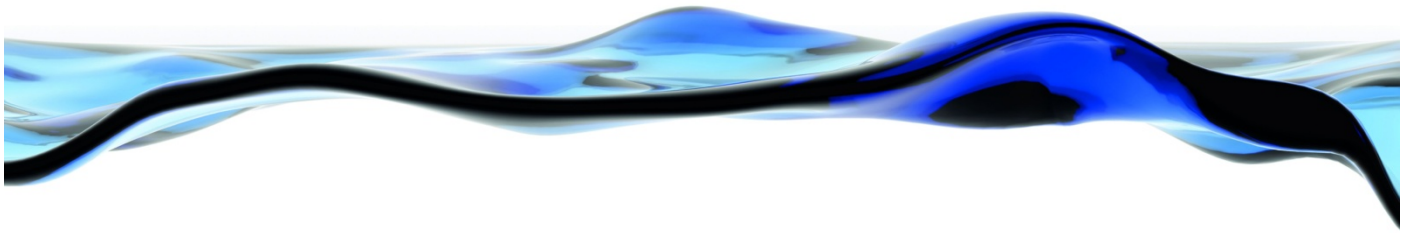
Annual Research & Development Plan and Budget 2014/15



GOYDER INSTITUTE FOR WATER RESEARCH

www.goyderinstitute.org

The Goyder Institute for Water Research is a partnership between the South Australian Government through the Department of Environment, Water and Natural Resources, CSIRO, Flinders University, the University of Adelaide and the University of South Australia. The Institute will enhance the South Australian Government's capacity to develop and deliver science-based policy solutions in water management. It brings together the best scientists and researchers across Australia to provide expert and independent scientific advice to inform good government water policy and identify future threats and opportunities to water security.

Goyder Institute Associates

Goyder Institute Associates typically contribute expertise and capabilities in areas outside of those contributed by the Goyder Institute Partners. Associates may participate in capacity building, knowledge exchange and/or specific research projects, and invest in the Goyder Institute Research program with in-kind commitments in the same manner as Goyder Institute Partners. The following Associate organisations have contributed to outcomes of Goyder Institute research projects.

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1 Introduction

The Goyder Institute for Water Research Agreement requires that the Director prepare an Annual Research and Development Plan and Budget for each financial year. This plan is to be submitted to the Research Advisory Committee for endorsement and then to the Management Board for approval.

1.1 Strategic Research Plan

The Strategic Research Plan 2011-2015 details the long-term strategic outcomes for the Goyder Institute research programme, which will help ensure the water resources of the state of South Australia are sustainably managed for economic, social and environmental benefits. The Strategic Research Plan links the ongoing and proposed research activities to these outcomes through Roadmaps.

Water for Good, the State's plan for water, sets out the actions the South Australian Government will take to ensure water supplies are secure, safe, reliable – and able to sustain continued growth – for at least the next 40 years. *Water for Good* provides extensive guidance to the development of the Research Programme.

1.2 Annual Research and Development Plan

Each strategic Roadmap is implemented through an integrated set of Research Projects with associated Research Project Plans. The Annual Research and Development Plan describes this annual rolling portfolio of projects that are the mechanism for achieving the outputs required to contribute to the Roadmaps.

Each financial year, the Director will produce an update of the Annual Research and Development Plan and Budget. This updated Annual Research and Development Plan describes the progress of ongoing projects and the development of new projects. Individual projects identified within the Annual Research and Development Plan may be varied and updated annually as policy priorities and budgets dictate.

The Annual Research and Development Plan and Budget for a given financial year describes:

- The proposed Research Projects to be undertaken by the Institute in that year; and
- The proposed budget for each Research Project.

In addition, potential investment in research activity over the remaining term of the Goyder Institute will be identified. These figures are indicative only and are designed to support strategic investment in research projects that will deliver outcomes by 30 June 2015, which is the current expiry date of the initial term of the Goyder Institute Agreement.

1.3 Approved Research Projects

An Approved Research Project consists of a Project Plan and Budget Pack that has been signed by all participating Partners in the project and that has been endorsed by the Research Advisory Committee (RAC) and approved by the Management Board, which is documented in the form of a Project Agreement that has been signed by the Chairman of the Management Board.

During the execution of an approved project, changes and modifications to the Project Plan and Budget Pack may be submitted to the Director for consideration. The Director may approve minor modifications to Project Plans that do not significantly alter the proposed outcomes, and do not have significant financial consequences for the project. The Director may consult the RAC about these modifications. Major modifications to Project Plans that may involve financial consequences will be prepared in consultation with the Director and in consultation with the RAC. After endorsement of these modified Project Plans by the RAC, the Director will formulate recommendations for approval by the Management Board.

2 Current Research Investment

2.1 Summary of Current Investment

2.1.1 Climate Change Theme

Climate Change is a cross-cutting research theme to support the incorporation of climate adaption policy into the research outcomes from the Urban Water, Environmental Water and Water for Industry Research Themes. *Water for Good* includes future scenarios, based on the best understanding at the time, that there are expected to be increases in demand and possible reductions to water supply across the State and potential for greater climate variability and more extreme weather events.

South Australia has been a national leader in responding to climate change having established the *Climate Change and Greenhouse Emissions Reduction Act 2007* (the Act) which aims to promote action within South Australia that provides consistency with national and international schemes. Climate change continues to be a pressing international issue and has significant implications for the wellbeing of South Australians.

The research being conducted in the Goyder Institute Climate Change Theme is aimed at developing an agreed set of downscale climate projections for South Australia to support pro-active responses to climate change. This investment will provide detailed local scale information to inform climate adaptation planning and management at a regional and State level.

2.1.2 Urban Water Theme

Water for Good presents an outlook that water availability and reliability under a changing climate and population growth will put pressures on water use and reduce the availability of traditional water supplies. Planning for these future supply scenarios that have a level of uncertainty is complex and requires a flexible approach. To achieve a sustainable, secure, long-term water supply for South Australia *Water for Good* calls for strategies to diversify fit-for-purpose water supply options from traditional sources, such as the River Murray and the Mount Lofty Ranges reservoirs, by increasing stormwater-harvesting and wastewater reuse.

The Goyder Institute has commissioned research into Water Sensitive Urban Design (WSUD), the Optimal Water Resources Mix for Adelaide and a national project on Managed Aquifer Recharge and Stormwater Use Options (MARSUO). Allied projects under the Water for Industry Theme are researching the storage capacity, sustainable yield and salinity constraints of the Adelaide Plains groundwater resources; Adelaide-Mount Lofty Ranges water allocation planning to improve catchment surface water storage and run-off models and an improved understanding of the hydro-ecological response of catchment environmental assets. These complement and will contribute to the Urban Water Theme.

Water Sensitive Urban Design (WSUD)

While WSUD is acknowledged to provide a range of benefits including water conservation, flood control and water quality improvement there has only been limited uptake of WSUD by local governments. An evaluation of existing WSUD systems across South Australia identified adoption across local government was influenced by in-house capacity, expertise of consultants engaged in projects and by individual champions. The project has also indentified that there is limited WSUD uptake by private developers due to the lack of incentives and capacity for them to adopt such practices.

Further work is planned to provide tools and guidelines and an economic justification framework to enhance adoption of WSUD practices by local councils and developers.

Water Resources Mix for Adelaide

The Goyder Institute is supporting the achievement of the *Water for Good* aims through assessing potential uses of stormwater, analysis of water governance options in delivering a diversified water supply, understanding household water use and developing methods for determining trade-offs between the multiple objectives of water security, economic efficiency and environmental benefits of different water supply options.

To support management of stormwater reuse, the Goyder Institute research teams have evaluated in depth the quality of stormwater, the treatment requirements and risk management measures necessary to assure safe water quality for public open space irrigation, third pipe reticulation to homes and for drinking water supplies at Parafield in Salisbury, South Australia, as a case study. They also evaluated and compared the economics of these options at Parafield, accounting for basic assessments of environmental and social impacts. Studies of satellite sites in Australia and overseas were undertaken to compare stormwater quality and treatment requirements for potable use and allow interpretation of the relevance of results from Salisbury.

To facilitate ongoing interaction with key government stakeholders responsible for delivery of integrated urban water management in South Australia, a Stakeholder Reference Panel was established to provide a mechanism for ongoing dialogue between the Goyder Institute experts and government policy makers. This dialogue has enabled the best available science regarding integrated water resource management issues to be considered in assessing options to diversify fit-for-purpose water supplies and in forming policies in South Australia.

2.1.3 Water for Industry Theme

Investment in the Water for Industry research programme by the Goyder Institute is providing an evidence base to support and promote equitable water sharing in multi-use catchments and in remote regions of the State. The objective is to develop sustainable water management practices for communities and industries (e.g. food, wine, forestry and mining) that are heavily reliant on safe and secure water supplies. In particular, the Goyder Institute is supporting Government in its initiative '*Finding Long-term Outback Water Solutions'* (FLOWS) and improving the understanding of the hydrology and environmental water requirements of key catchments to inform water allocation planning.

Water Allocation Planning (WAP) and Water Quality Improvement

The Mount Lofty Ranges and metropolitan Adelaide region encompasses one of the major water resource areas in South Australia. This highly inter-connected hydrologic system encompasses the multi-use catchments in the western MLR with the Adelaide Plains surface water and stormwater systems and the Adelaide coastal waters through discharges. The surface water and stormwater systems are now strongly connected to the Adelaide Plains groundwater systems through managed aquifer storage and recovery of treated stormwater. Water allocation plans have been adopted for the eastern MLR catchments draining to the River Murray system and the western MLR. A plan is being developed for the Adelaide Plains groundwater systems, which is used for industrial purposes, horticulture irrigation, irrigation in the urbanised areas with managed aquifer recharge and potentially for human needs as an emergency water supply.

The Goyder Institute research programme is focusing on a number of critical elements of the interrelated Adelaide-MLR hydrologic system to address specific issues relating water allocation planning. Specific activities include improving surface water modelling capability, developing a consistent framework to specify eco-hydrological responses for the determination of environmental water provisions, catchment water quality assessment, managing the risks of algal bloom outbreaks in the Torrens Lake and quantifying the capacity of the Adelaide Plains groundwater system to store large volumes of water.

In addition, the Salinity and Recycled Water for Irrigation project is undertaking detailed investigations regarding the opportunities to use recycled water for irrigation as part of a national project to expand the water source options for agricultural industry. The outcomes of this research will provide an evidence base to achieve water security objectives for peri-urban agricultural activities, as well as potential additional benefits related to reducing the impacts of wastewater discharges to the Adelaide coastal waters.

Mining and Outback Water

The outback of South Australia is an important ecological, social and economic asset for the State and the regional communities, industry and the environment depend upon the outback groundwater resources and the dryland rivers for survival. To ensure sustainability of these systems for all users, the Goyder Institute has invested in programmes to understand the groundwater resources of outback South Australia and the hydro-ecology of the iconic Lake Eyre Basin.

The Department of Environment, Water and Natural Resources (DEWNR) has developed an initiative called '*Finding Long-term Outback Water Solutions'* or the FLOWS Initiative, which is supported by the Department of State Development. The Goyder Institute is addressing the research and development component of the FLOWS Initiative under a staged G-FLOWS program. The research has developed methodologies to interpret airborne geophysics to locate and better define new groundwater sources. The G FLOWS program is contributing to the State's strategic priority '*Realising the Benefits of the Mining Boom for All South* Australians' by providing new knowledge on groundwater resources. This work will also assist in the development of water supplies for remote Far North communities under Action 66 in *Water for Good* by identifying alternate groundwater sources to improve water supply security.

The rivers in the Lake Eyre Basin (LEB) are generally considered to be in relatively good condition, and are amongst the last unregulated, dryland river systems in the world. The arid rivers of the LEB are home to a 'boom-and-bust' ecology adapted to enormously variable flow conditions. This variability makes it very difficult to pick up trends in resource condition and our knowledge of the ecology of these arid rivers and their catchments is limited and not uniform across the LEB.

The Goyder Institute is investing in research that will provide a platform for delivering targeted and highly applied evidence based science to progress the application of natural resource management evaluation in the LEB. An improved understanding of the water resources of the LEB, including its hydrology and groundwater dependant ecosystems, is needed to develop and implement sustainable water resource plans. This initiative will provide a significant boost to the management and protection of a highly significant and vulnerable desert drainage system that is recognised on a global scale.

2.1.4 Environmental Water Theme

The Environmental Water theme is concentrating on developing a detailed understanding of the ecosystems of our major water resources like the River Murray and the groundwater-fed system of wetlands in the South-East of South Australia. These systems contain several Ramsar wetlands of international importance, which require a robust integrated management approach to maintain the environmental values of these regions while also achieving social and economic outcomes.

River Murray

The Goyder Institute brought together the expertise from each of its partner organisations to provide scientific expert analysis and review of the Guide to the Murray Darling Basin Plan, an independent expert analysis on the ecological consequences for South Australia of the proposed Basin Plan and a peer review of the State Governments' scientists' analysis of the ecological implications, risks and consequences of the draft Basin Plan. The partnership model of the Goyder Institute brought together experts from across its research partners to provide independent and expert scientific analysis of the modelling that underpinned the analysis of flow scenarios to achieve environmental water requirements in preparing the Basin Plan. This advice was delivered to the South Australian government and formed a key element of the South Australian Government's response to the Basin Plan that ultimately secured a return of up to 3200 GL of water to the environment and to remove constraints that impede delivery of that water.

The Goyder Institute research teams are now providing science advice regarding key implementation aspects of the Basin Plan. This includes development of River Channel Environmental Water Requirements, assessing the risk and management interventions regarding riverbank collapse in the lower River Murray, modelling floodplain salt dynamics, developing a monitoring strategy to evaluate the effectiveness of environmental watering actions and evaluating the operations of environmental infrastructure on SA floodplains.

Surface Water, Groundwater, Wetland Relationships

The surface water and groundwater systems of the South East are highly interconnected. The Goyder Institute surface water, groundwater, wetlands program is supporting the local water resource managers to manage the water resources of the South East as a holistic system recognising the interconnection between surface water, groundwater and wetlands to maximise the environmental, economic and social benefits of the regional water resources.

Initial investigations in the South East developed a preliminary cross-border hydrostratigraphic model for the study area, including reconstruction of land use data as a basis to develop historical recharge rates. A regional water balance model of the Tertiary Limestone Unconfined Aquifer and the Tertiary Confined Sands Aquifer is now being developed based on the initial foundation work that will also include an assessment of the connectivity between surface water, groundwater and wetlands and the environmental water requirements of these wetlands.

Other research is supporting the management of wetlands and drains in the region through evaluating the water quality risks, such as nutrients and alkalinity, and development of a software tool to better estimate flow volumes in key drains of the South East (such as Drain M) in order to support decisions about optimisation of environmental water requirements for a number of regional environmental assets. The model will underpin water allocation planning for the Lower Limestone Coast.

2.2 Project Overview 2013/14

A summary of the Goyder Institute projects by Roadmap up to the end of the 2013/14 financial year are identified in the table below. The projects listed are at various stages from newly approved through to complete. This status is based on that at 30 June 2014. Additional information on each of the projects is provided in the following sections of this report.

Theme	Roadmap	Project Number	Project Title	Status
Climate Change				
C.1 Regional downscaling		C.1.1	Downscaled Climate Projections for SA	Active
Environmental Water				
E.1 River Murray		E.1.1	MDB Review	Completed
		E.1.2	Murray Flood Ecology Urgent	Completed
		E.1.3	Murray Flood Ecology	Completed
		E.1.4	Expert Panel MDB draft Plan	Completed
		E.1.5	River Murray Scoping	Completed
		E.1.6	Peer review	Completed
		E.1.7	River Murray Program	Active
		E.1.8	Riverbank Collapse	Active
		E.1.9	River Murray Channel EWRs	Completed
		E.1.10	SDL Adjustment Technical Panel	Completed
		E.1.11	Modelling Floodplain Salt Dynamics	Active
		E.1.12	Operating Environmental Infrastructure on SA Floodplains	Active
		E.1.13	Monitoring Strategy for Environmental Water	Active
E.2 Surface water, groundwater, wetland relationships		E.2.1	South East Urgent	Completed
		E.2.2	South East Phase 1	Completed
		E.2.3	South East Regional Water Balance	Completed
		E.2.4	Improved modelling of catchments and drains	Active
		E.2.5	Water Requirements of Wetlands	Active
		E.2.6	SE Regional Water Balance Phase 2	Active
		E.2.7	SE Risks	Active
Water for Industry				
I.1 Water allocation planning & water quality improvement		I.1.1	AMLR WAP Scoping	Completed
		I.1.2	Torrens River Water Quality Improvement Trial	Completed
		I.1.3	Salinity Management of Irrigating with Recycled Water	Active
		I.1.4	AMLR WAP Program	Active
		I.1.5	Torrens Dilution Trial 2	Completed
		I.1.6	Adelaide Plains Groundwater Study	Active
I.2 Mining & outback water		I.2.1	G-FLOWS	Completed
		I.2.2	G-FLOWS 2 –Northern Eyre Peninsula	Active
		I.2.3	Lake Eyre Basin Eco-Hydrological Indicators	Active
		I.2.4	Outback Water Supplies	In Prep
Urban Water				
U.1 Water sensitive urban design		U.1.1	WSUD Targets	Completed
		U.1.2	WSUD Impediments and Opportunities	Active
U.2 Water resources mix for Adelaide		U.2.1	MARSUO	Active
		U.2.2	Optimal Water Mix for Adelaide	Active
		U.2.3	Governance for the Urban Water Blueprint	Active

Details of each of these research projects are provided at **Appendix 3**.

2.3 Actual Project Expenditure to end of FY 2013/14

A detailed description of Goyder Institute expenditure in FY 2013/14 can be found in the 2013/14 Finance Report. A summary of the expenditure (cash + in-kind) in active projects up until the end of FY 2013/14 is given below.

Goyder Institute
Budget Expenditure from 2010/11 through 2013/14 and Total Approved Budget and Expenditure over lifetime of the Institute

		Expenditure					Cash				
		Financial Years 10/11 - 13/14			Total Approved		Financial Years 10/11 - 13/14			Total Approved	
		Budget	Actual	Actual %	Budget	Actual %	Budget	Actual	% Actual	Budget	Actual %
Research Projects	CSIRO	14,617,494	14,487,629	99%	17,311,833	84%	6,875,884	6,947,078	101%	8,485,778	82%
Research Projects	Flinders	3,915,683	2,674,670	68%	5,893,931	45%	1,634,971	1,720,755	105%	2,887,710	60%
Research Projects	Uni of Adelaide	6,291,879	5,430,481	86%	7,798,410	70%	2,674,362	2,718,185	102%	3,765,178	72%
Research Projects	Uni of SA	3,222,097	3,215,741	100%	3,480,896	92%	1,218,591	1,214,990	100%	1,637,286	74%
Research Projects	SARDI	3,696,221	2,986,251	81%	4,845,915	62%	1,755,769	1,750,541	100%	2,402,090	73%
Research Projects	SA Water	503,220	388,836	77%	537,047	72%	227,623	201,642	89%	273,094	74%
Research Projects Total		32,246,594	29,183,608	91%	39,868,031	73%	14,387,201	14,553,191	101%	19,451,136	75%
Research Adoption	PhD Stipend TopUps	690,000	670,000	97%	780,000	86%	690,000	670,000	97%	780,000	86%
Research Adoption	ANZSOG	330,000	329,635	100%	700,000	47%	165,000	164,818	100%	350,000	47%
Research Adoption	Knowledge Management	223,832	201,985	90%	400,000	50%	223,832	201,985	90%	400,000	50%
Research Adoption	PhD Cont - Goyder Office	1,415,802	1,366,402	97%	1,933,914	71%	-	-		-	
Research Adoption Total		2,659,634	2,568,023	97%	3,813,914	67%	1,078,832	1,036,803	96%	1,530,000	68%
Admin	Institute Office	3,077,254	3,051,277	99%	4,007,231	76%	1,789,612	1,772,847	99%	2,380,572	74%
Goyder Institute Total		37,983,483	34,800,579	92%	47,689,176	73%	17,255,645	17,378,854	101%	23,361,708	74%

			Expenditure				Cash				
			Financial Years 10/11 - 13/14			Total Approved	Financial Years 10/11 - 12/14			Total Approved	
Research Theme		**Roadmap**	Budget	Actual	Actual %	Budget	Actual %	Budget	Actual	% Actual	Budget	Actual %
Climate Change	C.1	Regional Downscaling	6,963,075	6,979,970	100%	7,073,659	99%	2,633,785	2,721,039	103%	3,411,876	80%
Environmental Water	E.1	River Murray	4,226,131	3,937,446	93%	5,547,308	71%	1,855,455	1,866,292	101%	2,108,695	89%
Environmental Water	E.2	Surface water, groundwater, wetland relationship	3,524,794	2,991,792	85%	5,235,756	57%	1,095,091	1,257,088	115%	1,420,378	89%
Water for Industry	I.1	Water allocation planning & water quality improvement	5,663,104	4,135,889	73%	8,059,019	51%	2,783,776	2,975,057	107%	3,987,509	75%
Water for Industry	I.2	Mining & outback water	4,511,074	3,882,396	86%	6,242,429	62%	1,803,188	1,984,236	110%	2,533,495	78%
Urban Water	U.1	Water sensitive urban design	1,812,951	1,786,135	99%	1,830,329	98%	780,511	752,175	96%	902,834	83%
Urban Water	U.2	Water resources mix for Adelaide	5,545,465	5,467,651	99%	5,879,531	93%	2,690,874	2,310,494	86%	2,810,126	82%
Total Research Projects			32,246,594	29,181,279	90%	39,868,031	73%	13,642,680	13,866,381	102%	17,174,913	81%

This table indicates that the expenditure on research is on target for most projects. The slight underspend in FY 2013/14 was primarily due to some delays in sign-off and start-up for a number of projects.

The budgeted and actual expenditures for each individual active project are given in detail in Table A1 in **Appendix 1**.

3 Future Research Investment

3.1 Proposed Investment Profile

Based on the outcomes of prioritisation workshops held with stakeholders and research providers, as well as discussions with the Management Board and the RAC, a proposed investment profile for all of the remaining research funds was discussed and endorsed at the RAC meeting of 12 May 2014 and the Management Board meeting of 20 May 2014.

Table 3.1 shows the current and proposed future investments per roadmap for the lifetime of the Goyder Institute. It indicates which new areas of investment are most likely to be related to short-term, targeted R&D advice projects and which areas are dedicated to medium to long-term strategic research. In all cases, the proposed level of investment is based upon a realistic estimate of the desired outcomes that would be achievable for the available finance and within the remaining timeframe of the initial term of the Goyder Institute (until June 2015). The prioritisation of areas of investment for the remaining research funding is also related to the desired investment across the research themes as described in Section 3.2.

A brief discussion of the proposed future priority areas per roadmap related to desired policy outcomes is given in Section 3.2. This year, more specific descriptions of the investment area has been considered due to the timeframes remaining of the initial term of the Institute and a greater level of direction was sought to give confidence that the right projects were being developed given the timeframes available. These directions were developed in joint consultation with research and policy staff and were agreed given the following criteria:

- Significance and innovation,
- expertise,
- value for money
- impact and capacity building
- industry participation
- project management
- delivery of the project by June 2015
- whether the proposed project concept builds on existing Institute investment

The budgets given in Table 3.1 provide an indication only of the potential maximum level of funding available for these activities, based on the remaining funding available. Any under-expenditure identified across the whole-of-Institute's program will be reallocated to the Research program as soon as practicable and will be consistent with the intent and purpose of the Institute.

At the RAC meeting of 12 May 2014 and the Management Board meeting of 20 May 2014, five areas for future work were endorsed. Proposals to develop project plans for the five areas endorsed will be invited from appropriate research teams amongst the Goyder Institute partners. Proposals will be developed in close consultation between the RAC, DEWNR and other government agencies to reach agreement on concise and realistic research outcomes and products. Final project plans and budgets will be endorsed by the RAC before being submitted to the Management Board for approval.

The overall investment profile of the Goyder Institute for the lifetime of the Institute is given in Table A2 in Appendix 2. This table also shows the total budgets (cash plus in-kind) for Research Projects, Research Adoption and Dissemination Activities, and the Admin Expenditure for the lifetime of the Goyder Institute until June 2015.

Table 3.1 Current and future investments per roadmap

	Approved Budget (cash and in-kind)	2014/15 Budget	2014/15 Endorsed Investment	TOTALS
C.1.1 Climate Change	7,073,659	110,584		
	7,073,659	110,584	0	7,184,243
E.1.1 MDB Review	477,783	0		
E.1.2 Murray Flood Ecology Urgent	41,927	0		
E.1.3 Murray Flood Ecology	1,527,329	0		
E.1.4 Expert Panel MDB Plan Review	160,759	0		
E.1.5 Scoping River Murray Catchment	210,142	0		
E.1.6 Peer Review MDB Plan	58,679	0		
E.1.7 Ewater Requirements SA MDB	286,756	39,153		
E.1.8 Riverbank Collapse	989,523	248,668		
E.1.9 River Murray Channel Env. Water Req.	389,054	0		
E.1.10 SDL Adjustment Technical Panel	100,459	0		
E.1.11 Floodplain Salinity Modelling	843,000	683,605		
E.1.12 Chowilla Operations	395,296	290,030		
E.1.13 RM Strategic Monitoring	66,601	59,720		
E.1.14 River Murray Operational DSS			500,000	
E.1.15 Chowilla Fish Monitoring			350,000	
E.1.16 Targetted Policy Advice			500,000	
	5,547,308	1,321,176	1,350,000	6,897,308
E.2.1 SE Urgent	93,127	0		
E.2.2 South East – Phase 1	542,435	0		
E.2.3 SE Regional Water Balance	865,326	0		
E.2.4 Improved modelling of catchments & drains	382,258	44,684		
E.2.5 Wetlands in SE	1,096,629	287,419		
E.2.6 SE Regional Water Balance Phase 2	1,580,852	898,822		
E.2.7 SE Water Quality Risks	675,128	480,037		
	5,235,755	1,710,962	0	5,235,755
I.1.1 Scoping AMLR Water Allocation Planning	264,238	0		
I.1.2 Torrens Lake Amenity Flows	406,383	0		
I.1.3 Salinity & Recycled Water	329,222	62,039		
1.1.4 AMLR WAP proposed research	3,794,951	1,416,993		
I.1.5 Torrens Lake Amenity Flows (2nd trial)	264,257	0		
I.1.6 Adelaide Plains Groundwater Assessment	2,999,968	916,883		
I.1.7 WQ Modelling in the MLR			460,000	
	8,059,019	2,395,915	460,000	8,519,019
I.2.1 G-FLOWS - Stage 1	3,247,286	0		
I.2.2 G-Flows - Stage 2	1,995,571	997,346		
I.2.3 Lake Eyre Basin	999,572	734,008		
I.2.4 Outback Water Supplies			80,000	
I.2.5 Clare Valley Water Supply Options			150,000	
	6,242,429	1,731,354	230,000	6,472,429
U.1.1 WSUD Targets	308,809	0		
U.1.2 WSUD Impediments & opportunities	1,521,521	17,378		
U.1.3 WSUD contributions to the urban water blueprint			230,000	
	1,830,330	17,378	230,000	2,060,330
U.2.1 MAR & Stormwater Use Options	2,313,663	103,803		
U.2.2 Optimal Water Mix	3,062,955			
U.2.3 Governance of Water	502,914	230,264		
U.2.x Urban Water Blueprint & other urban issues			1,006,585	
	5,879,532	334,067	1,006,585	6,886,117
PhD Supplements	780,000	90,000		
	780,000	90,000	0	780,000
	40,648,031	**7,711,436**	**3,276,585**	**44,035,200**

3.2 Priority policy areas for research investment in 2014/15

Research investment planned for the fifth year of the Institute has been targeted towards those short, targeted pieces of work that will add value to the previous investments made through the Goyder Institute. A summary of the proposed investment areas per Research Theme are provided below.

3.2.1 Environmental Water

Research investment will focus on work to support the development of a Decision Support System (DSS) for operations of the Murray River to enable real time decisions to manage inflows into SA to meet the various flow and storage objectives for irrigation, urban water supplies, environmental and recreational purposes. The River Operation DSS will provide an overall framework to which additional targeted studies can contribute.

To support operational management of environmental water, investigations to evaluate the effectiveness of risk mitigation measures and ecological response assumptions, with a focus on water quality and fish populations, will be undertaken during early operations of the Chowilla Environmental Regulator. This research activity will enable validation and calibration of the models used in the development of the operations regimes and the risk management approaches before and after commissioning of the infrastructure and will then provide advice regarding operations of other regulators on the river and contribute to the underlying knowledge base being built into the River Murray DSS.

3.2.2 Water for Industry

There is significant investment under this research theme targeted toward quantifying outback and Adelaide plains groundwater resources, assessment indicators for the Lake Eyre Basin Rivers, water allocation planning and water quality aspects of water management. To build on this existing investment base it is proposed that further investigations focus on water quality elements of the Mount Lofty Ranges water allocation planning project and innovative solutions to support water management in the Clare Valley.

More specifically, the Mount Lofty Ranges water quality project (I.1.4. GWAP) will seek to include water quality modelling into the current project by:

1. Review existing models;
2. Develop approaches to undertake water quality modelling; and
3. Conduct scenario modelling using the recommended approaches.

These elements will complement the tiered water quality risk assessment being conducted in the GWAP project (Project I.1.4).

The Clare Valley Water Supply project is seeking to test new approaches and partnerships to undertake Goyder Institute research. An initial literature review collating existing water resource information has been undertaken. This information will form the basis of any short, targeted, proof of concept projects to identify alternative water technology solutions or innovative business model approaches that achieve improved water management operations.

3.2.3 Urban Water (U2)

Future investments in the roadmaps associated with the Urban Water theme will be closely aligned with the requirements of the newly released strategy regarding WSUD and those being developed relating to integrated water management in urban environments.

Four targeted investigations are proposed:

- *Water Sensitive Urban Design*
  This project will develop a framework for local councils to include WSUD into Catchment Stormwater Management Plans. This will be done by developing a framework for economic justification and provide information on maintenance and management models for developers.

- *Optimal Water resources Mix – Model Enhancement*
  The science support to the Urban Water Blueprint requires further scoping based on the outcomes of the Optimal Water Resources Mix project and clarification regarding the use and application of the Source Model and material benefits of enhancements to informing policy development. There may be opportunity to also assess the benefits of stormwater interventions in the metropolitan area on coastal water quality.

- *Stormwater Interventions – proof of concept*
  Development of a preliminary modelling capability for identifying catchment scale stormwater intervention measures that have the potential to reduce sediments at known coastal hotspots. The proposed work will involve sediment generation and transportation processes associated with a selected set of stormwater intervention measures to the Source Model developed as part of the Optimal Water Resources Mix project (U.2.2) and couple it with SA Water's biogeochemical model and the outputs of the WSUD project (U.1.2) where applicable.

- *Urban Water Knowledge Adoption*
  Delivering targeted communications and science advice activities that link the science outputs from the Goyder Urban Water Investments into formats relevant for policy development and decision making.

3.3 Investment across Research Themes

The selection of future research projects must also take into account the desired mix of research investment across the strategic research themes of the Institute as determined by the Goyder Institute Management Board. The following table provides an indication of the distribution of research funding across the Themes based on the proposed investments indicated in Table 3.1. In the last column, the proposed investment across research themes is compared to the desired level of investment that was identified in the 2013/14 R&D Plan and Budget, which was based on the SA Government priority directions.

THEME	Approved Budget	Future research	TOTAL	%	2013/14 R&D Plan
Climate Change	7,073,659	0	7,073,659	15.9%	16.1%
Environmental Water	10,783,063	1,350,000	12,133,063	27.1%	27.5%
Water for Industry	14,381,447	610,000	14,991,447	33.3%	33.6%
Urban Water	7,709,862	1,198,766	8,908,628	19.9%	20.9%
PhD Supplements	780,000	0	780,000	1.8%	1.9%
	40,728,031	**3,158,766**	43,886,797	**98.0%**	

3.4 Portfolio mix of projects

In general, a Goyder Institute project can be considered to comprise a number of related activities that can be classified in terms of the "policy-readiness" of the research; ranging from a clear and immediate uptake pathway to less clear and protracted uptake. For ease of classification, we can define the following types of research activities:

- short-term targeted *R&D advice* activities with clear and immediate uptake in policy & management (e.g. 6 month – 12 month path to uptake);
- longer-term *applied* research activities. Demand-driven with clearly defined outcomes, but with less clear and protracted uptake (e.g. 1 – 3 year path to uptake);
- *fundamental* and enabling research activities. PhD-style research of fundamental principles aimed at supporting applied research outcomes, but not directly related to uptake. (e.g. 3 – 4 year path to uptake).

Each project may contain a different mix of each of the above types of project activities.

Table 4.4 provides the results of an analysis of the current and proposed 2014/15 projects in terms of their mix of project activities.

Table 4.4 Portfolio mix of projects

THEME	Fundamental	Applied	R&D advice
C1 - Climate Change	30%	50%	20%
E1 - River Murray	19%	45%	36%
E2 - SW/GW & Wetlands	19%	71%	9%
I1 - WAP & WQ Improve	18%	55%	28%
I2 - Mining & Outback	20%	63%	17%
U1 - WSUD	5%	51%	43%
U2 - Water Res Mix	14%	54%	32%
PhD Supplements	100%	0%	0%
OVERALL	**21%**	**55%**	**24%**

On balance, the mix per roadmap is appropriate to support the strategic intent of the Goyder Institute for Water Research, which is primarily to provide excellent science to underpin policy.

4 Adoption and Dissemination

4.1 Knowledge Management and Dissemination

At this stage of the life cycle of the Institute a greater focus is being applied to the translation, adoption processes and transfer of knowledge within partner organisations, decision makers and other relevant stakeholders. There are a number of events and activities in the pipeline that are designed to showcase the outcomes of the Institute's research programme. These activities include:

- A monthly PhD forum that provides an opportunity for the Goyder Institute PhD Supplement holders to present the findings of their research to all stakeholders of the Institute. These presentations will be streamed live to enable those interested from regional locations to listen to the presentations.
- Sponsoring a Water Research Exhibition at the 2014 Science Alive event that includes the Goyder Institute research, SA Water, DEWNR, SARDI, NCGRT and the Salisbury Council.
- An event during National Water Week, which has a theme of Water Sources: There are more than you think, focussing on the Urban Water research activities of the Institute.
- The 2014 Water Forum will be held in December over two days
- Sponsorship of the National Rangelands Conference in Alice Springs in April 2015. Sponsorship will be for a stream within the conference focussed on the outcomes of the Institute's Lake Eyre Basin project (I.2.3)

With a powerful knowledge base coming to fruition, a focus of the Institute is to ensure that the research outcomes are appropriately communicated to relevant stakeholders, with more focussed adoption activities undertaken to ensure that the Goyder Institute science is available in an accessible and meaningful format. Availability of this expert science, in a format relevant for decision makers, will help ensure that the expert science created by the Institute is embedded in partner organisations and other stakeholders that could benefit from the outcomes of this research investment.

An important part of the knowledge management strategy of the Goyder Institute is the development of a common framework for data management. A set of consistent processes to ensure research data arising from Goyder Institute funded projects is well described and discoverable through Research Data Australia (RDA) has been developed with the Australian National Data Service (ANDS) and is being implemented for all project before project completion is signed-off by the Director. The ANDS support will help ensure that the data collected from the Institute's research program continues to be available beyond the life of the Institute.

4.2 ANZSOG Appointment

In 2010, as part of the negotiations to create the Goyder Institute for Water Research Agreement (the Agreement), it was agreed that the Goyder Institute would make a cash contribution to co-fund the ANZSOG and Goyder Institute Chair of Public Policy and Management. The position was advertised without success in 2010 – 2011.

In 2012, Flinders University, the Australia and New Zealand School of Government (ANZSOG) and the Goyder Institute for Water Research agreed to reformulate the position as a series of short-term (3 to 6 month) Visiting Professorships. This approach was endorsed by the Goyder Institute Management Board on 28 September 2012 and a final proposal was accepted by the Management Board on 27 November 2012.

Flinders University has estimated the total cost for the revised Program as $700,000.
This will be funded as follows:

Flinders University	$300,000	cash and in-kind
ANZSOG	$50,000	cash
Goyder Institute	$350,000	cash
TOTAL	**$700,000**	

The following Professors have participated in the ANZSOG program.

Professor Steve Rayner

Professor Steve Rayner, James Martin Professor of Science and Civilization, Oxford University, was the first ANZSOG – Goyder Institute Visiting Professor during the period 1 November 2013 to 28 February 2014. Prof Rayner was involved in a number of events, such as the Goyder Institute Climate Change project workshop and the DEWNR Climate Adaption Showcase.

Through the Visiting Professor program, Professor Rayner collected data for a South Australia case study to contribute to a larger project of the Oxford Martin School of Oxford University on the use and usability of weather and climate information in resource management.

The aim of this interdisciplinary project is to address how and why scientific information is (or is not) used in decision making for the management of natural hazards and resources. In particular, it focuses on understanding the role of weather and climate information in the current practices of water-resource management. It seeks to identify factors that promote, enable or constrain the successful use of data and forecasts, and the extent to which forecast information quality and/or institutional practices of decision makers contribute to these forecasts being used or not used. In addition to South Australia, case studies are being conducted or are planned, in the Columbia River Basin of the US Pacific Northwest, the UK's Thames Valley, Belize, Kenya, and India's Ganges Basin.

For the South Australian case study, interviews were conducted with a diverse cross section of about 100 individuals, mostly in South Australia, but some in Melbourne and Canberra that included a diverse range of organisations including:

- Weather, climate and streamflow modelers/forecasters (BoM, MDBA, CSIRO, UniSA, U Canberra)
- State and Commonwealth river operators (DEWNR, MDBA)
- Environmental water managers (CEWH, DEWNR)
- Water quality managers and regulators (DEWNR, EPA)
- Water allocation planners (DEWNR, NRM Boards)
- Municipal water suppliers (SA Water, Allwater)
- Waste and stormwater managers (Allwater, Cities of Onkaparinga and Salisbury, DEWNR)
- Emergency services (CFS, SES)
- Irrigators (Infrastructure operators, grape, stone-fruit and almond producers)
- Indigenous peoples (Ngarrindjeri)
- Water traders (Waterfind)
- Environmental scientists (Goyder Institute, SARDI, CSIRO, FUSA, UniSA)
- Economists (UniSA, ANU)

A full report on the case study and integration into the international study will be available late in 2014.

Professor Bruce Mitchell

Professor Bruce Mitchell, Professor of Geography and Environmental Management, the University of Waterloo, was the second Visiting Professor during the period 27 January 2014 to 11 May 2014. His research specialization is the governance and policy aspects of water management, and integrated resource and environmental management.

Prof Mitchell's investigation focused on assessing the evolution of increasingly integrated approaches to water and natural resources management in South Australia between the early 1990s and 2014. Three basic approaches to integration were examined: (1) Ministerial Water Resources Advisory Committees, (2) Catchment Water Management Boards, and (3) Natural Resources Management Boards, as well as their related plans programs and initiatives.

A review was conducted of key statutes, terms of reference of the committees and boards, plans, regulations and examples of specific initiatives. In addition, 88 interviews were conducted with

stakeholders, ranging from politicians, SA public service staff, members of Catchment Water Management and Natural Resources Management Boards, as well as individuals and representatives of groups related to agriculture and conservation.

A final report and series of journal publications are being prepared and are anticipated to be available late 2014.

Professor Barbara Cosens

The next confirmed Visiting Professor is Prof Barbara Cosens from the University of Idaho, College of Law, who is due to commence in April 2015 for approximately 3-4 months. Prof Cosens has an interest and expertise in water law with particular interest in governance and use of science in decision making concerning water resources and co-chairs a project aimed at developing models for translating adaptive governance into administrative law using North American river basins to vet and tailor models. There is potential to apply these models in the context of an Australian river basin as part of the Visiting Professor Program.

4.3 PhD Supplements

The Goyder Institute for Water Research awards PhD Supplements to outstanding PhD candidates from each of the University partners. Each PhD Supplement is valued at $10,000/pa for three years. Eight supplements commenced in 2011, nine supplements in 2012 and eight supplements in 2013. No supplements were offered in 2014.

PhD Students	Title	Road Map	Status of Candidature
ADELAIDE UNIVERSITY			
Chris Stokes	Methods for the reduction of greenhouse gas emissions associated with water distribution systems	U2 Water Mix	Enrolled to 02/2014
Eva BEH	Optimal sequencing of water supply options at the regional scale incorporating sustainability and uncertainty	U2 Water Mix	Enrolled to 08/2014
Michael Di Matteo	Multi-objective decision analysis for blending of urban water resources for potable and non-potable water supply	U2 Water Mix	Enrolled to 08/2015
Deborah Furst	The Chowilla Floodplain: The influence of water regime on the development and transport of zooplankton and the implications for native fish	E1 Murray	Postdoc Fellow at Adelaide Uni, involved in Goyder Institute projects
Chaturangi Wickramaratne	Synergistic effects of nutrients and climate change on cyanobacteria	I.1 WAP&WQ	Enrolled to 03/2015
Kayla Gilmore	Hypoxia in the Murray River region: identifying impacts to fish and tracking long-term trends	E1 Murray	Enrolled to 07/2016
Sanjina Upadhyay	Flow and nutritional resources: does DOC or phytoplankton productivity drive food webs in the Lower River Murray?	E1 Murray	Enrolled to 02/2016

FLINDERS UNIVERSITY			
Jessica Liggett	An analysis of surface-subsurface exchange and solute transport processes in a fully integrated code	E2 Wetlands	Hydrogeologist at Alberta Geological Survey, Canada
Saskia Noorduijn	Quantifying surface water-groundwater fluxes in a heterogeneous environment	E2 Wetlands	Postdoc Fellow, University of Calgary, Canada
Megan Sebben	Numerical modelling of ephemeral, transient wetland systems using a fully integrated code	E2 Wetlands	enrolled to 09/2015
Kelly Wiltshire	Connection and Continuity - Investigating Ngarrindjeri history and life ways of Waltowa Wetland	E1 Murray	enrolled to 02/2014
Harriet Whiley	Detection of opportunistic intracellular pathogens in potable and reuse water	U2 Water Mix	Enrolled to 09/2014
Matthew Knowling	Effect of climate change and groundwater management approaches on the Uley South Basin, Eyre Peninsula	I2 Outback	enrolled to 08/2015
Robert Andrew	Natural and managed hydrological changes and the implications for urban planning and water management	U1 WSUD	enrolled to 02/2016
Saeedeh Gharib	Land surface and atmosphere interactions in selected environments with emphasis on the temperature effects	C1 Climate	enrolled to 08/2015
UNIVERSITY OF SOUTH AUSTRALIA			
Mostafa Razzaghmanesh	Climate change and stormwater quality effects from green roof design in Adelaide	U1 WSUD	Enrolled to 10/2014
Sina Alaghmand	A conceptual model to capture salinity risks from the River Murray floodplains	E1 Murray	Lecturer, Monash University based in KL, Malaysia
Sithara Gamage	Probabilistic nature of hydrologic losses in South Australian forest catchments	E2 Wetlands	Enrolled to 09/2014
Hamideh Nouri	Precision Irrigation of the Adelaide Parklands with Recycled Wastewater	U1 WSUD	Enrolled to 12/2013
Kelly Hill	Development of low-clogging permeable pavements suitable for harvesting and reusing stormwater runoff from roads, car parks and industrial areas.	U1 WSUD	Enrolled to 04/2015
Mamunur Rashid	Assessment of climate change impacts on the spatial variability of rainfall and its influence on runoff generation	C1 Climate	Enrolled to 02/2015
Alaa Ahmed	Hydrogeology of fractured rock aquifers in the Central Flinders Ranges, SA	I2 Outback	Enrolled to 12/2015
Niranjani Semananda	Experimental investigation into performance of capillary subsurface irrigation of container gardens using recycled water	U1 WSUD	Enrolled to 10/2016
Shiv Umapathi	Integrated water consumption characteristics through real-time monitoring and ongoing community engagement at a new development that is representative of future residential living	U1 WSUD	Enrolled to 12/2015
Jonathan Cohen	Impacts of catchment conditions, climate and seasonality on water quality	I.1 WAP&WQ	Enrolled to 03/2016

A.1 Financial report to 30 June 2014: Annual Budget 2014/15

Goyder Institute Annual Research and Development Plan
Annual Budget

		Participant	Goyder Institute Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Cash Total	In-Kind Total	In-Kind to Goyder	Participant Interest
Research Projects		CSIRO	1,495,999	3,307,311	4,962,012	4,852,172	2,694,338	17,311,833	8,485,778	8,846,401	104%	50%
Research Projects		Flinders	184,459	382,082	453,055	2,896,088	1,978,248	5,893,931	2,887,710	3,013,902	104%	17%
Research Projects		Uni of Adelaide	225,628	1,121,261	2,135,849	2,809,142	1,506,530	7,798,410	3,765,178	4,105,199	109%	23%
Research Projects		Uni of SA	265,701	762,850	1,037,939	1,155,607	258,799	3,480,896	1,637,286	1,936,059	118%	10%
Research Partners		Sub Total	2,171,787	5,573,503	8,588,855	11,713,008	6,437,916	34,485,070	16,775,951	17,901,562	107%	100%
Research Projects		SARDI	445,925	594,786	866,121	1,789,389	1,149,694	4,845,915	2,402,090	2,457,678	102%	
Research Projects		AWQC	6,588	20,208	283,519	192,906	33,827	537,047	273,094	263,953	97%	
Research Projects Total		**Total**	**2,624,299**	**6,188,498**	**9,738,495**	**13,695,303**	**7,621,437**	**39,868,031**	**19,451,136**	**20,623,193**	**106%**	
Research Adoption	PhD Stipend TopUps	Total	-	240,000	255,000	175,000	90,000	780,000	780,000	-	-	
Research Adoption	ANZSOG	Flinders			-	330,000	370,000	700,000	350,000	350,000	100%	
Research Adoption	Knowledge Management			28,566	95,266	100,000	176,168	400,000	400,000		-	
Research Adoption	PhD Contributions - Goyder Office	Total	85,862	319,188	469,835	540,917	518,112	1,933,914	-	1,933,914	-	
Research Adoption Total		**Total**	**85,862**	**587,754**	**820,102**	**1,165,917**	**1,154,279**	**3,813,914**	**1,530,000**	**2,283,914**	**149%**	
Admin	**Goyder Office**	**Total**	**444,616**	**867,176**	**865,916**	**899,545**	**929,977**	**4,007,231**	**2,380,572**	**1,626,659**	**68%**	
Goyder Institute Total		**Total**	**3,154,777**	**7,643,428**	**11,424,513**	**15,760,765**	**9,705,693**	**47,689,176**	**23,361,708**	**24,533,765**	**105%**	

Program	Project		Goyder Institute Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Cash Total	In-Kind Total	In-Kind to Goyder	Other Funding
Climate Change	**C.1.1 Climate Change**	**Total**	526,020	2,117,139	2,214,372	2,105,544	110,584	7,073,659	3,411,876	3,661,783	107%	144,212
Environmental Water	**E.1.01 MDB Review**	**Total**	477,783	-	-	-	-	477,783	237,148	240,635	101%	259,055
Environmental Water	**E.1.02 MFE Urgent**	**Total**	41,927	-	-	-	-	41,927	20,963	20,964	100%	-
Environmental Water	**E.1.03 Murray Flood Ecology**	**Total**	671,692	683,887	171,749	-	-	1,527,329	754,958	772,371	102%	10,300
Environmental Water	**E.1.04 Expert Panel MDB Plan Review**	**Total**		153,541	7,218	-	-	160,759	80,576	80,183	100%	187,990
Environmental Water	**E.1.05 Scoping River Murray Catchment**	**Total**	-	105,608	100,833	3,701	-	210,142	99,592	110,550	111%	-
Environmental Water	**E.1.06 Peer Review**	**Total**		-	58,679	-	-	58,679	30,970	27,709	89%	-
Environmental Water	**E.1.07 River Murray eWater Requirements**	**Total**	-	-	-	247,603	39,153	286,756	142,625	202,160	142%	-
Environmental Water	**E.1.08 Riverbank Collapse in Lower River Murray**	**Total**	-	-	270,856	470,000	248,668	989,523	494,761	494,762	100%	258,501.0
Environmental Water	**E.1.09 River Murray Channel EWR**	**Total**	-	-	16,026	373,028	-	389,054	196,892	192,162	98%	-
Environmental Water	**E.1.10 SDL Adjustment**	**Total**	-	-	-	100,459	-	100,459	50,210	50,249	100%	-
Environmental Water	**E.1.11 Modelling Floodplains**	**Total**	-	-	-	159,395	683,605	843,000	421,500	421,500	100%	41,449
Environmental Water	**E.1.12 Chowilla Floodplain**	**Total**	-	-	-	105,266	290,030	395,296	197,647	197,649	100%	47,000
Environmental Water	**E.1.13 Efficient Monitoring**	**Total**	-	-	-	6,881	59,720	66,601	33,300	40,920	123%	-
Environmental Water	**E.2.1 SE Urgent**	**Total**	93,127	-	-	-	-	93,127	38,601	54,526	141%	-
Environmental Water	**E.2.2 South East – Phase 1**	**Total**	189,419	331,557	21,459	-	-	542,435	245,272	297,163	121%	-
Environmental Water	**E.2.3 Regional Groundwater Balance**	**Total**	-	-	662,264	203,062	-	865,326	408,924	456,402	112%	99,600
Environmental Water	**E.2.4 SE Catchment & Drains**	**Total**	-	36,748	186,633	114,193	44,684	382,258	179,267	223,826	125%	-
Environmental Water	**E.2.5 Wetlands in SE**	**Total**	-	-	225,713	583,498	287,419	1,096,629	548,314	548,316	100%	319,354
Environmental Water	**E.2.6 Regional Groundwater Balance Phase 2**	**Total**	-	-	-	682,031	898,822	1,580,852	790,426	790,426	100%	-
Environmental Water	**E.2.7 Risks in SE**	**Total**	-	-	-	195,091	480,037	675,128	333,564	341,564	101%	-
Urban Water	**U.1.1 WSUD Targets**	**Total**	95,837	212,971	-	-	-	308,809	142,073	166,735	117%	-
Urban Water	**U.1.2 WSUD Impediments**	**Total**	-	-	928,269	575,873	17,378	1,521,520	760,760	865,704	114%	-
Urban Water	**U.2.1 MAR & Stormwater Use Options**	**Total**	15,317	331,306	1,198,323	664,914	103,803	2,313,663	1,065,000	1,248,663	117%	4,825,271
Urban Water	**U.2.2 Optimal Water Resource Mix**	**Total**	-	-	1,579,523	1,483,432	-	3,062,955	1,493,669	1,569,286	105%	156,048
Urban Water	**U.2.3 Governance**	**Total**	-	-	-	272,650	230,264	502,914	251,457	261,533	100%	17,680
Water for Industry	**I.1.1 Scoping MLR Water Allocation Planning**	**Total**	-	155,296	108,942	-	-	264,238	128,960	135,278	105%	92,815
Water for Industry	**I.1.2 Torrens Lake Dilution Flow Trial 2011/12**	**Total**		161,233	245,151	-	-	406,383	174,472	231,911	133%	870,069
Water for Industry	**I.1.3 Recycled Water & Salinity**	**Total**	-	-	89,061	178,122	62,039	329,222	164,611	164,611	100%	1,065,714
Water for Industry	**I.1.4 Water Allocation Planning**	**Total**	-	-	584,176	1,793,781	1,416,993	3,794,950	1,898,619	1,896,331	100%	1,240,951.0
Water for Industry	**I.1.5 Torrens Lake Dilution Trial 2012/13**	**Total**	-	-	138,080	126,178	-	264,257	120,863	143,394	119%	657,216
Water for Industry	**I.1.6 Adelaide Groundwater**	**Total**	-	-	96,271	1,986,814	916,883	2,999,969	1,499,984	1,499,985	100%	-
Water for Industry	**I.2.1 GFLOWS 1**	**Total**	513,176	1,899,212	834,898	-	-	3,247,286	1,535,710	1,711,576	111%	88,542
Water for Industry	**I.2.2 G-FLOWS 2**	**Total**	-	-	-	998,225	997,346	1,995,571	997,785	1,001,022	100%	1,500,000
Water for Industry	**I.2.3 Lake Eyre Basin**	**Total**	-	-	-	265,564	734,008	999,572	499,786	501,344	100%	-
Research Projects Total			2,624,299	6,188,498	9,738,495	13,695,303	7,621,437	39,868,031	19,451,136	20,623,193	106%	11,881,767

Not Approved Program			Goyder Institute Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Goyder Institute Cash Total	Goyder Institute In-Kind Total	In-Kind to Goyder
Research Projects	**Not Approved**	**Total**	-	-	-	-	3,276,584	3,276,584	1,638,292	1,638,292	**100%**
Goyder Institute Total		**Total**	3,154,777	7,643,428	11,424,513	15,760,765	12,982,277	50,965,760	25,000,000	26,172,057	**105%**

Project Actual Expenditures 2013/14

Goyder Institute Annual Research and Development Plan
Annual Actuals as at 30 June 2014

		Participant	Expenditure 2010/11	2011/12	2012/13	2013/14	2014/15	LTD	Cash LTD	In-Kind LTD	In-Kind to Goyder
Research Projects		CSIRO	1,183,698	3,586,697	5,092,827	4,624,407	-	14,769,698	6,947,078	7,577,670	101%
Research Projects		Flinders	179,295	380,727	335,387	1,779,260	-	2,912,212	1,720,755	1,042,728	46%
Research Projects		Uni of Adelaide	216,441	1,273,586	1,719,866	2,220,588	-	5,422,983	2,718,185	2,781,592	103%
Research Projects		Uni of SA	264,205	743,092	963,076	1,245,368	-	3,215,741	1,214,990	2,000,751	165%
Research Partners			1,843,640	5,984,102	8,111,156	9,869,623	-	25,808,521	12,601,008	13,402,741	101%
Research Projects		SARDI	318,893	725,713	528,295	1,413,350	-	2,986,251	1,750,541	1,264,548	64%
Research Projects		AWQC	6,513	20,297	230,366	131,660	-	388,836	201,642	194,537	96%
Research Projects Total		**Total**	**2,169,046**	**6,730,112**	**8,869,817**	**11,414,633**	**-**	**29,183,608**	**14,553,191**	**14,861,826**	**95%**
Research Adoption	PhD Stipend TopUps	Total	-	240,000	255,000	175,000	-	670,000	670,000	-	
Research Adoption	ANZSOG	Flinders			-	329,635		329,635	164,818	164,818	
Research Adoption	Know ledge Management	Total		28,556	88,206	85,223		201,985	201,985	-	
Research Adoption	PhD contributions	Total	86,210	324,452	399,102	556,638	-	1,366,402	-	1,366,402	
Research Adoption		**Total**	**86,210**	**593,008**	**742,309**	**1,146,496**	**-**	**2,568,023**	**1,036,803**	**1,531,220**	**-**
Admin	**Goyder Office**	**Total**	**444,268**	**861,902**	**861,902**	**883,206**		**3,051,277**	**1,772,847**	**1,278,430**	**72%**
Goyder Institute Total		**Total**	**2,699,524**	**8,185,022**	**10,474,028**	**13,954,120**	**-**	**34,802,908**	**17,362,841**	**17,671,476**	**96%**

Program	Project	Participant	Expenditure 2010/11	2011/12	2012/13	2013/14	2014/15	LTD	Cash LTD	In-Kind LTD	In-Kind to Goyder
Climate Change	**C.1.1 Climate Change**	**Total**	515,442	2,271,282	2,158,843	2,034,403	-	6,979,970	2,721,039	4,258,931	157%
Environmental Water	**E.1.01 MDB Review**	**Total**	238,689	239,093	-	-	-	477,783	237,148	240,635	101%
Environmental Water	**E.1.02 MFE Urgent**	**Total**	30,298	11,629	-	-	-	41,927	20,963	20,964	100%
Environmental Water	**E.1.03 Murray Flood Ecology**	**Total**	534,083	906,448	159,362	1,080	-	1,600,973	716,921	884,052	123%
Environmental Water	**E.1.04 Expert Panel MDB Plan Review**	**Total**		153,541	7,218		-	160,759	80,576	80,183	100%
Environmental Water	**E.1.05 Scoping River Murray Catchment**	**Total**		105,608	100,833	3,701	-	210,142	99,592	110,550	111%
Environmental Water	**E.1.06 Peer Review**	**Total**		-	58,679		-	58,679	30,970	27,709	89%
Environmental Water	**E.1.07 River Murray eWater Requirements**	**Total**		-	-	149,585	-	149,585	45,443	109,885	242%
Environmental Water	**E.1.08 Riverbank Collapse**	**Total**		-	164,659	394,268	-	558,927	371,564	187,363	50%
Environmental Water	**E.1.09 River Murray Channel EWR**	**Total**		-	16,026	373,028	-	389,054	196,892	192,162	98%
Environmental Water	**E.1.10 SDL Adjustment**	**Total**		-	-	100,459	-	100,459	50,210	50,249	100%
Environmental Water	**E.1.11 Modelling Floodplains**	**Total**		-	-	123,599	-	123,599	96,945	26,654	27%
Environmental Water	**E.1.12 Chowilla Floodplain**	**Total**		-	-	58,061	-	58,061	52,635	5,426	10%
Environmental Water	**E.1.13 Efficient Monitoring**	**Total**		-	-	7,498	-	7,498	14,500	-	-
Environmental Water	**E.2.1 SE Urgent**	**Total**	84,175	-	-	-	-	84,175	38,601	45,574	118%
Environmental Water	**E.2.2 South East – Phase 1**	**Total**	189,419	332,224	21,459		-	543,103	245,272	297,831	121%
Environmental Water	**E.2.3 Regional Groundwater Balance**	**Total**		-	662,264	203,062	-	865,326	408,924	456,402	112%
Environmental Water	**E.2.4 SE Catchment & Drains**	**Total**		21,234	163,184	143,187	-	327,605	152,000	175,605	116%
Environmental Water	**E.2.5 Wetlands in SE**	**Total**		-	116,357	535,615	-	651,972	412,291	155,535	38%
Environmental Water	**E.2.6 Regional Groundwater Balance Phase 2**	**Total**		-	-	519,612	-	519,612	357,169	162,443	-
Urban Water	**U.1.1 WSUD Targets**	**Total**	95,837	212,971	-	-	-	308,809	142,073	166,736	117%
Urban Water	**U.1.2 WSUD Impediments**	**Total**		-	839,537	637,789	-	1,477,326	610,102	867,224	142%
Urban Water	**U.2.1 MARSUO**	**Total**	14,127	320,049	1,219,302	675,953	-	2,229,431	1,033,000	1,196,431	116%
Urban Water	**U.2.2 Optimal Water Resource Mix**	**Total**		-	1,464,848	1,525,779	-	2,990,627	1,195,691	1,794,936	150%
Urban Water	**U.2.3 Governance**	**Total**		-	-	247,593	-	249,921	81,803	168,118	206%
Water for Industry	**I.1.1 Scoping MLR Water Allocation Planning**	**Total**		155,296	108,942	-	-	264,238	128,960	135,278	124%
Water for Industry	**I.1.2 Torrens Lake Dilution Flow Trial 2011/12**	**Total**		161,233	245,151	-	-	406,383	174,472	231,911	133%
Water for Industry	**I.1.3 Recycled Water & Salinity**	**Total**		-	-	39,341	-	39,341	102,882	-	-
Water for Industry	**I.1.4 Water Allocation Planning**	**Total**		-	307,269	1,537,816	-	1,845,085	1,449,753	251,275	17%
Water for Industry	**I.1.5 Torrens Lake Dilution Trial 2012/13**	**Total**		-	138,080	126,178	-	264,257	120,863	143,394	119%
Water for Industry	**I.1.6 Adelaide Groundwater**	**Total**		-	-	1,316,584	-	1,316,584	998,127	318,457	32%
Water for Industry	**I.2.1 G-FLOWS 1**	**Total**	466,974	1,839,503	917,805	23,004	-	3,247,286	1,535,710	1,711,576	111%
Water for Industry	**I.2.2 G-FLOWS 2**	**Total**		-	-	603,120	-	603,120	448,526	226,380	50%
Water for Industry	**I.2.3 Lake Eyre Basin**	**Total**		-	-	31,990	-	31,990	181,574	10,557	6%
Total			**2,169,046**	**6,730,112**	**8,869,817**	**11,412,304**	**-**	**29,183,608**	**14,553,191**	**14,710,426**	**95%**

A.2 Investment profile

A.2 Investment Profile

Project Register & Investment profile v13.xlsx		Budget Approvals ToDate			Budget Approvals 2014_15			Total LifeTime		
		Budget	Cash	In-Kind	Budget	Cash	In-Kind	Budget	Cash	In-Kind
RESEARCH BUDGET										
Research projects										
C.1	Regional Downscaling	7,073,659	3,411,876	3,661,783	-	-	-	7,073,659	3,411,876	3,661,783
E.1	River Murray	5,547,308	2,761,142	2,851,813	1,350,000	675,000	675,000	6,897,308	3,436,142	3,526,813
E.2	Surface water, groundwater, wetland relationship	5,235,755	2,544,368	2,712,223		-	-	5,235,755	2,544,368	2,712,223
I.1	Water allocation planning & water quality improvement	8,059,019	3,987,509	4,071,510	460,000	230,000	230,000	8,519,019	4,217,509	4,301,510
I.2	Mining & outback water	6,242,429	3,033,281	3,213,942	230,000	115,000	115,000	6,472,429	3,148,281	3,328,942
U.1	Water sensitive urban design	1,830,330	902,834	1,032,440	230,000	115,000	115,000	2,060,330	1,017,834	1,147,440
U.2	Water resources mix for Adelaide	5,879,532	2,810,125	3,079,482	1,006,585	503,293	503,293	6,886,117	3,313,418	3,582,775
	projects subtotal	*39,868,031*	*19,451,135*	*20,623,193*	*3,276,585*	*1,638,293*	*1,638,293*	*43,144,616*	*21,089,428*	*22,261,486*
Research adoption and dissemination										
Knowledge management & dissemination		223,832	223,832	-	176,168	176,168	-	400,000	400,000	-
PhD Supplements		750,000	750,000	-	30,000	30,000	-	780,000	780,000	-
Additional in-kind PhD		1,415,802		1,415,802	518,112		518,112	1,933,914	-	1,933,914
ANZSOG		700,000	350,000	350,000		-	-	700,000	350,000	350,000
	adoption & dissemination subtotal	*3,089,634*	*1,323,832*	*1,765,802*	*724,280*	*206,168*	*518,112*	*3,813,914*	*1,530,000*	*2,283,914*
Research budget TOTAL		**42,957,665**	**20,774,967**	**22,388,995**	**4,000,865**	**1,844,461**	**2,156,405**	**46,958,530**	**22,619,428**	**24,545,400**
ADMIN BUDGET										
Goyder Institute Office		3,077,254	1,789,612	1,287,642	929,977	643,980	339,016	4,007,231	2,380,572	1,626,658
Admin budget TOTAL		**3,077,254**	**1,789,612**	**1,287,642**	**929,977**	**643,980**	**339,016**	**4,007,231**	**2,380,572**	**1,626,658**
Goyder Institute TOTAL		**46,034,919**	**22,564,579**	**23,676,637**	**4,930,842**	**2,488,441**	**2,495,421**	**50,965,761**	**25,000,000**	**26,172,058**

A.3 Completed and On-going Projects

This section of the R&D Plan provides further detail regarding each of the project investments under each Road Map.

Climate Change Theme

C1 – Regional Climate Change Downscaling

C.1.1. Downscaled Climate Projections for SA

Project Lead: Prof. Simon Beecham, UniSA
Project Partners: UniSA, CSIRO, Flinders University, Adelaide University, SA Water, SARDI, DEWNR
Status: Active, Commenced October 2010
Development of an agreed set of downscaled climate projections for South Australia.

Project Overview:

1. This project involves four major components: Understanding the key drivers of climate change in South Australia.
2. Selection of Global Climate Models for regional downscaling and projection.
3. Downscaling and climate change projections for South Australia.
4. Development of an application test bed.

This project is producing far more than a set of environmental data. It will develop a robust fit for purpose framework that will allow the projections downscaled from IPCC AR4 to be readily updated with AR5 modelling results when they are released. In addition, this project will lead to greatly increased levels of confidence in State Government policy decisions since they will always be based on the most reliable scientific evidence about both climate change and the localised climate variability caused by seasonality, trends and identified climate drivers for South Australia.

Research Highlights
The varying influence of climate drivers on rainfall across the eight SA NRM regions has been published in a leading scientific journal and a preliminary set of downscaled climate projections has been produced for the Onkaparinga test case catchment. A suite of diagnostic tools have been developed that not only measure model performance, but also provide an indication of possible actions which can be taken to remedy model weaknesses. The project has also produced a number of peer reviewed journal publications, including an article in *Nature* and an invited paper in a book commissioned by the International Water Association on climate change impacts. The downscaled data and model documentation will be available in October2014.

Urban Water Theme

U1 – Water Sensitive Urban Design

U.1.1 WSUD Targets

Project Leader: David Pezzaniti, UniSA
Project Partners: UniSA, CSIRO,
Status: Completed
Identify interim WSUD targets that are appropriate for the climate and urban environmental conditions of the greater Adelaide region.

Project Overview

The Government's water security plan, *Water for Good*, includes a number of commitments to manage water supplies effectively, including the adoption of WSUD measures. While considerable work on WSUD targets has been carried out interstate, climate characteristics significantly affect the performance of WSUD systems. One of the primary purposes for developing interim targets for Adelaide is that they are appropriate for the region and that local data such as climatic information is used. This project investigated and identified potential WSUD targets for Adelaide's regional conditions in three main areas:

- Mains water conservation
- Stormwater runoff quality
- Stormwater runoff quantity

Research Highlights

The interim water sensitive urban design targets for greater Adelaide recommended from this research were incorporated into a broader WSUD consultation document by the Department for Environment, Water and Natural Resources. Following this consultation process, a WSUD policy ('*Water Sensitive Urban Design for South Australia - Creating More Liveable and Water Sensitive Cities*') was developed was developed by DEWNR in 2012/2013, which includes targets for WSUD that are based on the outcomes of this project and on stakeholder consultation.

U.1.2 WSUD Impediments & Opportunities

Project Lead: Dr Ashok Sharma, CSIRO, and David Pezzaniti, UniSA
Project Partners: CSIRO, UniSA,
Status: Active, Commenced October 2012
The project aims to identify and address impediments and constraints as well as identify opportunities and enabling mechanisms to facilitate the strategic uptake of WSUD in the State, with a focus on local capacity building and cost of living.

Project Overview

The project consists of three components:

- A post implementation assessment of developments designed with WSUD systems and consultation with various stakeholders for South Australian to identify specific impediments and constraints in the uptake of WSUD.
- A community consultation, investigating the social and technical impediments, drivers and opportunities for the uptake and management of WSUD systems.
- Research into the potential for WSUD in South Australia to achieve water conservation through alternative resources application, water quality, water quantity and flood management. It will review the economic impacts of WSUD strategies and options.

Research Highlights

The project team have been working closely with Local Government to bring together a comprehensive understanding of WSUD interventions that have been installed throughout Adelaide and the effectiveness of these interventions. Several Technical reports have been published on the Goyder Institute website.

U2 – Water Resources Mix for Adelaide

U.2.1 MARSUO

Project Lead: Dr Peter Dillon, CSIRO
Project Partners: CSIRO, National Water Commission, Adelaide University, UniSA, AMLR NRMB, United Water, City of Salisbury, DEWNR, WQRA
Status: Active, Commenced January 2011
Investigating managed aquifer recharge and stormwater use options for Adelaide

Project Overview

This is a national project to assess a range of potential uses of stormwater including via managed aquifer recharge is currently underway with a project hub site in the City of Salisbury and satellite sites at various locations around the country and overseas. The project is addressing the health risk assessment of uses for public open space irrigation, third pipe non-potable supplies to households and industry and for drinking water supplies. For several of those uses prototype risk management plans are being developed. The economics of some specific options are also being considered taking account of environmental impacts, and surveys of public acceptance of the more novel options have been undertaken. This NWC/Goyder Institute research project is intended to be of use to inform policies, blueprints and plans for stormwater harvesting in South Australia, and to provide methodologies to assist in maximising the total economic value of harvested stormwater in Australia.

Research Highlights

The catchment risk assessment approach developed in MARSUO has been adopted by Water Proofing the South and Water Proofing the West projects and National Guidelines are being developed for Managed Aquifer Recharge with the National Water Commission.

U.2.2. Optimal Water Resource Mix

Project Lead: Sue Cuddy, CSIRO
Project Partners: CSIRO, Flinders University, Adelaide University, UniSA, SA Water
Status: Active, Commenced October 2012
Supporting integrated water management for metropolitan Adelaide

Project Overview

The 'Optimal Water Mix' project will provide foundational knowledge to inform the development of policy and planning for integrated urban water management in metropolitan Adelaide. A key product of this project will be to develop methods for determining trade-offs between the multiple objectives of water security, economic efficiency and environmental benefits of water supply options that are consistent with the city's social values.

The tradeoffs analysis methodology that will be developed provides a framework that could be applied to other cities/regions to inform the development of total water cycle management plans. The project is highly innovative because it is the first time that these methodologies to identify options and evaluate trade-offs will be applied at a city-wide scale. The knowledge gained from this complex research project will inform policy development and progression of a total water cycle management plan for Adelaide.

Research Highlights

A Stakeholder Reference panel has been established and an initial stakeholder workshop to identify the broad objectives the project should focus on has been held. A modelling framework has been established, with initial modelled estimates of end-use demand, Mt Lofty catchment inflows and identification of discharge objectives for environmentally sensitive locations. A draft technical report has been produced summarising capital and operating costs of, and greenhouse gas emissions from, all major sources of water. Installation of 150 smart meters in households has been completed with follow-up attitudinal/behavioural surveys underway. A Technical report on the use of greenspace as a function of park type has been published and a summary of grey and published literature on externalities for each water source investigated in this study is nearing completion. A draft technical report has been prepared that has reviewed the institutional arrangements for implementing a portfolio of supply sources in Australian cities as well as international practices.

U.2.3. Water Governance Assessment

Project Lead: Prof. Jennifer McKay, UniSA
Project Partners: UniSA, Adelaide University, CSIRO, SA Water, Flinders University, Water Industry Alliance, DEWNR, City of Holdfast Bay, AMLR NRMB
Status: Commenced June 2013
Identify options for improved water governance in managing the complexity of diversified supply options

Project Overview

The project will assess the legal and governance options and risks of the scenarios identified in the development of the proposed Urban Water Blueprint to inform decision making around the selection of models and implementation approaches. Where there are unresolved legal or governance issues, the project team will work with key stakeholders in government to identify solutions, based on South Australian law and national and international experience. Solutions could include legislative (changes to the law), regulatory (changes in the way the law is implemented) and institutional (changes in the governance of water supply and management).

Research Highlights

The project will evolve with the needs of the Blueprint based on the direction provided by DEWNR and will be informed by Project U.2.2 Optimal Water Resource Mix for Metropolitan Adelaide and U.1.2 Water Sensitive Urban Design (WSUD). Project U2.2 will identify a limited number of optimal water supply scenarios for input into the considerations of the Urban Water Blueprint and U.1.2 will identify impediments to the implementation of WSUD. Each of these scenarios will include legal and governance risks, challenges and benefits that will need to be assessed.

Water for Industry Theme

I1 – Water Allocation Planning and Water Quality Improvement

I.1.1. AMLR WAP Scoping

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: Adelaide University, SARDI, CSIRO, UniSA, DEWNR, SA Water, EPA
Status: Completed
Identify high priority R&D needs to support water allocation planning

Project Overview

Research and policy staff within this project reviewed then prioritised research needed to refine a decision support framework for developing water allocation plans (WAPs) in South Australia.

Research Highlights

The project has provided a review and evaluation of components of the WAP framework including the establishment of relationships between hydrology and ecological expression, a process to determine the effectiveness of returning low flows for environmental watering, and the notion of a library of metrics to support future WAPs across the state. It also assessed surface water-groundwater interaction models that may help in the WAP process in SA, and it explored opportunities for new areas of research such as hydro-economic modelling (i.e. transparently balancing social, economic and environmental needs for water).

The Technical Report summarises existing knowledge and monitoring activities, and identifies key research priorities for future investment. The high priority R&D gaps have formed the basis of the AMLR WAP program (I.1.4.).

I 1.2 Torrens River Water Quality Improvement Trial

Project Lead: Assoc./Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI, SA Water, AMLR NRMB, DEWNR, Adelaide City Council
Status: Completed
Determining the feasibility of an 'amenity flow' for the Torrens Lake to reduce or eliminate algal blooms.

Project Overview

A trial was undertaken during the summer of 2011/12 to determine the effectiveness of using dilution flows as a strategy to control cyanobacteria in the Torrens Lake. The aim of this dilution flow trial was to monitor the release of water from an upstream storage to dilute cyanobacteria in the Torrens Lake. In addition, a fish monitoring component was established to evaluate the effect of flow management on fish populations within the lower Torrens and Breakout Creek. This component was developed to provide a baseline survey of fish communities, against which post- flow patterns could be compared and to conduct a survey during flow releases to determine any short-term responses or impacts.

Research Highlights

The use of flows to control cyanobacterial growth shows promise as an event management technique to control the growth of cyanobacterial biomass. This is supported by both the modelling of growth and dilution and the results of the field trial. The coordination of the 2011/12 trial demonstrated that it was feasible to deliver flow in response to cell counts two days prior, which was observed to be appropriate considering the rate of growth, and this should again be considered in the operational planning of flow releases. The results of the trial suggest that if dilution flows are released early enough, the size of the cyanobacterial population can be controlled, recognising that there is a reliance on rain events to flush the system and dilute the resident cyanobacterial population. On average, the flow return interval analysis suggests that rain events occur frequently enough in summer for this strategy to be effective. However, in a variable climate like that observed in Adelaide, there may be incidences of very long periods between significant rainfall events. This may reduce the confidence in rain events to reset the population. The dilution flow was not observed to have any impact on the freshwater fish community.

I.1.3. Recycled water and salinity

Project Lead: Tim Pitt, SARDI
Project Partners: AWRCoE, SARDI, Adelaide University, Treasury Wine Estates
Status: Active, Commenced February 2013
Demonstrating the economic and environmental value of water recycling to Australia's agri-food industry.

Project Overview

The project is collaborating with local viticulture and horticulture businesses and the University of Adelaide, to demonstrate the economic and environmental value of water recycling to Australia's agri-food industry.
More specifically, the project will test whether re-directing rain falling on the mid-row, to the soils immediately under the vines, will reduce the salinity pressure on vines and will assess how the changing concentrations of salt, in the various soils being assessed, affect plant response in terms of vigour, yield and crop quality.

Research Highlights

Rainfall redirection treatments have been established at the grape site at McLaren Vale and year one plant samples have been collected. Analysis of these samples is ongoing. Preliminary data suggests little difference in salt uptake between treatments. This is not an unexpected result given the dry growing season and the early stages of this work. Treatment effects will become more apparent as rain events accumulate and future seasons data, both plant and soil, are assessed.

I 1.4 AMLR WAP Program

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, CSIRO, AMLR NRMB, SAMDB NRMB, DEWNR, SA Water, EPA
Status: Active, Commenced March 2013

Project Overview

Building on the existing knowledge, management and monitoring systems in the Mt Lofty Ranges, the Water Allocation Planning project will refine the understanding of environmental water needs, patterns of flow and water quality within the Mount Lofty Ranges. It will also develop a tool to help bring together all the information needed to make robust decisions on water allocations and assess the potential outcomes of alternative management options. The tool and the research outcomes can then help to underpin the further development of sustainable water use in the region, and support the review and improvement process built into water planning in the Mt Lofty Ranges and other parts of the state.

The research will also involve collecting important hydro-ecological data to support the ongoing development of water allocation plans for the region, including installing monitoring equipment in high priority regions over to measure water flow and quality and the subsequent ecological response from fish, vegetation and macro-invertebrates.

Research Highlights

The overall objective is to develop an integrated catchment water planning support system for a multi-use catchment based on best practice methods and modelling and enable the evaluation and planning for risks of water extraction both on catchment water resources and water dependant ecosystems.

At present, baseline environmental monitoring has been completed and installation of instrumentation to undertake full monitoring (flow, veg and macroinvertebrates) has been completed and full monitoring is now underway. The modelling framework has been developed and the background databases on water quality in the Mount Lofty Ranges have been collated.

I 1.5 Torrens Lake Dilution Flow Trial for Summer 2012/13

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI, SA Water, AMLR NRMB, DEWNR, Adelaide City Council
Status: Complete
A second trial to further examine the feasibility of an 'amenity flow' for the Torrens Lake to manage algal blooms.

Project Overview

Following the initial trial in 2011/12, a second trial in 2012/13 was undertaken with a focus on the key aspects of:

- cyanobacterial growth responses to managed flows over a long period, Lake inflow mixing performance and potential enhancements;
- water temperature, quality and cyanobacteria monitoring;
- native and exotic fish responses;
- water quality of inflows and outflows checking their fit for purpose use; and
- monitoring community response generally and in terms of the Torrens Lake and Linear Park's amenity.

Research Highlights

This project was an experimental trial but was also a high profile strategy to improve water quality in the River Torrens. The results were used immediately for setting flow targets maintain cyanobacterial populations below concentrations that would force lake closure. The trial 2011/12 had unanswered questions and so was repeated to determine whether this is an appropriate long-term strategy for controlling cyanobacteria in the River Torrens.

The results of the trial suggest that if dilution flows are released early enough, the size of the cyanobacterial population can be controlled. However, there is a reliance on rain events to flush the system and dilute the resident cyanobacterial population. Although on average, the flow return interval analysis suggests that rain events occur frequently enough in summer for this strategy to be effective this did not occur in 2011/12 or in 2012/13. In a variable climate like that observed in Adelaide, there may be very long periods between significant rainfall events. This may reduce the confidence in rain events to reset the population. In the absence of rain events to reset the cyanobacterial populations in the lake, large water releases from upstream reservoirs could fulfil a similar role.

I.1.6. Adelaide Plains Groundwater Assessment

Project Lead: Prof. Okke Batelaan, Flinders University
Project Partners: Flinders University, NCGRT, CSIRO, DEWNR
Status: Active, Commenced June 2013
Assessment of Adelaide Plains Groundwater Resources

Project Overview

The project will build upon existing knowledge to provide a thorough assessment of the groundwater resources beneath Adelaide, and the impacts of current and future extraction and climate change. One of the key outcomes will be an upgraded and improved groundwater model capable of predicting impacts of current and future extraction, and uncertainties surrounding these predictions. It will be the first study to provide an integrated assessment of the groundwater resources of the entire Adelaide metropolitan region.

Research Highlights

The focus area of the project is the Adelaide plains region west of the Eden-Burnside fault (which separates the plains from the Mount Lofty Ranges). The study area will extend north to the Light River. Although the focus will be on the region north of Seacliff, the study region will extend south to include the Noarlunga Embayment and the Willunga Basin. Inclusion of the Willunga Basin within this project area will facilitate transfer of research findings from the Willunga Basin to similar environments within the Adelaide Plains region. Ongoing research within the Willunga Basin (being undertaken through NCGRT) will provide an understanding on issues like flow across faults, leakage between aquifers and seawater intrusion that can inform our understanding of the Adelaide Plains region.

I2 – Mining and Outback Water

I.2.1 G-FLOWS – Phase 1

Project Lead: Dr Mat Gilfedder, CSIRO
Project Partners: CSIRO, Flinders University, SARDI, Adelaide University, DEWNR, DMITRE
Status: Commenced January 2011.
Facilitating long-term outback water supplies.

Project Overview

This project has focused on data poor areas of arid South Australia, and made advances using a range of scientific methods to better understand the water resources of arid inland South Australia. G-FLOWS-1 has used multiple data sources to bring together a comprehensive current conceptual model of hydrogeology in the Musgrave Province. This harnessed remotely-sensed datasets, with on-ground and borehole measurements, to provide a much greater sense of the subsurface variability in the area.

Research Highlights

G-FLOWS Stage-1 incorporated 10 tasks, and these combine to address the overall Project objectives. In broad terms, the project delivered against the objectives in the following ways:

- Adapt, apply and test methods and techniques for combining topographic and airborne geophysical datasets, leading to the development of a hydrogeological framework for the Musgrave Province.
- A review of key water values in arid zones of South Australia, identify attributes for each value and threats to these attributes. This was expanded through the organisation of a two-day forum and workshop entitled ‘Cultural and Environmental Values of Outback Water Resources: Forum and Workshop’ which attracted 52 delegates.
- Combination of recharge modelling work across arid Far North South Australia, supported by field trip APY Lands (Musgrave Province) to collect groundwater samples for chemistry and environmental tracer analysis. This allowed groundwater residence times and aquifer properties to be better defined in the area.
- Collation and enhancement of multiple spatial datasets in the Musgrave Province, to provide best available information of groundwater, aquifer characteristics and variability. A methodology has been developed to use these to support the hydrogeological model (Objective 1) and allow targeting of future finer-scale assessments of extensive subsurface drainage features (ancient buried river valleys: aka palaeovalleys)
- Development of a processing and inversion strategy for employing historical and contemporary EM data affected by system uncertainties and errors, to produce calibrated data for hydrogeological assessment. This was undertaken in the Frome Embayment using fixed-wing and helicopter TDEM datasets acquired between 2000 and 2012.

I.2.2. G-FLOWS – Phase 2

Project Lead: Dr Mat Gilfedder, CSIRO
Project Partners: Flinders University, CSIRO, Adelaide University
Status: Commenced Dec 2013
Facilitating long-term outback water solutions: Stage 2

Project Overview

Goyder FLOWS Stage 2 will improve broad knowledge about the location and interaction between groundwater resources in the northern part of the Eyre Peninsula area, which has been identified as a priority area for potential mine developments. G-FLOWS Stage 2 will focus on the development of hydrogeological conceptual models for these areas and improved understanding of water resources including water sources, the geometry, extent and character of aquifers, their connectivity and groundwater movement pathways. This will be done through data collation, field data collection and scenario modelling for selected case-study areas in the northern region of the Eyre Peninsula. A key output will be a hydrogeological framework (e.g. digital maps and sections) for the northern Eyre Peninsula.

Research Highlights

The project has been very successful in gaining access to essentially all of the airborne electromagnetic (AEM) datasets across the northern Eyre Peninsula and the project team have effectively engaged the exploration industry holding tenements across the Eyre Peninsula. This has resulted in access to all airborne EM surveys flown across the region. The data are being collated and several data sets have already been inverted. The results are being prepared for upload into the CSIRO Data Portal to allow access for the Department of State Development, DEWNR and other FLOWS project staff. The Department of State Development has committed additional support for the acquisition of additional AEM data across an area of particular exploration interest in the northern part of the study area. This work was undertaken collaboratively with Investigator Resources, resulting in an ASX announcement recognising the collaboration with the Goyder FLOWS project.

I.2.3. LEBRA

Project Lead: Prof Jim Cox, SARDI
Project Partners: SARDI, Flinders University, CSIRO, Adelaide University
Status: Commenced March 2014
Researching environmental condition indicators to support the management of Lake Eyre Basin Rivers

Project Overview

This project aims to build upon existing frameworks and methodological development activities to undertake analysis of new and existing data to identify a suite of useful condition indicators of environmental condition for the aquatic ecosystems of the Lake Eyre Basin (LEB). While the project will focus on areas for which monitoring data exists, baseline research will be conducted in areas where priority knowledge gaps have been identified. The outcome of the project is to provide research to underpin a world class approach and methodology for undertaking condition assessment that is based on well-defined and researched indicators and threshold values consistent with the Strategic Adaptive Management (SAM) approach endorsed by the LEB Ministerial Forum.

Environmental Water Theme

E1 – River Murray

E.1.1 Science review of the guide to the Murray-Darling Basin Plan

Project Lead: Sue Cuddy, CSIRO
Project Partners: CSIRO
Status: Completed

Project overview

Prior to the release of the Guide, the South Australian Government invited the Goyder Institute to determine whether the proposed sustainable diversion limits would meet the Government's environmental water requirements and improve or maintain water quality. The review was also to assess the socioeconomic implications of reductions in diversion limits to the major water users within South Australia.

Research Highlights

This project produced a synthesis report that described the findings of the review, with the following four accompanying peer-reviewed technical reports describing the methods and findings of the work undertaken:

- an analysis of the South Australian Government's environmental water and water quality requirements and their delivery under the Guide to the proposed Basin Plan;
- an independent peer review of the science underpinning the environmental water requirements of the Coorong, Lower Lakes, and Murray Mouth;
- a report on the socioeconomic implications of the Guide to the proposed Basin Plan;
- a compilation of reports informing a socioeconomic review of the Guide to the proposed Basin Plan.

E 1.2 Murray Flood Ecology - Urgent monitoring program

Project Lead: Dr Qifeng Ye, SARDI
Project Partners: SARDI,
Status: Completed
Monitoring the fish spawning response to the flow increase in the Lower River Murray, South Australia.

Project Overview

This study investigated the annual change in abundance and species diversity of native fish populations in the lower River Murray during varying hydrological conditions. Larval assemblages of both native and introduced species were examined after the 2010 flood and compared to those recorded during the Millennium Drought.

Research Highlights

The project developed a quantitative sampling protocol for larval and adult fish sampling which was conducted over a period of two months between October and November 2010. The sampling protocol has been applied in a larger project investigating the ecological response to flooding in the River Murray (E.1.3.).

E 1.3 Murray Flood Ecology

Project Lead: Dr Qifeng Ye, SARDI
Project Partners: SARDI, CSIRO, Flinders University, Adelaide University, SA Water, SAMDB NRMB,
Status: Completed

Ecological responses to flooding in the Lower River Murray following drought.

Project Overview

The 2010 flood event is a unique opportunity to undertake time critical ecological investigations, measuring how biological systems respond and recover when water is restored to the system after a long period of drought. This research project takes a more empirical approach to understanding ecological responses to flow regimes, and fills significant knowledge gaps in how flow affects various ecological components (e.g. vegetation and fish) and processes (e.g. river metabolism). Further, the project takes a landscape scale approach to understanding ecological responses, in some cases, assessing how movement of species with large ranges (e.g. large bodied fish) respond to water across the

landscape, as opposed to within a single geographic location such as a wetland.

The Project will contribute to delivery of the following:

- Advanced knowledge of environmental water requirements (including quantity, flow regimes and water quality), that account for landscape-scale processes and connectivity
- Determination of early warning indicators, critical thresholds and triggers for key environmental assets
- Improvement in understanding of links between the River Murray and the wetlands/floodplain and implications of the return of flows after a protracted drought period for ecological outcomes.

Research Highlights

Technical reports and journal publications have been prepared for all aspects of this investigation, including a synthesis report.

Some key findings of the research investigations include:

- The river requires flooding to transfer nutrients into and along the River channel. Floods improve longitudinal and lateral connectivity, facilitate natural processes, and lead to a more diverse and interesting River. Artificially inundating the floodplain during a period of low flow, although required at times, will not serve the complete ecological function of a natural flood. Low flows are also important for some species that thrive under these conditions.
- Recognising that some species may have a lag in response time is essential for accurately and effectively quantifying and understanding the processes involved in riverine ecology
- It is very important to recognise the origin of the water. Water from different sources will have different biological and chemical characteristics that will have different effects on the ecosystem response to watering events.
- Floodplains provide a valuable service to the health of the river: as a food source, and a source of propagules to repopulate populations from areas where they have disappeared. Some floodplains, such as Chowilla, are major sources of microbiota (protitsts, algae, zooplankton) that are important food resources for the River; they provide a disproportionate amount of nutrients and propagules to feed the River system during flood events and thereafter because of their significant inundation area, but also their geomorphology. It is important to maintain the floodplain ecosystem and its connectivity to the river channel, and recognise its importance during different flow conditions.

E 1.4 Expert Panel MDB draft Plan

Project Lead: Dr Sebastien Lamontagne, CSIRO
Project Partners: CSIRO, SARDI, Adelaide University, Flinders University
Status: Completed
Expert advice on the potential ecological implications, risks and consequences of the draft Basin Plan.

Project Overview

The South Australian Government evaluated the extent to which the South Australian Government's and the Murray-Darling Basin Authority's Environmental Water Requirements would likely be met for key environmental assets in South Australia under the proposed Basin Plan. The South Australian Government sought advice from the Goyder Institute on the likely ecological consequences for South Australia of the proposed Basin Plan. Given the very limited time available to formulate and provide advice, the Goyder Institute assembled an Expert Panel to provide (largely qualitative) advice based on the South Australian Government analysis.

Research Highlights

The key findings and recommendations from the Expert Panel report contributed to the SA Government response to the draft Basin Plan and provided the scientific basis for the Government's recommendations to the MDBA.

E.1.5. River Murray Scoping Study

Project Lead: Dr Kate Holland, CSIRO
Project Partners: CSIRO, Adelaide University, SARDI, Flinders University
Status: Completed
Identify research priorities in the broad area of River Murray flows and environmental flow management in South Australia.

Project Overview

The purpose of this project is to scope out (a) potential follow-on project(s) by providing an inventory of knowledge and knowledge gaps, on:

- flows within the Murray-Darling Basin, the resulting flows into South Australia, and how they are affected by climate change, SDLs, environmental flow management and other influences;
- the constraints and opportunities presented by those flows for environmental and Indigenous flow management within South Australia; and,
- the relation of the knowledge and knowledge gaps to SA departmental priorities for environmental and Indigenous flow management.

To assess these matters, the project team comprises experts in flow modelling and water accounting, and ecological responses to flows within South Australia. The team will consult widely with other experts and, particularly, the relevant South Australian departments with which a workshop will be held to assess departmental priorities in relation to knowledge and knowledge gaps.

Research Highlights

A workshop held with key stakeholders to identify research gaps within the River Murray Road Map and the provision of expert advice regarding the options available to address these gaps. This advice has been prepared into a synthesis report to support decisions regarding future investment.

E.1.6. Peer review of the SA Government analysis of the Murray Darling Basin Plan

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University, CSIRO
Status: Completed
An independent peer review of the additional model scenarios for the proposed Basin Plan

Project Overview

The Premier's Murray-Darling Basin Plan Taskforce requested an independent peer review process of the South Australian Government analysis. The purpose of the Goyder Institute peer review process was to critique the hydro-ecological analysis undertaken by DEWNR and to suggest improvements, where deemed necessary, to achieve the best quality analysis within the available timeframes.

Research Highlights

The major highlight was the ability of the South Australian Science Team (in DEWNR) to rapidly extend the modelling done by the MDBA to show and communicate the ecological benefits to the South Australian River Murray floodplains and CLLMM region within very short timelines. The outcomes of the Peer Review were directly relevant to policy makers within the state government in supporting the states position on environmental water to support ecological objectives.

E.1.7 River Murray Program

Project Lead: Dr Kane Aldridge, Adelaide University
Status: Commenced August 2013

Project Overview

The aim of this project is to conceptualise the current understanding of the ecological and cultural response to flow for the entire SA MDB and use this information to build a decision framework for decision making. This will build on previous Goyder Institute projects as well as other research. The outputs of the project will be:

- An assessment of appropriate decision support tools for the particular 'problem'
- Consolidation of our understanding into conceptual models including, documenting the environmental and cultural water management system, the hydrology and ecological and cultural response to flow (incorporating outputs of previous Goyder projects)
- Development of 'watering principles' that can be used to inform environmental and cultural watering decisions based on our current understanding of the ecological and cultural response to flow in the SA MDB
- Development of an adaptive management framework that can be used to guide future research and monitoring programs and decisions about environmental water provisions

E.1.8. Riverbank Collapse

Project Lead: Prof. Mark Jaksa, Adelaide University
Project Partners: Adelaide University, DEWNR, University of Sydney, Durham University
Status: Commenced January 2013
Understanding riverbank collapse to inform management

Project Overview

A systematic process of risk management to date has identified a number of critical knowledge gaps in understanding hazard dynamics. This research project focuses on addressing fundamental knowledge gaps of collapse processes which is affecting DEWNR's ability to accurately and reliably assess the likelihood of failure events and riverbank collapse risk. The outcomes of this research will support DEWNR in developing a long-term management strategy for riverbank collapse and identify changes that are required to development planning guidelines and legislation to reduce the likelihood of future risks associated with riverbank collapse events.

Research Highlights

A literature review and knowledge gap analysis has been completed as is available as a Goyder Institute Technical report. The University of Adelaide team have undertaken the back analyses of historical riverbank collapse events. The numerical simulation examined the effects of temporal climatic and river level fluctuations on riverbank stabilities. The results have shown that riverbanks will remain stable in static conditions and the riverbank collapses are caused by dynamic events such as extreme rainfall and large river fluctuations. These numerical models have shown promising predictive capabilities and there is significant potential application for modelling various flow scenarios at a number of sites along the River Murray, both downstream and upstream of Lock 1, to assist in the management of river flows and to optimise environmental and riverbank stability constraints.

E.1.9. In-Channel EWRs

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University, CSIRO, DEWNR
Status: Completed
Development of ecological objectives and ecological targets for the River Murray in-channel functions and assets.

Project Overview

This project will contribute to the development of the first draft of the long-term watering plan for the South Australian River Murray water resource area (SA River Murray LTWP), which is a requirement under Chapter 8 (Environmental Watering Plan) of the Basin Plan. Sound State long term environmental watering plans and annual watering priorities, based on best available science, will be instrumental in supporting the allocation of environmental water to South Australian River Murray environmental assets.

Research Highlights

The information generated has informed the first draft of the SA River Murray LTWP which in turn facilitates the development of the state's annual environmental water plan. This project has contributed directly to DEWNR planning for environmental water management. One highlight was the new hydrological modelling undertaken by SA Water to determine the hydrological metrics with distance from a river regulator (weir). This gave a better understanding of where along a river reach the conditions become optimum (closest to non-regulated) to achieve the required ecological outcomes.

E.1.10 SDL Adjustment Mechanism

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University
Status: Completed
Science review of the benefits and risks of the adjustment methodology for South Australian ecosystems

Project Overview

Experts from the Goyder Institute for Water Research have been engaged to provide eco-hydrology advice on the development of the ecological elements of the SDL adjustment method. The Goyder expert advice will supplement the Department's technical expertise and will assist the Department's representatives on the Ecological Elements Inter-jurisdictional Technical Panel to provide constructive and informed feedback on the science informing the development of the method.

E.1.11 Modelling Floodplain Salt Dynamics

Project Lead: Dr Juliette Woods, NCGRT
Project Partners: Flinders University, CSIRO, DEWNR
Status: Active, Commenced Jan 2014
Representation of floodplain salinity processes to inform floodplain and river salinity management

Project Overview

A major outcome of the Basin Plan is to deliver environmental flows to help protect and restore River Murray wetlands and floodplains. This project will use The MODFLOW-based Salinity Register models, BIGMOD and SOURCE to understand the short-term movement of water and salt within the floodplain landscape, under present conditions and under various management options for delivering environmental water. It will also increase floodplain modelling capacity of DEWNR staff to allow DEWNR to internally assess different management options for delivering environmental water.

The key outputs are:

- A literature review of prior studies and existing datasets to prioritize river reaches and floodplain processes and to establish a salinity risk framework.
- An examination of key floodplain processes to determine how DEWNR can simulate these in-house.
- Development of MODFLOW and Source pilot models to simulate River
- Murray and floodplain dynamics
- Prioritisation of modelling improvements required to inform targeted data collation and scientific studies.

E.1.12 Operating Environmental Infrastructure on SA Floodplains

Project Lead: Dr Todd Wallace, Adelaide University
Project Partners: University of Adelaide, DEWNR, MDBA, SA Water
Status: Active, Commenced Jan 2014
Knowledge to underpin the management and operations of infrastructure on floodplains for environmental outcomes

Project Overview

There has been significant investment (~$M60) the Chowilla Environmental regulator and ancillary structures as infrastructure to restore the condition and ecological function of the Chowilla Floodplain. The Chowilla Operations Plan and initial operations of the regulator and ancillary structures will be heavily reliant on untested models that predict the impact the infrastructure will have on water quality on the floodplain. This project will enable the testing of our understanding regarding key areas of risk management and testing of the effectiveness of risk mitigation measures during early operations of the Chowilla infrastructure. It will enable validation and calibration of the models used in the development of the operations regimes and the risk management approaches. This project will validate and, if necessary, calibrate the 1D-2D Mike FLOOD hydrodynamic model used to predict water exchange and changes to hydraulic habitats on the floodplain.

E.1.13 Monitoring Strategy for Environmental Water

Project Lead: Dr Deborah Furst Adelaide University
Project Partners: DEWNR
Status: Active, Commenced Jan 2014
Expert advice to identify appropriate measures to inform a monitoring and reporting program to assess the outcomes of environmental watering

Project Overview

The ability to demonstrate environmental outcomes achieved through the delivery of the environmental water under the MDBP will be a key measure of success for the Basin Plan implementation in South Australia. Under the Basin Plan South Australia, through DEWNR, is required to report on:

- Reporting Matter 8: Achievement of environmental outcomes at an asset scale.
- Reporting Matter 9: Identification of environmental water and the monitoring of its use.

This project will support the establishment of a set of monitoring measures, environmental water reporting processes and a draft template for monitoring defined environmental outcomes The template will include guidelines for reporting and interpreting monitoring information.

E2 – Surface Water, Groundwater, Wetland Relationships

E.2.1 South-East Urgent Monitoring program

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI
Status: Completed
Detecting salinity thresholds of aquatic plants in the South-East.

Project Overview

For the management of wetlands and the drainage network in the South-East, there is a critical need to identify salinity threshold values for the condition of wetland ecosystems. This project harnesses the occurrence of the 2010 wet season in order to fill this knowledge gap. Field and laboratory investigations were carried out, utilising the natural north-south salinity gradient that exists in the South-East.

Research Highlights

This project produced a database to support policy decisions of the state government, particularly in relation to the provision of environmental water to support ecological outcomes.

E.2.2 South-East Wetlands and Groundwater Research program - Phase 1

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, Flinders University, NCGRT, CSIRO, SARDI
Status: Completed
A research program to support the sustainable management of water in the South-East.

Project Overview

This project was identified as a priority to:
1. Develop a conceptual model of how the hydrology, water use, land use and ecology interact – based on recent research undertaken in this region and to use best-practice science to determine how a decision support system can be used to inform policy development;
2. Improve the understanding of the relationship between groundwater and drains in the South-East and how this varies in time and space;
3. Evaluate the utility of trace techniques in understanding and quantifying this process in the region; and
4. Install monitoring infrastructure in the newly constructed REFLOWS floodway prior to the release of floodwaters.

Members of the South-Eastern Water Conservation and Drainage Board were involved in planning the fieldwork for this project. The infrastructure investment at two key sites enabled detailed assessments of how interactions between groundwater and drains change in time and vary with land use to assist in water management and planning for the South-East.

Research Highlights

This project produced an extensive literature review of current science and knowledge to form one basis for further work in the South-East region and has developed a decision support framework that draws on new science techniques that could be incorporated into the decision support frameworks used for water management in South Australia. It has also investigated the connectivity of surface and groundwater along drains of the SE, using a recently cut drain as a study site, by undertaking field work at two sites and conducting a reconnaissance assessment of the surface water-groundwater connection across the SE region. Preliminary results from this project showed potential for future application of methods to identify connectivity between surface water and groundwater but further refinement and data is needed.

E.2.3.Regional Groundwater Balance

Project Lead: Dr Sebastien Lamontagne, CSIRO
Project Partners: CSIRO, Flinders University, DEWNR,
Status: Completed
Development of a framework for a regional groundwater flow model for the Lower Limestone Coast region.

Project Overview

This project will lay the foundations for the development of a regional water balance model, to facilitate future water allocation planning for the Lower Limestone Coast region in the South-East of South Australia. It includes:

- Development of a regional water balance framework;
- A preliminary assessment of the spatial variability and indicative fluxes of groundwater discharge to the marine environment;
- Assessment of the role of geological faults on regional groundwater flow and inter-aquifer leakage.

Research Highlights

A framework was developed for a regional groundwater model that will support water resources management for the Lower Limestone Coast PWA. This model will cover the entire Gambier Basin and part of the western Murray Basin, including part of western Victoria as it is designed to be governed by natural flow boundaries. The framework includes the model design, boundary conditions and strategies for implementing difficult parts of the conceptual model, including the man-made drainage system and coastal boundary. The framework also includes the datasets required to support the model development. In many cases this was the first time such information has been collated for the whole regional flow system.

E.2.4. Improved modelling of catchments and drains.

Project Lead: Dr Matt Gibbs, Adelaide University
Project Partners: Adelaide University
Status: Active, Commenced May 2012
Improving the ability to estimate flow volumes of drains in the SE drainage network.

Project Overview

The need for an enhanced method accounting for the ecological response of the South East wetlands has been identified by DEWNR to provide more scientific rigour to the decision making process for water diversions from the drains. As a basis for this method, an accurate conceptual representation of the hydrology of the drainage network is required to inform the decision making process, on aspects including water availability, the volumes required to meet desired objectives, and as an input to ecosystem response modelling. This project aims to extend existing modelling of the Upper South East catchments and drainage network to include interaction with recharge and groundwater processes. The resulting models will be fit for the purpose of ecological response modelling and integration into the Drain Operation DSS and decision making processes.

Research Highlights

Initial results of the statistical modelling component of this project indicate that novel inputs including remotely sensed soil moisture and modelled rainfall forecasts provide valuable information for forecasting flows in the upcoming month. Investigation into subset selection methods is being carried out to better address this difficult issue and ensure the best subset of inputs are selected from a wide range potential model inputs (including different catchment wetness and climate information) for the statistical model.

Changes in runoff model parameters, to represent declining trends in streamflow, have been related to changes in groundwater level to allow these trends to be simulated based on a trend in groundwater level.

A Source model of the drainage network considered for the project has been completed.

E.2.5 Wetlands in SE

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI
Status: Active, Commenced February 2013
Understanding the response of wetland ecosystems in the South East to changes in water quantity and salinity.

Project Overview

This project will provide information on wetland ecosystem response to changes in water quantity and quality (salinity). This information will be available to be used to inform future water allocation planning and management in the South-East region and decisions regarding directing water to wetlands through the drainage and floodway system by providing an understanding of the response of various wetland types to altered hydrological conditions.

Research Highlights

A draft report describing each of the case-study sites has been completed, including a review of available data and a synthesis of relevant wetland classification systems. Preliminary analysis of the MODIS NDVI (greenness) temporal data has been conducted as well as digitisation of the vegetation community from 2008 aerial photography is complete, with digitisation of vegetation community from 1969 imagery now underway. The initial two rounds of field surveys are complete, including the provision of data to the spatial analysis group for validation of spatial imagery and inclusion in the spatial database.

The project team have established a working relationship with key stakeholders in the region that has proven to be a valuable avenue for engaging with a broad range of stakeholders regarding communicating outcomes of the research and assistance with accessing relevant data.

E.2.6 SE Regional Water Balance Phase 2

Project Lead: Dr Nikki Harrington, NCGRT
Project Partners: CSIRO, NCGRT
Status: Active, Commenced January 2014

Project Overview

Groundwater in the SE is one of the major factors affecting the viability of agriculture and industry, and ecosystem health. Effective management of surface water and groundwater availability and quality requires accurate modelling of the groundwater system and its interactions. Phase 1 of this project concluded that a framework of integrated models at various scales was required for water resources management in the SE. Phase 2 will involve the following tasks:

- Construction of the regional water balance model.
- A detailed assessment of recharge and modelling.
- Modelling of groundwater – wetland connectivity.

E.2.7 SE Environmental Risks

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI, Flinders University, SEWCDB, EPA
Status: Active, Commenced June 2014

Project Overview

This project will determine the causes of high alkalinity in water moving through the SE drainage system that drain into Ramsar wetlands. Elevated alkalinity has caused a reduction in presence and abundance of key wetland species. Mitigation strategies to manage elevated alkalinity through management of the agricultural practices or the operations of the drainage network will be investigated. The nutrient budget and sources of nutrients to the Ewens and Piccaninnie Ponds will also be modelled. Management guidelines will be developed and actions identified to reduce the risks of elevated alkalinity and nutrients in drainage water in the region.