FINAL DRAFT

STRATEGIC PLAN

PHASE 2 2007–2010

Foreword

The sustainability of irrigation is a key component of water resource management. Increased demand for water for agricultural, industrial and urban uses has put the management of Australia's river and groundwater systems under scrutiny. Management must balance the various water use needs, providing also for in-stream requirements of biodiversity and water quality.

The irrigation industry is marked by not really being considered an 'industry' at all. Irrigators tend to identify themselves in other ways (grains or broadacre; permanent plantings, dairy, vegetables, etc.). The National Program for Sustainable Irrigation (NPSI) Phase 1 has played a substantial role in providing a forum for irrigation stakeholders to collaborate and invest in common issues impacting on the sustainability of irrigation. Advances in knowledge have been made that has led to improvements and savings at the farm and landscape scale. Research projects have delivered new tools and information specific to water re-use, plant growth, water use efficiency, precision irrigation, and irrigation community wide planning. However there remain whole areas of inquiry essential to achieving sustainable irrigation.

There is the opportunity to progress this substantially through another 3-year investment program.

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Strategic Plan Summary

The National Program for Sustainable Irrigation (NPSI) is a coalition of investors in sustainable irrigation research and innovation from throughout Australia. The investors are from all aspects of the irrigation industry – public and private interests – including policy, growers, water providers, commodity and extension groups. The Program has a management committee that provides the priorities, direction and financial management of the Program. Land and Water Australia is the Managing Agent that provides overall governance and day to day management of the Program.

Coordinated investment in irrigation research and development first commenced through the National Program for Irrigation Research and Development (NPIRD) in 1993 through till June 2002. It was then replaced by NPSI Phase 1 (2002–2006). These programs have provided important new information and a mechanism for irrigation research investors Australia wide to collaborate. Program funding partners have defined research outcomes and invested in research that addresses the imperative of improved production *and* sustainability. NPSI responds to the common desire of industry and the Australian community to achieve irrigated landscapes that are environmentally sustainable, and support viable irrigated industries with improved production and offer regions a vibrant future.

By investing in Phase 2 (2007-2010), partners will have the opportunity to shape research direction and rapidly access new information crucial to short term productivity and long term viability.

	Phase 2 2007–2010
Vision	**Sustainable irrigation is valued within Australian landscapes**
Mission	**To provide Australia with leadership through collaborative investment in research and innovation to achieve sustainable irrigation**
Planned Outcome	**Substantial improvement in the environmental and productive performance of Australian irrigation**
Aims	**Collaborate with irrigation research investors Australia wide to define, commission and manage research projects that provide benefits to a broad range of industries facing common issues;** **To produce new information of national importance and to facilitate its adoption**
Strategies	**Strategy 1: Commissioning and Managing Research** **Strategy 2: Leadership and Collaboration** **Strategy 3: Knowledge into Practice**

The new Phase of NPSI will focus its investment on answering questions around: plant performance and how that impacts on various farm irrigation systems; system-level sustainability: and tools for irrigators, water suppliers and policy makers to measure change. Research will be commissioned to provide either new information (smart science) or development; ensuring that the new information can be readily used by practitioners, planners and policy makers. Research questions that will shape our investments are shown in the table below.

Smart Science Questions	↔	**Change Questions**
How can whole irrigation systems be harmonised so that irrigation is a sustainable component of the landscape, at the same time as being resilient to unanticipated shocks?		What are the systems-level messages for policy makers and planners?
How would a harmonised system function at various scales in existing and new irrigation systems?		What are the implications for refurbishing existing systems?
What are the water and solute triggers and tolerances at (on and below) the rootzones of plants that can affect plant production?		How should this fundamental information be interpreted across different climatic zones and commodities?
What are the further definitions of wetting and drying characteristics of soils?		What management strategies will minimise negative impacts and maximise production?
Given the emerging information about systems-level harmonisation, soil characteristics, and rootzone triggers and tolerances, what research can be shaped that may lead to substantial breakthroughs in concepts, technologies, designs or practices for production and the environment?		How do producers, industries, water managers and policy makers know that they are acting sustainably?

Phase 2 will provide research information in readily accessible formats to help achieve the program's mission. An important client group are policy and planning professionals who need to consider change at the level of whole systems. For these people, single pieces of research information are not considered useful. Additional investment as an adjunct to research projects will draw out the implications of new information for natural resource management at a systems scale to inform decision making. The *Knowledge into Adoption strategy* will invest in providing specialists to work with small groups – within or across policy or planning organisations – to discuss the place of new information in systems thinking about a sustainable irrigation topic. It will combine new research information with the existing body of knowledge on key sustainable irrigation issues so that advances in thinking on whole systems and themes can be made.

The program's role is to provide leadership amongst sustainable irrigation research investors by:

- providing a forum for the development of irrigation stakeholder research priorities and exchange of information;
- investing in research (including pre-empting issues) that will improve the sustainability of the irrigation industry; and
- providing a mechanism for joint inquiry to achieve effective and efficient use of industry funds for sustainable irrigation research, innovation and knowledge dissemination.

The program develops, purchases and manages research from the most suitable research teams Australia-wide, so that lessons learnt and new knowledge can be adapted and adopted by irrigation stakeholders. The program does not make water policy, however the knowledge generated by the program informs policy makers.

NPSI Phase 2 will purchase research from the most capable research teams for any given project.

A skills-based program management committee, appointed by and representing the interests of the program partners, will manage Phase 2. Functions of the committee will include decisions on strategy, funding priorities and program expenditure. Day-to-day administration of the program will be undertaken by the managing partner, Land & Water Australia (LWA). Program partners enter into a signed agreement with Land & Water Australia. The current NPSI management committee expects that investment in Phase 2 will exceed Phase 1 program-level investment of $7 million.

Conclusion

NPSI offers a unique service – providing leadership to identify, scope, purchase and manage research useful to partners, that can help to substantially improve the sustainability of irrigation. Phase 2 will enable irrigation industries to be responsible and profitable users of water. Research results will be developed for use by practitioners, policy makers and planners so that irrigation within a landscape can be environmentally sustainable, productive, and valued.

Vision, Mission and Planned Outcome

Vision

Sustainable irrigation is valued within Australian landscapes.

Mission

To provide Australia with leadership through collaborative investment in research and innovation to achieve sustainable irrigation

Planned Outcome

Substantial improvement in the environmental and productive performance of Australian irrigation

Aims

To collaborate with irrigation research investors Australia-wide to define, commission and manage research projects that provide benefits to a broad range of industries facing common issues

To produce new information of national importance and to facilitate its adoption

Strategies

Strategy 1: Commissioning and Managing Research
Strategy 2: Leadership and Collaboration
Strategy 3: Knowledge into Practice

Strategy 1: Commissioning and Managing Research

- Background
- Research Investment Planning Process
- Development of Tools
- Groundwork for Innovation
- Joint Inquiry
- Research Investment Rationale
- Research Questions and Proposed Research, Phase 2

Planning the direction of research investment for Phase 2 is the culmination of 12 years of activity, commencing with the National Program for Irrigation Research and Development (NPIRD) in 1993. The background steps that have led to the identification of research priorities for 2007–2010 are presented below. The key points are shown in the boxed section.

Key Points

- NPSI Phase 1 commenced in July 2002 with 14 funding partners from throughout Australia. It brought industry to the table with government in a stronger way than ever before.
- The skills-based NPSI program management committee exhaustively reviewed research priorities in 2004 to help pre-empt possible new areas of research. This led to 6 scoping studies undertaken in 2005 to help inform research investments.
- The program has consciously been kept flexible to best generate the articulation and design of pre-emptive research that can lead to innovation and change.
- Most research projects are developed and implemented using joint-inquiry principles and are strongly informed by the Leadership & Collaboration Strategy and the Knowledge into Practice Strategy. Working directly with industry and government aids the adaptation and adoption of new information.

Background

As a new program in 1993, NPIRD's mission was to provide leadership for national research and development and to facilitate the adoption of technology that improved the natural resource sustainability and the economic viability of irrigation regions. What today we consider as standards, at that time were ill defined or non-existent. The research investment priorities in the final years of NPIRD were:

- water use efficiency -30% of funds
- irrigation knowledge and its use – 20% of funds
- benchmarking, monitoring and feedback – 10% of funds
- environmental impacts on the effects of irrigation – 20% of funds
- socioeconomic and policy issues – 15% of funds

In its final year, NPIRD registered an expression of interest for an irrigation cooperative research centre and provided the major cash contribution towards kick-starting its development. The NPIRD program management committee believed that longer term planning for irrigation research and development was a prerequisite to improving the

sustainability of irrigation. The Cooperative Research Centre (CRC) opportunity, if realised, could bring some security to the provision of research and innovation services, particularly through the introduction of an active PhD program.

NPIRD was brought to a close and the National Program for Sustainable Irrigation (NPSI) was born in July 2002 with 14 funding partners from throughout Australia – including some commodity research and development corporations. The new NPSI had a stronger emphasis on addressing critical emerging environmental issues impacting on the sustainability of irrigation.

Phase 1 of NPSI strengthened collaboration with industry and government more than ever before. A strategic plan reflected the imperative to provide Australia with research and innovation to make irrigation more sustainable. Two strategies were determined – a *Research & Innovation Strategy* and a *Knowledge Management Strategy* to achieve the planned outcome of 'substantial improvement in the environmental and productive performance of irrigated agriculture and horticulture in Australia'.

Priorities for investment were set that reflected the program's strengths – the ability to achieve public good and improved productivity by determining gaps in knowledge and articulating ways forward:

- Scheme and catchment – building improved, integrated, regional systems covering productivity, ecology and community development
- Commodity – bringing innovation to farming systems that both reduce ecological impacts and enhance productivity
- Smart science – achieving substantial breakthroughs in concepts, technologies, designs or practices

To date, 25 research projects and scoping studies have been contracted and 11 have been completed This has been achieved despite challenges of continuous restructuring of research providers and funding difficulties partly due to the extensive drought affecting matching funding available for research. Some research projects generated new teams of scientists from diverse disciplines. Research teams and their steering committees crossed State and institutional lines.

Investment Planning Process

In 2004 the program management committee began a review of research priorities. It was agreed that the current NPSI investments were reasonably well balanced against the objectives. To identify new investment that would help achieve the mission and objectives of the program, consideration was given to:

- knowledge gaps identified via the Research Review of the last 10 years of irrigation research
- any gaps between the Strategic Plan and research currently funded
- gaps in research funding relative to CRC Irrigation Futures' strategic direction
- telephone survey of members of the project management committee to identify new or emerging concepts
- issues raised by industry leaders

- recommendations for expansion of funding of existing projects
- the three priority projects from first round that were not able to be funded

The detailed investigation sought not only to identify logical progressions in research, but also to identify possible new areas of research that could help achieve our mission. A number of ideas and thoughts were elicited from the skills-based program management committee that were developed for discussion. A workshop subsequently determined investment themes.

A number of investment decisions were made by the program management committee including undertaking scoping studies to help inform larger research investments, and active liaison with other research activities such as the University of Melbourne study, 'Regional and Economic Benefits through Smarter Irrigation', so that full contextual understanding was achieved in the scoping studies.

The program undertook 6 scoping studies. The information achieved from these studies helped to shape the research direction for Phase 2. Each scoping study is described below.

1. Evaporation from farm dams (FSA1)

   The committee recognised there were a number of priority issues for immediate funding and that further consideration of evaporation issues is needed as part of Phase 2.
   The projects funded immediately were:
   'The Significance of Night-time Evaporation from Irrigation Farm Dams' (UWA45)
   A 'ready reckoner' to determine under what circumstances an evaporation reduction system would be economical (USQ11).

   A briefing on the scoping studies findings was provided to the National Water Commission. The presentation concentrated on the potential for real water savings if effective solutions could be found for evaporation

2. 'Sharing Landscapes' concept and project scoping (RST6)

   The concept requires further development and it is an important area that cuts across many organisations including natural resource management,, agriculture and local government. There may be linkages with the CRC Cotton Catchment Communities. The concept was not sufficiently developed for Phase 1 investment. The program management committee agreed to keep the project concept 'live', and revisit during Phase 2.

3. Soil water and salt movement associated with precision irrigation systems (USQ6)

   The program management committee agreed to commence investment during Phase 1 and invest in further priorities during Phase 2. An outputs and outcomes framework was developed with input from various commodity groups.
   As part of Phase 1, the project 'Rootzone Water, Salinity and Nutrient Management under Precision Irrigation' (SRD8) was contracted.

A subsequent project will be commissioned (as part of Phase 1) to interpret the research from this and other projects for other commodities, climatic zones and irrigation water qualities.

4. Improving plants water use efficiency and potential impacts from soil structure change (USQ7)

   The program management committee agreed to commence investment during Phase 1 and consider further priorities for Phase 2 investment. As part of the project's development an outputs and outcomes framework was developed with input from various commodity groups.

   As part of Phase 1, the project 'Long-term Ssustainability of Precision Irrigation'(UAD25) was contracted.

5. Smart systems and system harmonisation (USQ8)

   The committee endorsed the need to work with the National Water Commission and encourage the concept to be linked into the development of projects that may be funded under Water Smart Australia. This has resulted in the program providing support towards the development of guidelines, a workshop in December 2005, and the provision of case study examples that will be used in the March 2006 workshop. The case studies demonstrate how recent research is helping with innovative solutions to water quantity, quality and agronomic problems faced in Australia. The case studies are based on research projects 'Changing Irrigation Systems and Management in the Harvey Irrigation Area' (DAW45) and 'Tri-State Project – Impact of Salinity on Lower Murray Horticulture' (DEP15). Linkages have also been made to the Pratt work and the CRC IF business plan approach to system harmonisation.

6. Common hydro-geological features in Australian irrigation areas (URS13)

   The scoping study demonstrated a need for a concise publication. It was agreed that policy makers and community leaders would have a use for such a publication. It is not a priority investment for NPSI but the program could act as a conduit for others to invest and facilitate a system various organisations could use to capture information from their projects that would form the basis of the publication.

Development of Tools

The committee decided to continue in Phase 1 to support the development of tools that would assist irrigators. A number have been mentioned above, and others include tools such as the Longstop wetting front detector. The Longstop's development is to confirm its suitability for use in cracking soils of the northern Darling Basin. The committee supported this project because of the tool's simplicity and ease of operation for irrigators. Informative guides such as the *Irrigation Insights* series, are researched and written to provide practical assistance to irrigators, extension consultants and policy makers. The publications translate research results and information on irrigation technologies. Tools such as the *Irrigation Insights* series and decision support materials are discussed in the section on 'Knowledge into Adoption'.

Groundwork for Innovation

The committee recognises that science and irrigation technology change rapidly. The program has consciously been kept flexible to best generate the articulation and design of pre-emptive research that can lead to innovation and change. To do this requires sometimes revisiting what is already known, and bringing people together to share knowledge. For example, during Phase 1 a workshop was held to coordinate research effort and strategic direction in the northern Darling Basin so that research to date could be collected and shared by researchers, policy makers, investors and NRM planners. A comprehensive document of research being undertaken into deep drainage and associated issues, *Coordinating Deep Drainage Research in the Northern Darling Basin* (CRD1), was produced from the workshop. The project also provided input to assist researchers of various disciplines in using the Weighing Lysimeter at Narrabri as a system for testing other ways to measure deep drainage.

Joint Inquiry

An understanding of social and institutional change informs the design and management of all projects. Research projects were shaped from original proposals into viable projects over a period that allowed discussion and input from interested parties including investors and end-users. In most cases, steering committees were formed including end users and technical expertise. These committees have provided ongoing discussion, relevance and direction to the projects, demonstrating a joint inquiry approach to the research. The requirement to respond to steering committees is embedded in the project design.

The fundamental framework used for the first call of research in Phase 1 still stands, however the program has tightened up the most critical area for future investment as shown in the next section. It is expected this will continue to be refined as a result of discussions with potential program Partners.

Research Investment Rationale for Phase 2

Phase 2 aims will be achieved by addressing the common ground for industry and the Australian community – where irrigated landscapes are environmentally sustainable and viable irrigated industries improve production and regional futures.

Sustainable irrigation research to date has identified and defined the fundamental issue of rootzone health in plant production. Irrigation-related issues impacting on plant productivity will be researched and implications for various climatic zones and associated commodities will be determined.

The development of irrigation systems in Australia was based on engineering and agricultural feats. Consideration of environmental sustainability was not a contributing factor in decision making at any point. In the short term, people who struggled in regional areas paid the price of this omission. In the longer-term all Australians are bearing the cost of omitting environmental sustainability from consideration in developing new irrigation regions. There is a push for opening new areas to irrigation, particularly in northern Australia. Science is needed to inform the policy frameworks that will determine whether, and how, systems can be established or refurbished that take account of ecological imperatives for environmental sustainability.

There exists considerable technical information to improve irrigation management and systems efficiency: however, the information is often underdeveloped and lacks a fit with the needs of practitioners, policy makers or planners. Often additional development work is required to make research information usable. Social, institutional, and technical research will be undertaken to aid the adoption of better irrigation management.

People derive diverse values – financial, recreational, spiritual and aesthetic – from landscape. Irrigation is a fundamental component in many landscapes in Australia. New information and technologies allow for consideration of landscape redesign that is resource efficient and based on a broad range of sustainability criteria that communities value. Irrigation system harmonisation considers the main structural and technical options such as channel automation, change of crop mix and intelligent systems.1 These need to be linked with the broader community interest to inform sustainable futures through total system harmonisation.

NPSI demonstrates excellent collaboration across private and public sector interests, and a way of working that stays flexible and attuned to opportunities for innovation. The research strategy will continually stay open to identifying and resourcing potential major breakthroughs.

[1] See M. Durack et al, 2005. NPSI Scoping Study 'Smart Systems & System Harmonisation'.

Research Questions and Proposed Research, Phase 2

A number of questions have been refined as a result of the new information from research carried out over the past 4 years, and discussion across the program partners. Our clients span policy, planning and practice, and all need to know how to responsibly use and manage natural resources. When answered, the questions outlined below will provide important new information.

Smart Science	**Change**
How can whole irrigation systems be harmonised so that irrigation is a sustainable component of the landscape, at the same time as being resilient to unanticipated shocks?	What are the systems-level messages for policy makers and planners?
How would a harmonised system function at various scales in existing and new irrigation systems?	What are the implications for refurbishing existing systems?
What are the water and solute triggers and tolerances at (on and below) the rootzones of plants that can affect plant production?	How should this fundamental information be interpreted across different climatic zones and commodities?
What are the further definitions of wetting and drying characteristics of soils?	What management strategies will minimise negative impacts and maximise production?
Given the emerging information about systems-level harmonisation, soil characteristics, and rootzone triggers and tolerances, what research can be shaped that may lead to substantial breakthroughs in concepts, technologies, designs or practices for production and the environment?	How do producers, industries, water managers and policy makers know that they are acting sustainably?

Responses to these questions are shown over in a table describing proposed research.

Research Questions	**Proposed Research**	**Comment**
How can whole irrigation systems be harmonised so that irrigation is a sustainable component of the landscape, at the same time as being resilient to unanticipated shocks? What are the systems-level messages for policy makers and planners?	Define and develop the *total system harmonisation* concept in a manner that • is integrated with the natural water system (including the interaction and management of surface and sub surface systems) and • maintains flexibility and resilience to reduce the impact of market or seasonal shocks • integrates with climate variability knowledge • considers water-dependent eco systems • responds to community interest to inform sustainable futures • develops an adaptive management process for ongoing water management, and develops knowledge support tools to assist adaptive management	NPSI Phase 1 has 2 projects that are moving towards the demonstration of system harmonisation. They are being used as case studies at the National Water Commission workshop in March 2006. Further work is envisaged on the development of decision support systems that are capable of incorporating catchment wide climate and farm information.
How would a harmonised system function at various scales in existing and new irrigation systems? What are the implications for refurbishing existing systems?	Identify the costs and benefits in terms of water use efficiency and energy (greenhouse) for flood and various precision irrigation systems across different climates and commodities. Identify whether there are additional environmental aspects to be considered. Identify what changes an optimised on-farm system may make to the rest of the water system. Initiate specific research to support the implementation of the National Water Initiative.	Changes in the on-farm system may impact on the system as a whole, e.g., groundwater rise or reductions, or solute movement. Some of the research described below on the development of new software tools will assist in achieving the goal of developing tools for good water management (part of the 'Raising National Water Standards' program).

Research Questions	**Proposed Research**	**Comment**
	Investigate appropriate national protocols for data communication networks. Understand critical gaps in sensor and control system hardware and software. Develop user-friendly software from existing analytical models for working at various scales – from individual plant to catchment Identify institutional barriers to achieving harmonised systems	Research will involve a close liaison with the University of Melbourne's 'Science Technology and Innovation' (STI) project, led by John Langford. Developmental work will incorporate research undertaken by CRC eWater Work at the plant and paddock scale will enable calculation of wetting characteristics and salt distributions; and the undertaking of work on characterising soil properties influencing soil-water and solute transport and storage at small scales appropriate to precision irrigation.
	Develop further techniques for reducing evaporation from stored and applied irrigation water.	Current research includes a 'ready reckoner' to assist irrigators to decide when evaporation control on farm dams is economically beneficial and to further understand the differences between night and day evaporation. Further work is required on storage and application techniques as it is one of the few areas where real water savings are achievable. This further work needs to include debate on the opportunity of widespread use of aquifer storage including the energy equation for using this technique.
What are the water and solute triggers and tolerances at (on and below) the rootzones of plants that can affect plant production? How should this fundamental information be interpreted across different climatic zones and commodities? What management strategies will minimise negative impacts and maximise production?	Investigate the dynamics of root growth and the propagation of valuable organisms such as the mycorrhizal fungi under various irrigation regimes. Investigate the ability to achieve satisfactory plant yields through precisely deployed water of various salinities, i.e., by timing the delivery of water according to physiological phases of the plants' growth or by delivering water to only part of the plant. Develop understanding of required soil characteristics and their maintenance.	These are still poorly understood, particularly in the context of ensuring that soil conditions remain suitable for the growth of a wide variety of species.
	Study the management of irrigation-induced soil structural decline due to precision irrigation Identify correlations between variations in yield within a paddock and irrigation management Develop management strategies to minimise rootzone salinity during	It is anticipated that there will be further research in areas such as the definition of water retention curves for Australian soils and the role of soil biopores in maintaining a healthy rootzone. Further projects will be commissioned to interpret the research for other commodities, climatic regions and water qualities.

Research Questions	Proposed Research	Comment
What are the further definitions of wetting and drying characteristics of soils?	times of low water allocations and minimise nutrient leaching from precision, (open hydroponics, drip and sprinkler) furrow and border check irrigation systems	
	Improve technologies for measurement and monitoring.	Current activities addressing this objective include: The CRC Irrigation Futures is continuing to work on defining standard methodologies for measuring crop evapotranspiration and crop coefficients. An *Irrigation Insight* is being written to assist irrigators to manage their on-farm monitoring processes and use the data fully to make irrigation decisions.

Research Questions	Proposed Research	Comment
Given the emerging information about systems level harmonisation, soil characteristics, and rootzone triggers and tolerances, what research can be shaped that may lead to substantial breakthroughs in concepts, technologies, designs or practices for production and the environment?	Undertake scoping studies and short investigations to improve understanding of emerging concepts that could be framed for research to achieve breakthroughs in information and understanding. Potential research areas but not limited to this include: • The stream of work that has been done on ecological risk assessment, and the introduction of a stochastic approach to modelling, is yet to be brought together with the likes of the SWAGMAN models to manage environmental risks. This would considerably help with evaluating and discussing trade-offs. • Determining valuehas moved towards $/ML rather than $/Ha. Continuing along this way of thinking, a way of expressing value in terms of energy used and environmental risk could aid decision making • Determine how latest technologies can be used or new technologies developed to improve the best placement of point source instruments • Conventions for using accounting approaches for physical resources that include energy, socioeconomic, and environmental considerations have been conceptually developed, but their application to Australian irrigation requires further work. There is a need to develop agreement on a series of appropriate indices, and the identification of target ranges for each of these indices	Phase 1 commissioned studies on broadacre open hydroponics, system harmonisation, night-time evaporation and the potential impacts of soil structure change that enabled the pre-empting of substantial research for Australia, rather than responding only to identified irrigation problems.

Research Questions	**Proposed Research**	**Comment**
	• Understanding the interaction between complex human systems and complex ecological systems has been the subject of considerable research over the past decade. Assess the current theories that inform adaptive irrigation landscapes and consider the frameworks and tools to incorporate flexibility concepts into water planning in existing irrigation regions.	
How do producers, industries, water managers and policy makers know that they are acting sustainably?	Describe the practical measures and indicators that can be used by growers across commodities and climatic zones, and policy makers and planners, that will demonstrate whether actions and management practices are helping to improve the sustainability of irrigation: Identify how sustainability indicators can be used in a benchmarking system so that growers can assess their collective economic + environmental performance. Identify the best (sustainable) management practices that address or exceed community and regulatory expectations Identify the tools and decision support systems needed to support growers, planners and policy makers knowing whether or not they are achieving best practice. Comment on what new knowledge, information and skills are required?	Achieving change in the right direction requires that research outputs from the past few years is reviewed and additional research specific to climate zones and commodities be undertaken, to provide useful indicators for growers, planners and policy makers.

Strategy 2: Leadership and Collaboration

- Introduction
- Relationship with Other Organisations
- Program Management Committee
- Strategic Direction
- Joint Inquiry
- Research Investment Rationale
- Research Questions and Proposed Research, Phase 2

Introduction

The irrigation industry is marked by not really being considered an industry at all. Irrigators tend to identify themselves in other ways (grains or broadacre; permanent plantings, dairy, vegetables, etc.). Some adjustments have been in evidence as the pressures on our water systems have increased, but the challenge is to ensure that collaboration crosses any and all former boundaries, in the interest of achieving productive and sustainable water systems.

Program partners in Phase 1 are:

Land & Water Australia (managing partner)
Horticulture Australia Ltd
Goulburn-Murray Water
SunWater Qld.,
Harvey Water WA
GWM Water
Commonwealth Dept. Agriculture, Fisheries, Forestry
Dept Environment, Water & Catchment WA
Qld Dept Natural Resources & Mines
Dept. Agriculture WA
Dept Primary Industries & Resources SA
Lower Murray Water Authority Vic
Cotton Research & Development Corporation
Ord Irrigation Cooperative WA

The program management committee has continually assessed its directions and needs with an important element always being to engage with commodity groups. Through this process Horticulture Australia and Cotton Research & Development Corporation have been strongly engaged at program level in Phase 1. Grains Research & Development Corporation and Grape & Wine Research & Development Corporation have engaged in Phase 1 at project level. All irrigation based commodities are being encouraged to participate as program partners. This direction is supported within the recommendations of the Corish Report.

Relationship with Other Organisations

Cooperative Research Centre for Irrigation Futures (CRCIF)

The Cooperative Research Centre for Irrigation Futures (CRCIF) is a research provider and NPSI is a research purchaser. NPSI often purchases research from CRC IF research teams. Continued collaboration with CRCIF, facilitated by the close linkages already established, will ensure that the strategic directions of NPSI Phase 2 and CRCIF's research program are complementary.

National Water Commission

The Commission's role is to drive national water reform and to help implement the Australian Water Initiative. NPSI provides advice to the NWC from time to time.

Murray Darling Basin Commission
The Commission has a role in managing water flows in the Murray Darling system, developing policy and achieving strategies such as the Living Murray and the Basin Salinity Management Strategy. It is a limited investor in irrigation research.

Program Management Committee

A skills-based program management committee, appointed by and representing the interests of the program Partners, will manage NPSI Phase 2. Functions of the program management committee will include decisions on strategy, funding priorities and program expenditure. Day-to-day administration of the program will be undertaken by Land & Water Australia.

Strategic Direction

Phase 1 demonstrated the benefits that could be realised with industry and government coming together to debate and determine research priorities to achieve sustainable irrigation. Phase 2 aims will be achieved by continuing to expand and strengthen this 'forum' approach. This will require that there be investment in Phase 2 from partners representing:

- the private and the public sector;
- irrigated agricultural and horticultural production and environment-focussed agencies; and
- Australia-wide

Phase 2 will promote partnership on fundamental issues across irrigation based commodities. 'Questions to the future' will be scoped and shaped by the program management committee into research projects that require engagement with many agencies and end-users to be achieved. In addition to attracting investment from program level partners as described above, individual research projects will require their own set of partners and collaborators. The process of developing project level investor partnerships and project steering committee membership based on technology specialists and end users can be time consuming and difficult. As noted elsewhere, change requires a focussed effort and should involve all stakeholders in the process. The technologies or practices that can be effectively developed in isolation and handed down to a waiting industry or community are rare. Participation in shaping and advising the research as the project unfolds is crucial to achieving knowledge and change. Research investors have a forum to reach consensus on priorities for research.

The *Commissioning & Managing Research Strategy* (see above) notes that investment will be focussed on research of national importance for irrigated agricultural and horticultural production and environmental sustainability. Involvement by commodity organisations is essential at every stage. For example, it is proposed that Phase 2 will study the management of irrigation-induced soil structural decline due to precision irrigation. Participation by commodity organisations is essential to help shape the initial research design, steer the first project, then participate in interpreting the research for their commodity.

Strategy 3: Knowledge into Practice

- Introduction
- Knowledge Investment Planning
- Knowledge & Adoption Objectives
- Areas for Investment, Phase 2

Introduction

Putting knowledge generated by NPSI into practice implies change. Considerable investment has been made into understanding change processes by many organisations such as NPSI's managing partner, Land & Water Australia. Phase 1 of NPSI has invested in research to better understand how knowledge is generated in the cotton and grains industry; with particular reference to the extension of information by private consultants. Previous investment under the former National Program for Irrigation R&D included an analysis of socioeconomic research needs of irrigation communities in making structural changes in the next thirty years.

Understanding change processes in natural resource management requires acknowledging that there are many factors that contribute to, or inhibit, practice change in natural resource management.[2] The broader social, cultural, political and economic context that people and organisations operate in produces myriad situations that have significant influence upon practice change. For example a water use efficiency measure may be adopted for a lifestyle reason, (it reduces sleep disruption) rather than for economic or environmental benefits.

People and organisations will adapt and adopt new information into their policy, planning or practice at different rates and times not necessarily related to the quality or usefulness of the new information. Understanding the characteristics of any information, ideas, technologies and knowledge that influence adoption, and responding to our target audiences' information preferences, has shaped Phase 2 investment.

Knowledge Investment Planning

The development of knowledge products for Phase 1 of NPSI was based on 'just in time' principles – having information accessible in suitable formats to the end-user, when required. Phase 2 can achieve more, now that essential resources and communication tools such as the Knowledge Base, research bulletins, Updates etc are established.

Organisations such as the Cooperative Research Centre for Irrigation Futures have a mandate to extend research information via a substantial training program. In addition to the CRC IF, there are around 40 other provider agencies and organisations undertaking some level of irrigation research and/or development in Australia, all

[2] This section quoted or adapted from Land & Water Australia, 2005. *Knowledge & Adoption Strategy – Managing information and knowledge for adoption outcomes* PRO50969.

generating some level of information. The Commonwealth and State governments are large investors in knowledge extension projects through many different organisations Australia-wide. Currently, for example, the Irrigation Association of Australia, in conjunction with ANCID, is developing a national irrigation industry certification and training framework. With so much investment in training and adoption, Phase 2 will concentrate its investment.

In considering how best to achieve change, the work of the Cooperative Venture for Capacity Building project[3] is useful for considering the spectrum of methods to encourage adoption of lessons from sustainable irrigation research. Five models of knowledge and extension used throughout rural and regional Australia (not just on NRM projects) were identified.

Model	**Philosophy/Rationale**	**Current examples in irrigation**
1. Group facilitation / empowerment	Rural industry participants are best served by providing them with a facilitative framework to allow them to define their own problems and opportunities and seek their own avenues to address them.	(1) Industry-run irrigator meeting groups such as Target10 Dairy groups, Citrus groups (2) ANCID[4] & IAA[5] conferences and activities
2. Programmed learning	Workshops/courses that can be taken across regions/states and be applicable to a large number of diverse participants can be developed and packaged. Most extension projects developed for this purpose also incorporate an 'adult learning' philosophy that recognises the knowledge already held by participants.	IAA, in association with ANCID, has been researching and developing a national industry certification and training framework to be delivered locally and regionally.
3. Technology Development	Change requires a focussed effort and should involve all stakeholders in the process. The technologies or practices that can be effectively developed in isolation and handed down to a waiting industry or community are rare. Participation and multiple approaches appear to be fundamental to projects in this model	Joint Inquiry research processes such as have been demonstrated by NPSI Phase 1, e.g., Goulburn Broken Irrigation Futures research on scenario planning at the regional level involving all stakeholders including the general population

[3] Jeff Coutts, October 2005. *Summary of Cooperative Venture for Human Capacity Building Projects,* Presentation to Land & Water Australia.
[4] ANCID – Australian National Committee on Irrigation & Drainage.
[5] IAA – Irrigation Association of Australia.

Model	Philosophy/Rationale	Current examples in irrigation
4. Information access	People require different information at different stages of their decision making and in a form that suits their individual needs. Projects under this model do not need to be resource demanding or complex.	NPSI Phase 1 – Development of a Knowledge Base drawing together and commenting on research from the past 10 years that can inform improving the sustainability of irrigation, readily searchable by general topic, author or search word and continually updated Queensland's Rural Water Use Efficiency Project is also a good example of information access.
5. Individual consultant or mentor	Working with individuals is a key component of some technology development projects, as well as in extension occurring in the private sector. Common characteristics of knowledge seeking behaviour in decision makers[6] includes preferring to solicit information from someone they trust rather than a recognised authority in the field. They seek up-to-date, concise overviews of current understandings in a particular area. They do not see the individual research project as the appropriate unit of knowledge transfer.	NPSI Phase 1 – Current research 'Knowledge Management in Cotton and Grains' considers the learning styles of cotton and grain operators and the way different service providers including consultants draw information and knowledge to meet these needs.

Phase 2 will concentrate its investment in models 3 and 4. Additionally, the lessons from model 5 – that decision makers solicit information from someone they trust and seek up-to-date, concise overviews – has helped shape the knowledge objectives and activities described below.

Knowledge & Extension Model	**Phase 2 Strategy**
3. Technology development	Via the *Commissioning & Managing Research Strategy* – joint inquiry processes as described in the Research Strategy
4. Information access	Knowledge & Adoption Strategy described below

[6] Andrew Campbell, 2005. *The Australian Natural Resource Management Knowledge System* summarises the findings of a number of studies into how policy and decision makers try to inform themselves.

Our clients span policy, planning and practice. Individually they may use any and every combination of the above models. People have their own learning styles and their own world views that shape what it is they 'know'. There is a very broad spectrum of life experience and tacit knowledge across our client base.

Organisations such as CRC Irrigation Futures and the Irrigation Association of Australia and ANCID have considerable investment in capacity building including training initiatives for irrigators and farm workers. NPSI Phase 2 will focus its investment at the level of providing information in accessible formats. All end users – including extension officers, irrigators, engineers, tutors, researchers and policy makers – will be able to access information relating to improving the sustainability of irrigation via the NPSI Knowledge Base and communications products such as *Research Bulletins* and the popular *Irrigation Insight* reference book series.

The focus of additional knowledge and adoption investment will be at the level of organisations involved in policy and planning. NPSI Phase 2 will provide tailored activities of benefit to those in planning and policy positions within and across industry groups, water authorities, catchment management authorities and governments.

To achieve the program's aims, the Knowledge into Adoption Strategy will:

- provide research information in readily accessible formats to help achieve the program's mission; and
- combine new research information with the existing body of knowledge on key sustainable irrigation issues so that advances in thinking on whole systems and themes can be made.

Whilst it may appear obvious that information needs to be easily and readily available in simple and detailed forms, by topic and interest area, it is not generally achieved well. Managing information in a manner readily usable by the full range of clients and stakeholders is time consuming. In Phase 1, NPSI invested in a research review and the development of searchable formats. The web-based NPSI Knowledge Base has made hundreds of reports accessible, discussed through the prism of making irrigation more sustainable. Thousands more reports are available by abstract. The program has made information available in multiple formats. Information should be continually updated and accessibility improved.

Many of our clients are policy or planning professionals who need to consider change at the level of whole systems. For these people, single pieces of research information are not considered useful. To illustrate this, we give the example of a current NPSI Phase 1 project. The 'Salinity Impact on Horticulture in the Lower Murray' research project is providing vital, new information about how much water needs to be supplied to a plant's rootzone, given salinity issues. This information may seem to be specific to economic sustainability for irrigators, but there are substantial environmental sustainability issues. This research can inform sustainability questions impacting on both soils and the Murray River and surrounds. Additional investment as an adjunct to the research project can draw out the implications of the new information for natural resource management at a systems scale.

Areas of Investment, Phase 2

Website
The NPSI website will be continually updated with information about the program's activities including progress on all current research projects, stories, updates, reports etc. Liaison with other complimentary websites will be undertaken with the aim of providing users with a clear text description of each website (with links).
The NPSI website also holds the Knowledge Base. Monitoring of visitors to the website commenced in October 2005. 1,800 visits are being made per month, with a little less than half visiting the general contents of the website, and slightly more than half going directly to the Knowledge Base.

Knowledge Base
The Knowledge Base will be monitored and evaluated for its usefulness to our stakeholders and improved as required with the aim of making relevant international journal literature more broadly available. It will be continually updated with the aim of becoming a trusted and easy reference for clients and stakeholders. Monitoring since October 2005 indicates approximately 930 'hits' per month on the Knowledge Base. A CD that replicates the web-based Knowledge Base will be produced annually for distribution at events (and will be available by order).

Communications Products
Media stories and case studies with photographs will be written demonstrating adoption of research findings. Such stories will form the basis of articles for the program's newsletter (*UPDATE*). Through liaison with communication officers from industry groups, Research & Development Corporations, authorities and others; stories will be adapted to suit partner publications. Fact Sheets, Research Bulletins and the Irrigation Insight publication series will continue to be written and published as authoritative sources of information on specific topics. For example, some of the research described for Phase 2 is fundamental – such as rootzone management – and some additional research is described to make use of that information by region or commodity. *Research Bulletins* specific to a commodity or rainfall area will be developed to ensure the new information can be easily accessed and used. Other communication products will be prepared as required to assist achievement of the objectives.

Research Reviews, Analysis and Scoping Papers
The purpose of this investment is to bring together the full range of new information from perhaps a number of disparate investigations; consider the new information with the existing body of knowledge; and draw conclusions for sustainable irrigation. This is in response to the growing awareness that policy makers and planners do not find single project research findings particularly helpful, as they are required to make considerations at the level of whole systems. Specific investigations will be commissioned resulting in occasional papers on topics to consider the range of new research information that could inform a particular policy or planning area of interest. Where necessary, this may include convening a panel of experts. The two topics discussed elsewhere in this strategy as examples are:

- 'Reconfiguring Irrigation Systems – Considerations in planning for sustainable irrigation'; and
- 'Rootzone Management and Soil Structure – Lessons in sustainable irrigation'.

There are a number of other areas that can be combined to provide a 'lessons learnt' framework of considerable use to our clients. An occasional paper would be produced as a basis for our clients to undertake investigations specific to their region or industry. The paper could also provide background material for workshops.

Workshops and Seminars

The program will invest in providing specialists to work with small groups - within or across policy or planning organisations – to discuss the place of new information in systems thinking about a sustainable irrigation topic.

Special Events including Event Sponsorship

As mentioned above, a number of organisations throughout Australia invest considerable resources into practice change. Phase 2 will support the endeavours of other organisations where it meets our strategic objectives. Special events or event sponsorship will be considered, based on:

- the alignment of the subject matter with the Sustainable Irrigation Program Strategic Plan;
- the relevance and timeliness of the activity/event/conference to the program's activities;
- the number and diversity of participants;
- the quality of knowledge exchange activities proposed; and
- the quality of event organisation.

Program Investment

The Land and Water Australia board has agreed in principle to invest $1.5 million in the program (providing there is industry support) and be the managing partner for the program.

During Phase 1, the Commonwealth Dept. Agriculture Fisheries, Forestry (DAFF) demonstrated a large and consistent commitment to the building of partnership approaches to the improvement in the sustainability of irrigation. This commitment has continued with Minister McGauran announcing an additional $500,000 for the first 2 years, with no barriers to seeking further investment.

The program management committee expects that investment in Phase 2 will exceed Phase 1 program-level investment of $7 million.

Program partners enter into a signed agreement with Land & Water Australia.

External Evaluation

In addition to a detailed monitoring program to understand progress and target issues, the program management committee will oversee an external evaluation that will independently report on how the program has performed against its strategic intent.

Such an evaluation has been undertaken for Phase 1 (final report pending). The preliminary report (Hassall & Assoc. 2006) found that NPSI:

- created a forum to identify and discuss issues impacting on sustainable irrigation;
- was consensus based and forward looking;
- and provided a mechanism for partners to invest in irrigation research of direct relevance and to share knowledge.

The report also found that the program scored very highly on direct relevance to industry, knowledge management and smart science.

Management Functions

Land & Water Australia (LWA) is the managing partner. LWA is a statutory corporation established under the *Primary Industries & Energy Research & Development (PIERD) Act 1989* (Cth), within the Australian Government's Agriculture, Fisheries and Forestry portfolio. The National Program for Sustainable Irrigation's Strategic Plan as drafted sits very well within the national research priorities, and within LWA's mandate.

Financial Management

Financial administration of the program is managed as part of the functions of the Land and Water Australia (LWA). LWA management reports monthly to the LWA board and the board has an audit program in place.

The program management committee is responsible for the budget allocation and receives financial reports for consideration at all meetings. They are also responsible for approving each project and the associated expenditure. The program manager has discretion for expenditure at levels approved by the program management committee and the LWA board.

Governance

The ultimate responsibility for the program's performance sits with the LWA Board. It has in place various procedures to ensure satisfactory financial, research and communication performance. An important part of this process is adoption of best practice meeting protocols by the program management committee. This has been demonstrated during Phase 1. For example Conflict of Interest was a standing agenda item and, where necessary, members removed themselves from specific discussions.

Accountability

Accountability provisions for all organisations participating in the program are articulated in the partner agreement. It includes in detail the responsibility of LWA officers participating in the program.

Personnel Plan

The program as such has not employed any personnel. LWA provides salaried staff to undertake the contracting of projects and high level management. The day to day management of the program and projects is contracted out. The contractor reports to the LWA program manager on administrative issues and the program management committee for strategic direction.

Organisational Model

The NPSI management committee sits as a management committee within the LWA structure. Appointed by and representing the interests of the program partners, it will meet to discuss progress and make decisions on strategy, funding priorities and program expenditure. Day-to-day administration of the program will be undertaken by Land & Water Australia.

The program management committee has a responsibility to keep the investing organisations fully informed of the programs results and overall performance. The management and accountability diagram is shown over.

Conclusion

NPSI offers a unique service – providing leadership to identify, scope, purchase and manage research useful to partners, that can help to substantially improve the sustainability of irrigation. Phase 2 will enable irrigation industries to be responsible and profitable users of water. Research results will be developed for use by practitioners, policy makers and planners so that irrigation within a landscape can be environmentally sustainable, productive, and valued.

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Management and Accountability Diagram