An Ecologically Sustainable Development Component System to Support Irrigation Decision-Making in Northern Australia

Jeff K. Camkin, Justin Story and Keith L. Bristow

CRC for Irrigation Futures Technical Report No. 10/07

CSIRO Land and Water Science Report 78/07

December 2007

Copyright and Disclaimer

ISSN: 1834-6618

[1] The Project Partners are: CSIRO, Land and Water Australia, National Program for Sustainable Irrigation, CRC for Irrigation Futures, and the Governments of Australia, Queensland, Northern Territory and Western Australia.

An Ecologically Sustainable Development Component System to Support Irrigation Decision-Making in Northern Australia

Jeff K. Camkin[1,2,3], Justin Story[1,3] and Keith L. Bristow[1,2,4]

[1]CSIRO Land and Water

[2]CRC for Irrigation Futures

[3]CSIRO, Private Bag 5, Wembley WA 6913

4CSIRO, PMB Aitkenvale, QLD 4814

CRC for Irrigation Futures Technical Report No. 10/07

CSIRO Land and Water Science Report 78/07

December 2007

Acknowledgements

This work was undertaken as part of the Northern Australia Irrigation Futures (NAIF) project and funded through a collaboration of private and public investors including the National Program for Sustainable Irrigation (NPSI), the Cooperative Research Centre for Irrigation Futures (CRC IF), the Australian Government and the Governments of the Northern Territory, Queensland and Western Australia.

A Steering Committee with representation from the funding partners and expertise in key project areas provides strategic guidance to this project. The guidance provided by members of the Steering Committee, including commenting on drafts of this document, is much appreciated.

The authors gratefully acknowledge the assistance provided by Dr Rick Fletcher (Fisheries Department of Western Australia) and Deb Atkins (CRC for Irrigation Futures) in reviewing this document.

Executive Summary

There is a unique and historic opportunity to ensure that management of Australia's northern water resources takes place within a strategic, ecologically, culturally and economically sustainable framework. There is also an opportunity to decide whether to expand irrigation in northern Australia, and if so what irrigation should look like, where it should be located, and how it should be managed. Such decisions require improved understanding of northern river and catchment attributes and of the risks and benefits associated with irrigation in northern Australia.

The Northern Australia Irrigation Futures (NAIF) project is a collaboration of the Australian, QLD, NT and WA governments, the Cooperative Research Centre for Irrigation Futures, Land and Water Australia's National Program for Sustainable Irrigation and CSIRO. Delivered through CSIRO, NAIF aims to develop new knowledge, tools and processes, including sustainability frameworks, to support debate and decision making regarding irrigation in northern Australia.

NAIF is guided by a Steering Committee which has adapted the nature and objectives of the sustainability frameworks as new research findings have emerged. Moving away from the initial idea that a sustainability framework should be a set of biophysical indicators, the research identified the need for a greater emphasis on the issues of complexity and uncertainty and how to manage them. Research began on approaches taken in other locations and industries which were aimed at building confidence by addressing uncertainty and complexity in decision making.

Ecologically Sustainable Development (ESD) Component Trees is a method that has been successfully used to address these issues in other fields. First developed through the Fisheries Research and Development Corporation in early 2000, ESD Component Trees aim to help breakdown the concept of ESD into understandable components, helping the concept of ESD to be implemented in a full and practical manner. ESD Component Trees are a complete set of all issues (either positive or negative) which may be of interest when considering a particular activity (e.g. irrigation). Each identified issue is a separate component within a hierarchical tree system.

ESD Component Trees have several key benefits, demonstrated through their application in agriculture, wild fisheries and aquaculture. Benefits include:

- **Comprehensiveness**: all potential issues are captured so that everything is considered
- **Dealing with complexity**: all potential issues are captured in a structured way and are systematically prioritised
- **Understanding and managing risk**: issues are identified and prioritised such that the high risk issues are considered first
- **Transparency**: stakeholders can see how each issue has been addressed because the reasons for inclusion or exclusion are clearly documented
- **Consistency**: consideration of each activity starts from the same set of potential issues which are then either accepted or rejected in relation to the particular activity
- **Encouraging thinking**: the user is guided in a manner which encourages them to consider other issues specific to the activity being considered.

Those charged with the responsibility of making decisions about irrigation proposals are increasingly required to consider the implications of those proposals at a range of scales, from on-site, local, catchment, regional, national and in some cases, international. When the range of potential social, economic, ecological and governance issues is identified at each

scale it forms a very comprehensive but complex matrix which represents the challenges of such decisions. Due to their previous demonstrated benefits in helping to address such complex decisions, ESD Component Trees emerged as an opportunity to enhance decision making about irrigation. Our research then focused on developing a set of ESD Component Trees and methodology for their application in decisions about irrigation in northern Australia.

A set of ESD Component Trees has been developed to help identify the potential positive and negative impacts of irrigation in northern Australia. At the highest level, the separate trees deal with four key areas: ecological impacts, social impacts, economic impacts and external impacts on irrigation. Each tree is then further refined until individual issues are identified.

While there are benefits in identifying all potentially relevant issues relating to a decision, not all issues will be of equal importance and prioritisations of the relevant issues is important to help focus the application of limited management resources.

ESD component trees are intended to enhance rather than replace existing decision-making processes by helping to ensure that they are carried out in a transparent, accountable and all-inclusive manner. They are designed to help determine how the existing regulations and requirements fit together to help reduce overlaps, redundancies and omissions in regulation. This can increase the level of confidence for all stakeholder groups (including industry) that decisions are comprehensive, relevant, effective and efficient. The ESD Component Trees for irrigation in northern Australia could be used to support decisions in relation to:

1. Catchment visioning and planning
2. Assessment of irrigation proposals
3. Development of irrigation proposals
4. Triple-bottom-line or ESD reporting
5. Improvements to existing irrigation areas
6. Identification and management of knowledge gaps.

The nature of ESD Component Trees allows them to be adapted to a wide range of industries. The ESD Component Tree system is already in use in agricultural, fisheries and aquaculture management and this document highlights its utility to irrigation in northern Australia. This approach could be adapted for irrigation elsewhere and for other industries and locations.

This document is to be used with the accompanying “NAIF ESD Component Trees Toolkit”. The Toolkit provides information in the process of using the generic NAIF ESD Component Trees to form a set specific to a particular location, proposal or planning process. This is demonstrated through the application of the ESD Component Trees to the Lower Burdekin, Queensland. The Toolkit includes:

- Process Guide for applying NAIF ESD Component Trees
- Generic ESD Component Trees set for irrigation in northern Australia
- Formatted Excel spreadsheet to assist in documenting which issues are relevant and which are not relevant to a particular decision
- Power Point Presentation to assist in applying NAIF ESD Component Trees
- Example of application: Application of the NAIF ESD Component Tree System and Construction of the Lower Burdekin Knowledge Platform 2

Table of Contents

1 Background

1.1 Irrigation in northern Australia

Northern Australia holds an iconic status for many Australians. The interplay between the landscapes, rivers and strongly monsoonal weather patterns has resulted in unique and diverse ecological systems. At present these ecological ecosystems are largely intact and water resources are generally not over allocated or overused. At the same time, with approximately 60% of Australia's freshwater runoff generated north of the Tropic of Capricorn (Petheram 2007), and reduced water availability in southern Australia, there are pressures from various quarters to extract some of the water, including for irrigated agriculture.

There is a unique and historic opportunity to ensure that management of Australia's northern water resources takes place within a strategic, ecologically, culturally and economically sustainable framework (Australian Government, 2007). There is widespread awareness of the opportunity to learn from previous decisions that have resulted in irrigation systems that are degraded or degrading both nationally and internationally. There is also increasing recognition of the need to view and manage northern Australia through a 'northern lens' and that an opportunity to set a course to a desired future exists.

Deciding on whether to expand irrigation in northern Australia, and if so what irrigation should look like, where it should be located, and how it should be managed, requires improved understanding of river and catchment attributes and of the risks and benefits associated with irrigation. Various studies are underway to improve that understanding and ensure decisions are made with the best information available about the long term implications for tropical catchments.

Australia also has the opportunity to consider what role northern Australia will play in future national and global food security. This could include consideration of future irrigation activities; their number; size; and potential impact. Recognising and dealing with the inherent complexity, uncertainty and risk in these matters is essential to give confidence to decision-makers and the community. Doing this successfully may require a level of sophistication in irrigation decision-making and management systems that is beyond that which currently exists.

1.2 Ecologically Sustainable Development in Australia

Sustainable Development and Ecologically Sustainable Development

The Australian national, state, territory and local governments endorsed the concept of ecologically sustainable development (ESD) as a guiding principle in their water reform initiatives as part of the *National Strategy for Ecologically Sustainable Development* (1992). The *National Strategy for Ecologically Sustainable Development* was formed in response to Australia becoming a member of the United Nation's Commission on Sustainable Development (UNCSD). The UNCSD was formed to ensure effective follow up to the United Nations Conference on Environment and Development (UNCED - also known as the Earth Summit), in Rio de Janeiro, Brazil, 1992.

ESD is an integrated approach of economic, environmental, social and equitable considerations. The principle seeks to ensure the benefits of development do not come at a heavy cost to the environment. Figure 1 is an adaptation of a figure which represented *"the decision making model needed for an ecologically sustainable future for Australia"* first published in the 1996 Australia: State of the Environment Report (State of the Environment Advisory Council, 1996) and adapted from Lowe (1994). This figure suggests that economic activity takes place within and is part of the social system which in turn takes place within and is part of the ecological system. Without ecological sustainability there can neither be social nor economic sustainability.

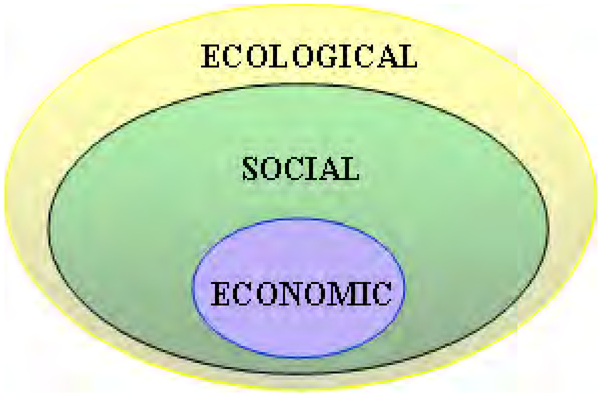


Figure 1. The decision-making model for ESD in Australia. Adapted from 1996 Australia: State of the Environment Report (State of the Environment Advisory Council, 1996) and Lowe (1994).

Sustainable irrigation

A sustainable irrigation system is one that will continue to generate agricultural products at reasonable costs into the future and ensure that environment is itself maintained so that it can sustain the communities that depend upon it (Cullen 2004). Sustainability requires that future generations have the same opportunities to benefit from our land as we do.

For irrigation to be sustainable, irrigation and drainage must be conducted in a way that does not degrade the quality of land, water and other natural resources that contribute to both agricultural production and environmental quality (Oster & Wichelns, 2003). Irrigation without groundwater control ultimately causes waterlogging and salinity problems and can only be sustainable if salts and drainage water are adequately removed from the underground environment and managed for minimal environmental damage (Bouwer 2000).

Cullen (2004) characterised a sustainable irrigation system as having the following qualities:

- Extract only a sustainable amount of water from the river systems that ensures river health is maintained. For groundwater systems extraction must not exceed replacement so the resource is maintained in the long term
- Water is applied to crops as efficiently as possible so that losses in delivery and application are minimised, and that the amount applied meets plant needs. This requires a high level of water control
- Farm level and regional efforts to minimise, intercept, isolate, reuse and dispose of saline drainage water rather than allowing these to degrade the land or rivers
- Irrigators understand the capacity of their soils and drainage systems to support various forms of agricultural production, and have the skills and capacity to produce crops that maximise the wealth coming from the water used without damaging our environment.

Irrigation decision making

Until the late 1970s and early 1980s decisions made about irrigation have tended to be weighted towards delivering economic outcomes, frequently disregarding ecological or social consequences as a result (Gleik 2002). However, environmental impacts that may have been more readily accepted in the past are not necessarily acceptable today (Petheram et al 2007). There has also been an increase in the awareness of the social and cultural values of water, as well as economic values other than irrigation (Petheram et al 2007).

Irrigation decisions today are aimed at ensuring that the decision-making drivers of sustainable economic, social and ecological outcomes are met and that suitable governance and other control structures are in place to support the achievement of sustainable outcomes. However, the greatest challenge is to understand how the system works so as to put all the decision-making drivers together (Montagu, K. et al 2006). Furthermore, each decision environment is different and the information driven, 'one size-fits-all' approaches are rarely successful. Even so they still seem to form the basis of many decisions (Montagu, K., et al 2006). For example, decisions are usually related to some level of environmental impact that is deemed to be acceptable and, therefore, sustainable. However, equally important are the social drivers in decision-making, which are probably some of the most important but are often poorly understood and difficult to measure (Montagu, K. et al 2006), as well as the economic drivers and the control structures within which decisions must take place.

There is a great deal of complexity surrounding irrigation decision-making and decisions are rarely straightforward. Achieving the often sought after "balance" of social, economic and environmental outcomes is a questionable goal because these decisions are more about understanding options, consequences and what is and what is not acceptable. Furthermore, decisions surrounding irrigation are made at all levels of the irrigation industry. From water policy and crop selection, to determining when and how much water to apply, decisions on irrigation are required. Increasing the complexity surrounding irrigation decision-making today is that these decisions are often made against a background of uncertainties and risks, such as markets and water allocations (Montagu, K. et al 2006). There is a need to deal with this complexity, uncertainty and risk surrounding irrigation decisions to help build confidence in decision-making.

1.3 The Northern Australia Irrigation Futures Project

The NAIF project is a collaboration of the Australian, QLD, NT and WA governments, the Cooperative Research Centre for Irrigation Futures, Land and Water Australia's National Program for Sustainable Irrigation and CSIRO. Delivered through CSIRO, NAIF draws on past experience of irrigation and the development of new knowledge to build understanding of risks and benefits associated with irrigation and of the key landscape attributes critical to sustainable irrigation in northern Australia. The project aims to develop new knowledge, tools and processes, including overarching sustainability frameworks, to support debate and decision-making regarding irrigation in northern Australia. It is anticipated that many of the ideas, tools and processes resulting from NAIF will be applicable to issues other then irrigation and areas other than northern Australia.

The NAIF project objectives are:

1. To delineate key landscape attributes (including soil & water resources, climate, vegetation, rivers, near shore marine environments, & where appropriate links to people, industries, markets) relevant to ecologically sustainable irrigation across northern Australia
2. To use key landscape attributes to develop sustainability indicators and associated management criteria covering a range of scales (field, farm, district, irrigation scheme, catchment) for northern Australia
3. To develop an overall framework that, through their involvement, is embraced by policy makers, regulators, investors and managers, to help ensure any irrigation is managed in a consistent, ecologically sustainable manner in northern Australia
4. To use a number of linked case studies and stakeholder input to support and inform development and testing of the framework

5. Through provision of a robust framework, contribute tools and knowledge to support considered debate, decision making and long term strategic planning for northern Australia & Australia as a whole.

A representative and skills based Steering Committee comprising of individuals from the WA, NT, QLD and Australian Governments, NPSI, CRC for Irrigation Futures (CRC IF), Sunwater and the North Burdekin Water Board provides strategic guidance on the project.

1.4 The NAIF Sustainability Framework

A key NAIF objective was to develop sustainability frameworks that, through their involvement, are embraced by policy makers, regulators, investors and managers to help ensure any irrigation is managed in a consistent, ecologically sustainable manner in northern Australia. The nature and objectives of the sustainability frameworks have adapted throughout the NAIF project as new research findings have emerged but the focus on supporting debate and decision-making on irrigation in northern Australia remains.

It was originally thought a sustainability framework should be a set or framework of biophysical indicators with guidelines on how they should be used. Ongoing research, including discussions with stakeholders, indicated that such an approach would not sufficiently capture social and economic issues and, therefore, would not address the complex and often uncertain nature of irrigation and water resources decision-making.

The research focus then shifted to a more detailed analysis of decision making processes and the natural and human context in which such decisions are made. It was recognised that irrigation and water resource decision-making requires much more than simply access to data. Decisions involve modelling risk, assessing cumulative impacts and weighting proposed alterations to ecosystem functions and values, and require knowledge from disparate disciplines such as biology, geology, hydrology, chemistry, engineering, sociology etc. It was recognised that practitioners within each discipline are often more cognisant of the technologies that dominate the market within their particular field, and local level decision makers are often restricted by limited time, access to data, technology platforms, physical media or training. A common outcome is that resource decisions are often made with whatever information and tools are readily at hand (Haddad et al, 2005). Correspondingly, this may contribute to a lack of confidence in decision-making if the complex and uncertain nature of decision-making is not sufficiently addressed.

Further research identified the need for a still greater emphasis on the issues of resilience, risk, complexity and uncertainty. The NAIF project then began researching approaches taken in other locations and industries to address similar challenges, aiming to build confidence by addressing uncertainty and complexity in decision-making.

Two methods that have been used to address these issues are ESD Component Trees (which aim to help breakdown the concept of ESD into understandable components) and Knowledge Platforms (which aim to improve access to relevant data, information and knowledge). This work also included examining how emerging technological environments and understanding of how, when and why individuals share and search for knowledge could support the resolution of complex natural resource management decisions. This document describes the potential application of ESD Component Trees to irrigation decision-making in northern Australia.

The NAIF Steering Committee endorsed a conceptual framework in October 2006 and a prototype has been developed for the lower Burdekin. The development of a Lower Burdekin Knowledge Platform and the overall sustainability frameworks will be reported elsewhere in the NAIF series of reports.

2. ESD Component Trees

2.1 What are ESD Component Trees?

ESD Component Trees have been developed to help break down the concept of ESD into workable components. This aids in the understanding of the concept of ESD as well as allowing the concept to be implemented in a full and practical manner (Fletcher et al. 2004). This work was initiated by the Fisheries Research and Development Corporation in early 2000 (Fletcher et al. 2002).

ESD Component Trees are a set of all issues (either positive or negative) which may be of interest when considering a particular activity (e.g. irrigation). Each issue is contained as a separate component which is then, in turn, connected in a hierarchical tree system to other components (Figure 2). This allows consideration of components on a level where operational objectives, indicators and performance measures can be specified.

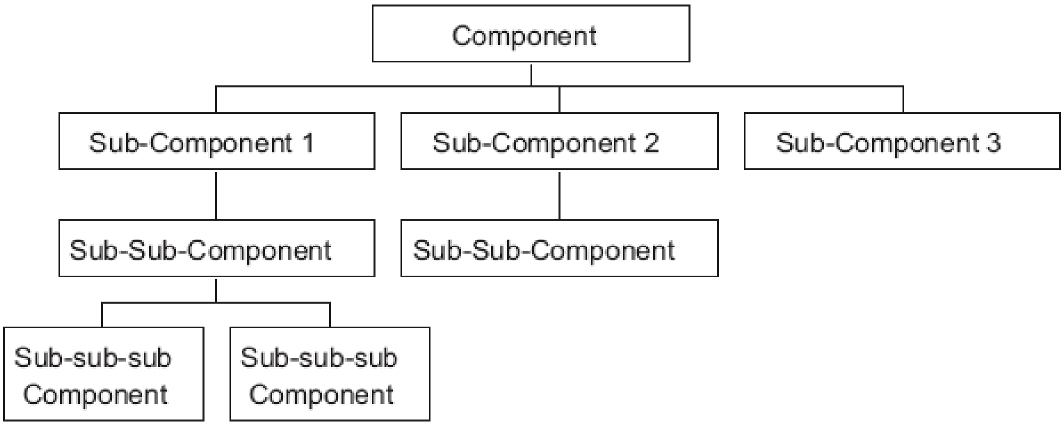


Figure 2. An example of a generic ESD Component Tree (Fletcher et al. 2004)

ESD Component Trees are designed to be comprehensive, covering all aspects of potential interest. However, they should also be thought provoking, rather than being a means to end in themselves, and allow for some flexibility. This is possible by ensuring that each issue is considered and the outcome of the consideration noted for each component.

Importantly, the ESD Component Trees are not designed to add more steps to the process of approvals for activities such as irrigation. There has been a long history of application and approval processes in place to regulate these activities. Instead of adding to this 'burden', ESD Component Trees can help determine how the existing regulations and requirements fit together to help reduce overlaps in regulations, redundancies and omissions. This should increase the level of confidence for all stakeholder groups (including industry) that the processes used to manage are comprehensive, relevant, effective and, most importantly, efficient (Fletcher et al. 2004).

2.2 Using the ESD Component Trees to identify and prioritise issues

One of the most important steps in the ESD process is determining the issues that need to be examined - if you haven't identified an issue, you can't deal with it (Fletcher et al. 2004). Furthermore, to be managed effectively, issues need to be identified at a level that will allow for relevant and sensible operational objectives (Fletcher et al. 2004).

The identification of issues is the first step for all management and assessment processes and frameworks, including Environmental Management Systems (EMS) and Environmental Risk Assessments (Fletcher et al. 2004). However, most of these systems do not specify the way this identification process should occur, often relying on rather haphazard techniques such as 'brain storming' to produce the list of issues (Fletcher et al. 2004). The use of ESD Component Trees provides a more structured and more robust approach.

The first step is to identify the relevant issues by applying and modifying a set of generic component trees. The generic component trees are used as a starting point to identify which issues are relevant to that particular decision. The generic component trees are then modified to suit the circumstances of specific locations or individual projects, expanding some sub-components and collapsing or removing others as needed. Decisions about including or not including any specific component are briefly documented to ensure that transparency is maintained throughout the decision making process. The best application of this system is when all elements have been examined in a coordinated manner and the linkages amongst the levels are understood and recognised within the management processes of both the government agencies and the industry participants (Fletcher et al. 2004). It is suggested that two half day sessions or workshops will be sufficient time to work through the generic ESD Component Trees and identify which are relevant.

The process of identifying the relevant issues for a specific location or project - by the modification of the generic component trees - can often result in a large number of potential issues being identified. The importance of each of these issues may vary from the relatively insignificant to the vitally important (Fletcher et al. 2004). If an issue is relatively insignificant, it is unlikely to require specific management arrangements and monitoring programs. However, those issues that are important may need strong management intervention if unacceptable outcomes are to be avoided. (Fletcher et al. 2004). Given the variation of levels in the importance of issues, and the scarcity of resources to address all of them at equal levels, there will generally be a requirement to prioritise the identified issues, so that management actions and monitoring systems are only implemented where appropriate. (Fletcher et al. 2004)

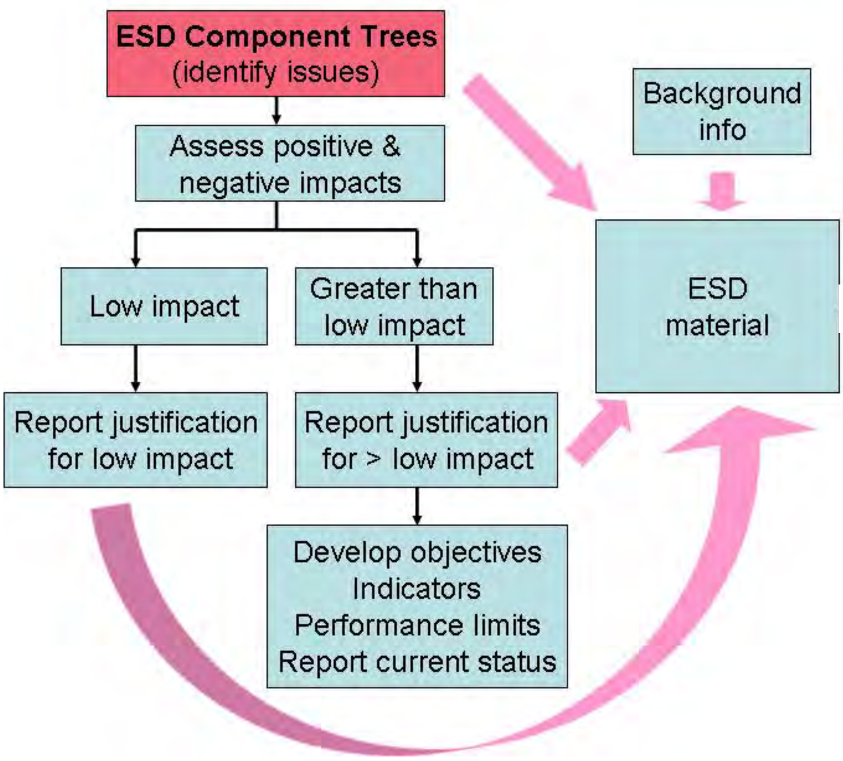


Figure 3. Flow chart showing how ESD Component Trees can be used to produce ESD material.

There are different approaches that can be used to assist in prioritising the issues. The use of risk analysis methodology as a tool to help the decision-making process has been adopted by the Fisheries National ESD Framework (Fletcher et al. 2004) and other sectors. This process involves using the risk assessment component of risk analysis to provide a disciplined and consistent approach for the calculation of the relative level of ‘risk’ associated with each issue. Figure 3 has been adapted from the Fisheries National ESD Framework and shows how ESD Component Trees can be used to identify issues and then prioritise those issues by characterising each issue according to how high an impact it will have. The resulting information can be used to produce a variety of ESD material which in turn can be used as part of key decision-making processes. In the case of irrigation in northern Australia six key processes have been identified: catchment visioning and planning; developing irrigation proposals; assessing irrigation proposals; improving existing irrigation areas; triple-bottom-line or ESD reporting; and identifying and managing knowledge gaps. A description of how ESD Component Trees can contribute to these decision-making processes is provided in Chapter 4. For more information on the use of ESD Component Trees in risk assessment see Fletcher et al. (2004).

2.3 Who has used ESD Component Trees to date?

The ESD Component Trees have been used in various contexts, including:

- Wild fisheries (National ESD Framework for Wild Fisheries)
- Aquaculture (National ESD Framework for Aquaculture)
- Agriculture (Signposts for Australian Agriculture project)
- Irrigation (CRC for Irrigation Futures Irrigation Sustainability Assessment Framework).

National ESD Framework for Wild Fisheries

In early 2000, the Fisheries Research and Development Corporation (FRDC) funded a study to develop an ESD reporting framework for Australian fisheries. A flexible process was designed to systematically identify issues, develop operational objectives and then work out what indicators need to be measured. ESD was divided into eight major components (within three main categories) relevant to fisheries. These were:

Contributions of the fishery to ecological well-being

1. Retained species
2. Non-retained species
3. General Ecosystem

Contributions of the fishery to human well-being

4. Indigenous well-being
5. Community and regional well-being
6. National social and economic well-being

Factors affecting the ability of the fishery to contribute to ESD

7. Impact of the environment on the fishery
8. Governance Arrangements.

There is one generic component tree for each of the eight components of ESD described above. The generic component trees are used as a starting point, being tailoring to suit the individual circumstances of each fishery by expanding some sub-components and collapsing or removing others, depending upon the fishing methods areas of operations and the species involved. The approaches uses four main elements in a process to complete an ESD report: (i) identifying the issues relevant to a fishery; (ii) prioritising those issues; (iii) completing suitably detailed reports on the performance of the fishery for each issue (dependent upon their priority and complexity); and (iv) compiling a summary of background material on the fishery, the major species affected and the environments that the fishery operates within (Figure 3). This enables the reader to put the material within the assessment report into an appropriate context.

Further information on the National ESD Reporting Framework for Wild Fisheries is available at http://www.fisheries-esd.com/c/implement/implement0200.cfm.

National ESD Framework for Aquaculture

The National ESD Framework for Aquaculture has similarities to the ESD framework that was previously developed for wild capture fisheries. Both of them help to identify the relevant environmental, social/economic and governance issues, assist with determining the appropriate level of management response using risk assessment techniques, and provide a reporting structure to document outcomes. There are, however, several important differences, the major one being the structure of the environmental components. For aquaculture the environmental components are divided into three different spatial levels: (i) whole of industry issues; (ii) catchment/regional issues; and (iii) within facility issues.

This hierarchical approach is designed to show the linkages between what is required at the operator level and the outcomes wanted by government/community at the regional and whole of industry scales. This guide can be used to facilitate the development of reports/assessments at the whole of industry level, at a regional level, or as the basis for an EMS at the facility level. Thus, it can be used at whatever level is appropriate depending upon the questions being asked and who is asking them.

Importantly, this ESD Framework is not designed to add more steps to the process of approvals for aquaculture leases/licences. Instead, it is designed to help minimise overlaps, redundancies and omissions in the current procedures to improve the efficiency and effectiveness of the outcomes for both industry participants and the wider community.

Further information on the National ESD Reporting Framework for Aquaculture is available at http://www.fisheries-esd.com/c/implement/implement0300.cfm.

Signposts for Australian Agriculture

The *Signposts for Australian Agriculture (Signposts)* project aims to inform policy development by assessing and reporting on the environmental, economic and social contributions of Australian agricultural industries.

The Signposts for Australian Agriculture (Signposts) project was established in 2004 and aims to inform policy development by assessing and reporting on the environmental, economic and social contributions of Australian agriculture industries. Signposts was designed to address the key question: *How does an agricultural industry contribute to ecologically sustainable development?* The information is used to:

- Build industry credibility in environmental management
- Address community concerns about industry practices
- Identify priority issues and areas for action.

Signposts recognised that any industry makes contributions to economic, social and ecological systems. These contributions are in the form of positive or negative impacts on the assets held within those systems by the industry and on the assets within those systems that are beyond the industry. Furthermore, Signposts recognised that economic systems are imbedded within social systems which are in turn imbedded within ecological systems. These ideas have been used by Signposts to develop a generic structure which broke down each of the components (economic, social and ecological) into sub-components which formed a component tree for the agricultural industry.

Further information on the Signposts for Australian Agriculture project is available at http://www.nlwra.gov.au/Natural_Resource_Topics/Signposts_for_Australian_Agriculture/ind ex.aspx. The Grains Research Development Corporation (GRDC) is currently applying the Signposts framework to the Australian grains industry. Further information on that application is available at http://www.signposts4ag.com/signposts-grains.

CRC for Irrigation Futures Irrigation Sustainability Assessment Framework

"The Irrigation Sustainability Assessment Framework (ISAF) has been developed to provide a structured objective-driven approach to TBL reporting for the irrigation sector and is complementary to the Global Reporting Initiative sustainability reporting approach. The ISAF approach is similar to the Standing Committee on Fisheries and Aquaculture method developed by Chesson et al. (2000) and Chesson (2002) as a reporting framework for sustainable fisheries. It ensures that the process does not begin selecting a core indicator set against which to benchmark performance because past experience suggests that this has failed to live up to expectations when dealing with complex systems involving natural resource management such as those related to agriculture and fisheries (Chesson, 2002). Instead, a structured objective-driven approach that begins by identifying the main sustainability issues of concern to the organisation and its stakeholders, sets the objectives relating to these issues, and then addresses the objectives using selected indicators and performance measures, is likely to be a more successful approach for complex systems. This approach ensures the focus is on what the organisation and stakeholders want to achieve and the indicators become a means of reporting against their specific objectives. As such, it is a similar approach to that commonly used by businesses as part of their strategic planning." (Christen et al, 2006).

The ISAF has a structure and methodology based on four tiers:

1. Sustainability principles
2. High level objectives; linking strategy to business planning
3. Operational objectives which link high level objectives to organisational planning and action
4. Indicators of performance.

(Christen et al, 2006).

2.4 What are the benefits of ESD Component Trees?

Application of the ESD Component Tree approach in wild fisheries, aquaculture, agriculture and irrigation has demonstrated the following key benefits.

Comprehensiveness

The system is designed to ensure that all issues that are possibly relevant are captured in the generic component tree. Issues of relevance can then be identified for a specific project, removing issues from the generic component tree that aren't found to be relevant and, importantly, allowing for issues which may have been missed in the generic component tree to be included in the project specific component tree. The result is that the system is as comprehensive as possible because the process starts from a broad and deep view that allows for additional issues to be included if identified. This can help to overcome uncertainty in decision-making and build confidence in decision-makers and the community that all issues have been considered in a decision-making process.

Dealing with complexity

The ESD Component Trees are comprehensive as they encapsulate all possible issues. After identification, each issue is prioritised, allowing for issues of a higher priority to be identified and managed. This helps users deal with extremely complex problems involving a multitude of issues. The complexity traditionally surrounding decision-making of these multifaceted problems is reduced because issues can be categorised and prioritised in a systematic way.

Understanding and managing risk

Each issue is individually considered for its respective level of risk. Issues of high risk are separated from issues of low risk (and reasons documented) so that higher priority issues are managed as such. This process ensures that not only all issues are identified and considered, but that limited management resources are optimised by applying them to the highest priorities. Furthermore, and importantly, it supports the understanding of the difference between uncertainty and risk as decision-makers and the community can focus on the relative risk and benefit of each issue rather than a general feeling of uncertainty as to whether all relevant issues have been identified and the correct priorities addressed.

Transparency

The process of documenting briefly why a generic issue is not relevant to a particular decision promotes transparency and allows all parties to clearly see how each issue was evaluated in a decision-making process.

Consistency

The assessment of all activities within an industry or area can be completed in a consistent manner as all assessments start with the same generic component tree.

Developing thinking and understanding of ESD

The ESD Component Trees are designed to encourage the user to think about all ESD issues that might be relevant to a particular decision. This can assist in the development of more comprehensive understanding within communities and governments of issues that are relevant to ESD.

2.5 How can ESD Component Trees support irrigation decision making in northern Australia?

The use of the ESD Component Trees to date has largely focused on identifying potential risks to guide triple-bottom-line or ESD reporting. ESD Component Trees can contribute to irrigation decision-making in northern Australia by helping to breakdown the concept of ESD, as it relates to irrigation, into understandable and workable components. Adaptation of this approach to irrigation in northern Australia should help identify not only potential risks but also the potential benefits of any existing or proposed irrigation activity. This can support more transparent consideration of the positive and negative contributions an existing or proposed irrigation activity may make to ecologically sustainable development in northern Australia. An ESD Component Trees system for irrigation in northern Australia is described in Chapter 3. Chapter 4 describes the potential uses of such a system in a variety of decision making processes about irrigation in northern Australia.

3. An ESD Component System for Irrigation in Northern Australia

3.1 Background

This ESD Component System for irrigation in northern Australia is part of the NAIF frameworks to support irrigation decision-making in northern Australia. The system is designed to help ensure that no aspect of ESD relevant to an irrigation decision is accidentally overlooked. It considers economic, social and ecological impacts of irrigation (positive and negative) and the external factors affecting irrigation, and includes a high level of detail. This Section describes the ESD Component Trees for irrigation in northern Australia and how they can be used in various decision-making processes. This document should be used in conjunction with the NAIF ESD Component Trees Toolkit which provides practical tools and guidance on the use of the NAIF ESD Component System.

Following is an explanation of how the concept of ESD has been applied to component trees dealing with irrigation in northern Australia. We have presented one way of organising the relevant ESD issues into component trees that was developed in consultation with the NAIF Steering Committee and Sub-Committee (consisting of representatives of the QLD, NT and WA government water agencies). We recognise that there are many alternative views on how such trees should be structured. In reality, the structure is not critical – what is important is that relevant issues are identified somewhere in the generic component trees and that the application of the generic component trees encourages comprehensive thinking about the positive and negative contributions of irrigation to ESD in northern Australia.

3.2 Generic ESD components for irrigation in northern Australia

At the highest level, the generic NAIF ESD Component Trees are organised into four areas, or trees: ecological impacts, social impacts and economic impacts of irrigation, and external impacts on irrigation. Each tree is then further organised as follows:

Positive and negative ecological impacts of irrigation

1. Outside of region impacts
2. Regional & catchment level impacts
3. Local and on-site impacts

Positive and negative social impacts of irrigation

4. Impacts on national & state wellbeing
5. Impact on regional & catchment community wellbeing
6. Impact on the local & on-site community wellbeing
7. Social impact on matters of particular significance to Indigenous community wellbeing and country

Positive and negative economic impacts of irrigation

8. Impact on national & state economy
9. Impact on regional & catchment community economy
10. Impact on local & on-site economy
11. Economic impact on matters of particular significance to Indigenous community and country

External factors affecting irrigation

12. Control structure and other influences
13. Political drivers
14. Economic drivers
15. Environmental impacts on irrigation

Matters of particular importance to Indigenous communities

For two of the generic component trees (social and economic impacts) matters of particular importance to Indigenous communities and country have been specifically identified in recognition of the growing proportion of indigenous people in the population of northern Australia. Furthermore, 71% of the Indigenous population of the NT currently lives in rural areas compared to 29% of the non-indigenous community (Northern Territory Government). Indigenous people have, therefore, a significant stake in irrigation decision-making in northern Australia.

3.3 Explanation of generic components – Ecological impacts

This branch of the ESD Component Trees system identifies aspects related to the potential ecological impacts of irrigation. It is important to consider each of the potential issues at all levels of the component trees for the project's set-up, operation and decommissioning phases. This will help to ensure that all potential impacts are identified for the full life cycle of an irrigation development.

The major components for consideration are atmosphere, energy, land, water and biodiversity. Each of these major components appears at all levels of impact (outside of region, regional/catchment and local/on-site) however each has different lower branches which are of relevance to the specific scale of impact. For each level, the user examines the impact of irrigation on atmosphere, energy, land and water first. The findings from these sections can then be used to help in addressing the potential issues found in the biodiversity section. This will ensure that both direct impacts to atmosphere, energy, land and water are considered as well as their subsequent impacts on biodiversity.

Outside of region impacts

This generic component tree identifies the impacts of irrigation activities beyond the region they are situated in. This covers issues that have a wider scope than individual irrigation activities or even a single catchment or region. For example the total water requirements for irrigation in the region and how they impact on availability at the state, territory or national level.

The major components consist of the areas where regional activities may influence out of regional systems. These are atmosphere, energy, land, water and biodiversity. These components address issues in a cumulative sense. Example: Impact on national Greenhouse gas emissions.

Regional & catchment level impacts

This generic component tree covers issues that may need to be considered when assessing the combined impact of all irrigation activities (or planned activities) in a defined region/catchment/area. The main purpose of this tree is to assist in the examination of the potential cumulative impact of all irrigation activities in relation to regional circumstances such as geography and other industries already operating. This will support compliance with regional objectives.

The potential ecological impacts at the regional and catchment level are more complex and form a greater variety of issues than those relevant outside of the catchment. Although many of the issues may still be considered cumulative, their footprint is more localised than the issues outside the region. The components in this generic component tree are correspondingly more numerous and of greater detail than of those found in Outside of Region Impacts. To help deal with the complexity of the components, each sub-branch is further divided into 'removals' and 'releases'. This is done in order to help the user think through each component in its relevant context. Likewise, impacts on water have been further been divided into quantity and quality. Example: Saline intrusion to aquifers.

Local and on-site impacts

These are the potential issues relating to the impact of an individual irrigation activity in its immediate vicinity, including impacts on on-site attributes. Example: Soil infiltration rate.

3.4 Explanation of generic components – Social impacts

The 'Positive and Negative Social Impacts' generic component tree covers all aspects to do with non-economic social impacts on national/state, regional/catchment and local/on-site community wellbeing. Employment is included but only so far as in regards to the number and distribution of employment within the community. Potential issues such as knowledge sharing, identity and distribution of benefits are the focus of the components in this branch. Several components are repeated at the three scales (national, regional and local) because they have different meanings for each level and it is important to consider all of them.

Impacts on national and state wellbeing

This generic component tree examines the potential impact of irrigation activities on the broader, national and state level, scale. It allows for the separate examination of both the direct and indirect social impacts of irrigation activities. The major components of the direct social impacts are national identity, health and safety and, attitudes to irrigation. Each of these components has sub-components attached to them which indicate possible ways of addressing these potential issues more readily. These components are repeated for the regional/catchment and local/on-site level as these issues are prevalent and important at all levels. There is only one indirect social impact listed and that is the distribution of social benefits and costs. Again, this issue is repeated at the regional/catchment and local/on-site level. Example: Food security.

Impacts on regional & catchment community wellbeing

Both the direct and indirect impacts of irrigation activities on community wellbeing at the regional and catchment level are addressed in this generic component tree. Issues of importance to the whole community are considered. Example: Development, use and sharing of technical skills and knowledge.

Impacts on local & on-site community wellbeing

It is equally important to consider the impact of irrigation activity on individuals and their families. Issues such as personal viability, resilience and societal contribution are considered in this generic component tree. Once again both the direct and indirect impacts of irrigation are considered. Example: Family.

Social impact on matters of particular significance to Indigenous community wellbeing & country

This generic component tree is used to identify social factors of particular significance to Indigenous communities, such as the impact of irrigation activities on traditional culture and knowledge. Example: Loss of sacred places.

3.5 Explanation of generic components – Economic impacts

The 'Positive and Negative Economic Impacts' generic component tree examines economic issues at the national/state level, regional/catchment level, the local/on-site level and economic issues of particular significance to Indigenous community and country. As with the social impacts, economic impacts are considered to be either direct or indirect. Most key components are repeated across the different scales levels, such as employment rate and economic returns. This highlights that the irrigation industry is directly linked to many other industries which may supply or demand services and provisions to irrigation activities. Each level of impact also has its own specific components or applications of the same components, however, which are important to consider.

Impact on national & state economy

The components of this branch address economic impacts for the Australian and state/territory governments as well as private investors. It contains both monetary benefits and non-monetary benefits. Example: Diversified regional growth.

Impact on regional & catchment community economy

The components of this branch address economic impacts for the Australian and state/territory governments as well as private investors. It contains both monetary benefits and non-monetary benefits. Example: Local government and private investment in public assets (e.g. infrastructure).

Impact on local & on-site economy

This component branch contains only direct impacts from irrigation as this is all that is relevant at the local/on-site level. It contains both monetary benefits and non-monetary benefits. Example: Income to irrigators.

Economic impact on matters of particular significance to Indigenous community and country

This generic component tree is used to identify economic factors of particular significance to Indigenous communities, such as the impact of irrigation activities on direct and indirect economic opportunity. Example: Employment opportunities on farm.

3.6 Explanation of generic components – External factors affecting irrigation

Control Structure and Other Influences

This Component Tree identifies the control structures which govern irrigation. These include legal, policy and planning frameworks at various scales, water and land allocation mechanisms, industry self-management arrangements, industry and community capacity etc. Example: RAMSAR.

Policy Drivers

This tree identifies political drivers such as responses to community and political opinion, power sharing relationships in catchment decision-making as well as competing land and water uses that are not directly controlled by the irrigation sector or individual developments. Example: Power sharing arrangements in irrigation and catchment decision-making.

Economic Drivers

This tree identifies economic drivers, such as financial policy, commodity markets, infrastructure funding, and availability of expertise. Example: Competition/demand fluctuation.

Environmental Impacts on Irrigation

This tree identifies other external impacts on irrigation, including external environmental impacts such as climate change. Example: Changes in rainfall averages, seasonality and variability.

4. Using ESD Component Trees to support irrigation decision-making in northern Australia

Those charged with the responsibility of making decisions about irrigation proposals are increasingly required to consider the implications of those proposals at a range of scales, from on-site, local, catchment, regional, national and in some cases, international. When the range of potential social, economic, ecological and governance issues is considered at each scale it forms a very comprehensive but complex matrix which represents the challenges of such decisions (Table 1). Failure to systematically deal with this complexity can result in uncertainty that all relevant issues have been identified and addressed, leading to reduced confidence for decision-makers, governments, proponents and the community.

Table 1. Matrix of issues relevant to irrigation decisions.

	Ecological Impacts of Irrigation	Social Impacts of Irrigation	Economic Impacts of Irrigation	External Factors Affecting Irrigation
Outside of Region Impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts
Region & Catchment Impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts
Local & On-site Impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts	+ve impacts -ve impacts

Based on their previous demonstrated benefits in helping to address such complex issues, ESD Component Trees emerge as an opportunity to enhance decision making about irrigation in northern Australia. ESD component trees can help reduce the perception of risk caused by uncertainty as to whether all relevant issues have been identified, considered and addressed. By reducing the perception of risk, ESD Component Trees can increase community and decision maker confidence and help reduce the likelihood of unnecessary regulation. The NAIF ESD Component Tree system is intended to enhance rather than replace existing decision making processes by helping to ensure that they are carried out in a comprehensive, transparent and inclusive manner. While ESD Component Tree systems have so far largely been used to support triple bottom line or ESD reporting processes, such an approach could be used more broadly.

This Section describes how the NAIF ESD Component Trees can support:

- Catchment visioning and planning
- Developing irrigation proposal
- Assessing irrigation proposals

- Improving existing irrigation areas
- Triple-bottom-line or ESD reporting
- Identifying and managing knowledge gaps.

It is understood that tools and processes for decision-making are already in place for each of these areas and we encourage the reader to think about how the ESD Component Trees can strengthen those processes. Each of the six areas of decision-making described are shown in Figure 4 which shows how that decision making process relates to using the ESD Component Trees system.

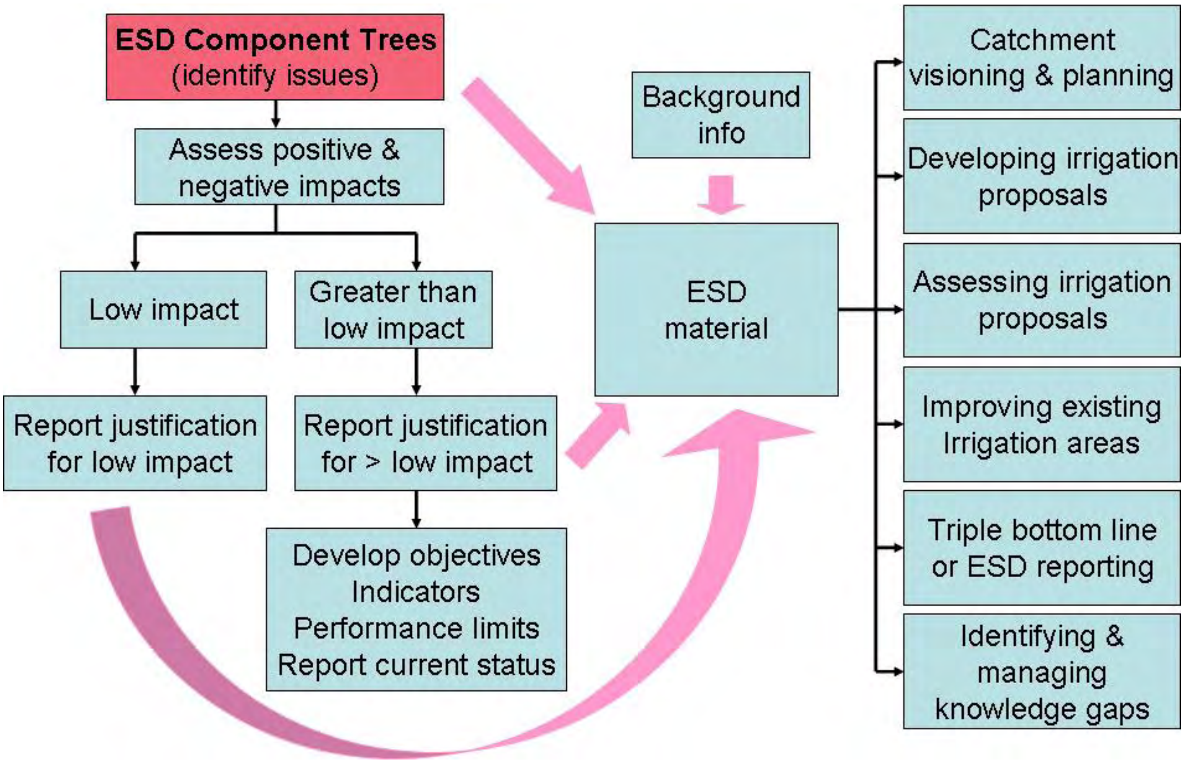


Figure 4. Flow chart showing how ESD Component Trees can be used to produce ESD material to help in six key decision making processes.

4.1 Catchment/regional visioning and planning

A range of techniques are used to identify issues for consideration in catchment and regional visioning and planning. ESD Component Trees provide a comprehensive and transparent ‘front end’ to ensure that potentially relevant issues are not missed. A comprehensive and transparent starting point can help ensure that all stakeholders are satisfied that issues they consider to be important have been dealt with and the reasons for the inclusion or exclusion of those issues have been clearly documented.

4.2 Developing irrigation proposals

If all relevant issues are identified and prioritised in catchment visioning and planning through the use of ESD Component Trees, the proponents have a detailed template which can be used to document the expected positive and negative contributions of their proposal. Component trees could be a useful tool for proponents to demonstrate that they have considered all relevant factors, and the suit of positive and negative contributions from the proposal, even if detailed guidance is not provided through planning instruments. ESD Component Trees can also help proponents identify all the necessary considerations in their own proposal development process (for example, whether the natural system can provide for the irrigation proposal or what control structures are in place) and to compare alternatives.

4.3 Assessing irrigation proposals

ESD Component Trees can support those responsible for assessing irrigation development proposals. If both catchment, regional or other objectives and a proposal have been developed using the ESD Component Trees, comparisons between the two will be easier. This can help decision-makers identify whether the key issues have been addressed in the proposal, what the strengths and weaknesses of the proposal are, and whether modifications are required or not. If applied as proposed, ESD Component Tree System can increase the transparency of this process, helping to develop stakeholder and community understanding, and acceptance, of such processes.

Where there are multiple alternative proposals, the comprehensive and consistent template provided by the application of ESD Component Trees can assist comparison of the alternatives by making the positive and negative contributions of each proposal across the range of important factors more apparent.

4.4 Improving existing irrigation

ESD Component Trees can support a comprehensive assessment, or rethink, of existing irrigation in northern Australia by ascertaining the positive and negative contributions from that irrigation to ESD. This assessment can then be used to guide management action towards changes that will best meet catchment or other management objectives by improving the ratio of positive to negative impacts. The ESD Component Trees can assist in developing objectives, indicators and performance limits, as well as to report current status of each of the outcomes identified as having a greater than low risk.

4.5 Triple-bottom-line and ESD reporting

The use of ESD Component Trees to support triple-bottom-line (TBL) or ESD in fisheries, agriculture and irrigation is well documented as this was the first use of this approach. ESD Component Trees provide a template identifying which factors need to be reported against, for monitoring the positive and negative impacts against expectations, for reporting the differences and for identifying and proposing priority areas for modification to improve outcomes.

ESD component trees can support adaptive management. Revisiting the ESD Component Trees from time to time in relation to a particular development, location or planning process can help ensure changing importance of factors is picked up. Processes that do not go back to the comprehensive starting point that ESD Component Trees provide may not pick up, for example, that community attitudes have changed and that an issue that was originally of low importance is now a high priority.

4.6 Identifying and managing knowledge gaps

ESD Component Trees can provide a template for tracking the availability of data, information and knowledge about the factors relating to a particular irrigation development, catchment, region etc. The process of identifying relevant factors, then determining relative priority, can assist the identification and communication of knowledge gaps, and tracking those gaps as they are addressed. If a knowledge gap exists about an issue which is considered low risk then a detailed investigation may not be required. However, if a knowledge gap has been identified that is considered high risk it is important to address this knowledge gap.

4.7 Other potential applications

The Component Tree system can be used for irrigation elsewhere in all the same processes that have been described in the preceding chapter. This will require the construction of generic Component Trees for, though many of the components are likely to be the same.

The Component Tree system revolves around the key concept of breaking down ESD into its components to help deal with complexity and uncertainty, and understanding and management of important risks and benefits. The nature of the Component Trees and how they are formed and used allows them to be adapted to a wide range of applications. The component tree system is already in use in agricultural, fisheries, aquaculture and irrigation, and this document promotes its utility for irrigation in northern Australia. The approach could be adapted to other sectors, including:

- Planning (Local/Regional/National)
- Mining
- Manufacturing
- Construction
- Processing.

5. The NAIF ESD Component Trees Toolkit

This document should be used with the accompanying “NAIF ESD Component Trees Toolkit”. The Toolkit provides information on the use of the generic ESD Component Trees and tools to support that use. Application of the Component Trees is demonstrated through their use in the Lower Burdekin, Queensland. The Toolkit includes the following sections which make up the balance of the report following the references:

Section 1: Process Guide for applying NAIF ESD Component Trees

Section 2: Generic ESD Component Trees set for irrigation in northern Australia

Section 3: Formatted Excel spreadsheet to assist in documenting which issues are relevant and which are not relevant to a particular decision

Section 4: Power Point Presentation to assist in applying NAIF ESD Component Trees

Section 5: Example of application: Application of the NAIF ESD Component Tree System and Construction of the Lower Burdekin Knowledge Platform 2

These tools allow the user to navigate through the components of the generic ESD Component Trees for irrigation in northern Australia and form a unique set for a particular activity and location, including documenting why each component was included or excluded.

References

Australian Government (2007) *A National Plan for Water Security*, Available: http://www.pm.gov.au/docs/national_plan_water_security.pdf [11th October 2007].

Christen, e., Shepheard, M., Jayawardane, N., Davidson, P., Mitchell, M., Maheshwari, B., Atkins, D., Fairweather, H., Wolfenden, J. and Simmons, B. (2006). The Sustainability Challenge: A guide to using triple bottom line reporting as a framework to promote the sustainability of rural and urban irrigation in Australia. CRC for Irrigation Futures Technical Report No. 03-1/06. June 2006. 40 pp.

Cullen, P. (2004) *The Journey to Sustainable Irrigation*, Irrigation Association of Australia Annual Conference, Adelaide, May 2004.

Fletcher, W.J., Chesson, J., Fisher, M., Sainsbury, K.J., Hundloe, T., Smith, A.D.M. and Whitworth, B., 2002. *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wold Capture Fisheries*, FRDC Project 2000/145, Canberra, Australia. 120 pp.

Fletcher, W.J., Chesson J., Fisher, M., Sainsbury. K.J., and Hundle, T.J. (2004) *National ESD Reporting Framework: The 'How To' Guide for Aquaculture*, Version 1.1 FRDC, Canberra, Australia 88 pp.

Gleick, P. (2002) *Fresh Water in the New Century: Old Problems, New Solutions*, Irrigation Association of Australia National 2002 Conference Proceedings: Irrigation – Conservation or Conflict? Irrigation Association of Australia, May 2002, (p.8).

Lowe, I. (1994) *Performance Measurement*, Proceedings of the Fenner Conference on the Environment. November 1994.

Montagu, K., et al. (2006) *Understanding irrigation decisions from enterprise planning to the* paddock, CRC Irrigation Futures, Available: http://www.irrigationfutures.org.au/imagesDB/news/UnderstandingIrrigationDecisions-final.pdf [11th October 2007].

Northern Territory Government, *Indigenous Population of the Northern Territory*, Available: http://www.dlghs.nt.gov.au/ih/indigenous_housing_environment/indigenous_population_of_the_northern_territory [11th October 2007].

Petheram, C. (2007) *Towards an understanding of the hydrological constraints and opportunities for irrigation in northern Australia: A review*, CSIRO Land and Water Science Report 2007.

Petheram, C., Tickell, S., O'Gara, F., Smith, A., Bristow, K. and Jolly, P. (2007) *Analysis of the Lower Burdekin, Ord and Katherine-Douglas-Daly irrigation areas: implications to future design and management of tropical irrigation*, CSIRO Land and Water Science Report No. 2007, CRC for Irrigation Futures Technical Report No. 04/07.

State of the Environment Advisory Council (1996) *Australia: State of the Environment Report*, CSIRO, Collingwood.

Section 1:

Process Guide for applying NAIF ESD Component Trees

Process Guide

ESD Component System to Support Irrigation-Decision making in Northern Australia

The ESD Component Trees for irrigation in northern Australia have been designed to identify any issue which *may* be relevant. The critical thing is to *identify all components* which *may* be of importance to the specific location or activity. The component trees have been structured in a way which allows the user to identify components of importance, remove those which are not (ensuring that the reasons for doing so are captured) and add components which are deemed to have been not included in the original ESD Component Trees.

The ESD Component Trees for irrigation in northern Australia have been included as a part of this toolkit. They have been included in two formats. One is a PDF which can be viewed like other PDFs in ADOBE© READER© (http://www.adobe.com). The reviewer can use the zoom function to work through each section before moving on to the next.

The second format is a Mind Map (mmap). This can be viewed in any mind mapping program which accepts mmap file format. There are several commercially available mind mapping programs available. Reviewing the ESD Component Trees using the mind map file format is highly recommended for several reasons. It allows the reviewer to collapse and expand each individual section and sub-section in order to more easily review each section. It also allows each component to be removed or new ones added (providing the reasons for doing so are captured) as the reviewer moves through the component trees.

What follows is an explanation of three tasks for which the user can use the ESD Component Trees to help develop management actions for a particular location, proposal or decision process.

First Task – Identifying

The first task is to use the generic ESD Component Trees to identify which issues are relevant to the particular location, proposal or decision process. Don't debate priorities now - this is done in the next stage. As such it is suggested that two half day sessions or workshops will be sufficient time in order to work through the entire ESD Component Trees and identify which are relevant.

Prior to working through the following steps of the first task it is important to consider the context for which the decision is being made. For this reason it is important to gather enough background information, and disseminate it to those involved with this task, prior to any work being done on identifying relevant issues.

The first task involves three steps:

Step 1

The first step is to choose a particular section (Ecological, Social, etc…) to start with. It is recommended to start with a section that the reviewer feels the most comfortable with. It is recommended to use the Mind Map version of the ESD Component Tree as it allows the reviewer to focus on the selected section more easily by collapsing the other sections whilst they work through the selected one.

Step 2

The second step involves the reviewer working through each component in the selected section. As the process is about *identifying* all components which are of relevance, the reviewer should not worry about how the ESD Component Trees are structured but rather what individual components are included or excluded. It is recognised that there are many different ways organise the issues which appear as components in the ESD Component Trees. One of these structures has been chosen as it is believed this structure will be clearest to the majority of users.

As part of this step that the reviewer must capture which components they decide are not relevant (and thus excluded) and, very importantly but briefly, the reasons why they have been excluded. Equally, any additional components added should be noted with the reasons why they have been added captured. The formatted spreadsheet which is included in this toolkit will assist in this process (Figure 1). It is by capturing the reasons *why* issues are excluded or added that a transparent process can be achieved. For this reason it is also important to include the reviewer's details so that reasons can be discussed if needed.

Reviewer/s:		
Date Reviewed:		
Contact Details:		
EXCLUDED COMPONENTS		
Section	**Component Path**	**Comment**
Ecological		
	Ecological-Regional-Biodiversity-Marine	There is no possibility of impact on the marine environment
	…	…
	…	…

Figure 1 Part of the Excel spreadsheet formatted to capture components excluded and reasons why. Reviewer details also need to be captured.

Step 3

Once the reviewer has reviewed the first section they should move to the next section (collapsing the finished section and expanding the new section if using the Mind Map) and complete Step 2.

The reviewer should continue in this manner until they have reviewed all four sections of the ESD Component Trees.

This process does not need to be done in one session. It is recognised that some additional research may be needed in order to decide on some issues or, equally important, other work may indicate that new issues have to be included or excluded.

Second Task - Prioritising

The second task is to classify each of issues identified as being relevant as either important or not important. This may be done by assessing the relevant positive and negative impacts each potential issue may have and classifying them as being either low impact or greater than low impact. This can be done by using a risk assessment approach.

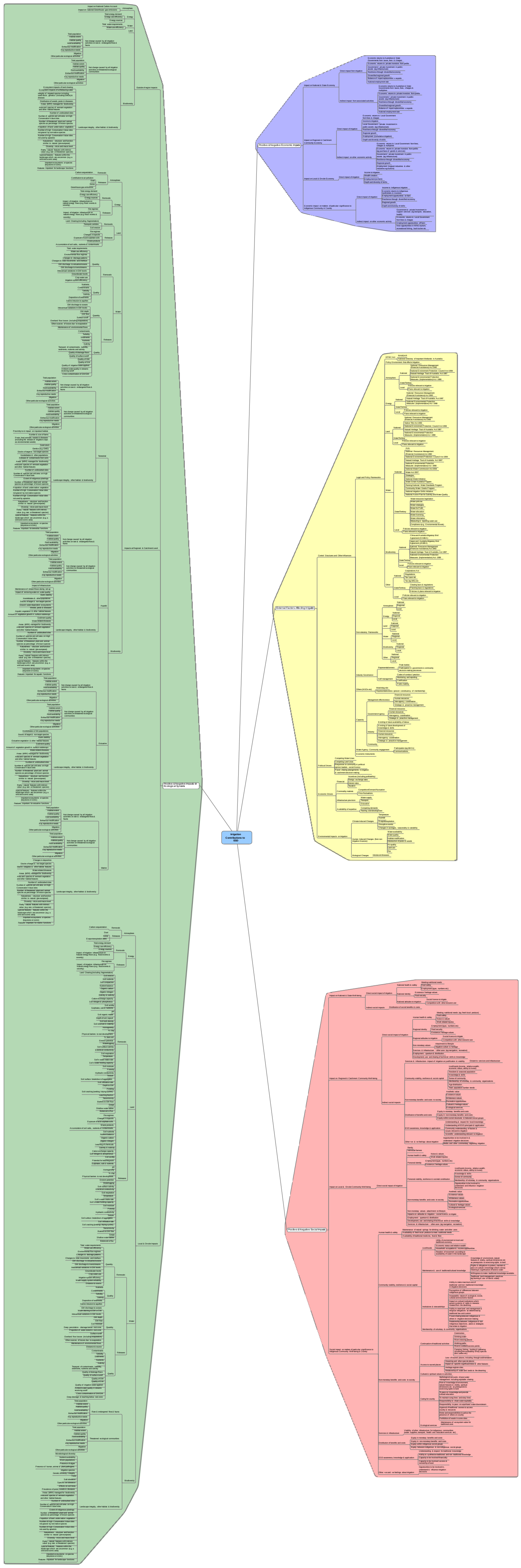
Third Task – Reporting

The third task is developing management actions. Reasons for why each issue was classified as either having a low impact or greater than low impact need to be documented. Further, each issue identified in the prioritising stage as having a greater than low impact needs to have appropriate objectives, indicators and performance limits identified as well as a report on the current status of the issue.

It is the information formed in these three tasks which forms the ESD Material which can be used to help make decisions about a particular location, proposal or decision process.

Section 2:

Generic ESD Component Trees set for irrigation in northern Australia



Irrigation Contributions to ESD
Positive & Negative Impacts on Ecological Systems
Positive & Negative Economic Impacts
Impact on National & State Economy
Impact on Regional & Catchment Community Economy
Impact on Local & On-site Economy
Economic impact on matters of particular significance to Indigenous Community & Country
External Factors Affecting Irrigation
Control Structures and Other Influences
Political Drivers
Economic Drivers
Financial
Environmental Impacts on Irrigation
Positive & Negative Social Impacts

Section 3:

Formatted Excel spreadsheet to assist in documenting which issues are relevant and which are not relevant to a particular decision

Reviewer/s:
Date Reviewed:
Contact Details:

EXCLUDED COMPONENTS

Section	Component Path	Reason/s
Ecological	Ecological-Regional-Biodiversity-Marine	There is no possibility of impact on the marine environment
	...	...
Social	Social-National-Direct-National Identity	The irrigation scheme is minor
	...	...
Economic	Economic-Regional-Indirect-Government / private investment in public assets (eg infrastructure)	There will be no additional infrastructure built
	...	...
External	External-Control Structures-Legal and Policy Frameworks-EPBC Act-RAMSAR	There are no RAMSAR wetlands in the vicinity
	...	...

COMPONENTS ADDED

Section	Component Path	Reason/s
Ecological	...	...
	...	...
Social	...	...
	...	...
Economic	...	...
	...	...
External	...	...
	...	...

Section 4:

Power Point Presentation to assist in applying NAIF ESD Component Trees

An ESD Component Tree System for Irrigation in Northern Australia

Jeff Camkin, Justin Story and Keith Bristow

NAIF
NORTHERN AUSTRALIA IRRIGATION FUTURES

www.clw.csiro.au/naif/

Presentation Overview

- Ecologically sustainable development
- The need for strategic frameworks
- ESD component systems
- The NAIF ESD component system
- Applying the NAIF ESD component system

Ecologically Sustainable Development

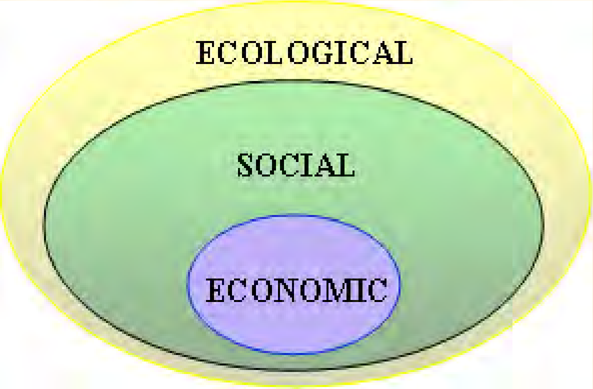
- All tiers of Australian government have committed to the principles of ecologically sustainable development (ESD)

- The National Strategy for Ecologically Sustainable Development (1992) defines ESD as:

  "Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"

Applying the Principles of ESD in Australia

- ***Must*** consider ecological, social, economic and external factors



- Economic activity is part of and takes place within the social system, which in turn is part of and takes place within the ecological system

- Need strategic frameworks to implement ESD

Why strategic frameworks?

- Frameworks put actions and issues into context
- Help to determine what actions should be undertaken
- Help avoid unnecessary work and/or missing important issues
- Help maximise the benefits of actions
- Frameworks are NOT an alternative for other necessary actions

(Adapted from National ESD Framework the ‘How To’ Guide for Aquaculture Version 1.1, 2004)

Incorporating ESD into decision making

- Requires a systematic process to:
  - identify what is relevant to the decision
  - determine relative importance of relevant factors
  - identify objectives and actions for most important ones
  - establish performance indicators for most important ones
  - monitor and report performance

- Process should feed adaptive management cycle

- Stakeholders are a key part of the process

The need for strategic frameworks for northern Australia

"Future and ongoing development of northern Australia's land and water resources must take place in ***a strategic framework*** *that is ecologically, culturally and economically* **sustainable***…"*

National Plan for Water Security, January 2007

The link between knowledge and confidence in decision-making

David Trebeck, National Water Commissioner, 2006

"…the three jurisdictions of the north – QLD, NT & WA – are facing increasing pressures to free up water for development, but the risk is that they ***lack sufficient knowledge*** *of their rivers & groundwater systems* ***to respond with confidence****."*

What impacts on confidence?

Decisions about irrigation development are complex

+

Lots of uncertainty

+

High risks & consequences

+

High community expectations and capable ‘watchdogs’

+

Increasing development pressure

But, decisions will need to be made!

Some things to ponder on

Must dealing with complexity result in more ‘red tape’?

Does every uncertainty carry a high risk?

How well are we using what is already known?

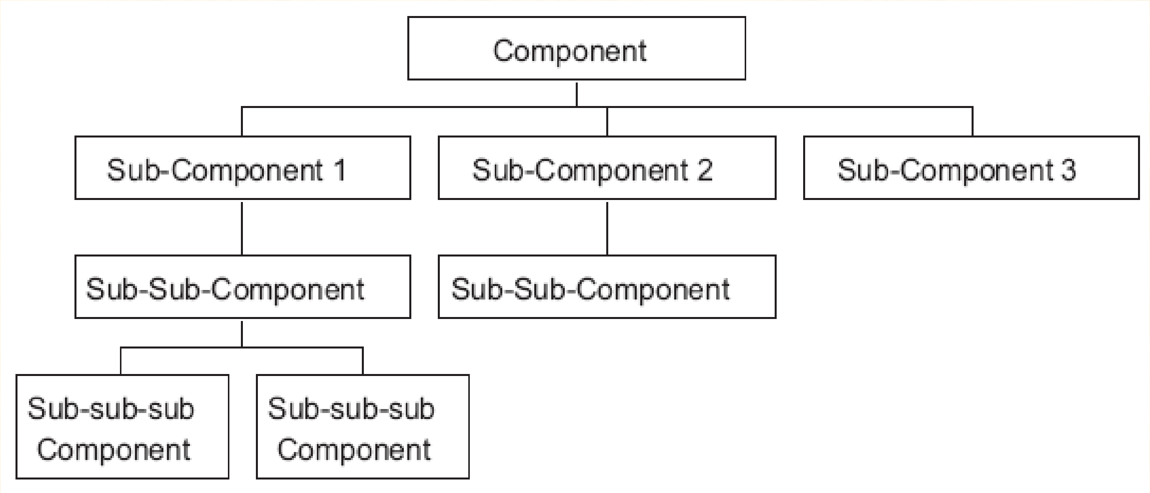
ESD Component Tree Systems

- Previously applied in Australia to:
  - wild fisheries (National ESD Framework)
  - aquaculture (National ESD Framework)
  - agriculture (Signposts for Australian Agriculture)
  - irrigation (irrigation sustainability assessment framework)

- Provides a framework to support and help guide decision making processes

What is a ‘component tree’?

- A hierarchical system of components
- Each component is a possible issue/factor
- Likely issues identified are developed into a generic tree for each component of ESD
- Generic trees are used as the starting point for all assessments



(The National ESD Framework the ‘How To’ Guide for Aquaculture Version 1.1, 2004)

Benefits of ESD Component Tree Systems

Comprehensiveness

- A starting point for identifying relevant factors
- Reduced chance of factors ‘falling through the cracks’
- Reduced likelihood of bias

Transparency

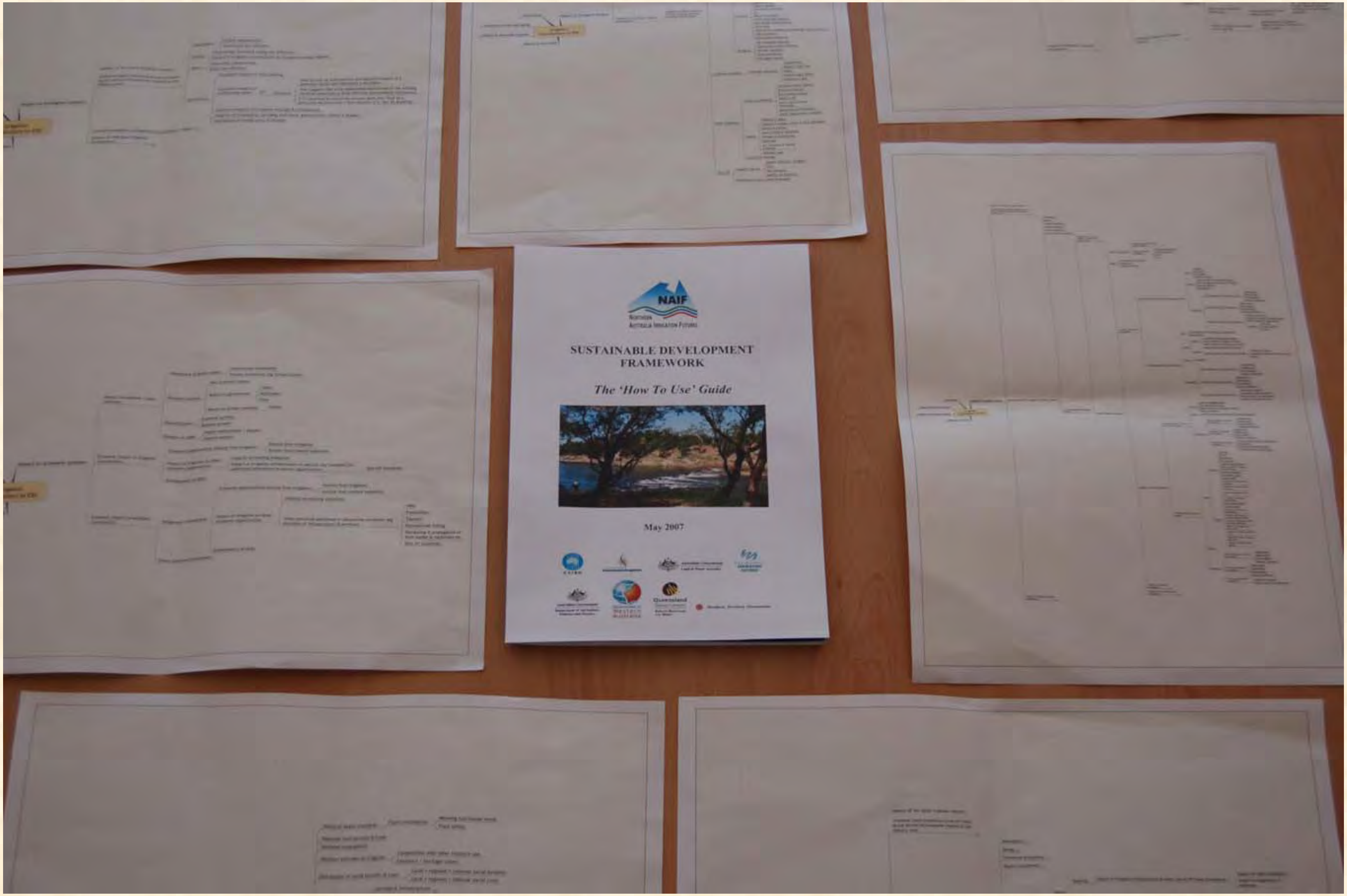
- Specifying why some factors are not relevant increases transparency

Consistency

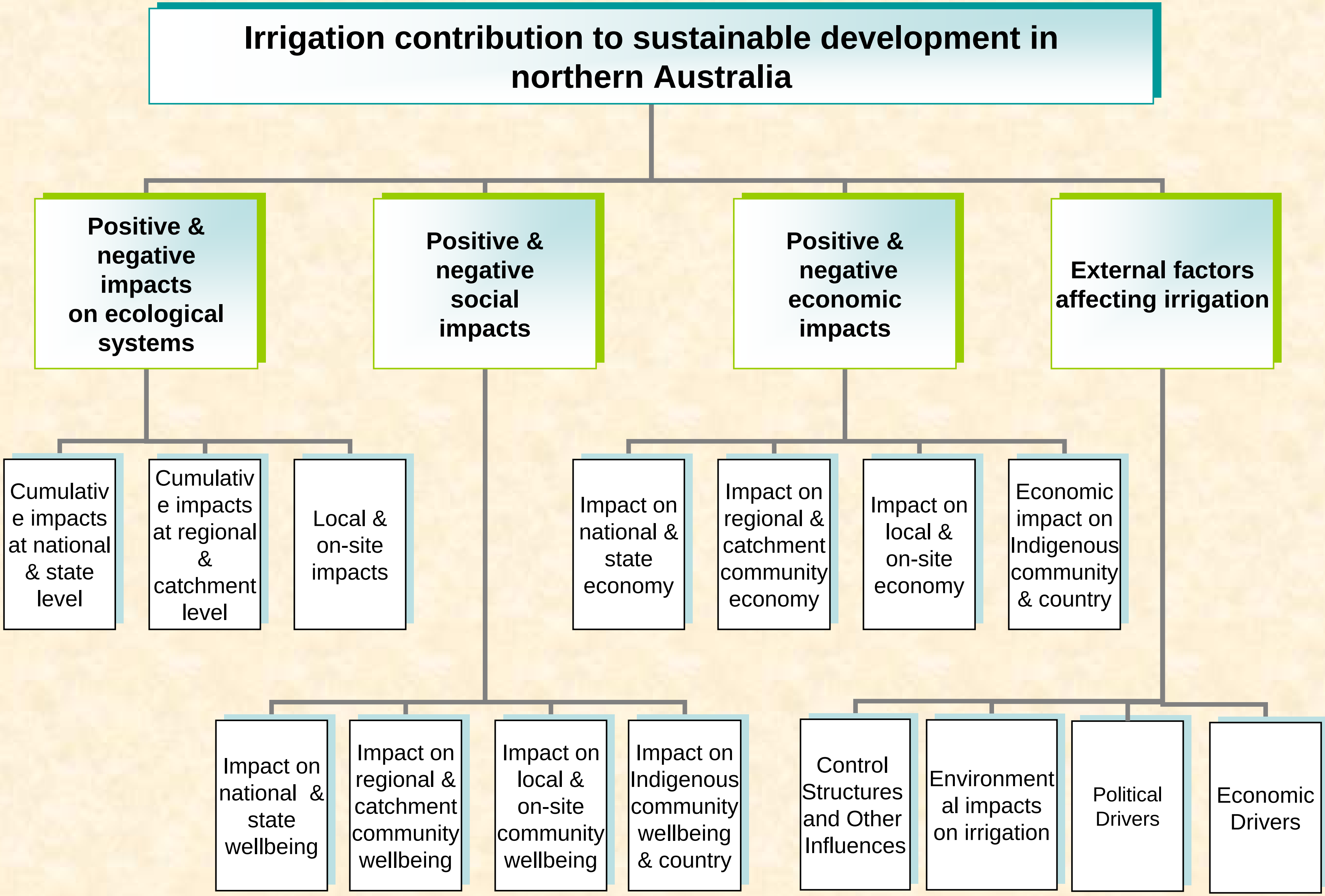
- Same starting point helps consistency between locations and proposals, where appropriate

Helps understand the difference between uncertainty & risk

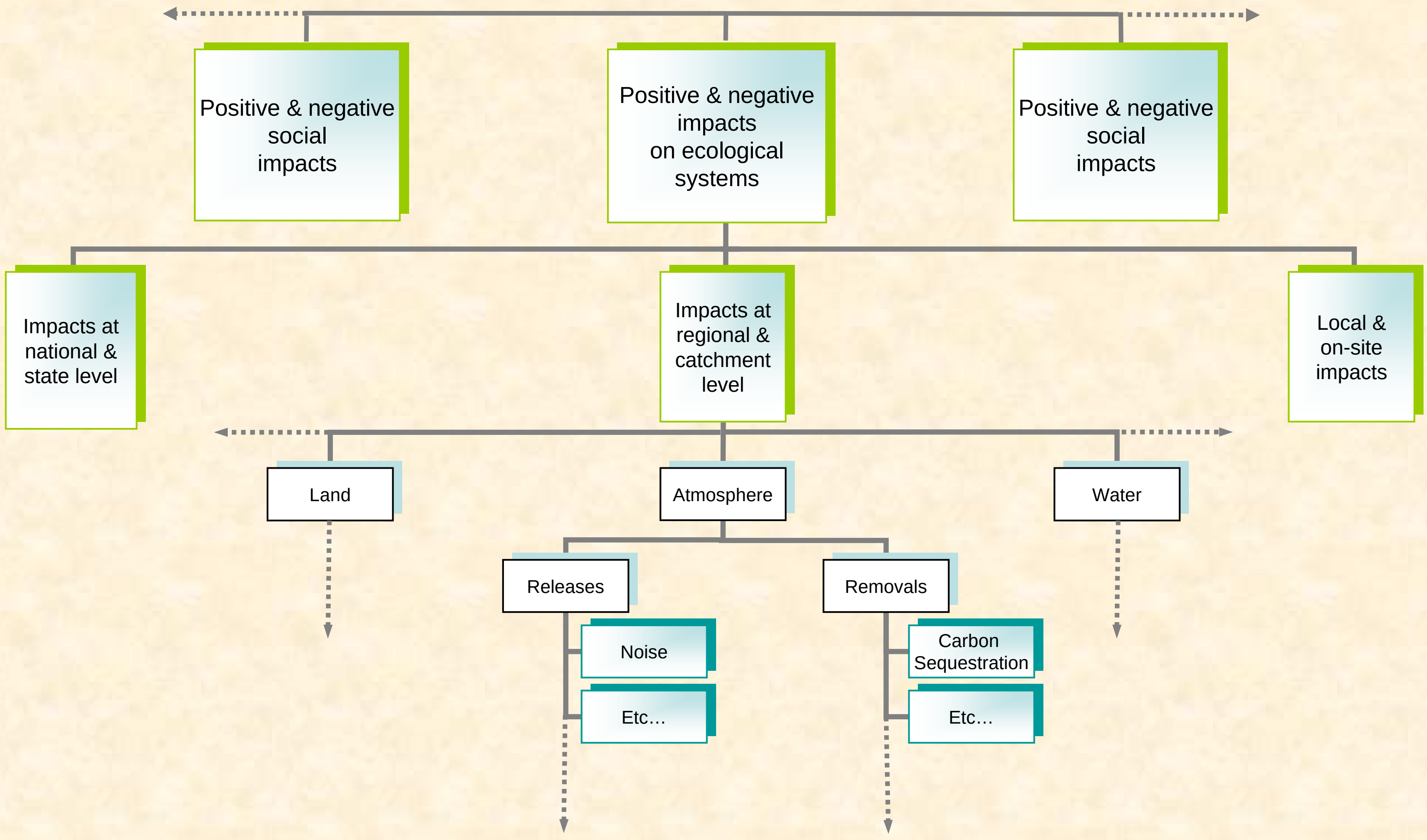
Developing an ESD Component Tree system for irrigation in northern Australia



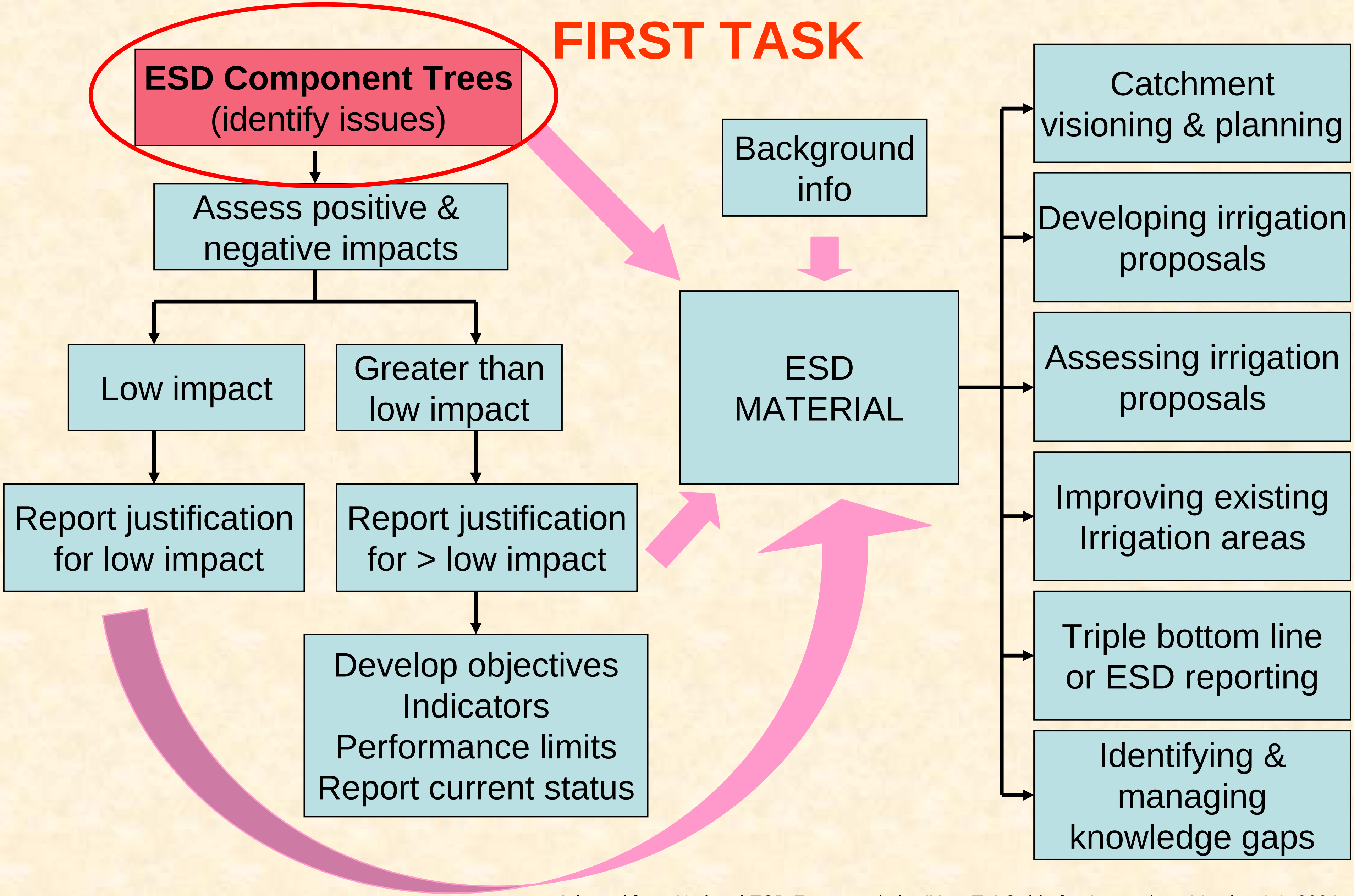
High-level NAIF ESD Component Trees



Low-level NAIF Component Trees



Using the ESD Component Tree system



Adapted from National ESD Framework the ‘How To’ Guide for Aquaculture Version 1.1, 2004

FIRST TASK – Identifying relevant factors

- Use the generic ESD component trees identify all components that ***may*** be relevant to the decision. Don’t debate priorities now - this is done in the next stage

- Add any issue you think has not been included in the generic trees provided

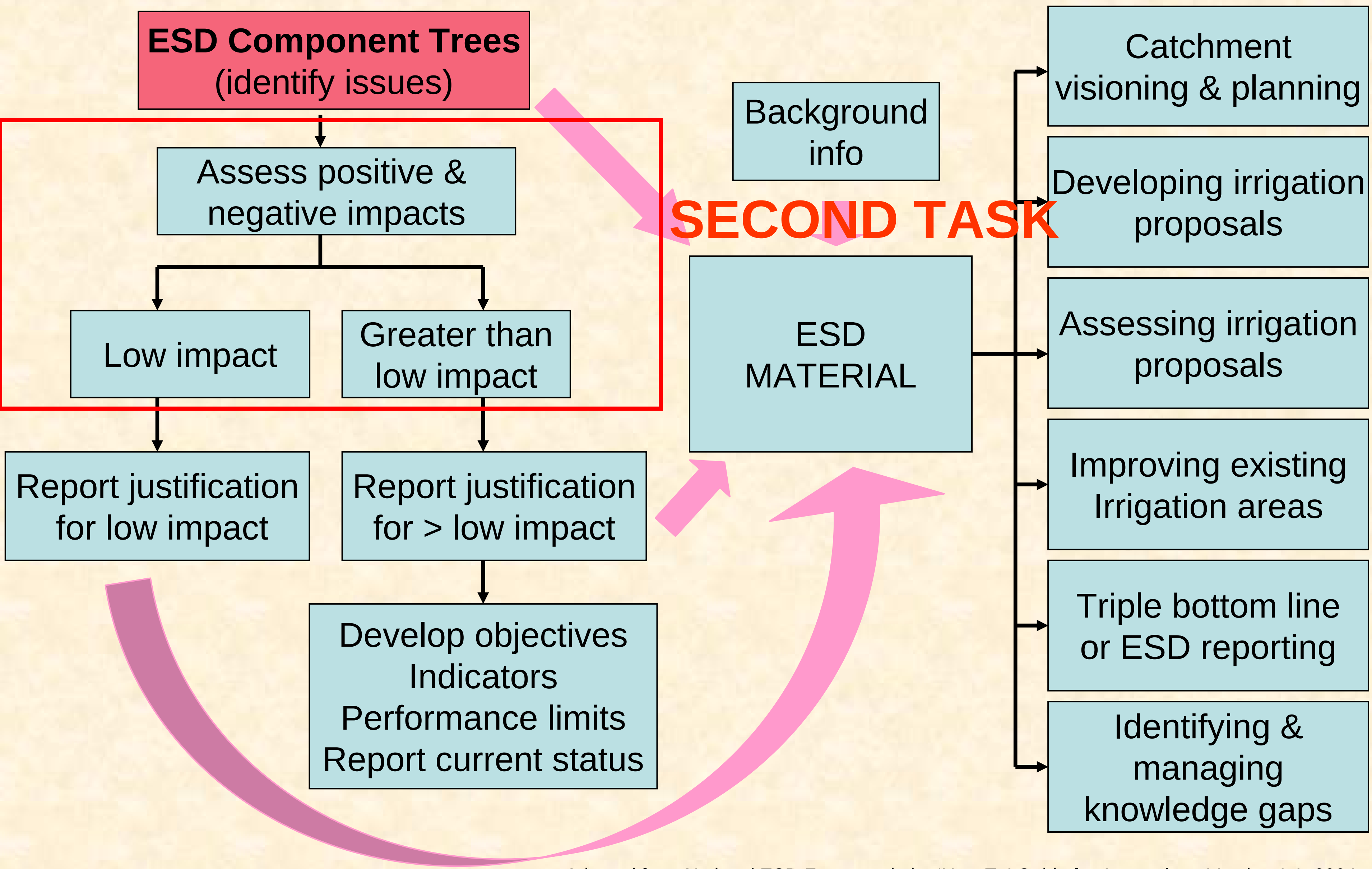
- Identifying a large set may result in a perception of more, not less, complexity and uncertainty. It is important to go beyond this to understanding their relative importance

FIRST TASK – Identifying relevant factors

- Pick one component tree (e.g. positive and negative social impacts) at a time to focus on
- Work through that tree to identify components which are relevant to irrigation and those that are not relevant
- If a component is not relevant, briefly document why in the Excel spreadsheet provided

Reviewer/s:		
Date Reviewed:		
Contact Details:		
EXCLUDED COMPONENTS		
Section	Component Path	Comment
Ecological		
	Ecological-Regional-Biodiversity-Marine	There is no possibility of impact on the marine environment
	...	...
	...	...

Using an ESD Component Tree system



Adapted from National ESD Framework the 'How To' Guide for Aquaculture Version 1.1, 2004

SECOND TASK – Prioritising factors

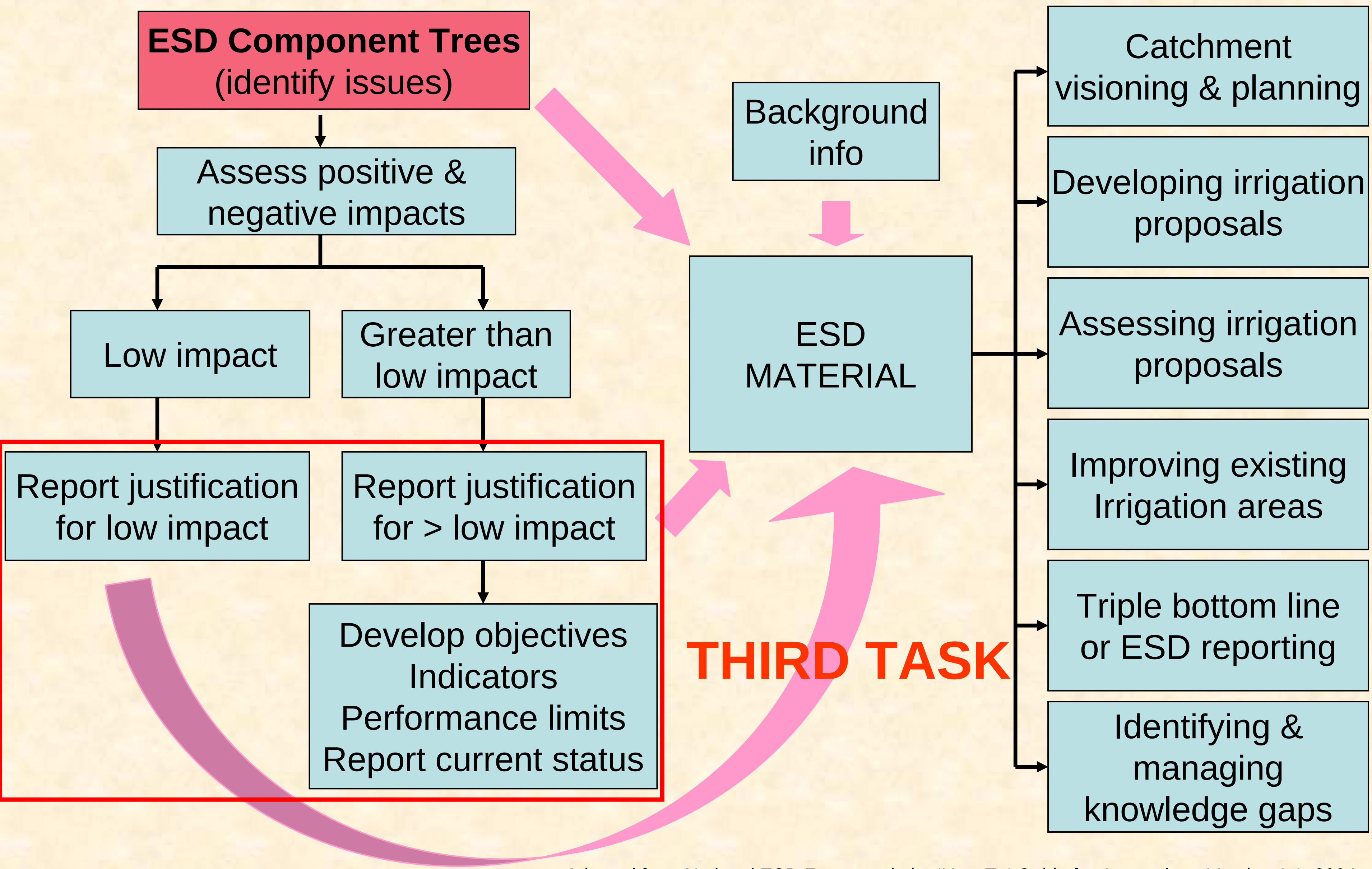
- While many components may be relevant, they will not be of equal importance and not all components require the same level of management
- In this step, the relevant components are assessed to determine their relative importance
- Asses the positive and negative impacts of irrigation on each factor and determine the appropriate level of response
- Standard risk assessment processes and a workshop environment can be used

SECOND TASK – Prioritising e.g. Risk Assessment

Consequence		Negligible	Minor	Moderate	Severe	Major	Catastrophic
Likelihood		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

National ESD Framework the 'How To' Guide for Aquaculture Version 1.1, 2004

Using an ESD Component Tree system



Adapted from National ESD Framework the ‘How To’ Guide for Aquaculture Version 1.1, 2004

THIRD TASK - Reporting

- Complete reports on each issue with detail suited to the level of importance
- Reporting the justification why an issue has low or greater than low impact is an important step for transparency of decision-making
- Can you justify that your management actions (or in inactions) are appropriate given the level of impact and available knowledge?
- Is current performance acceptable given the levels chosen?

THIRD TASK - Reporting

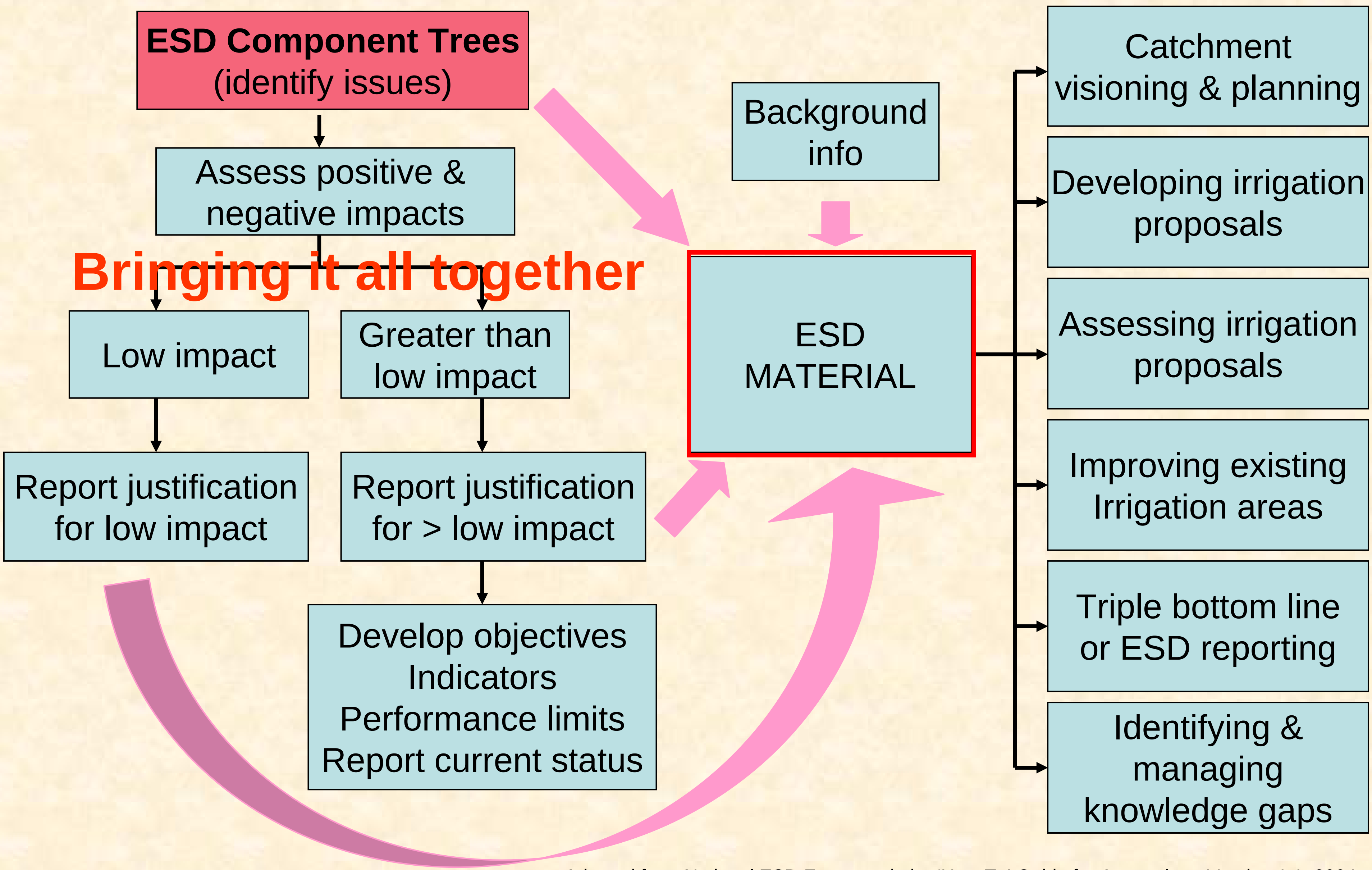
- Rationale for ind… impact rating)
- Develop ope…
- Indicator
- Performance limits (… *stification)*
- Data Requirements
- Data Availability
- Evaluation
- Evaluation Reliability
- Management Response… *reached)*
- Summary of Actions and Co… sions
- External Drivers

What <u>specifically</u> do you want to achieve and why for each issue?

These three are a package

These need to link directly to the objective package

Using an ESD Component Tree system

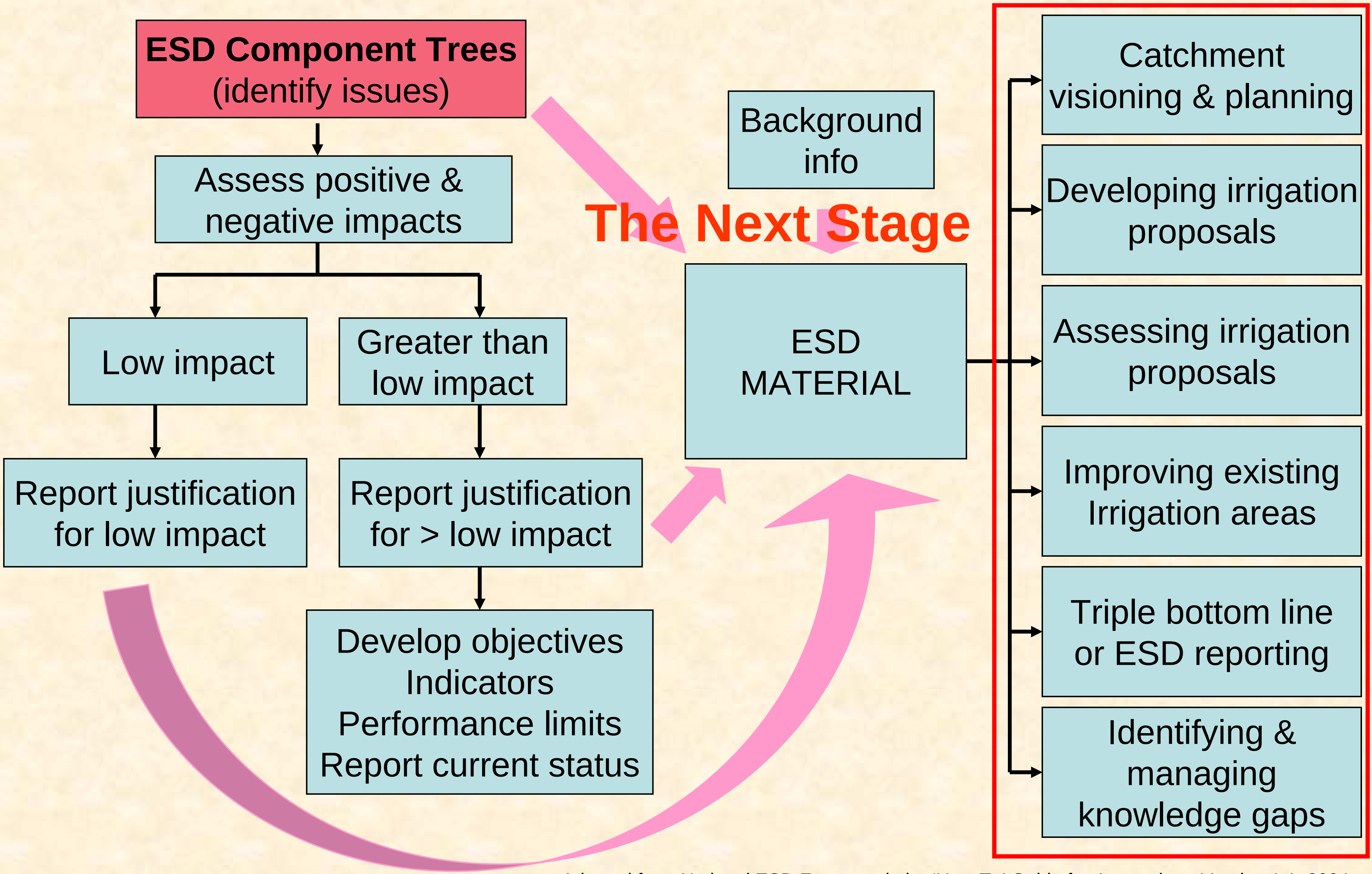


Adapted from National ESD Framework the 'How To' Guide for Aquaculture Version 1.1, 2004

Bringing it all Together

- Material from Tasks 1,2 and 3 as well as background information forms the ***ESD MATERIAL***
- The ESD material can be used in a variety of ways to help guide decision making
- The NAIF ESD Component Trees support existing decision-making processes by providing a comprehensive and transparent front-end process
- Six applications for the NAIF ESD Component Trees identified to date are shown in the figure

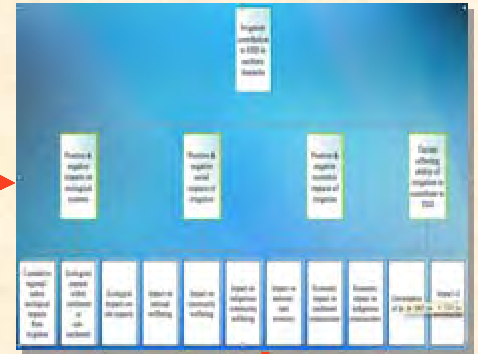
Using an ESD Component Tree system



Adapted from National ESD Framework the 'How To' Guide for Aquaculture Version 1.1, 2004

Example: Applying the ESD Component Trees to develop a Lower Burdekin Knowledge Platform

Develop NAIF ESD Component Trees



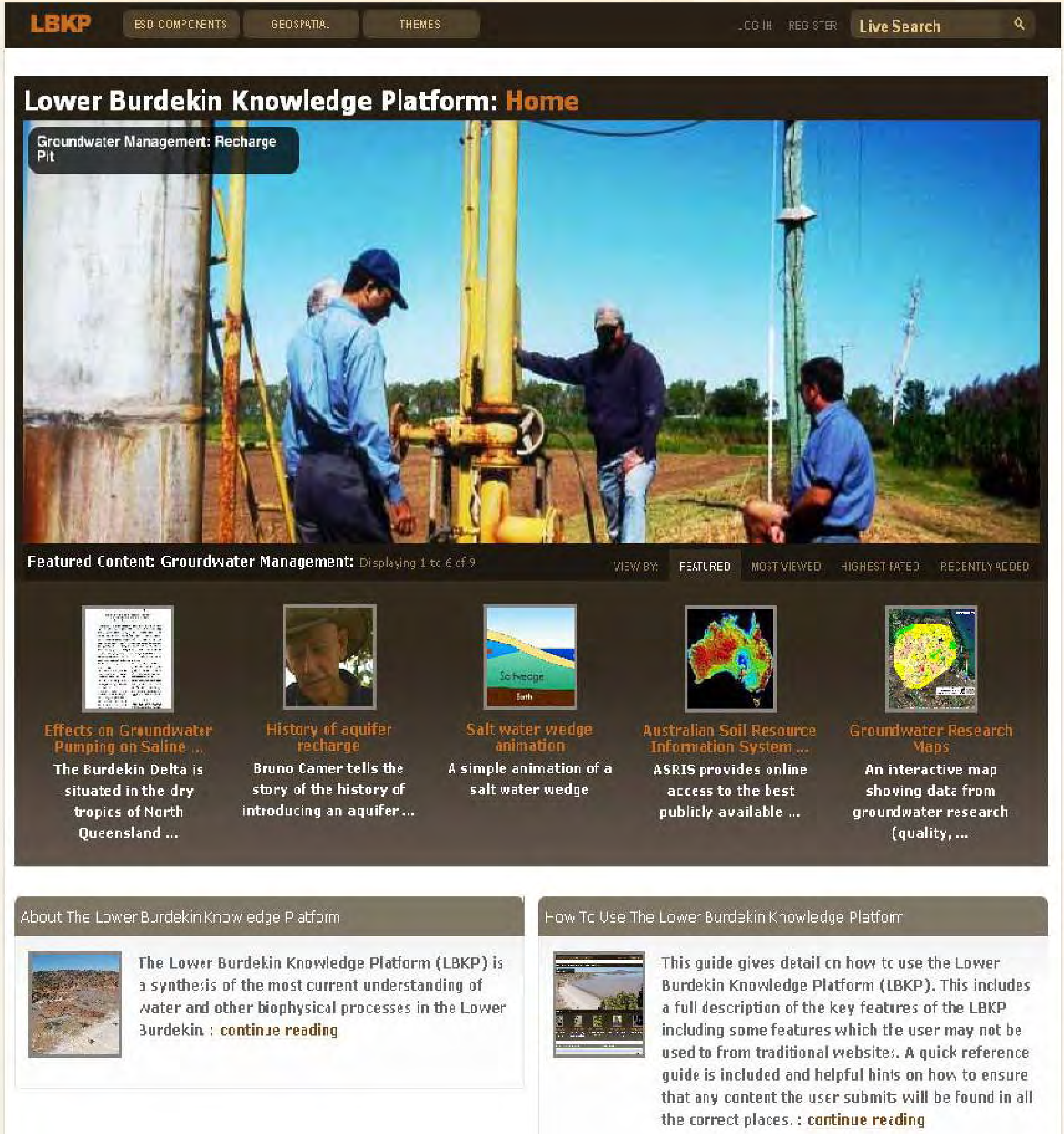
Prepare Draft LB Component Trees

Stakeholder feedback on LB Trees

LB Component Trees

Stakeholders inform & test LBKP

Lower Burdekin Knowledge Platform


LBKP
THEMES
Live Search
Lower Burdekin Knowledge Platform: Home
Groundwater Management: Recharge Pit
Featured Content: Groundwater Management: Displaying 1 to 6 of 9
VIEW BY:
FEATURED
MOST VIEWED
HIGHEST RATED
RECENTLY ADDED
Effects on Groundwater Pumping on Saline ...
The Burdekin Delta is situated in the dry tropics of North Queensland ...
History of aquifer recharge
Bruno Camer tells the story of the history of introducing an aquifer ...
Salt water wedge animation
A simple animation of a salt water wedge
Australian Soil Resource Information System ...
ASRIS provides online access to the best publicly available ...
Groundwater Research Maps
An interactive map showing data from groundwater research (quality, ...
About The Lower Burdekin Knowledge Platform
The Lower Burdekin Knowledge Platform (LBKP) is a synthesis of the most current understanding of water and other biophysical processes in the Lower Burdekin : continue reading
How To Use The Lower Burdekin Knowledge Platform
This guide gives detail on how to use the Lower Burdekin Knowledge Platform (LBKP). This includes a full description of the key features of the LBKP including some features which the user may not be used to from traditional websites. A quick reference guide is included and helpful hints on how to ensure that any content the user submits will be found in all the correct places. : continue reading

Categories

- Positive and Negative Impacts on Ecological Systems
- Positive and Negative Social Impacts
- Positive and Negative Economic Impacts
- External Factors Affecting Irrigation

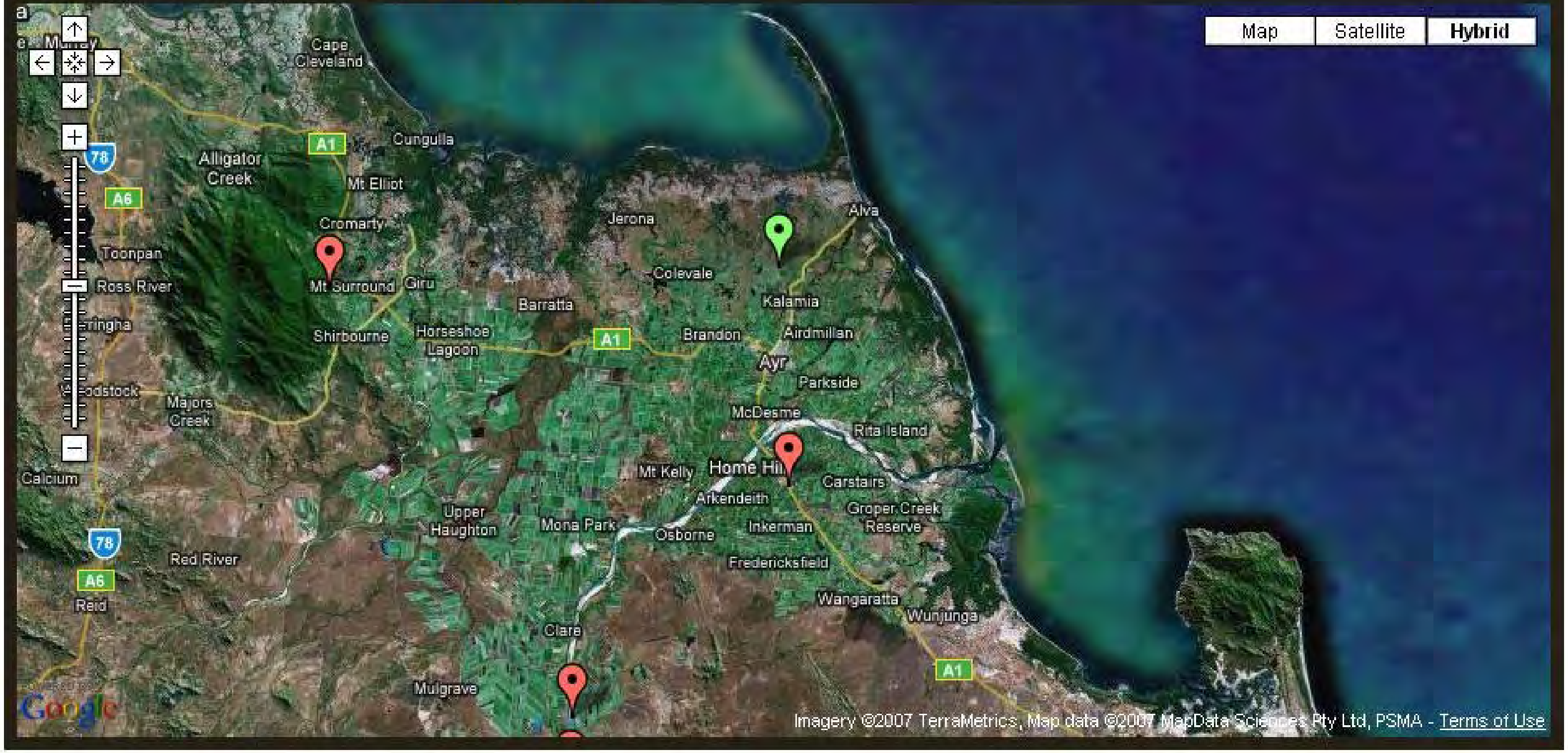
ESD Component: ESD Components

No content is classified using this classification.

Sub Categories:

- Positive and Negative Impacts on Ecological Systems | 19 items
- Positive and Negative Social Impacts | 4 items
- Positive and Negative Economic Impacts | 8 items
- External Factors Affecting Irrigation | 7 items

Geospatial Explorer: All Locations

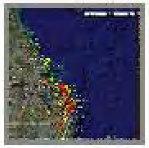


Other Maps

VIEW BY: ALPHABETICAL RECENTLY ADDED

Groundwater Research Maps

An interactive map showing data from groundwater research (quality, levels, etc...)

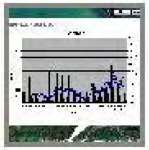


Live Dam Levels

Check dam levels at a glance.

Lower Burdekin Management Body Boundaries

A map showing overlays detailing the Lower Burdekin Management Body Boundaries

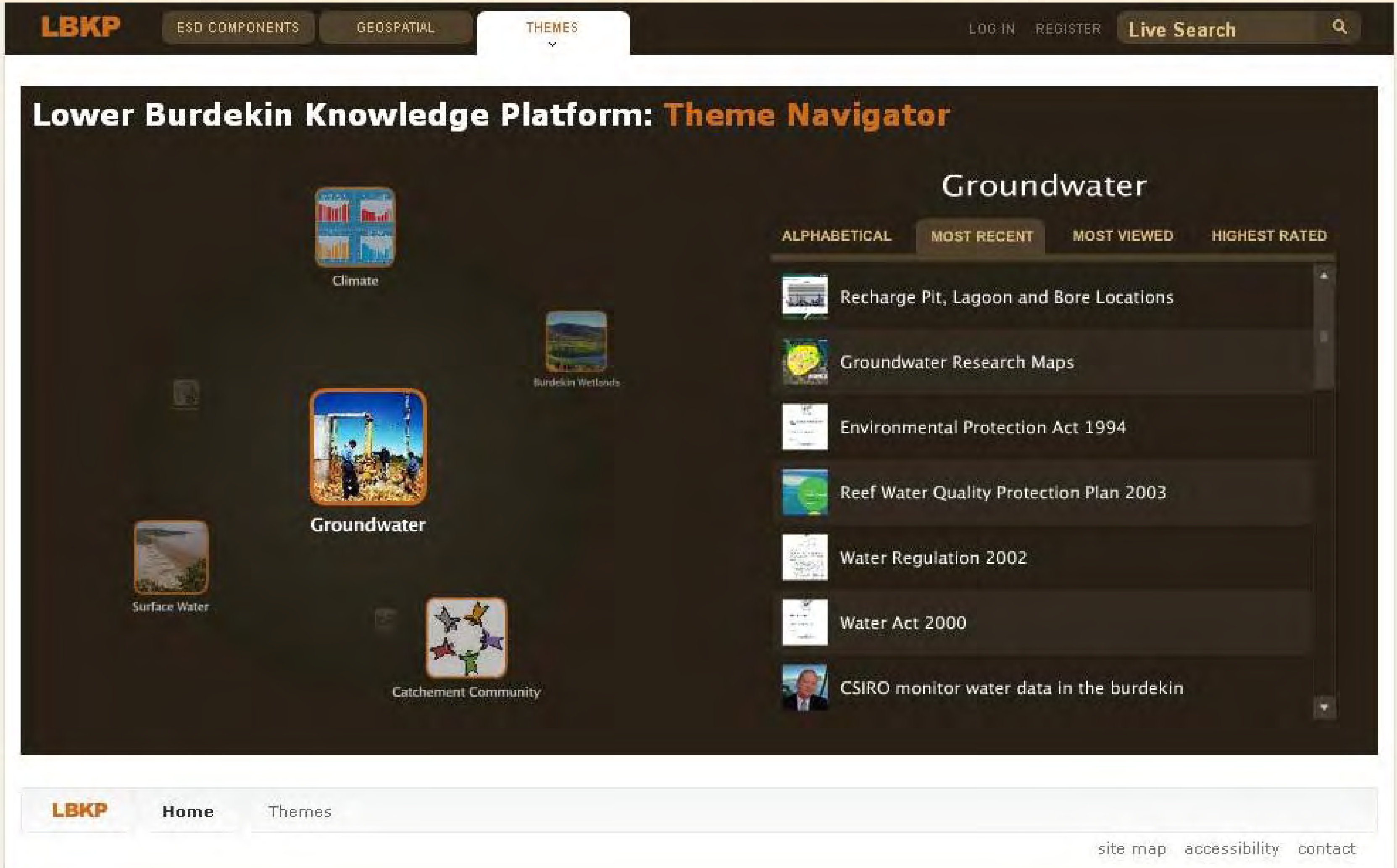


Recharge Pit, Lagoon and Bore Locations

An interactive map displaying recharge pit, lagoon and bore locations

Time Series Satellite Images

The satellite image overlays show the area used for irrigation for the years displayed


LBKP
ESD COMPONENTS
GEOSPATIAL
THEMES
LOG IN
REGISTER
Live Search
Lower Burdekin Knowledge Platform: Theme Navigator
Climate
Burdekin Wetlands
Groundwater
Surface Water
Catchement Community
Groundwater
ALPHABETICAL
MOST RECENT
MOST VIEWED
HIGHEST RATED
Recharge Pit, Lagoon and Bore Locations
Groundwater Research Maps
Environmental Protection Act 1994
Reef Water Quality Protection Plan 2003
Water Regulation 2002
Water Act 2000
CSIRO monitor water data in the burdekin
LBKP
Home
Themes
site map
accessibility
contact

Key Messages

- ESD Component Trees are a proven way of supporting decision-making
- Previous concepts developed for fisheries, agriculture and irrigation have been adapted for decision making about irrigation in northern Australia
- ESD Component Trees provide a simple method to help ensure that relevant factors are considered in decisions
- Coupled with methods for prioritisation (eg risk assessment) they provide a mechanism to help ensure that effort is focussed on all the relevant and most important issues

Further Information

This work is part of the Northern Australia Irrigation Futures project. For more information on NAIF visit www.clw.csiro.au/naif/

Further guidance and tools for the application of the NAIF ESD Component System is available from the report Application of ESD Component Trees to Support Irrigation Decision Making in Northern Australia and the associated toolkit.

Dealing successfully with the complexity of irrigation in northern Australia will require much more sophisticated planning, decision making & management systems

www.clw.csiro.au/naif/

NAIF

NORTHERN AUSTRALIA IRRIGATION FUTURES

Section 5:

Example of application: Application of the NAIF ESD Component Tree System and Construction of the Lower Burdekin Knowledge Platform

Application of the NAIF ESD Component Trees
The Lower Burdekin Knowledge Platform

Background

During the research phase of the NAIF project it was realised that a way of dealing with uncertainty and complexity in decision making is needed. The NAIF Steering Committee endorsed the concept of improving access to and the utilisation of available knowledge in a catchment based system. Subsequent to a request for a prototype from the Steering Committee, NAIF has developed a prototype for the Lower Burdekin.

The prototype is called the Lower Burdekin Knowledge Platform (LBKP) and can be accessed via http://lbkp.test.ktstudio.org

Lower Burdekin Water Futures Group

The role of the LBWF Group is to be the 'eyes and ears' of the Lower Burdekin catchment community and to promote improved decision making through identification of agreed priorities and needs, communicating key issues to the community and to reach agreement through understanding all dimensions of the complex issues involved. The LBWF is comprised of members from a variety of government and non-government groups which adds to the depth of their role in the Lower Burdekin. For these reasons the LBWF was the ideal candidate to review the work leading to the LBKP.

ESD Component Trees for the Lower Burdekin

The first stage in constructing the LBKP was to form a set of ESD Component Trees which were specific to the Lower Burdekin. This was achieved by using the generic ESD Component Trees for irrigation in northern Australia and then making a sub-set of components specific to the Lower Burdekin. The ESD Component Trees specific to the Lower Burdekin were used to identify what issues needed to be included in the LBKP. This was a crucial process so as to ensure that the LBKP was useful and relevant to the Lower Burdekin catchment.

The Lower Burdekin Knowledge Platform

The LBKP is to aid decision making about irrigation in the Lower Burdekin by providing access to appropriate knowledge and ultimately expertise relevant to making decision about water management in the catchment. This means re-thinking the use of technology to be more than static presentation of content but a more sophisticated and responsive systems approach to deal with the inherent complexity of the management of all aspects of the catchment. This includes connecting information, ideas, people and projects across the catchment and over time to inform debate and decision-making.

Core to this approach is a flexible and responsive content framework that will allow objects of content to be put into the environment once and then used in different contexts without duplication. These objects can be documents, audio files, video, compound objects such as presentations or online reports or even live data feeds from other sources. The ability to make best use of the power of rich media objects such as video in the knowledge platform will enhance the capacity of the platform to make available content that is succinct and descriptive. These rich media types which may contain such things as interviews, stories etc have much more immediacy and impact than documents alone.

Aside from the numerous types of information, the strength of the LBKP is the capacity to generate multiple points of view for navigation or different contexts for understanding complex issues. The ability to engage with content from different points of view make it possible to get a better understanding of the complexity of the content but also to find what is needed faster. This aids in supporting many different types of users according to their specific interests and needs.

The four methods of accessing the information are as follows.

"ESD Components"

Provides a set of component trees based on each of the relevant ESD factors (ecological, social, economic and external). This allows the user to explore all information related to a specific ESD factor. The ESD Components view is probably the one that is most familiar on web sites, often in the form of static menus.

"Geospatial"

The LBKP is about a specific location. Content is related to other content by being physically close. The geospatial view provides a map based system where all information related to a particular location is displayed on a map of the Lower Burdekin. The type of content that takes the most advantage from this view point includes: bore monitoring data, rainfall data, live feeds of dam levels, management boundaries and satellite images.

"Themes"

Provides a "navihedron" with eight themes (e.g. groundwater) that have been identified as being crucial issues in the Lower Burdekin. The user can move the navihedron in order to select the desired theme. Eight themes were identified for the Lower Burdekin: Groundwater, Surface Water, Catchment Community, Climate, Sustainability, Farm Management, The Reef and The Wetlands.

"Live Search" function

Provides a more traditional "search engine" style method of searching for information which searches for the information simultaneously with the user entering the key search words.

Sustainability of the platform

Having many contributors to a successful knowledge platform also means potential institutional confusion, concern or at worst disengagement. Careful management and definition of roles and contributions will help to build a successful platform and will avoid problems of maintaining a centrally controlled platform. While some central editorial responsibility is needed it is important that also takes advantage of distributed authoring of the content.

Technology

The software used to build the LBKP is open source that means there will be no ongoing licensing costs once the platform is established. The software used in called Zope and Plone and will be run initially from KT Studio, Perth.

Future extension

Knowledge Platforms: The next step is to create knowledge platforms for other catchments. Each one will be designed in collaboration with the catchment community specific to that catchment to ensure that the issues related to the four ESD factors (ecological, social, economic and external) are addressed completely as needed on a case-by-case basis. Subsequent to this is the possibility of creating multi-location networks of knowledge platforms so that catchment communities can share their experience with other catchments. This will ultimately foster increased capacity building about water management on a catchment scale.

Knowledge Spaces: The LBKP helps to form the first step towards the future extension of knowledge platforms – "knowledge spaces". The flexible use of content in different contexts is the important step that organises and promotes access to information or content. Knowledge however is not always explicitly available as content, it is in people's heads or buried inside a project. Enabling access to expertise, experience and ideas is the broader aim of knowledge spaces. This means bringing people into the space not as observer but as participant through discourse, collaboration or personal filtering of the content. These tools will allow individuals to share thoughts and to filter content for the benefit of others with similar interests and allow for complete access to the full breadth of knowledge relating to a specific catchment – an approach that supports the development of the relationship within communities as well as between communities and their respective natural and built environment.

END OF REPORT

Cooperative Research Centre for
IRRIGATION FUTURES

PARTNER ORGANISATIONS

CHARLES STURT UNIVERSITY

CSIRO

GOULBURN-MURRAY WATER

Australian Government
Land & Water Australia

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Queensland Government
Natural Resources and Water

Government of South Australia

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SunWater

THE UNIVERSITY OF MELBOURNE

UNE
THE UNIVERSITY OF NEW ENGLAND

UniSA

USQ
AUSTRALIA

University of Western Sydney
Bringing knowledge to life

State Government Victoria
Department of Primary Industries

> BETTER IRRIGATION
> BETTER ENVIRONMENT
> BETTER FUTURE

COOPERATIVE RESEARCH CENTRE
FOR IRRIGATION FUTURES
PO Box 56, Darling Heights Qld 4350
Ph: 07 4631 2046 | Fax: 07 4631 1870
Email: enquiries@irrigationfutures.org.au
www.irrigationfutures.org.au

CRC AUSTRALIA