capability primarily located within a corporate services branch. Whether aligned with a science capability, or NRM activity, most GIS branches had biodiversity and estate management as their core business.

This was reflected in their recruitment strategies. While some staff were GIS technological specialists, many were also trained biologists with a particular interest in spatial analysis. Managers saw this as an essential part of their overall skill base.

Where agencies had central GIS branch staff physically placed within regions, local staff were less likely to undertake specialist mapping themselves and more able to focus on their core business and strengths. In conjunction with suitable web-based mapping capability (described below), regional staff were more able to undertake their GIS requirements without being trapped in a cycle of becoming amateur technologists whilst lacking the time to perform their primary functions.

Another strategy employed by most GIS branches was the consistent use of externally sourced GIS specialist skills. Rather than expect staff to keep abreast of all technology changes, external consultants were used to implement most major projects. However, rather than awarding a tender to different applicants on a project by project basis, some agencies chose to award a tender to a consultancy for a fixed period, and on an hourly basis. This encouraged continuity so that, over time, the consultancy developed a detailed understanding of the agency's business requirements. On the downside, this left the agency open to an element of risk that the consultancy might not continue in business.

4.3.3 High level support for information management

Of the agencies visited, some were particularly effective in integrating systems and organisational processes. In these agencies the role of senior and executive management was observed to be crucial. Agency staff discussed two particular areas where senior management influenced how information management was performed: the implementation of standard policies and procedures, and the issue of resourcing.

4.3.3.1 Policies and procedures

In the case of standard procedures and policies, documentation, enforcement and compliance were key components. If there were not a strong message from senior management that they supported and endorsed standards, staff would see little reason to comply if they thought it wasn't in their interests to do so. If there was insufficient positive communication about standards compliance, and if no action was taken when standards were breached, then traditional behaviours would continue.

This was no less the case in matters relating to information management. If senior management was seen to not just passively endorse, but actively encourage, best practice through their own behaviour and that of their immediate managers, then staff would quickly understand the relative importance of this issue and act accordingly.

Two agencies, in particular, had high-level management that clearly embraced and supported information technology and demonstrated a clear understanding of its capability when applied with best-practice methodology. That created a flow-on effect to other staff, who were more motivated to see how information systems could be used strategically in their organisation. Examples

included the use of their collections databases in high-level decision-making, such as environmental impact assessments, as a matter or course rather than innovation.

4.3.3.2 Resourcing

While not the only issue requiring attention, the way resourcing was handled determined how information was regarded and managed within the agency. Where there was an expectation that information systems were not regarded highly or understood well by senior management, projects which may have had a strong business case and intrinsic merit were less likely to be submitted. This was not so much an issue of overall resourcing within an agency, but the relative prioritisation of resources.

Some agencies well understood the importance of information systems in achieving business goals. Thus project proponents, rather than scaling down potential projects with a more likely hope of success, were able to accurately cost what was actually needed. While more money was spent on information systems, those systems were more likely to achieve their intended functionality.

The converse of this situation was that the true cost of implementing a functional system was both underestimated and under-resourced. This left senior managers with an unrealistic impression of the true cost of IT systems, and they were therefore less willing to countenance more realistically scoped and accurately costed proposals. It also exacerbated the proliferation of desktop solutions where there was little expectation of a good, but more costly, project being funded.

4.3.4 Key applications

After reviewing the various agencies and their in-house applications, some applications stood out as being of high strategic importance. A degree of commonality in some applications also became apparent. These are discussed below.

4.3.4.1 Web databases and web services

All agencies hosted databases over the Internet, and all but one provided that capacity using agency infrastructure. The only exception was one agency hosting its data on a third party government facility through lack of support from its own IT section.

Another key technology yet to be implemented by any agency, but cited as the subject of research and testing, was that of web services. Web services are a means for applications to talk to each other over the Internet. For developers, this is a way of integrating databases without having to customise firewall and security rules.

Web services were seen as a key strategy in the provision of integrating mechanisms for databases across agencies with disparate systems. Most agencies had already identified applications that could only be achieved effectively through web services, and there was a commitment to implementing that technology in the short to medium term.

4.3.4.2 Atlas systems

All visited agencies provided some kind of online mapping capability. In Queensland, New South Wales, Victoria and South Australia, this included a full Atlas capability showing point distributions of collections, survey data and public contributions. The Federal DEH focused only on EPBC species through their SPRAT database. With the exception of Queensland and South Australia these systems were visible over the Internet, though Queensland had an expressed commitment to make theirs accessible via the Internet in the short term.

4.3.4.3 Standardised ecosystem administrative boundaries

Both Queensland and Victoria had developed a set of boundaries with a combined biological and administrative function. In both cases their boundaries were a composite of IBRA regions, landscape and geology, vegetation mapping through aerial photography, and floristic associations through on-ground survey.

While their respective methods differed (and were the subject of debate within scientific circles), these boundaries provided a useful and appropriately scaled mechanism for regionalising the landscape for both conservation and administrative purposes.

4.3.4.4 Maps on the web

Two States had independently implemented a similar functionality called *Maps on The Web* in Queensland and *BioMaps* in Victoria.

A user could nominate an area of interest, either by lot number or map sheet number. By clicking the Submit button they would be emailed a message containing a link to a map. The map was stored as a medium to high resolution PDF file that could be downloaded and printed on a medium to large format printer.

While simple in conception, this application was an exemplar of the 80/20 rule. ie 80% of the time people only require a very basic functionality. If this could be addressed through an easy to access mechanism, then a very high benefit to cost ratio could be achieved.

In this particular situation, staff were not required to have any GIS expertise. No specialised hardware or software was required (except for an appropriate printer), and the map produced was of similar quality to that of standard topographic maps.

4.3.4.5 Sites of significance

Although only demonstrated in Victoria, this application had high strategic significance and should be an essential part of any integrated biodiversity information system.

The application *BioSites*, a database of sites of interest, documented sites of significance to a number of different activities within DSE. While the definition of ‘interest’ varied, each site gained a unique ID and a set of attributes relevant to a particular activity.

While simple in concept, this facilitated the managing of research plots, long-term monitoring sites and a range of other applications. Used in conjunction with survey activities and management follow-up, as it was in Victoria, it was a powerful way of retaining knowledge of sites that required ongoing attention.

4.3.4.6 Actions for biodiversity conservation

DSE in Victoria, in response to legislative requirements, had developed a system called Actions for Biodiversity Conservation (ABC). This web-based database system aimed at documenting management actions at key locations for a species, community or threatening process. It recorded details of what actions and been done, by whom, and results. This provided a very effective means of communication of on-ground actions and outcomes, and facilitated the prioritisation and more effective use of management resources.

5 Discussion and recommendations

This section discusses ways of improving information management and delivery within CALM, based on the experience gained on the study tour. However, rather than providing piecemeal suggestions, an attempt is made to provide a cohesive set of recommendations covering related aspects of information management within the Department. While key findings have been presented in a somewhat generic manner, it is important that final discussion and recommendations for CALM be specific and candid, so that CALM, *and* contributing organisations, might gain some tangible benefit from the study tour. The intention of the following discussion is to offer suggestions and recommendations in a constructive manner.

Many issues are complex and there is no one solution. In other cases, there are aspects of Departmental organisation that can only be changed in the longer term. Thus, where possible, options are provided.

It is also intended that the findings of the report be presented to a wider range of CALM staff to encourage discussion.

As with the key findings section, discussion and recommendations are grouped under the three headings, organisational context, data collection and management, and information systems and technology.

5.1 Organisational context

This report aims to recommend options and suggest a strategic direction for improving our level of integration between, and availability of, our information systems so that we are more effective in our decision-making and so that operational staff have relevant, timely and sufficiently detailed information to undertake core business. As stated many times in this report, it is impossible to achieve this without considering our organisational context.

5.1.1 Strategic use of information technology

After visiting and reviewing five other conservation agencies at both State and Federal level, the view was reached that CALM needs to use its information systems in a more strategic manner; in particular, to improve its support for biodiversity information systems.

In comparison with other agencies, our support for applications directly supporting core business is weak, relative to mandatory functions such as financials (see the section *Affirming core business* on page 34). Some examples are cited below that demonstrate this point, as well as the relative immaturity of information systems in CALM:

- The Declared Endangered Flora system (DEFL), with which this author has had personal involvement, languished for many years with little or no financial support. Though this corporate application plays a major role in the Department, and is widely used in managing gazetted and priority flora, and though there were many requests for improved functionality, it nevertheless received little support. Only recently was funding made available for the application to be ported to a new environment, primarily because the old environment was obsolete and CALM would incur heavy maintenance costs. A new specification is currently being developed for a substantially enhanced application, and in-principle support has been received from output purchasers.

  In comparison, a number of other States have online systems supporting threatened species and communities with a high degree of functionality.

- CALM has made an initial foray into providing online, spatial services (only Intranet at this stage) through the EcoBase project. EcoBase is gradually progressing to a production stage after a considerable time in development and testing. Much of this time has been taken with the adoption of a new technology for CALM and an associated learning curve. Strategically this is an important project, and its implementation is only the start of CALM's

move towards corporate spatial data repositories and online systems. EcoBase is the first application of its kind in CALM, and receives a total (permanent staff plus consultant support) commitment of approximately one FTE. EcoBase has been supported from within Corporate Services Division but as yet has no formal purchaser support.

In comparison, other agencies have a well-developed experiential base for implementing such systems, and have had so for some time. In other States, the deployment of online spatial services is common, and IT and GIS sections have extensive experience in implementing database and spatial applications online.

- CALM is yet to develop a centralised repository for its survey and species distribution information, and there is, as yet, no production application for publishing that information to the web. There has been a trial project to provide similar functionality through *NatureMap*, an application developed within Science Division. While it has received limited Divisional support, it is yet to be developed as a corporate-level production system available internally and externally.

  All other agencies have some kind of corporate repository for displaying point records of species distributions online, such as the Wildlife Atlas in NSW and Victoria, as well as a variety of online systems featuring other Departmental corporate data.

- To date, FloraBase, an application that publishes information about WA's flora, is the only CALM application that publishes biodiversity data online to the Internet, and this it does, apart from some minor exceptions, without specific tied funding.

  In all other States, the publishing of corporate data to the web is common.

There are a number of possible reasons why CALM is in this situation.

- It may be a reflection of historical priorities set by previous generations of management that had difficulty accepting the use of information technology into the workplace. This is a cultural legacy still reflected in parts of the organisation.

  Any change to this situation needs to start at the top. The most important message that upper management can deliver is that the strategic use of information management is essential in achieving our core business goals, namely to conserve biodiversity and manage our estate. Rather than seeing IT as a necessary evil, it should be promoted as a fundamental part of how we do business and deliver outcomes. IT should not be regarded as 'special'. It should be normal, like telephones, and electricity and photocopiers.

  This situation has been improving in recent years, evidenced by the recent support for purchasing GIS infrastructure by Corporate Services Division. Another example is the recent acquisition of a corporate-level Electronic Document and Records Management System (EDRMS). This was purchased, not just because of legislative obligations, but also because of a sound business case for acquiring a capacity to improve our knowledge management in the organisation. Nevertheless, there is still substantial ground to be made up in recognising the strategic value of using information systems to help conduct our core business.

- The current implementation of the *purchaser / provider* model may be exacerbating the situation. Many applications of information technology involve both a common infrastructural component as well as specific functionality. If can be difficult to separate these components. This, in turn, makes it difficult for purchasers to purchase just that functionality relevant to their Output without subsidising the other Divisions. Thus, even relatively simple applications may not be purchased if there is any significant impact on infrastructure.

As stated above, some major infrastructural components for managing and hosting spatial data online have been purchased through the initiative of Corporate Services Division (which is also responsible for supporting administrative functions such as financials, but is itself a provider Division). A greater degree of buy-in from output purchasers is highly desirable, so that infrastructure is more adequately funded *and* is more likely to meet the future needs of output purchasers. Yet it is difficult to see how this can happen through the current model, where purchasers focus primarily on their own output.

R1 Corporate Executive actively promotes and encourages the strategic use of integrated information systems as a mechanism for achieving our core business goals.

Ways of achieving this include:

- R1a Implementing CALM policies that support and affirm the strategic role of information systems, and mandating standards and procedures developed by EIMC and other relevant groups
- R1b Affirming the need for a strategic group to advise on policies, and a separate technical group to focus on procedures and standards for information management and application development across CALM
- R1c Providing, via output purchasers, increased financial support for specific, high profile projects that benefit the Department as a whole
- R1d Encouraging and recognising staff who develop innovative solutions for integrating our information systems
- R1e Publicising the need for integrated systems through the standard channels of internal and external CALM publications

5.1.2 Role of Executive Information Management Committee (EIMC)

The EIMC is a high-level committee with the role of overseeing Departmental activity relating to information management, providing guidelines and policies and informing Corporate Executive, through the Director, Corporate Services Division, on major issues (see *Appendix 2 – Executive Information Management Committee Terms of Reference* on page 50). While, in theory, all Directors are members of the committee, in practice they are mostly represented by delegates.

The original charter, developed and endorsed by Corporate Executive in 1998, specifically included a strategic role in overseeing and approving projects to ensure the achievement of CALM goals. It also tended to have primarily a review function, and shows the EIMC reporting to a single Director, Corporate Services. More recently, a new draft terms of reference document for EIMC has been developed which appears to have reduced the oversight and approval role, with a greater focus on technical issues (though with an increased proactive role).

It is essential that EIMC contributes to all major corporate projects by assessing the implications of projects across the Department, providing advice and ensuring that projects are integrated with each other and supported by the existing IT environment, in terms of a hardware / communications perspective *and from a data management perspective*. Part of the committee's role is to ensure that projects, from an informational perspective, promote the core business and objectives of the Department. This is clear from the current terms of reference.

However, the EIMC does not appear to have assumed this role in a consistent manner. Most discussion is concerned with technical issues such as network infrastructure, equipment replacement programs, and desktop infrastructure. As important as these issues are, it is equally important to discuss agency business at a strategic level, assess the implications for information management, and have an opportunity to assess or comment on business plans for new initiatives.

However, there is currently little discussion from a business perspective ie. vetting or commenting on new, or interrelated, projects at a business level. While there is opportunity for Divisional representatives to present status reports on Divisional activity, in the absence of Directors this is

primarily informational. And reporting to only one Director limits the scope of EIMC to influence policy in a corporate manner.

EIMC should be able to ask questions such as “Will this project actually achieve what it sets out to do? Does this project promote the Department’s goals? How does this project relate to other projects? Does it comply with standards?” EIMC should also take on a proactive role to determine what we are not currently doing and anticipate future information requirements.

Given the current purchaser / provider model, it is difficult to see where else these questions can be asked. It is currently the purchaser who determines which projects get the go ahead (either through their own initiative or through the provider having made a sufficient case). By the time the project comes to EIMC it may have already been granted approval through the *Service Provider Agreement* process, reducing the EIMC’s role to primarily a technical one. There is benefit in the proponents of major projects utilising the considerable combined experience of EIMC members at the conceptual stages of project development, rather than presenting an essentially *fait accompli*.

There are also issues with current Divisional representation. Marine Branch, which comes under Nature Conservation Division within CALM, is a major user of GIS systems, has substantial experience in managing a wide variety of marine-related datasets, and is involved with high profile projects involving information systems. Yet Marine Branch has not had representation within EIMC, nor has EIMC had the opportunity to discuss with Marine Branch how these systems might interact with other CALM systems or affect CALM infrastructure.

For EIMC to adequately take on the role of assessing projects, it must also have the appropriate skill mix within its membership that can comment from both business and information management perspectives.

In 2003, after the start of the EcoBase project, a new steering committee was formed to help guide the project (see *Appendix 3 – Spatial Information Steering Committee Terms of Reference* on page 34). The purpose and scope of the committee was strategic: to set standards and policies, ensure interoperability between future applications based on the EcoBase infrastructure, and to ensure the effectiveness of applications in carrying out core business. This committee has subsequently taken on a strategic and approval role similar to the one advocated above for EIMC.

The strategic and planning function is distinct from the implementation function, and requires different expertise. These roles appear to have become confused between the two current groups. A more effective arrangement would be for EIMC to focus just on the strategic, planning and approval issues, and for another group to focus primarily on technology, standards and implementation issues. In other words, EIMC should focus on the ‘if’, ‘what’, ‘when’ and ‘why’ questions, while the technology, data and standards group focusses on the ‘how’ question.

R2:	Corporate Executive reviews the current role and terms of reference of EIMC, and implements a process for developing two new groups, one focussing on strategic issues and the other on technology and data organisation.

5.1.3 Putting people in the right place

One key to implementing and maintaining integrated information systems is to have better integrated processes and functions. In some cases this can be as simple as having the right people in the right place.

Having people within the same branch physically together has many advantages. However, with a geographically decentralised agency like CALM, this can be hard to achieve. The Science Division senior management within CALM has already initiated a medium to long-term plan for bringing as many of its staff together under one roof as possible. This will help substantially within the Division to improve communication, more consistently apply standards and develop information systems that enshrine those standards.

R3: Corporate Executive continues to advocate, promote and resource initiatives for consolidating Branch and Divisional structures so that, where possible, staff within a branch are collocated.

Another strategy for achieving better integration is to ensure that staff are appropriately skilled in the data they are managing or analysing. This is a major issue within CALM and there are numerous examples where, through lack of appropriate recruitment and prioritisation, staff lack the relevant background and skills so that some functions are not undertaken, or staff are forced to develop skills outside their areas of strength or job description.

5.1.3.1 Ensuring appropriate science and other skills within GIS section

The GIS section within CALM has a responsibility for managing biodiversity data. It interacts with Science Division staff on a daily basis yet there is not one GIS section staff member with a formal qualification in the biological sciences. This leaves GIS section staff without the capacity to properly interpret or validate biological datasets.

One option is to call for more resources to fund new positions with a biological background. However, this is not always possible, particularly where financial constraints hinder the establishment of new positions.

Another option is to physically relocate appropriately skilled staff from one branch to another. Administratively, those staff would retain their existing alignment, but would interact with local staff on a daily basis. This is a minimal-cost approach (though accommodation arrangements may be an issue) that has already been partly adopted by some Divisions eg the Science Division recently collocated two of its information systems staff within GIS section.

R4: Divisional managers facilitate and, where necessary, resource the placement of appropriate skilled information specialists within GIS section. Options include:

- R4a: GIS section modifies its recruitment policies to favour applicants with a formal background in biology and with a specific interest and capability in GIS data management and analysis.
- R4b: Science Division collocates further science positions with GIS section

It is open to other Divisions to consider the same strategy so that their interests and knowledge domains are more adequately catered for when spatial analysis and management are required.

5.1.3.2 Ensuring specialist information management skills in remote centres

It is not unusual for regional staff to commit substantial time to specialist information management activities even though they may have no formal qualifications or expertise in that area. In the absence of on-site specialists, and the increasing availability of desktop GIS capability, there is the potential for a proliferation of GIS activity across the Department that lacks integration with existing systems, duplication of effort, multiplicity of software environments, and staff working outside their strengths or job description. Some of these issues are evident in parts of the Department.

A recent case study by GIS section saw a specialist placed in the Pilbara Region for a short-term contract to address issues relating to GIS data organisation, versioning, standards and software operation. That contract enabled a number of problematic areas to be partly addressed. However, on contract cessation, regional staff again had to undertake their field-based tasks as well as GIS and LAN administration tasks.

In the case of LAN management, there are examples of senior positions such as regional ecologists and managers taking on LAN administration duties. Rather than expecting untrained staff to acquire sophisticated mapping or LAN administration skills, the Department should resource the placement of specialists in strategic locations to provide that function.

One option for achieving this is for GIS or ISS sections to relocate individual staff to remote centres (GIS section already has two staff located in Bunbury and Manjimup). Those staff would still

answer to their respective sections and would implement Departmental standards within the local environment. However, GIS and ISS sections already have insufficient staff to undertake normal duties, so this option is not feasible.

An alternative strategy is for remote centres to convert an existing field-based or clerical position to a specialist position when the opportunity arises. If a staff member has a substantial proportion of their time occupied with GIS mapping or LAN support, this may be an indication that a specialist support position is warranted. It can also be argued that if information is not being used appropriately or effectively through lack of adequate data organisation or GIS capability, that position might be better utilised as a specialist position so that existing staff can operate more effectively.

In the event that remote centres are able to create such positions, it is essential that those positions come under the joint supervision of both the remote centre and GIS (or ISS) section. This is to ensure Departmental standards are met, and that the latest changes in technology are implemented in a coordinated manner.

R5:	Each remote centre should have on-site, specialist capability to undertake GIS data management and mapping activities, application of relevant data standards, and, where possible, basic LAN and desktop support.

R6:	Managers at remote centres consider the option of converting existing field-based positions to specialist information management positions.

There is no reason why recommendation R5 could not be extended to include a separate position for LAN support. However, given the limited capacity for positions, a GIS specialist is probably more able to undertake basic LAN and desktop support than a LAN support specialist to undertake GIS data management.

Although GIS mapping and analysis should ideally be carried out by specialist positions, this may not be required if sufficiently capable online GIS systems were available at remote centres, particularly those able to carry out routine tasks.

The Department should encourage and support the development of online GIS applications that service basic GIS tasks, which often comprise the majority of GIS requirements. This is also known as the 80/20 rule – 80% of what people want to do can easily be implemented by an online GIS application – the other 20% can be achieved through a specialist. (See the section *Strategic applications* on page 41 for relevant recommendations.) Such an approach might also represent significant cost savings through avoiding unnecessary purchases of expensive desktop mapping software.

5.1.3.3 Bridging positions

Another key position in helping to integrate information are *bridging positions* – staff with a clear understanding of core business as well as information technology. These positions provide a means for clients to articulate their requirements and translate these into the information systems and infrastructure needed to support the client's proposal.

A number of agencies had created such positions to provide that bridging role. These were generally senior positions (L7 or greater) and variously titled *Business Development Manager*, or *Client Services Manager*. Their roles included liaising with clients, developing projects specifications, managing tenders and possibly project management, as well as participating in high-level information management committees (see R2 on page 31).

These positions should be located strategically within an agency. An obvious and essential location is within ISS. However, such a position might also be within GIS section or any other branch having a mandate to manage data associated with core business, particularly biodiversity data.

In some cases these roles are already being performed (eg within Science Division and ISS), though not at the level of seniority advocated above. These positions should be upgraded to recognise the level of work being undertaken and the responsibility associated with the position.

R7:	Corporate Executive supports the creation of (or upgrading of existing) positions to function as business development managers within both ISS and GIS sections, and that Divisional managers convert or recruit existing positions to business development managers as deemed appropriate.

5.1.4 Affirming core business

In no area has there been more change to the modern organisation than in the introduction of information management as a means of doing core business and achieving business goals more effectively. One of the effects of such change can be a lack of clarity about what core business is.

5.1.4.1 Information Services Section (ISS)

As stated previously, IT sections in many agencies lacked adequate capability for supporting GIS software or biodiversity data management. The datasets were not understood, and the infrastructure and software used were often outside their skill base. Reasons for this included a lack of resources, inadequate recruitment policies, and a misunderstanding of core business.

In most IT sections, the predominant services provided include LAN/WAN connectivity, security, email, file and print services. Their major clients are usually those providing administrative or support services ie., financial and accounting systems, human resource systems, records management and so on. These are, of course, services that any large organisation needs, and are typical of a commercial business situation. Without these services a modern organisation could not function, communicate, or be accountable. Most large organisations have dedicated, in-house IT sections to support these essential services, though some outsource specialist technical functions.

In the case of CALM, ISS has a professional relationship with other sections. In my view, and in comparison with IT sections in sister agencies, it does an excellent job in providing IT support, given its base funding, though perceptions of ISS' performance vary within the Department.

However, important as they are, financials and human resources are *not* CALM's core business, though they overlap with and support core business. The core business of this conservation agency is conserving WA's biodiversity and managing our entrusted lands and waters (CALM, 2002). It is therefore essential that ISS be adequately resourced, and adopt appropriate recruitment policies, to provide better support for those applications directly relating to biodiversity data and managing our estate. *Note that the argument is not to reduce resources for essential corporate services, but to provide more resources supporting applications directly relating to core business.*

Because of the nature of the agency, applications managing biological data do not fit the standard commercial mould. Invariably, they involve an understanding of biological concepts, complex analyses and applications, and the provision of data and other services over the web. A*n integrated, one-stop shop cannot be achieved without these capabilities. And they, in turn, cannot be implemented without specialised support from ISS.*

In CALM there is a reasonably widespread perception that, while resources seem to be available for essential corporate services, it is much harder to gain resources for other applications, despite the fact they may relate directly to core business. ISS does its best to provide support for such applications, but is hampered by having insufficient staff with relevant skills. If Divisions are to make a greater investment in information systems supporting core business, ISS must accordingly have increased resources to support those systems. If purchasers and providers are being encouraged to invest in more core business systems, this is going to place a greater reliance on ISS to support those systems, not just from an infrastructure perspective but also from a data management perspective. That will involve ISS staff needing to have a greater understanding of the business rules associated with each application, and therefore a better understanding of

CALM's core business. The need for ISS to integrate better with GIS, CIS and communicate better with CALM's Divisions is therefore paramount.

Of particular note are two roles: the *database administrator* (DBA) and the *data administrator* (DA). The DBA position is responsible for all database installation, configuration, security and backup. All database developers, including online mapping developers, must liaise with this position. As the number of database and mapping projects increases within CALM, a greater reliance is placed on this role for updating and deploying applications. If inadequately resourced, the position can become a bottleneck for all corporate application development within CALM.

ISS currently outsources the DBA role, with a time availability of less than one FTE. This is already inadequate for CALM's current needs as experienced by the delays in getting even basic changes implemented. Some of the basic database administrator task can be delegated to permanent staff. However, of greater concern is the increasing requirement for DBAs to have knowledge and experience of online databases, particularly those with spatial mapping capabilities. ISS cannot adequately meet this requirement at present.

The DA position is responsible for managing the corporate data model – ensuring that fundamental datasets are designed in accordance with existing standards and data. For a data-rich Department such as CALM, this is an indispensable position as it provides the glue helping information systems to share and integrate data. CALM does not currently have a data administrator. Given that ISS has been taking an increasing role in application development, and that it should increase its understanding and support for core business data, it is a logical place for the DA to sit administratively.

R8: Information Services Section be assigned increased resources, and adopt appropriate recruitment policies, to better support specialised information applications such as providing data and web services over the web, and to better support other sections in managing spatial applications and biodiversity data.

- R8a: DBA availability should be doubled to two FTE positions, with one position having specific experience in administering spatial databases.
- R8b: A new Data Administrator position should be created within ISS, with responsibility for developing and maintaining the CALM corporate data model.

5.1.4.2 GIS Section

The GIS section within CALM is currently located within Information Management Branch (as is ISS), which is itself part of the Corporate Services Division. The GIS section is currently responsible for the provision of both digital and paper spatial products to clients (primarily CALM operational staff). Historically, the section has devoted substantial effort to data uptake programs for creating and maintaining primary layers such as conservation estate, tracks and hydrology, and it currently maintains and distributes a range of standard digital layers to CALM staff. More recently it initiated a trial project, EcoBase, to publish spatial layers within an Intranet environment. Additionally, it does some GIS project work on a bureau basis, and provides a high quality paper mapping capability, training and other services.

With the advent of GIS systems and the increased demand for spatial analysis products, there has been a substantial increase in the management of biodiversity data. This, in turn, has required an increased understanding of data content, hampered by the fact there are no GIS staff with a biological science background (see recommendation R4 on page 32).

In this author's view, the GIS section has a primary responsibility to compile and provide spatial and other information supporting conservation and estate management, particularly biodiversity information. While not a data gatherer *per se*, it must nevertheless provide expertise in data content. The alignment of GIS activity with science and biodiversity was reflected in almost every agency visited, where sections were named with words to the effect of "Biodiversity Information Management", and was aligned within the science or NRM sections of the agency. Only CALM and one other agency have their GIS effort located with the "corporates" group.

R9: Corporate Services Division explores ways of renaming or realigning GIS section so that its core business is more self-evident. Options include:

- R9a: Merging GIS section with the Science Division to produce a new entity concerned with both science and spatial information
- R9b: Renaming GIS Section to include words reflecting biodiversity information management

Until recently the GIS section has occupied a primarily service role, responding to requests for products, advocating some standards for GIS mapping but lacking the authority or mandate to enforce those standards.

Concurrently, some CALM staff have acquired desktop GIS capability and undertaken data collection and mapping functions without any clear standards for both data management or application development (discussed further below). This represents a departure from core business, an exacerbation of existing information integration issues and a business risk to the Department.

GIS section should continue its progress in assuming a more explicit leadership role in helping set and maintain standards for spatial data and GIS software, through contributing to the standing working group on technology and corporate standards (see the following section).

5.2 Data and application standards

One of the cornerstones of an integrated information system is the use of standards. Systems need to be able to handle the various kinds of data collected and maintained across different parts of an agency. If datasets are conceptually or logically related, but captured or maintained in inconsistent ways, then attempts to integrate them become difficult and time consuming. This effort may well have to be repeated for each and every new project. For an organisation with limited resources, this practice is unsustainable. It is therefore imperative that a standards-based approach is adopted across as many aspects of data collection, project management and application development as possible.

While preferred development environments have been developed in CALM by ISS relating to application development, there has been, until recently, no process or forum I am aware of for the comprehensive and systematic development of standards and procedures covering spatial applications or data, across all aspects of this agency's data gathering activities and information systems.

An effective way of doing this is to assign working groups the task of developing a set of proposed standards and protocols covering as wide a range of information management activities as is practical, focusing in the short term on high priority business needs. This is particularly urgent given the impending upgrade of RATIS, an information system from Parks and Visitor Services, or new Internet capabilities required by Fire Management Branch through its involvement with the SLIP process (DLI, 2004).

The establishment of a working group to establish standards for application development was endorsed recently by EIMC, focusing particularly on online mapping applications and utilising experience gained through the EcoBase project. This group should ultimately be subsumed by an ongoing technical group with overall responsibilities for developing procedures, protocols and standards for information management in CALM.

R10: Under the aegis of the strategic group, and the relevant and supporting policies from Corporate Executive, a technical group is assigned the responsibility of developing standards and protocols for all aspects of data gathering and information management within the Department. This group should work in conjunction with Divisions to develop relevant, applicable and workable standards and procedures. The resultant standards should be referred to the strategic group for comment and endorsement, and finally referred to Corporate Executive for approval.

5.2.1 Data standards

In CALM, few standards are applied to biodiversity data collection and management. Although *de facto* standards are used within some parts of the organisation, there is no consistent mechanism or repository for publishing or advocating standards relating to a given aspect of data management. Examples include:

- Despite the abundance of, and demand for, survey-based data collected within and for CALM, and despite the existence of national standards, there are no mandatory standards in place for which fields should be collected. This is the case not only for external consultants providing data under contract to the CALM, but also for data collected within the Department.

- Even if surveys are well designed and adhere to strict scientific standards, this does not necessarily ensure that data are well organised or managed. Data management is commonly performed on an *ad hoc* and inconsistent basis, even within the same project.

- There is currently an increased interest in site monitoring, or documenting sites of special interest (eg research plots). Yet there is no standard within CALM for how site-based data should be identified and organised, whether in terms of projects or some other mechanism, and no repository for capturing site-based data across multiple projects.

While individual projects have produced high quality output for the Department, this does not imply results are integrated with existing systems. Where a project is seen as a one-off exercise, with paper publication the primary output, integration has been less of an issue. However, there is an increasing requirement to make data from projects more readily available to a wider client base, and to combine information from multiple projects (see the section *Project life cycle* on page 39). Therefore data need to be organised in a consistent manner in the first place.

5.2.1.1 Survey and opportunistic data gathering

CALM employs scientists with nationally recognised expertise in conducting surveys. In collaboration with other scientists, both internal and external, and with other agencies, CALM could provide leadership by defining a set of common standards for collecting and organising species and community data. This should include both survey and opportunistic data, both vouchered and sight observation data.

R11: Science Division facilitates and promotes the development and use of data collection and management standards for field survey projects. In collaboration with other agencies, workshops and working groups should be set up that will, in the first instance, develop a specification for how general-purpose flora and fauna survey project databases should be designed. These standards should be published and distributed widely.

Many scientific or other staff do not have the specialist skills required to design databases in a corporate, integrated manner. Such specialist skills should be brought in at the inception of every data collection project to ensure that data are organised in order to facilitate their subsequent integration into other systems.

R12: New data collection projects should first be scrutinised and endorsed by a high-level committee with both business and information technology expertise to draw from. This committee should ensure that the project has received specialist data advice and input and that it has also met the conditions described in R17 (page 40).

- R12a Science Division affirms the Science Management Team as the appropriate committee to assess Divisional data collection projects and that it ensure both business and information management skills are drawn on in the assessment process.

5.2.1.2 Species names

Within a species database no single item is more important for integration than the species name. This was a noted area of difficulty in all agencies visited, with a lack of integration between agency systems and Herbarium and Museum species names. The reconciliation of species master lists was often a major project in its own right.

Species names are the result of continuous taxonomic research applied to documenting biodiversity, and are therefore subject to change, particularly when studying little-known groups of organisms. It is essential that species database systems be written to accommodate that change.

The WA Herbarium in CALM is a national leader in the management of plant names, with a well-developed set of protocols and information systems for updating and distributing plant names online. This has resulted in increased integration between plant datasets using Herbarium names and codes.

R13: All CALM applications referring to plant names must use WA Herbarium names and codes, either through directly accessing WA Herbarium systems or using regularly updated products from the Herbarium.

In contrast, a similar situation does not exist for fauna names. Although a fauna names checklist was published in 2001 (WAM, 2001), it has only been digitally available as a Word document, not as a database. The Western Australian Museum has experienced a consistent lack of resources and strategic direction with respect to its information systems, and has been unable to develop its systems to provide names information on a similar basis to the Herbarium.

Because WAM is part of a separate agency, there has been a proliferation of fauna master lists for different fauna groups, and a lack of integration of fauna databases throughout the agency, and probably the State. The WA Museum is the custodian of fauna names within Western Australia and is to be regarded as the finally arbiter where clarification is required.

It is within CALM's interests, as well as the interests of the State, to assist WAM, where possible and appropriate, in developing its information systems. In this way the Museum's fauna names and changes may become entrenched within CALM's information systems and thereby assist the integration process.

R14: Corporate Executive endorses and promotes the development of WAM's information systems, through officer to officer support, so that CALM can better rely on WAM as the authoritative source of names and codes for WA fauna.

R15: Science Division, with the endorsement of Corporate Executive, facilitates the development of web services that will enable integration between WAM fauna names and CALM systems.

5.2.1.3 Data collection tools

A key mechanism for enshrining standards is to develop and provide data collection tools that support those standards. For example, at the WA Herbarium, the **Max** software program has helped enshrine standards by providing name-checking capabilities for WA plants, and providing standard fields for capturing plant specimen data. This tool is used widely across the State.

There has been no equivalent tool for collecting fauna data until recently, through a grant-assisted project initiated by the University of Western Australia (UWA). The development of an online database of fauna returns has now commenced. This, in turn, has required and promoted collaboration between CALM, WAM and UWA on this project. One of the outcomes may be an increased functionality for Max to support the checking of fauna names and capture of fauna specimen or returns data. This will significantly assist data integration within the Department.

There are also current, and well developed, initiatives by an external consultant to develop a standard database for assembling vegetation survey. Other consultants are increasingly using this database as a *de facto* standard for capturing vegetation survey data. CALM has the capacity to lead and collaborate in this process so that consistent standards are applied and tools developed.

Recommendations have already been made for the development of survey standards (see R11 on page 37). However, CALM should further promote the development a standard survey data capture tool in conjunction within existing efforts.

R16:	Science Division facilitates a working group to review existing efforts for the development of a survey data capture tool and work towards consolidating these efforts, based on the standards referred to in R11.

5.2.2 Project life cycle

Every modern survey or other data collection project uses information management technology. IT is involved from the beginning in the design of databases to hold the collected data, in analysis and summarising and publishing data and making it available for further use. If projects are not costed adequately, or if there is inadequate database design, the capacity to integrate the project's results into the corporate knowledge base may be impeded.

The traditional project life cycle has resembled the flowchart depicted in Fig. 2 (dark boxes and lines only).

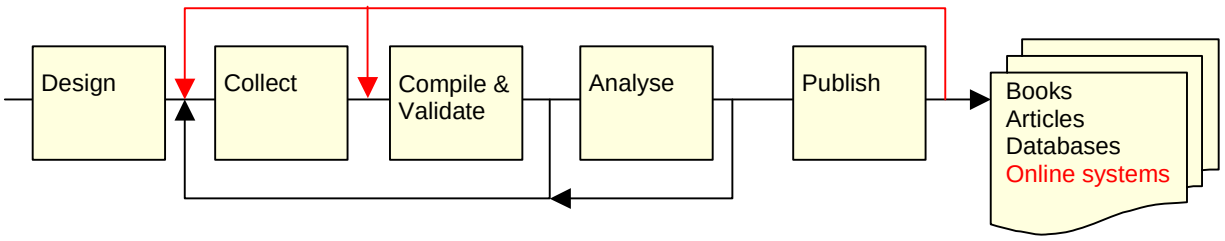

Figure 2. Project life cycle

The premise of this model is that the project is complete once the results are published. The primary outputs include formal reports or peer-reviewed publications, sometimes a database, and, for CALM, some conservation management advice and outcomes.

However, with the advent of personal computers, easy to use software and the Internet, and an increasing awareness of the value of information systems in decision-making, there is an ongoing demand for the data to be used in other applications, or for statutory archival purposes.

Over time, data accessibility and archiving become an issue as storage media become obsolete. If the primary output was a paper publication, the original data often become difficult to access, and are frequently discarded or become irretrievable.

Given the modern requirements for increased access to data, and the increased likelihood of new applications requiring those datasets, a more realistic model is *that which includes the lighter lines* in Fig. 2. Note the loop from publishing back to data compilation and validation, and possibly even data collection. In other words publication is no longer the end of the project cycle. *Online systems make publication a continuous activity.* Through increased data access and scrutiny, feedback may result in data being corrected, or further data being collected (ie gap analysis).

FloraBase has had a continuous publishing model for many years. Through exposing the underlying database to wide scrutiny there has been a significant investment in maintaining the database, a cost that is borne through existing resources.

The current project approval process within the Science Division and elsewhere does not adequately take this into account. Every new project funded through a one-off grant invariably saddles the Department either with the choice of the project ceasing when funding runs out, or

bearing the cost of system maintenance. This cost is rarely factored into project budgets and, as a result, the true cost to the Department is understated.

This presents a conundrum: does the Department not implement the project, despite its intrinsic merits, or is a more realistic costing process undertaken?

R17: All Departmental Divisions endorse the principle that new data collection projects should factor in the expectation they will have an ongoing life, that the underlying data will be ultimately archived or warehoused in an online environment with access by a range of clients. This will bring with it ongoing custodial responsibilities, and ongoing maintenance costs. New projects should not be approved by the relevant body (see R12 and R12a on page 37) unless these considerations have been adequately acknowledged, addressed and funded.

It can be difficult to factor in data maintenance costs as a line item in funding applications given that the costs are ongoing. Contractual conditions may even prevent this. However, it may be possible to factor in certain costs into each new project that involve a component of data maintenance during the project's term.

It is also possible that new applications for creating corporate repositories may be able to factor in a data maintenance component (see the section *Strategic applications* on page 41). Such applications may also reduce the cost of maintenance, as there will already be a corporate infrastructure in place dealing with part of the maintenance process.

While part of the custodial role of data collectors is to provide a level of resource to maintain data, this may place an intolerable burden and hinder starting new projects. The preferred option is for Science Division to appoint a data administrator or biologist with specific responsibility for maintaining data quality as part of an atlas-style project. (This is currently the case in Victoria).

5.2.3 Application development standards

The design of software applications, particularly database applications, can significantly impact on the capacity of an organisation to integrate information. If an application uses local data rather than corporately stored data, then versioning or backup problems will arise. If an application does not use the correct data tables for a given knowledge area, then data integrity may be compromised.

Of particular note is the proliferation of corporate database applications written in Microsoft Access. Because of the wide availability and low cost of Access, many staff have developed database applications. If these databases remain restricted to a single user, responsibility for data backup lies with the single user, and with only one copy of the database there are no versioning issues.

However, once a single desktop database becomes a fully-fledged corporate application, yet is still developed and managed as if it were a desktop database, major versioning issues invariably arise. Additionally, if the databases are not designed according to specific data management principles, the application may operate sub-optimally, with problems in data duplication, performance or data integrity.

This was seen as a major issue by many of the agencies visited, to the extent that the transmission of Access databases was prohibited, both internally and externally. Some agencies had policies expressly prohibiting or discouraging their development.

Ideally, software applications, particularly corporate database applications, should be developed against a set of standards to ensure that industry-standard practices are used in software development, deployment and maintenance. Within CALM such standards are still being developed.

While staff generally acknowledge the above points, a major impediment to developing applications in a corporate manner is cost. The development of a corporate application is always

more expensive than a standalone, single-user application. Nevertheless, CALM has a responsibility to manage its data in a professional manner and to facilitate data integration where possible.

There has probably been an unwillingness to properly cost projects because of expectations that adequate funding was unlikely. This, in turn, may have been a reflection of the perceived attitude to information management by senior management (see the section *Strategic use of information technology* on page 28).

While it would be unreasonable and impractical to completely ban the use of Access for application development by non-specialists, it is reasonable to expect a review of any application development by immediate supervisors to assess whether the activity constituted corporate application development.

In that instance it is essential that a formal project business plan be submitted and assessed by relevant parties, including purchasers (or other potential fund sources), ISS *and* EIMC. The application should then be developed using the most appropriate technology for the specific context.

R18: All corporate application development is to adhere to Departmental standards and be assessed and approved at a project level by senior Divisional management, ISS and EIMC.

5.3 Information management systems and technology

This final part of the discussion addresses specific requirements for CALM's IT environment, and a number of projects identified as highly desirable from a Departmental perspective.

5.3.1 Supporting IT infrastructure

With the exception of FloraBase, CALM is the only agency that does not publish its corporate biodiversity data externally via the Internet. Compared to the agencies visited, CALM is currently the only one without an online production mapping capability. While there have been initiatives to implement a mapping functionality internally through EcoBase and NatureMap, CALM is still in the early stages of developing a robust and secure IT environment to support those initiatives.

Recommendations have already been made to increase FTE resources for ISS to improve support (see R8 on page 48). However, specific recommendations need to be made regarding the IT environment itself.

R19: ISS, as a matter of priority and in collaboration with other stakeholders, continues and progresses its initiative in developing a secure model and infrastructure for publishing corporate Oracle databases, web services and GIS mapping over the Internet.

5.3.2 Strategic applications

A number of key projects have been identified, after reviewing those applications with CALM's sister agencies, which are central to core business and play a major role in a) providing essential information to clients and b) facilitating an integrated approach to information management.

These include:

- *Implement a corporate biodiversity data register*

  A centralised register of all corporate data should be implemented as a joint project between Science Division, GIS Section, and other stakeholders.

- *Corporate biodiversity data repository*

  A centralised repository and accompanying data model of Divisional biodiversity data, particularly including survey data, herbarium records, and other species and community based information.

- *Internet version of EcoBase*

  EcoBase provides a web-browser view of standard spatial layers such as CALM estate and biodiversity layers. EcoBase is currently being designed for internal access. This should be expanded at the earliest opportunity to support an Internet visible view.

- *NatureMap*

  NatureMap is a trial application that warehouses species point distributions from a wide range of sources and provides web-based mapping and query. Its functionality is similar to the wildlife and flora atlases used in many agencies. NatureMap should be upgraded to use the same environment as EcoBase and be available over the Internet.

- *Sites of significance register*

  For some time CALM has required a corporate method for identifying sites of significance. This could include research plots, long term monitored quadrats and so on. A “sites of significance” register should be developed and extended to provide a site-identifier functionality similar to that in Victoria.

- *Data archiving*

  There needs to be an organised repository and set of processes for archiving data, particularly where corporate data is not currently archived in a central location, and with a particular focus on ensuring information is captured prior to resignation or retirement of staff.

- *Standard data capture tools*

  It is in CALM’s interests to develop standard tools for data capture, including surveys conducted by CALM staff, external consultants and the public. This will help ensure the promulgation of Departmental standards and facilitate data integration.

- *Easy generation of high resolution maps*

  CALM should implement functionality to generate high-resolution maps based on simple interaction by the user, in a similar manner to that implemented in Queensland and Victoria.

Other future systems could include:

- *Ecosystem regions*

  Development of a standard set of administrative / ecological boundaries as an alternative to, or enhancement of, IBRA sub-regions. This could possibly use recent endemism work (Hopper & Gioia, 2004) as a method for determining a first cut in evaluating new regions.

- *NRM interfaces*

  Development of a content-rich site specifically designed for NRM groups, which gave links, access to datasets, and online query capability for specific projects, such as the Salinity Action Plan.

  There is a lot of commonality in the data requirements of NRM groups. Additionally, much of the data they require is biodiversity data, which CALM is the logical agency to provide. By implementing an online mapping infrastructure, the same database and applications could be used for each NRM group, but with a customised front-end to suit specific requirements. This would be highly cost-effective to each group, as well as providing a conduit to up-to-date information on a continuous basis.

- *Parks systems*

  There are a range of Parks systems in use around the country, some very basic and some using online GIS to quickly target a specific park. CALM would benefit from implementing a spatially-enabled site, giving visitors the ability to select parks visually, rather than through a text based system. Such a system could also have access to a range of biodiversity databases through the corporate repository. (The proposed upgrade of RATIS does not envisage Internet accessibility at this stage. However, there is no reason why medium-term planning couldn't envisage this highly desirable functionality.)

R20: GIS Section, in collaboration with other Divisions, develops a business plan for extending the functionality of EcoBase to include Internet visibility.

R21: Science Division develops a business plan for upgrading NatureMap to use a consistent architecture with EcoBase and be Internet visible.

R22: Science Division, in collaboration with GIS Section and other stakeholders, develops a business plan for implementing a corporate data register, a corporate biodiversity data repository, a data archival system, and a sites of significance register

R23: Each Division encourages the identification and development of new, innovative information systems that will improve how CALM does its core business.

5.3.3 Knowledge management

As with other agencies, there is no one, single solution within CALM for how we can manage knowledge better, or to put it more specifically – how we could bring all relevant knowledge to bear on a specific topic. Part of the problem is location of the knowledge, and part is the definition of relevance.

There are a number of tools available that can expose different parts of our hidden corporate knowledge. Some of that knowledge is hidden deep inside databases. These databases might be easily accessible, or the content may only be available through a web interface with a proprietary querying interface. While there are many tools available for extracting information on a keyword basis, not all the results will be relevant.

The Department has recently purchased an EDRMS with the capability of supplementing traditional records management with more generalised document management and data retrieval through directly accessing other databases and web sites. This will provide an increasingly important capability for the Department in retrieving information by providing an integrating capacity across disparate systems, and will provide an important part of the solution to managing Departmental knowledge.

R24: CALM continues to provide support for extending the existing EDRMS system to incorporate knowledge management functions, subject to satisfactory performance and operation of records management functionality.

The other difficulty in managing knowledge is determining relevance. While a long listing of documents or database records might provide a launching point for exploring data, it does not necessarily bring together knowledge in a meaningful way. In this context, there may be no alternative to the traditional approach of developing 'fact pages' ie a composite document, manually edited by an expert or authoritative person, which brings together not just query results, but information targeted to a specific set of clients.

This thematic approach is not new, and is a part of standard web site development. However, it requires appropriately skilled staff (ie having both web development and biological background) to interact with scientists and other staff, and is an essential component to providing a one-stop shop on the Division's knowledge.

R25:	Science Division funds a web content position, as part of the NatureBank proposal, to assemble and publish biological information.

5.3.4 NatureBank

The NatureBank proposal (Science Division, 2002) contains a vision for providing a single point of entry into the Division's knowledge base. The key findings of this report and recommendations of this report support and affirm most of the aspirations of that initial proposal. In particular, the proposal recommends the creation of a number of positions that would undertake data management, GIS analysis and specialised biological modelling, as well as acquiring GIS hardware and software.

While Corporate Executive has endorsed the proposal in principle, NatureBank has yet to receive material support.

R26	Science Division, in collaboration with other stakeholders, updates the NatureBank proposal to be consistent with, or incorporate, relevant recommendations from this report and resubmitted to Corporate Executive for endorsement and support.

R27	Corporate Executive endorses and support the recommendations contained within the NatureBank proposal and provides resources for the new positions outlined within the proposal.

5.3.5 Risk assessment

This report makes a number of suggestions and recommendations involving a change in attitude towards information systems, a more flexible approach in placing specifically skilled positions within the organisation, and a significant overall increase in funding for information management within the Department.

In a climate where there are limited funds available to the Department to meet all its obligations, this presents a major challenge. An important consideration, therefore, is the consequence of doing nothing ie. continuing with the same budgeting process, the same apportioning of financial and human resources, the same information policy environment. Two particular risks are:

1. Loss of credibility: CALM is one of many agencies dealing with the transition to a knowledge-based economy. Anecdotally, many agencies are making great progress in transforming how core business is done. There is an increasing expectation that agencies will interact with one another using industry-standard methods for sharing information. That expectation is being placed on CALM. If CALM does not appear to be moving forward in a similar manner, its credibility will be affected.

2. Loss of opportunities: there are a number of Federal funding opportunities either directly to State agencies, or through NRM and other local groups. Agencies are competing against each another to provide services. If an agency is not competitive because it lacks capability, those opportunities may be lost.

5.4 Concluding remarks

This report has reviewed many aspects of how information is managed in a range of conservation agencies across the country. In that process, it has identified a number of effective practices required to assist CALM's core business. In so doing, it has also identified many areas in CALM requiring attention so that information management can align with best practice.

Some of the recommendations are of a medium to long-term nature. Most recommendations require attitudinal changes if they are to succeed.

Some of the above recommendations have been specific to managing biodiversity data within the context of the Science Division. However, many are directly relevant to the operation of the Department as a whole, and it is open to other Divisions to adapt the relevant recommendations to their own situations.

Many parts of CALM already approach the high demand for information and services in a professional manner. This is to be particularly applauded given the complexity of the task and the limited resources available. Many of these efforts are hampered by the fragmented nature of the Department and its information systems. However, taken together over the medium term, these recommendations provide an opportunity for the Department to become a leader in demonstrating best practice, and providing the State with the best possible basis for supporting conservation.

It is hoped this report will be of benefit to the many participants in sister agencies who made themselves available for interview and discussion, with the understanding that discussion about CALM's areas for improvement is seen as helpful in moving all agencies towards better information management, and therefore more effective conservation outcomes.

As a Department, CALM recently celebrated its 20th birthday. This stability should be seen as an asset in helping move our information management efforts towards a more integrated whole, so that we will be better positioned to provide the right information, in the right place, at the right time.

6 Acknowledgements

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Bill Barker (Acting Chief Botanist & IT Manager)

Science Programs, Botanic Gardens of Adelaide, Science and Conservation Directorate
Tony Kannellos (Information Resources Manager)

Queensland – Environmental Protection Agency

Queensland Herbarium, Environmental Sciences Division
Gordon Guymer (Director)
Peter Bostock (Principal Botanist)

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Sally Box (Policy Officer)

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ERIN Strategies Section, Knowledge Management and Education Branch, Corporate Strategies Division
Tony Rosling (Director)

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8 Appendix 1 – Interview Questions

This study aimed to look at how selected Australian Federal and State Government agencies involved in biodiversity conservation assembled and deployed research findings on the biota and landscape to support decision-making, operational activities and requests for information. For the purposes of this study, the term research in the questions below applies specifically to that supporting biodiversity conservation. The questions can be grouped into three main areas:

1. What is the organisational and political context of the research?
2. How (and how effectively) is that research data gathered, managed and applied?
3. What information systems have been put in place to support desired outcomes?

Many of the questions below are qualitative in format, and were designed to inform interviewees the key areas of interest, and to elicit general discussion. Some of the questions involved complex matters that were difficult to quantify. However, any information, guidance or broad answers along the general lines of the questions was accepted and appreciated.

By their nature, some of the questions apply to broader range of Departmental activities, such as gathering and deploying spatial reference data. Given the limited time for the study, it was necessary to focus on how research data was used and managed, but there will obviously be wider applications of the results. The questions were also framed within the context of biodiversity conservation in Western Australia. Again, the results will have a wider application.

8.1 Organisational context

- In broad terms, what are the main research drivers? ie Why is the research done in the first place
- What are the expected outcomes? eg new conservation areas, reduction in extinctions, support for Departmental operations, reporting to Government, etc.
- Does your Department conduct its own research? If not then who does?
- Who are the primary users or clients of that research, and what is the level of demand? eg Government, academia, public
- What effort is devoted to research in terms of:

  Percentage of research FTE versus total Departmental FTE
  Indicative percentage of expenditure on research IT versus total Departmental expenditure
  Total jurisdictional area (eg area of State)
  Total area of conservation estate

- What kind of priority does research have within the Department?
- What positions (if any) are specifically related to biodiversity information management? At what level?

8.2 Gathering, managing and applying research data

- What kinds of data are captured? How is it used?
- To what extent is research data shared within the Department, or across Government? Does corporate culture play a role in this process, and if so, how?
- From a strategic perspective, to what extent, and how, is data from survey or opportunistic collection (vouchered and/or unvouchered) used in key decision-making processes (eg environmental impact assessments arising from land clearing applications)?
- To what extent does systematic research play a role in how data is managed and used?
- How much research data is collected within a year?
- What processes or protocols are used in assembling, integrating or managing research data after collection? Is there an archiving or handover process when staff leave or retire?
- To what extent does the Department provide research information publicly over the Internet?

8.3 Information systems

- To what extent does research information feature in the Department's online published content? eg publications, reports, fact pages, databases

- How do you choose what goes on the web site and what doesn't, what is Internet and what is Intranet?
- What attempt has there been to integrate data across the organisation? How has this been done? eg is there a data model covering research data?
- What technologies have been used to provide queryable data online (eg maps or databases, as opposed to static content, like fact pages or reference information)?
- How often is web site maintained? By who? Internal / external?
- What, if any, software is used for content management?
- Are libraries integrated within Departmental information systems? Are they regarded as information systems in themselves?
- What are current weaknesses in how research information is deployed that still need to be overcome?

9 Appendix 2 – Executive Information Management Committee Terms of Reference

Note: Certain phrases have been underlined for emphasis, and are *not* part of the original text.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Executive Information Management Committee

Charter

ROLE

The role of the Executive Information Management Committee is to promote the achievement of CALM goals and the efficiency of resource use in the information management area by overseeing the development and maintenance of information management systems and the infrastructure that supports them.

AUTHORITY

This Charter was approved by Corporate Executive on 26 February 1998. Corporate Executive determined that the Committee should operate as an advisory committee to the Director Corporate Services.

RESPONSIBILITIES

The responsibilities of the Committee are:

1.1 Policy

- To ensure necessary policies, procedures, guidelines and standards are developed and promulgate to guide Information Management within CALM;
- To ensure data and information custodianship within CALM is adequately identified; and
- To oversee CALM's conformity with the policies of the W.A. Information Policy Council

1.2 Planning

- To review organisational information requirements;
- To review and approve the strategic plans and business plans for Information Management Branch, Information Services Section, Corporate Information Section and Geographic Information Services Section;
- To foster appropriate access to CALM's corporate information systems; and
- To review the security of CALM's corporate information systems.

1.3 Resource Allocation

- To examine and approve all proposals for new information systems development involving corporate information;

- To coordinate and oversee all information systems development, implementation and infrastructure purchase within CALM; and

- To recommend to Corporate Executive on expenditure on Information management systems and technology.

1.4 Education

- To ensure processes and procedures exist to enable all staff to become appropriately skilled to engage in the information management activities associated with their responsibilities.

1.5 Performance Review

- To periodically evaluate the processes in place for CALM to operate legally with respect to the acquisition of information management infrastructure, and the use of software.

- To periodically review information management performance against the information management Plan

- To periodically review organisational information management impacts and risks.

MEMBERSHIP

Director Corporate Services (Chairman)		
Director Regional Services	)	
Director Forests	)	
Director Nature Conservation	)	
Director Parks, Recreation, Planning and Tourism	)	or delegates
Director Science and Information	)	
Director Project Management	)	
Director Corporate Relations	)	
Executive Officer		
Manager Management Audit		
Manager Financial Services		
Manager Information Management		
Manager Information Services		
Manager Corporate Information	)	as required by agenda
Manager Geographic Information Services	)	

10 Appendix 3 – Spatial Information Steering Committee Terms of Reference

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Spatial Information Steering Committee

Terms of Reference

Background

At its meeting on 24th November 2003 Corporate Executive agreed to the following Action:

It was agreed that a high-level steering committee be formed to examine in the first instance opportunities and directions for information management within the Department in the context of the EcoBase project. It was agreed that the high-level steering committee have representatives from each Division with the representatives generally to be people with a strategic and policy overview rather than a technical viewpoint. Corporate Services Division to convene the group.

It was agreed that the steering committee report back to Corporate Executive in three months on the potential future directions of the EcoBase project.

Terms of Reference

Scope of the committee:

To formulate policies, procedures and standards for the management of all shared spatially-referenced information in the Department as corporate information, in a way which is consistent with CALM's approved information management policies and compliance requirements. The committee should promote the consistency and interoperability where appropriate of all spatially related information within Regional Services, Nature Conservation, Parks and Visitor Services, Sustainable Forest Management and Science Divisions, and Information Management Branch. The overall objective of the committee should be to maximize the efficiency and effectiveness of the use of spatial information in carrying out the Department's core business.

Specific focus areas:

1 Data and information management policies, including custodianship, maintenance and production versions of spatial data, security, metadata.

2 Responsibilities and roles of data and information custodians, and of application owners and custodians.

3 Consistency and interoperability of spatial data across the department, including the metadata standard.

4 Steering the management of EcoBase, including datasets and applications, and their management and access.

5 Project sponsorship:

- Spatial metadata capture program covering entire department
- Identification of data requirements to service core outputs; proposals, including funding, to acquire data to meet these requirements; identification of data sharing opportunities across department.
- Development of a data model for spatial and related data held throughout the department
- Development of a training program for capture and management of spatial data based on agreed standards and protocols.
- Identification of custodians of all spatial and related data sets, and their responsibilities.

Membership:

Representatives of all divisions, able to represent the strategic requirements of their divisions, C.Pearce, J.Dunn, R.Wilson, D.Rule, P.Soong.

Reporting:

The committee will report to Corporate Executive as requested, and will provide minutes to the EIMC. The agenda should be prepared by the chairman, and distributed to the members prior to each meeting.

C.P.
29th April 2004