

# Scoping study

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*Common hydrological features  
in Australian irrigation areas*

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*David Fuller  
David Ife  
Nick Watkins  
Andrew McLean*

*URS Australia Pty Ltd*

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## Executive Summary

This scoping project investigated the following two questions:

- What is the best way to present material on the common hydro-geological systems where irrigation areas are situated.
- Which hydro-geological systems should be represented?

From the investigation we:

- Confirm the primary audience.
- Acknowledge the potential for secondary audiences.
- Identify the need for more than one delivery mechanism.
- Investigate content, typologies, and management issues with key State, Territory and national contacts.
- Develop a hierarchical typology to identify the hydrogeology under particular areas of irrigation, and the likely management issues which might occur.
- Identify ways in which to map hydrogeological types and irrigation across the country.
- Assess the potential for case studies including pulling together a resource set as appendices to this document.
- Recommend a standard case study content.
- Develop a landscape layout of one case study.
- Construct an electronic navigation tool for accessing information which could be translated into web format.
- Access preliminary publishing costs for a hardcopy A4 portrait book similar to 'Water Innovation'.

The primary audience is policy makers, that is decision makers who can affect the distribution of funding to invest in new developments or support the movement of existing developments towards sustainability.

State Agencies are keen to have a national web product which links to their local information sets.

Case studies are most powerful when they include personal stories, local attempts to manage issues, and identify the support needed to move forward.

# Executive Summary

It is concluded that there is potential and support for a project which supports an increased appreciation of the contrasts and similarities across irrigation regions, supports investment opportunities and highlights key issues for sustainability.

## Supporting Investment

Information to support investment can be provided in a hierarchical fashion. At the highest level a map base or on-line tool which highlights the basic hydrogeological types in each area of Australia together with potential issues can be developed quickly from the resources collated here. References (or links) to State based information can support further investigation of potential areas of investment. In some instances there may be local or regional information which can be used to prove up a particular opportunity. However, the likelihood is that significant on-ground investigations will be required to provide a high level of confidence in investment.

Case studies also provide salutary examples of the potential and timescale of problems which might arise.

## Supporting Sustainability

Existing irrigation schemes often have comprehensive analyses and reports as an information base. There is a challenge for landholders in terms of managing large scale problems which they have little capacity to deal with. Case studies provide a key avenue of highlighting the challenges from different points of view. Importantly, carefully capturing messages from the landholders and local NRM officers will provide an avenue to humanise the hydrogeological challenges, highlight the different mixes of policy and action which are effective, and list the key actions which government can implement to assist landholders face the challenge.

Investment can be supported through broad scale mapping and links to State and regional information.

Case studies are a primary vehicle to capture the variability of local issues, emphasise the human face of the challenges, and communicate key actions necessary to achieve sustainability.

Significant investment is needed for a quality product.

## The Investment Required

There will be significant investment required if such a product is to be developed.

Key tasks include:

- Confirmation with the NPSI Management Committee the key messages and content to be delivered.
- Completion of the typology through digitising, mapping and presentation.
- Reworking of standard images of hydrogeological types for consistency and presentation.
- Capturing stories and histories from local groups and land holders.
- Taking and using professional quality photographs.
- Working with key NRM contacts in the States to rework existing information into robust case studies.
- Editing of material for consistency and flow (specialist input from a hydrogeologist, irrigation expert and scientific editor)
- Reworking of preliminary layouts to satisfy printing standards including colour schemes.
- Printing, binding and distribution.
- Co-development of a web product to distribute information.

It is likely that the cost for these tasks will be of the order of \$200,000 including information collation, workup, hardcopy and web delivery.

The product could be delivered in approximately 6 months.

## 1 Project Objectives

URS was engaged to undertake a 3 – 4 week Scoping Study investigating the following questions:

- **What is the best way to present material on the common hydro-geological systems where irrigation areas are situated.**
- **Which hydro-geological systems should be represented?**

In undertaking this Scoping Study we were required to include:

1. A hard copy and electronic layout of how material would be presented and the audience skill level it is being written for.
2. A table of contents and a brief description of the systems that are to be covered and the locations each system represents.
3. Example case studies of actual regions.
4. For the various systems a set of diagnostic tips that would help the reader identify the type of system.
5. Are there computer models available that illustrate system function and are there opportunities for integrating these?
6. Consider the format of “ Water Innovation” – Editor, Kathleen H Bowmer ISBN 0-0580670-1-5

## 2 Methodology

URS approached this study in the following way:

- Confirmation of intended audience and desired outcomes of the project through discussions with the Project Coordinator and NPSI Management Committee members where available.
- Identification of the prospective audience and confirmation of the level of communication required in any publication.
- Development of a draft Information Framework for use in identifying the information to be captured and reported via an appropriate mechanism(s).
- Design and use of focus questions in interviews with key State and Territory Agency personnel including a scan of existing typologies in each jurisdiction.
- Collation of readily available regional information for each State/Territory via literature and web searches, State submissions, and publications.
- Development of a draft hydrogeological typology and confirmation of this with State, National and CSIRO contacts wherever possible.
- Selection of potential case study areas and collation of information for each area to support a gap analysis.
- Development and population of a presentation template for one case study.
- Preparation of a Summary Report and Brief.

## **Methods**

### **3 Target Audience and Potential Delivery Methods**

There is potentially a range of audiences to be targeted and a range of delivery mechanisms which could be used.

#### **3.1 A Range of Audiences**

The primary audience has been identified as “policy makers”. That is, decision makers who can affect the distribution of funding to invest in new developments or support the movement of existing developments towards sustainability.

This audience could include banks, insurance companies, CEO’s of catchment management groups or water authorities, politicians, industry leaders, and community leaders outside the irrigation sector.

However, there is potential for the work to reach additional audiences including the communities that irrigators support, NRM professionals who work with irrigators, businesses who interact with irrigators, and the next generation of irrigation farmers.

#### **3.2 The Message**

The basic premise of the scoping project is to seek ways in which to inform ‘policy makers’ of hydrogeology in irrigation areas and to determine which hydrogeological types should be presented.

However, our discussions with stakeholders reveal a range of purposes for communicating, and a possible range of emphases in presentation. Many of these directions require similar data sets.

Three key opportunities clearly present themselves:

- Building capacity in irrigation management for all those involved
- Supporting investment decision for new irrigation.
- Supporting investment decisions to ameliorate current impacts.

A critical issue remains for the NPSI Management Committee which is best posed by asking the apparently simple question:

*What is the name of this publication?*

### Methods

Answering this question will provide much needed context for the document by:

- Reaffirming the focus on State and Federal policy makers.
- Confirming the content and messages to be delivered.
- Providing guidance on the tools and formats which can be utilised to support the messages.

### 3.3 Matching Information to Audience Needs

The International Commission for Science (ICSU, 2003) identified significant challenges in communicating science to policy makers and the community; and recommend that at least the following issues be addressed :

- Deliver science relevant to the policy agenda.
- Encompass risk assessment and uncertainty in outputs.
- Integrate assessments across a range of disciplines.
- Promote increased system level analysis.
- Balance societal, economic and environmental issues.
- Utilise appropriate temporal and spatial scales.
- Ensure messages recognise the range of cultures which are part of the decision making process.

CARE (200?) emphasise the need to recognise that policy makers are people, not institutions. The lesson from this is that examples and stories of human endeavour can carry significant weight with decision makers.

In work in progress on a parallel NPSI project, Day (2005) reports the need to:

- Recognise and build upon existing programs and past work
- Increase understanding of investor behaviour and how these decisions affect regional and State plans.
- Integrate business decisions with social and environmental outcomes.

## Methods

- Make a special effort to capture and promote the social aspects of decision making which are often ignored.
- Recognise the dollar imperative – many business decisions are currently made on achieving ‘sustainable returns’ within the (often short term) “foreseeable future”.
- Share communications across ‘groups’.

With such a broad range of potential audiences we believe there is a need for a high level enlightening view of hydrogeology / irrigation interactions avoiding the detail and jargon and delivering the key messages. The document should provide a means for the audience to further investigate issues of interest via the use of bibliographies, key contact lists, websites, etc.

For the purposes of our information collation we have targeted a grade 10 or 11 student doing an assignment. This paradigm has concentrated the review on the need to promote an understanding of the basic processes and key issues. Feedback has variously suggested we target primary school students or university level, but we feel comfortable that a level of information to suit end of high school is appropriate.

### 3.4 Delivery Mechanisms

Influencing policy makers or investors requires an understanding of their needs and objectives as well as a commitment to long term and multiple channels of communication and advocacy. For this reason, more than one delivery mechanism is probably required, and there is a need to capture and reuse information into the future.

The Management Committee has identified a ‘coffee table book’ as a key delivery mechanism. This will require a significant investment in the further development of case studies, the use of a technical editor, professional document design or conversion of the preliminary design contained here to a printing house standard, professional photography, print runs, binding and distribution.

The information sets, graphics and photographs required to support the development and delivery of the book are a precious resource. To provide a platform for storage and reuse of the information it is important that - as a minimum - these resources should be captured within the NPSI Knowledge Base. With little additional investment a structured HTML design could readily be delivered as both a web page or CD.

There is considerable interest at the State level in having a national website which provides links to State and local information. This opportunity provides an avenue to take the broadscale

## Methods

hydrogeological typology recommended in this report through the hierarchy to a local scale of particular importance to communities, catchment managers, regional investors, and irrigators.

*Notably, if different delivery mechanisms are used the earlier question regarding what title to use becomes relevant to each publication or website that is created.*

### 3.5 Form of Delivery

Various forms of hardcopy delivery were considered including Water Innovation (Bowmer, 2004), National and State SOE<sup>1</sup> reports, the Workboot series by Kondinin Group, Tasmania's State Water Development Plan (Anon., 2001), project newsletters for the Tangguh LNG Project in Indonesia, Queensland's Golden Energy Opportunities CD (Anon., 2004), various sustainability reports, the recently completed Groundwater Status Report for the MDBC (URS, 2005) and CSIRO's Groundwater Flow Systems booklets (Walker et al, 2003a and 2003b). Opinion was sought from social engagement specialists and others not directly involved in the project on the effectiveness of the various mechanisms based upon the target audience. Based on this review we believe a combination of the style of the Groundwater Flow Systems booklet complemented by attractive case studies is the most appropriate form of hardcopy delivery.

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<sup>1</sup> SOE – State of Environment

## 4 Information Needs

A draft information framework (see Appendix 5) was derived early in the project to facilitate data searches, target data collation activities, concentrate the typology development and support the case study content. The core of the framework was a concentration on those key elements of information which were considered important in supporting a range of publications or other delivery mechanisms regardless of format.

For convenience we developed the draft framework in a way which could readily be translated to a web site format, or used to structure chapters in a book.

The fundamental elements of the Framework included:

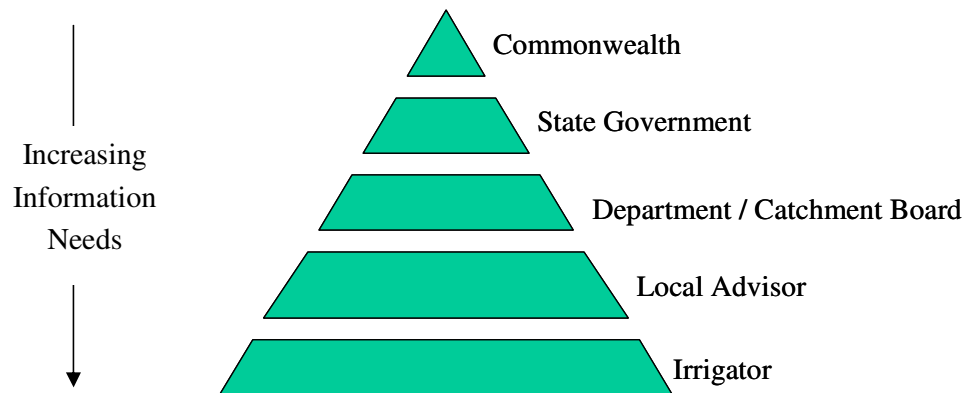
- Hydrological types – what are they, where are they, what are their key features, and what are the potential management issues associated irrigation on them.
- The current distribution of irrigation with typology.
- Conceptual models of each type including 2D and 3D models.
- Irrigation case studies.
- Further information (eg links, references, regional contacts)

The remaining sections of the report deal with each of these elements.

Following further data collation we have reworked the framework (shown in Appendix 5) into a draft Table of Contents (see Section 9) and a example website configuration in Microsoft Powerpoint.

## 5 Hydrogeological Types

Our discussions with State and Territory contacts confirmed the need for local information rather than national information in understanding the complexities of hydrogeology and irrigation at the farm and even catchment scale. That is, there is a hierarchy of information needs as one moves from the national to the regional to the local management scale.



Importantly, the type of information needed will change depending upon perspective. For example, information needed by an irrigator needs to be practical and provide guidance to on-farm activities within the context of the hydrogeological situation, while information at the State Government level might be more strategic and risk based.

State contacts were supportive of the creation of a website with links to their own websites and of a hardcopy publication which references their agencies. They saw that the creation of a national typology and information supported by state and local information would provide the ‘best of both worlds’.

### 5.1 Existing Typologies

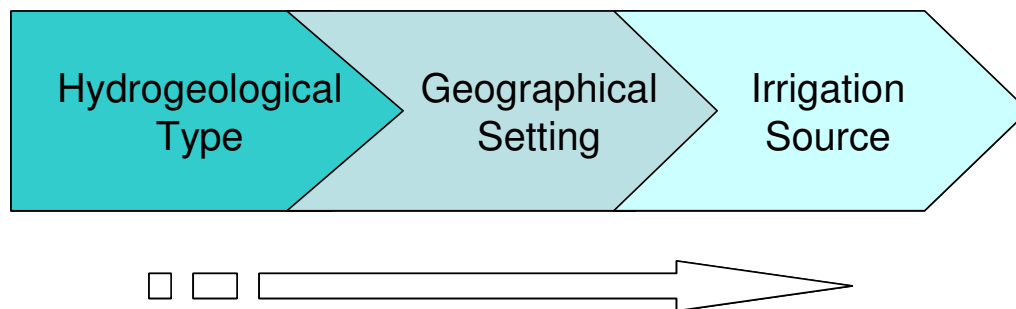
Our research - supported by discussions with State and Territory experts - reveals a considerable variability in the existing hydrogeological typologies used across Australia. Many of these typologies have been developed for particular purposes such as salinity management (eg Groundwater Flow Systems approach), the description of geology, water quality, or for other purposes which are not specifically aligned with the consideration of irrigation development and its attendant management issues.

Many systems are derived at the State, region and subregional scales. Typically there is a lack of consistency in approach across jurisdiction boundaries, and there is too much detail included to support a simple comparative national representation such as required by this project.

A particular difficulty with a typology is the degree of variability in geology (in all 3 dimensions), landscapes and geographic settings.

## 5.2 Recommended Typology

To encapsulate all hydrogeological settings of irrigation areas within Australia within a common framework we believe it is necessary to take a broad representation of hydrogeological types supported by a hierarchy of information to define particular management issues and increase the relevance of the material to the local user or land manager.



Increased Knowledge and Evidence of Management Issues

### 5.2.1 Hydrogeological Types

The recommended hydrogeological types are restricted to the following categories based upon their geology and hydrogeological characteristics:

- Shallow unconsolidated sediments
- Unconfined sedimentary basins
- Confined sedimentary basins
- Limestone
- Fractured Rock & Basalts

These types are sufficiently generic and broad enough to encapsulate existing State approaches as confirmed in our discussions with contacts. Characteristics of these types are provided overleaf.

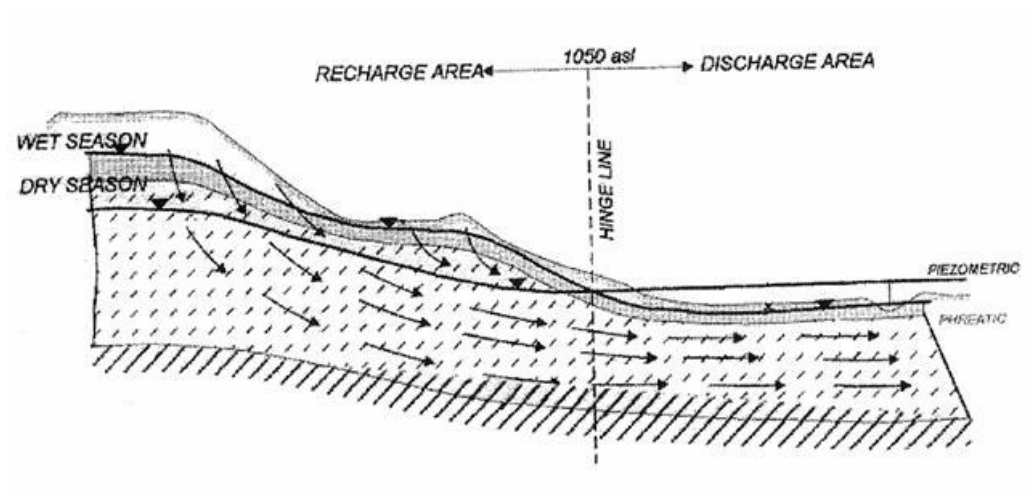
## Hydrogeological Types

**Table 1** Characteristics of Recommended Hydrogeological Types

Classification	Typical Landscape Unit	Typical Geological Features	Typical Aquifer Properties	Comments
Shallow unconsolidated sediments	Modern rivers and floodplains, coastal and inland dune systems.	Usually shallow dune sand systems or alluvial sands/gravels.	Generally moderate to high rates of water movement Small water storage capacity and bores generally have low flow rates. Local to intermediate flow connections and effects. Recharge often occurs annually.	High risk of aquifer dewatering and contamination. See Figure 1 for typical cross section.
Unconfined Sedimentary basin	Generally found in undulating hills to broad flat plains.	Can be a variety of materials but generally alluvial or marine sediments.	Generally moderate to high rates of water movement. Low to high yielding bores and variable water storage capacities. Local to regional flow connections, commonly with a coastal discharge boundary. Recharge may occur over short (eg annual) or long term (eg thousands of years).	Aquifer systems are generally of large extent, but individual aquifers can be of sporadic distribution due to complex geological layering.  See Figure 2 for typical cross section, Figure 3 for illustration of salt water interface and Figure 4 for illustration of basin aquifer layering.
Confined Sedimentary basin	Generally found in undulating hills to broad flat plains.	Individual aquifers can range from loosely consolidated to hard, cemented material.		
Limestone	Generally found in broad flat plains (eg Nullarbor) but can locally form dissected hilly terrain (eg Chillagoe, North Qld)	Usually consists of loose or cemented material containing shells or shell material. Under weathering and water solution can form karst terrain.	Can range from moderate to extremely high rates of water movement in karst. Moderate to extremely high yielding bores and water storage capacities. Local to regional flow connections and effects. Recharge may be short-term (eg annual) or long term. (eg thousands of years)	Can be at high risk of contamination from pollutant producing land uses. See Figure 5 or typical cross section.
Fractured rock & Basalt	Usually found in steep to low undulating hills and ranges with narrow valleys	Generally present in older basement rocks.	High rates of water movement along fractures, but otherwise very low water movement within the rock material. Low yielding bores and low water storage capacities. Local to regional flow connections and effects. Recharge - short term (annual) or long term (thousands of years).	High risk of aquifer dewatering.

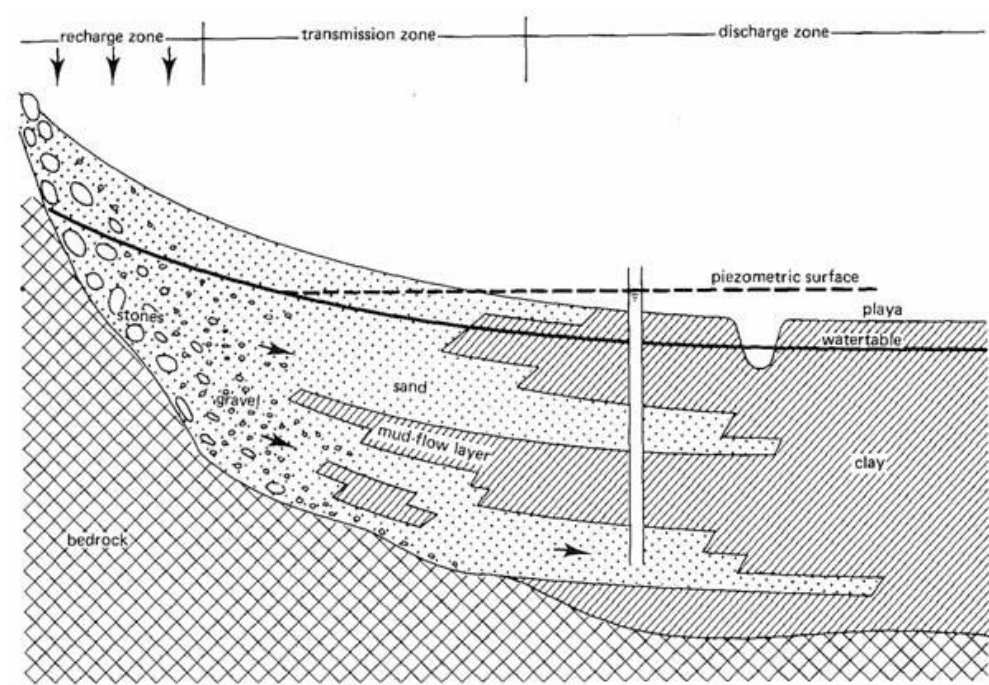
**Figure 1** Typical Cross Section – Shallow Unconsolidated Sediments Typology

(Soetrisno, S. (1996) *Impacts of Urban and Industrial Development on Groundwater, Bandung, West Java, Indonesia.* in Groundwater and Land Use Planning, Conference Proceedings, CSIRO, September 1996.)



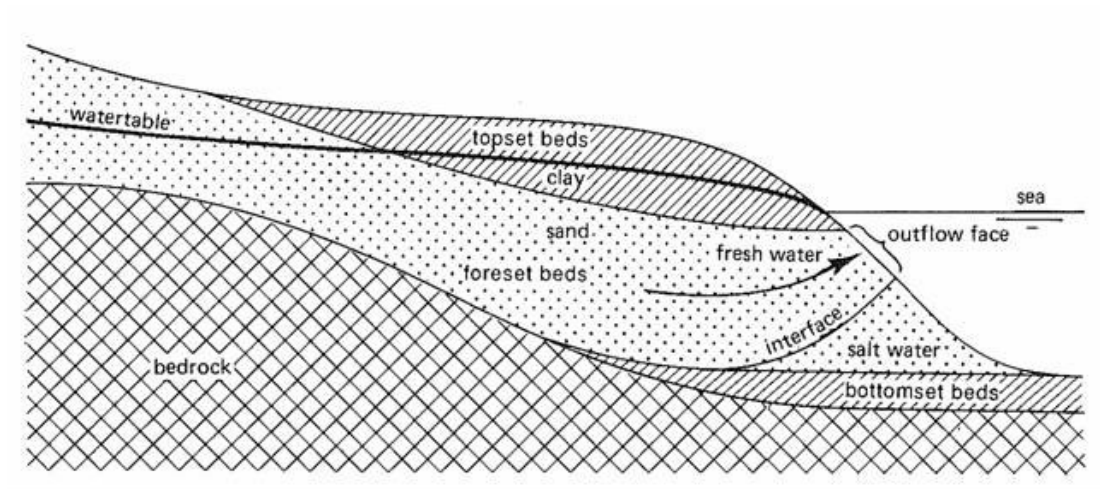
**Figure 2** Typical Cross Section – Sedimentary Basin Typology

(Ritzema, H.P. Editor-in-Chief (1994). *Drainage Principles and Applications.* ILRI Publication 16, Second Edition, The Netherlands 1994.)



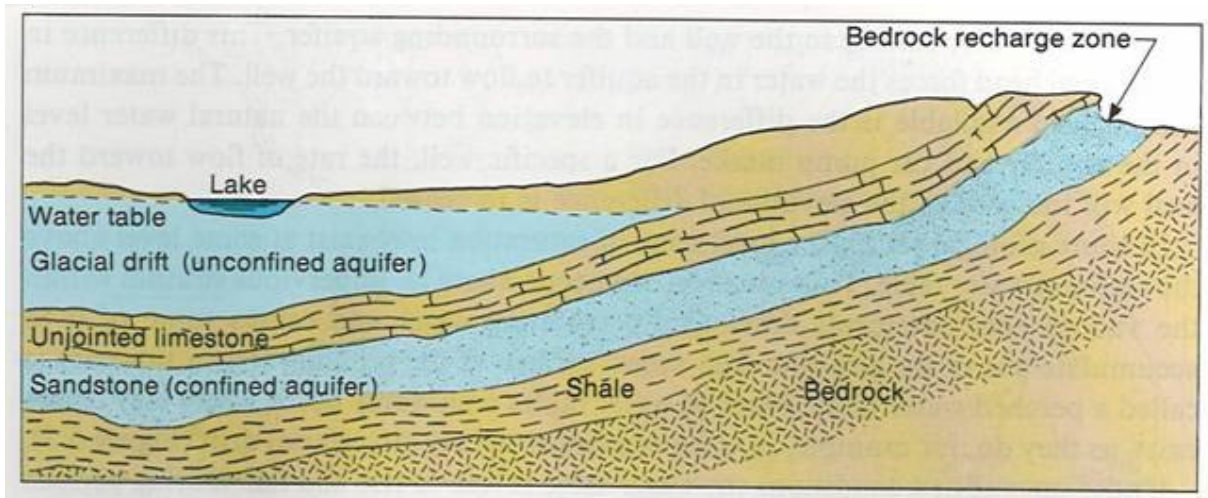
**Figure 3** Salt Water Interface

(Ritzema, H.P. Editor-in-Chief (1994). *Drainage Principles and Applications*. ILRI Publication 16, Second Edition, The Netherlands 1994.)



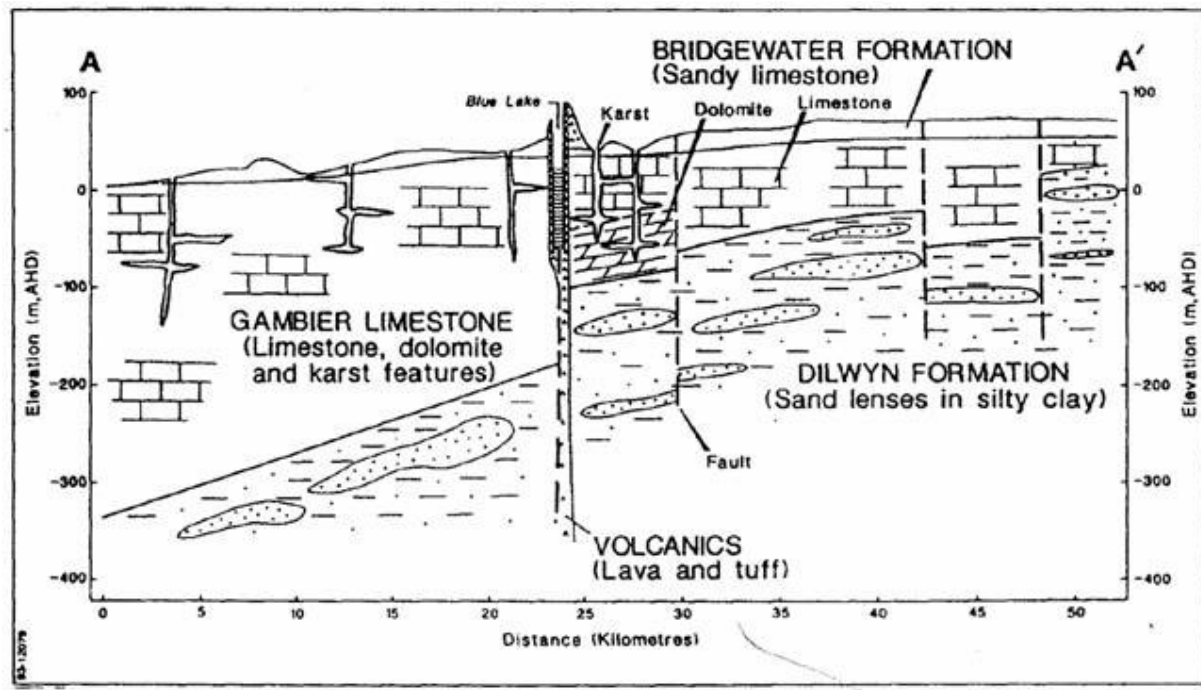
**Figure 4** Layered Sedimentary basin Typology

(Driscoll, F.G. (1987). *Groundwater and Wells*. Johnson Filtration Systems Inc. ISBN 0-9616456-0-1.)



**Figure 5** Typical Cross Section – Limestone Typology

(Telfer, A. (1996). *100 Years of Stormwater Recharge: Mount Gambier, South Australia.* from Proceedings of Aquifer Storage and Recovery, Adelaide, October 1996.)



## 5.2.2 Geographical Settings

Geographical settings are vital in understanding the boundary conditions on these types. For example, the issues associated with unconsolidated sediments 20 km away from the nearest river may be very different from the management issues adjacent to a river. Similar issues arise with respect to the proximity of coastal seawaters, bounded aquifers, etc.

It is difficult to provide a comprehensive list of the geographic settings associated with irrigation in Australia, except by reference to information from our contacts, and examination of particular case studies. Information is more readily found on formal irrigation areas than areas of private irrigation.

Even at the State level there is a significant gap in information on the distribution of irrigation.

*We recommend the use of case studies as the primary vehicle to explore and promote these issues.*

## 5.2.3 Irrigation Source

The source and application of irrigation water is also an important factor in the response of groundwater systems and the management issues faced by irrigators. Again the wide variety of irrigation types and practices makes it difficult to fully enunciate this situation on an Australia wide basis. As the National Land and Water Audit (2002) found, this situation is unlikely to be resolved very well even if substantial resources are assigned to this task.

Again it is advisable to utilise case studies as the specific avenue to demonstrate issues and opportunities.

An example of the classification for some irrigation areas is shown in Table 2.

## 5.3 Identifying Hydrogeological Types

The easiest way for readers to assess the hydrogeological type of existing irrigation areas, or potential irrigation areas is through the use of maps.

We completed a search of available maps including the National Land and Water Resources Audit site, AGSO, Commonwealth contacts, CSIRO personnel working on similar projects at a local scale, etc.

The best available maps to support the Hydrogeological Types identified here are those produced some time ago for the Australian Groundwater Atlas. We have examined these colour A1 maps and consider that with a few days digitising and reworking them could provide sufficient information to support the project. Scanning the maps could only produce black and white versions due to limitations of technology in Adelaide (see Appendix 4). Digital versions of the maps do not appear to be available.

It is likely that 2 days digitising, collation and presentation work would be sufficient to produce the necessary map layers from the originals.

State and local maps could form a secondary level of information within the book, but there will be a need to manage the tensions between the use of a common national classification type and state, regional and local variations.

**Table 2** Example Classification for Some Individual Irrigation Areas

State	District or Region	Hydrogeological Type	Landscape	Irrigation Characteristics	Observed Impacts of Irrigation					
					Nutrient Enrichment	Soil waterlogging	Groundwater salinisation	Watercourse salinisation	Seawater intrusion	Aquifer dewatering
SA	Clare Valley	Fractured rock	Plateau of corrugated ridges, weathered surface shale with deep fissures	Uses local groundwater, impending use of imported River Murray water		✓	✓	✓		✓
	Barossa Valley	Sedimentary basin (unconfined and confined) with some fractured rock	Rolling hills with uplifted sections and valley bases with alluvial sands and silts.	Local groundwater use with limited use of imported River Murray water		✓	✓			✓
	South East SA	Limestone	Extensive plains with low rolling hills.	etc.			✓			✓
WA	Harvey region (WA)	Unconsolidated sediments with sand systems or alluvial sands/loams and clays.	Sandy coastal plain	Imported water from reservoirs	✓					

## **5.4 Distribution of Irrigation**

The distribution of irrigation in Australia is again difficult to discern outside of the major irrigation areas, and we are aware from communications with MDBC (eg SunRise 21), MIA and MIL that only recently have these distributions been completed in these intensive agriculture areas. Part of the problem is that the footprint of irrigation often changes from year to year.

The best available data at a national scale appears to be that from the National Land and Water Audit as shown in Appendix 4.

Again, additional work with State agencies and private irrigation companies may be able to create an improved picture of the situation.

## **5.5 Matching Irrigation and Type**

For national readers we believe that there is sufficient information to place irrigation areas on revised Australian Groundwater Atlas layers to provide maps and tables showing the interaction between irrigation and hydrogeological type.

## 6 Hydrogeological & Conceptual Models

A review of existing hydrogeological models suggests that there is little opportunity of placing these models on a system for ready access to non-expert users. In many instances an intimate knowledge of the local hydrogeology is required, data inputs must be interpreted appropriately, and data outputs must be analysed and refined to improve calibration for particular purposes.

It is concluded that the incorporation of hydrogeological models in any product could be misleading and confusing. The best that can be hoped for is to reference the existence of such models and provide State/Regional contacts for follow-up by the interested reader.

Two and three dimensional conceptual models of local hydrogeological settings are available and should be incorporated in case studies. In many instances these conceptual models need to be refined for the reader as they often contain many technical terms and concepts, lack consistency between prospective case study areas (see Appendix 6) and need to be refined to add landscape activities (eg irrigation).

In a number of instances the inclusion of a time series or snap shot of resource condition (eg groundwater level) may be possible.

Most conceptual models require refinement in conjunction with local experts to suit the purposes of publication, and will require reformatting and change of colours to provide consistency and optimise print quality in a coffee table publication.

## 7 Case Studies and Document Layout

We concentrated significant effort on collating information for a range of prospective case studies. Our aims were to:

- Identify the real potential for working up existing information into full case studies.
- Expose some key issues at a case study level and match these with key issues identified by State and Regional stakeholders.
- Prepare a case study in the proposed layout.
- Scope the potential for a standard case study format, including a gap analysis.

### 7.1 The Potential for Case Studies

We collated information for 8 out of 10 targeted case studies across the range of jurisdictions and hydrogeological types encountered in Australia.

Location	State	Hydrogeological Type
Loxton	SA	Sedimentary Basin
North Adelaide Plains	SA	Multi-layered Sedimentary
Daly River	NT	Limestone (karst)
Ord River	WA/NT	
Burdekin River	Qld	Unconsolidated Sediments
Meander River	Tas	Limestone (karst)
	* NSW - MDB	
	* NSW - Northern	
Shepparton IA	Vic	Sedimentary Basin
Clare Valley	SA	Fractured Rock

\* Case study information is available from NSW and we have recently had confirmation of willingness to participate in data provision for the proposed study. Turnaround times did not provide sufficient opportunity for NSW to deliver information on these areas for this report.

It was concluded that in many instances there is substantial information already available for irrigation areas which can be built upon to deliver case studies. However, information for large irrigation company areas seems to be more readily available than for privately owned irrigation areas.

There is generally a lack of human stories. Stories which would enrich the case studies by placing the historical context in human terms, trace the emergence of issues, describe attempts to deal with issues, and highlight the support needed to address issues. It is acknowledged that such stories might quickly become out-of-date and could lead to a shorter life for the book.

### 7.2 Key Management Issues

Table 1 lists a number of potential management issues which might arise from water movement associated with each of the hydrogeological types.

During the case studies we also attempted to capture key management issues:

Location	Key Management Issues
Loxton, SA	<p>Drainage and channel leakage of irrigation water from River Murray has created a groundwater mound up to 15m higher than the River.</p> <p>Over time problems arose including waterlogging of irrigable land, seepage and salinisation of the adjacent river floodplain and increasing River Murray salinity levels.</p>
North Adelaide Plains, SA	<p>Groundwater extractions for irrigation have decreased pressures in the aquifer. As well as on-going water level decline, salinity increases have also been noted. The resource is over-allocated.</p>
Daly River, NT	<p>Competing needs of irrigators, the environment and cultural owners need to be balanced.</p>
Ord River, WA/NT	<p>Rising groundwater levels have already occurred on the Ivanhoe and Packsaddle Plains. Rising groundwater levels could lead to increased groundwater discharge to the rivers as well as land degradation and could alter groundwater ecosystems within the subsurface environment.</p>
Burdekin River, Qld	<p>Inadequate surface water storage</p> <p>Ecological sensitivity</p> <p>Saline intrusion</p>
Meander River, Tas	<p>Groundwater and surface water contamination from nutrients, pathogens, BOD.</p>
Shepparton IA, Vic	<p>Conjunctive groundwater and surface water use in a complex system.</p> <p>Unsustainable groundwater extraction is leading to a drop in water levels.</p> <p>Mounding of the watertable beneath surface water irrigation areas has <b>not</b> been as significant an issue since the start of the drought but is expected to become a significant issue under more normal conditions.</p>

Location	Key Management Issues
	<p>Salinity in highland areas has resulted from clearing of trees, increased infiltration and rising groundwater levels.</p> <p>Surface water quality and river health is impacted by contaminants including salt, nutrients from irrigation drainage, sewerage treatment plants, sediment mobilisation, urban stormwater and intensive animal industries. Altered flow patterns in waterways have impacted aquatic biodiversity, water quality and the waterway environment.</p>
Clare Valley, SA	<p>Due to the nature of the fractured rock aquifers, the volume of good quality underground water is unknown and it is difficult to predict the long-term sustainability of the underground water resource.</p> <ul style="list-style-type: none"> <li>▪ large drawdowns in water table levels during the summer are recorded but these have been shown to recover during an average rainfall winter.</li> <li>▪ some wells show a large seasonal variation in salinity. When water levels drop, some wells show an increase in salinity.</li> </ul>

The principle issues raised are:

- maintenance of a water balance (ideally near steady state conditions for the water table),
- groundwater contamination, and
- surface water contamination.

### 7.3 Case Study example

Loxton was chosen as a case study to work up further as an example of the layout. This work was completed in parallel with the collation of information for other case studies.

After reviewing the proposed content our graphic designer suggested the use of landscape A4 as this provides a balance for the plots, figures, photographs and text.

Key elements included in the case study are:

- An introductory paragraph acknowledging the genesis of the irrigation area.
- A timeline of development and emerging issues.
- A location map showing approximate location in Australia.

- A plot of growth in irrigation over time.
- A highlighted list of key issues and a list of key management actions
- An irrigators' story and their opinion on what help is needed<sup>2</sup>

The draft case study layout is provided in the separate pdf document, raw information sets used in the compilation of this case study are included in Appendix 6.

### 7.4 Towards a Standardised Case Study

The information collated from each of the potential case study areas is highly variable and sometimes at different levels. For a professional publication it is clear that considerable work will be required on each case study to rework or recreate consistent diagrams, textual content, tables and pictures in a common format and style.

The proposed standard case study should have the following content:

- Location Map – Australian
- Location Map – State/Region.
- 1 or 2 page Map of Irrigation Area highlighting key points of interest, hydrogeological types, landscapes, geographic settings and photos.
- Irrigation Area
- Source(s) of water supply and annual volumes
- Management arrangements (eg irrigation company vs private, planning mechanisms, actions)
- Type(s) of irrigation and crops
- Climate
- Growth of irrigation over time.

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<sup>2</sup> Note we contacted three irrigators who were willing to take part in interviews, but needed more time to consider their responses / appropriateness / representativeness than was allowed in this project. Similarly capturing the benefits of local actions needs further time and engagement with the local community, NRM officers, etc.

- Key Management Issues (past, current, future)
- Value of irrigated agriculture to the local, regional and national economy.
- Hydrogeological Type(s)
- Landscape(s)
- Geographic Setting(s)
- Current policy context, desired future policy context and gaps.

### 7.5 Future Case Studies

The areas identified as potential case study sites were chosen on the basis of hydrogeological type, jurisdictional coverage, known issues, and type of irrigation (company vs private).

Clearly the sample is biased towards irrigation company areas. This is because these areas are often better known and defined, and have information available. Information on private irrigation areas tends to reside within water management plans (if anywhere) and is typically of a different focus to the type of information provided by companies.

Availability of information is a key determinant of the amount of effort (and hence cost) which will be required to develop formal case studies for publication.

The set of 8 case studies provided here does provide a reasonable coverage of most of the issues. Case studies for NSW (2) can be added delivered as long as significant lead time is provided to DIPNR.

We believe that 10 case studies is enough to show the variability and issues associated with irrigated agriculture on different hydrogeological types in Australia.

Section 10.2 provides a minimum cost estimate to bring each case study up to the same standard.

## 8 References and Further Information

Each of the States has long lists of hydrogeological studies and information. We collated some of this information during this project's interviews, and even more during the compilation of the case study information. However, there is a real need to bring this information together in a robust set.

As one of our respondents has noted, it is insufficient to simply provide lists of references (especially grey literature). Providing contacts or references to a way to get hold of this information is critical.

*We believe there is an opportunity for a partnership with the States in this enterprise including the incorporation of a critique of the references as per the NPSI Knowledge Base.*

## 9 Table of Contents

Based upon our review, we recommend the following Table of Contents:

- 1 Overview of Irrigation in Australia
  - 1.1 History and growth
  - 1.2 Where is irrigation occurring
  - 1.3 What are the potential areas for new irrigation
- 2 Hydrogeological types
  - 2.1 A typology
  - 2.2 Characteristics of the types
  - 2.3 Landscape settings
  - 2.4 Distribution of irrigation
  - 2.5 Geographic settings
- 3 Key issues associated with irrigation on different hydrogeological types
  - 3.1 Water balance
  - 3.2 Groundwater contamination
  - 3.3 Surface water contamination
- 4 Case Studies of Irrigation
  - 4.1 Case study 1
  - 4.2 Case study 2
  - 4.3 Case study 3
  - 4.4 Case study 4
  - 4.5 Case study ...
- 5 References, contacts and further information

## **10 Viability of the Project**

Based upon our discussions with stakeholders it is clear that there is considerable support for a web based tool which links to State Agency websites. It is less clear whether there is substantial support for a hardcopy publication.

### **10.1 Ability to meet needs of policy makers**

While a coffee table book could be created the critical question to ask is “Who’s coffee table will it sit on?”

There is no doubt that a critical element in effecting change is to demonstrate the human side of the problem and we believe this can best be done through the use of pictures, case study stories combined with scientific results interpreted as far as possible in everyday language.

The book will need to have plenty of stories if it is to be attractive. However, the pace of change in our understanding of irrigated areas and in irrigated agriculture is significant. Stories and information could become out of date very quickly limiting the life of a book.

The likelihood of a once off publication leading to significant change in policy makers perceptions is low. However, such a publication does have a role to play in a prolonged and concerted advocacy effort.

The nature of the information collated as part of a project like this has a life beyond a single publication and it is critical that the investment is protected through the long term storage of the information in an electronic form. The creation of a website or tool to support the publication would be relatively straightforward if developed as part of the initial design and would serve not only a storage purpose, but also provide an additional avenue for communication. And it will be of more value to most people who have a specific reason for seeking info (as in investors, govt decision makers etc)

### **10.2 Indicative Costs of Case Studies**

Case studies will required significant work to achieve a common look, feel and content. Based upon our review we believe that each case study will require approximately 6 days to complete at approximately \$1000 per day this represents a \$60,000 investment for 10 case studies.

### **10.3 Indicative Costs of Mapping and other tasks**

Map generation, artist and drafting work will also be substantial. It is likely that this and other incidental work will require up to \$40,000.

### **10.4 Indicative Costs of Publication**

#### **CD & Web Delivery**

If developed as part of the initial design it is likely that the delivery of a CD and web tool would require a budget of approximately \$10,000.

#### **Hardbound book similar to Water Innovation:**

CL Creations have provided a cost for the above in the range \$85,000 to \$100,000 without technical support and engagement of individuals in the case study areas.

### **10.5 Total Costs**

Full costs for production of the hardcopy publication plus web application is likely to be of the order of \$200,000.

## 11 Recommended Project Brief

### Hydrogeological features of Australian Irrigation Areas

The main Australian irrigation areas are made up of a number of common hydrogeological types. These systems are not well understood and this lack of understanding may be leading to less than optimal decision making.

Development of a quality publication that details in simple terms how the various hydrogeological systems operate, establish the hydrogeological context of Australian irrigation and provides case study examples will be of assistance to many across the industry and give greater confidence by irrigation stakeholders in policy decision making.

A scoping study has prepared a background paper which has recommended a suitable typology and assessed the viability of delivering this product together with a web based tool. The electronic tool will aid in updating information over time and provide wider access to the content of the book as well as providing links to State and Regional bodies which are the first point of contact for more detailed information.

#### **Project Objectives:**

The objectives of the project are to:

- Develop and deliver a quality full colour hardcopy publication supporting the aims of this project.
- Develop and deliver an electronic web-based tool which mirrors the style and content of the hardcopy publication.

#### **Project Activities:**

The main activities of the project will be:

- Engage the NPSI Management Committee to confirm the contents, title and key messages of the proposed publication.
- Develop a Communications Plan for the proposed publications.
- Confirm the hydrogeological typology and develop the map and tabular products recommended by the scoping study.
- Engage State, Regional and Expert contacts in the collation of case study information to a common standard and format.

- Compile and print a first class full colour hardcopy publication in a coffee table style.
- Develop a web-based tool which mirrors the style and content of the hardcopy publication.

**Supporting Material:**

The Scoping Study report has collated significant information regarding possible case studies, hydrogeological typologies and potential map products. Tenderers are advised to read this publication and note the accepted style of publication, the recommended Table of Contents and the standard case study contents for the proposed publication.

**Selection Criteria:**

Tenders are invited from individual consultants or organisations with demonstrated knowledge and experience of hydrogeology, irrigation and communication. Tenders will be evaluated against value for money and the following criteria:

- Demonstrated skills and experience in project management.
- Demonstrated experience in the interaction between irrigation and hydrogeology.
- Geomorphological knowledge and expertise.
- Experience in the development and application of hydrogeological typologies.
- Demonstrated experience in liaising with irrigation stakeholders, regional irrigation bodies, State agencies and Commonwealth agencies.
- Demonstrated experience in delivering high quality publications.
- Ability to deliver web-based tools and products.

**Indicative Budget:**

An indicative budget for this project is \$200,000 excluding GST.

**Contact:**

Murray Chapman  
Program Coordinator  
Sustainable Irrigation Program  
0357633214

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## 13 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of National Program for Sustainable Irrigation and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 25<sup>th</sup> January 2005.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 8<sup>th</sup> February 2005 and 24<sup>th</sup> March 2005 and is based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.