GOYDER INSTITUTE FOR WATER RESEARCH CASE STUDY 1

BOX 1 GOYDER INSTITUTE FOR WATER RESEARCH - EXECUTIVE SUMMARY

Key findings

The Goyder Institute's research for the G-FLOWS project has led to the refinement of techniques used to reinterpret airborne electromagnetic data. This, in turn, has enabled the development of detailed groundwater surface maps of the Eyre Peninsula and Musgrave Province in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands. .

Innovation impact

The following elements of G-FLOWS were new or innovative:

- Development and refinement of hydrogeological methodologies (airborne electromagnetic, nuclear magnetic resonance).
- Development of region-specific hydrogeological models for Musgrave Province and the Eyre Peninsular.
- Development of a processing and inversion strategy for overlapping historical and contemporary electromagnetic data.

This case study uses the evaluation framework outlined in the CSIRO Impact Evaluation Guide. The results of applying that framework to the Goyder Institute for Water Research case study are summarised in **Figure 1.1**.

FIGURE 1.1 GOYDER INSTITUTE FOR WATER RESEARCH CASE STUDY – IMPACT FRAMEWORK DIAGRAM

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACTS
Cash and or in kind support from: – CSIRO – FUSA – University of Adelaide – SARDI – DEW – DSD PACE and Geological Survey of SA – PepinNini.	– Airborne electromagnetic surveys – Development of hydrogeological framework – Targeted data acquisition, interpretation and mapping, and ground-based hydrogeological investigations	– Development and continued refinement of the hydrogeological framework – Publications: and technical reports – Finalist at the Australian Mining Prospect Awards 2014 Expected outputs: – A probabilistic groundwater modelling package – Economic development of the APY Lands	– Continued Goyder Institute funding for G-FLOWS stages 2 and 3 – Identification of high yield, deep water sources in the APY Lands – Built trusting relationship with local Indigenous communities – Reduced risk for mining exploration – Understanding of groundwater system complexity	– Reduced need for exploratory drilling for water and minerals (reduced cost and impact on communities and environment) – Improved water security for remote Indigenous communities – Opportunities for mineral exploration and economic development of the region (mining and the pastoral industry).

SOURCE: ACIL ALLEN CONSULTING

1.1 Purpose and audience for case study

This case study describes the economic, environmental and social benefits arising from the Goyder Institute for Water Research.

This evaluation is being undertaken to assess the positive impacts arising from the Goyder Institute for Water Research project undertaken by CSIRO. However, it can also be used to inform a range of other stakeholders. The case study can be read as a standalone report or aggregated with other case studies to substantiate the impact and value of the Land & Water (L&W) Business Unit's activities as a whole relative to the funds invested in these activities.

This information in this case study is provided for accountability, communication and continual improvement purposes. This case study is primarily intended to be an input into the independent review of the L&W Business Unit however other audiences for this report may include Members of Parliament, Government Departments, CSIRO and the general public.

1.2 Background

In 2010, South Australia (SA) had experienced a prolonged drought. There were concerns regarding the equitable distribution of water through the Murray Darling Basin system and growing recognition of the need to adopt legislative changes to the *Water Act 2007*. In response, the SA government allocated new funding to establish and operate the Goyder Institute for Water Research (Goyder Institute) to enhance SA water security and the capacity of the SA government to deliver science-based policy and water management outcomes. The Goyder Institute's activities are adaptive in order to meet the evolving priorities of the SA government.

The Goyder Institute is administered by Department for Environment and Water (DEW, formerly DEWNR) and is a partnership between the SA Government (led by DEW and the Department of State Development (DSD)), CSIRO, International Centre of Excellence in Water Resources Management and the three Adelaide-based universities: University of South Australia, Adelaide University and Flinders University. The Goyder Institute has three associate organisations: South Australian Research and Development Institute (SARDI), National Centre for Groundwater Research and Training and SA Water.

The Goyder Institute was initially funded for 5-years from 2010 to 2015 (Goyder 1). During this time, the Goyder Institute undertook 46 projects to the value of $43.9 million. In 2015, a business case for additional funding was developed and this led to renewed funding for 2015 to 2020 (Goyder 2). Goyder 1 focussed on research projects organised under four research themes: urban water, water for industry, environmental water and climate change. Goyder 2 has three research themes: economic development (three research projects), healthy ecosystems (two research projects) and climate action (five research projects).

One research project conducted during Goyder 1 and 2 was selected for more detailed analysis for this case study, namely: Facilitating Long-Term Outback Water Solutions (G-FLOWS).

G-FLOWS aims to locate, define and quantify groundwater resources in key areas of the state, including priority mineral prospective zones, across the Musgrave Province, the north east and north west Gawler Craton, parts of the Frome Embayment in the east, and the northern Eyre Peninsula. Limited water in these regions threatens the sustainability of regional communities and the resources sector, both of whom rely primarily on groundwater aquifers for human water consumption, mining (ore-processing, slurry transport and dust suppression) and the maintenance of environmental and cultural assets. Further, water is critical to the planned expansion of the resources sector, through the DSD's Plan for Accelerating Exploration initiative 2020 (PACE), which is intended to generate significant economic value to South Australia. G-FLOWS supports the PACE initiative.

The project was conducted in three stages: G-FLOWS Stage-1 (2011-12), G-FLOWS Stage-2 (2014-15) and G-FLOWS Stage-3 (2016-19). This case study will focus on G-FLOWS 2 and 3.

1.3 Impact Pathway

1.3.1 Project Inputs

The total cost for G-FLOWS Stages 1, 2 and 3 was about $11.45 million in cash and in-kind contributions (see **Error! Reference source not found.**). CSIRO contributed $5.99 million in cash (around 52 per cent of the total cost). Other contributors were: Flinders University of South Australia (FUSA), DEW, DSD (previously the Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE)) and PepinNini Lithium Limited (PepinNini).

TABLE 1.1 SUPPORT FOR G-FLOWS 1, 2 AND 3

Contributor / type of support	G-FLOWS 1		G-FLOWS 2		G-FLOWS 3		
	2010-11 ($)	2011-12 ($)	2013-14 ($)	2014-15 ($)	2016-17 ($)	2017-18 ($)	2018-19 ($)
Cash							
CSIRO	74,227	1,313,667	371,003	271,477	180,000	610,950	175,000
FUSA		45,109	187,575	119,316	75,000	200,000	189,800
University of Adelaide		59,200	36,836	11,578			
SARDI		35,791					
DEW					1,050,000	365,000	58,650
DSD – PACE initiative					1,530,000		
In-kind							
CSIRO	469,305	918,587	466,903	175,578	190,524	765,096	10,319
FUSA		45,109	187,578	119,313	72,572	364,930	27,282
University of Adelaide		45,109	36,837	11,577			
SARDI		35,792					
DEW					106,816	302,814	64,063
DSD – Geological Survey of SA						49,800	
PepinNini						20,000	
Sub Total	543,532	2,498,364	1,286,732	708,839	3,204,912	2,678,590	525,114
Total	**11,446,083**						

1.3.2 Project activities

G-FLOWS Stage 1 reinterpreted small-scale airborne electromagnetic (AEM) data obtained through the mineral industry. Additional geologic and landscape information was used to develop a hydrogeological framework to identify groundwater resources in palaeovalleys.[1]

G-FLOWS 2 and 3 have built on the foundations established during G-FLOWS 1, drawing on more extensive and precise AEM data collection, topographical information, existing SA geological (through DSD and Geosciences Australia) and hydrogeological data (through DEW) and targeted ground-based hydrogeological investigations. The aim was to reduce uncertainty in groundwater resource characterisation through improved geophysical interpretation techniques and a repeatable methodology that integrates datasets to identify and characterise groundwater resources.

Key activities from G-FLOWS 2

G-FLOWS 2 refined the AEM interpretation technique, focussing on groundwater resources in the Eyre Peninsula. This region was prioritised by the mining industry for mineral exploration and potential mine development. The project aimed to calibrate the redeveloped hydrogeological maps using existing abundant mining information and by conducting ground-based hydrogeological investigations. However, this was complicated by limited groundwater information in the region combined with largely dry or unused holes.

Key activities from G-FLOWS 3

G-FLOWS 3 involves a targeted program of data acquisition, interpretation and mapping, and ground-based hydrogeological investigations to characterise and quantify groundwater resources and mineral deposits in the Musgrave Province in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands. This work will extend the AEM geophysical interpretation by calibrating and validating data analysis through exploratory drilling.

— DSD through the PACE initiative

[1] Ancient buried river valleys.

— DEW, CSIRO and PepinNini for the acquisition and processing of new AEM data.

1.3.3 Project outputs

The major outputs from G-FLOWS 2 and 3 include the development and continued refinement of a hydrogeological framework to enable finer-scale identification and assessment of groundwater resources. This has necessitated the refinement of techniques to reinterpret AEM data and the development of detailed groundwater surface maps that provide important inferences about the scale, nature and behaviour of the dominant groundwater flow systems. These outputs have occurred as a result of cooperation and information exchange between government (DEW, DSD through the PACE initiative), industry (PepinNini) and research stakeholders.

While the research is ongoing, the key outputs to date from G-FLOWS 3 are expected to include:

- A probabilistic groundwater modelling package that links AEM data to a repeatable methodology that integrates datasets to identify and characterise groundwater resources. This modelling package is unique. It will guide low-risk assessment of groundwater resources in data poor regions. It can also be applied elsewhere in Australia and overseas in areas where valuable water resources are hidden by deep sediments and cover. This aims to increase the chances of finding water and identify locations where data coverage should be improved.
- Economic development of the APY Lands, including employment opportunities for the APY Lands community through agricultural development.
- Reduced exploration risks faced by potential developers of minerals resources, allowing for faster and better-informed decision-making and more robust feasibility studies.

Publications

G-FLOWS 2 resulted in the publication of five journal articles, 15 conference publications (including two keynote presentations), two conference posters, one magazine article, two honours theses and three technical reports.

As G-FLOWS 3 is still underway, the outputs are likely to be realised over the next few years. To date, the project has produced one conference publication and one technical report. Further publications are in preparation.

Awards

G-FLOWS was a finalist in the "Innovative Mining Solutions" category for the Australian Mining Prospect Awards, 2014 (Innovative Mining Solutions).

Innovation / commercialisation

To date, the commercialisation outputs of the G-FLOWS project have been limited, with no patents or licences. There has however, been ongoing and regular engagement with PepinNini which has exploration leases in the APY Lands. G-FLOWS project members have been involved in ongoing briefing of APY Lands executives since 2015 and briefed the Aliytijara Wiluara Natural Resources Management Board twice, in 2017 and 2018.

G-FLOWS project members provided regular briefings to the former State Government Mining Infrastructure Task Force on G-FLOWS 1 and 2, which identified water access as an infrastructure constraint for mining development. This Task Force contained representatives from the mining and private sectors, and members from the State Economic Development Board. G-FLOWS 1 project members also presented to an international mining conference in Brisbane 2014 and to annual mining conferences in Whyalla in SA.

Over the course of the G-FLOWS project, the technologies and methodologies have been refined and deployed on a large scale. This includes the hydrogeological methodologies (AEM, NMR[2]), region-specific hydrogeological models (i.e. for Musgrave Province and the Eyre Peninsular) and the development of a processing and inversion strategy for overlapping historical and contemporary electromagnetic data affected by system uncertainties and errors. This strategy can be directly applied elsewhere in Australia and overseas, however there are no plans for commercialisation.

1.3.4 Project Outcomes

The outcomes from Goyder Institute projects conducted between 2010-15 were reviewed in 2015. This included G-FLOWS 1 and the initial contributions of G-FLOWS 2. The resulting Business Case provided the basis for a successful application to continue funding for the Goyder Institute through to 2020. One CSIRO official commented:

[2] Nuclear magnetic resonance is the only geophysical technique that directly detects subsurface water. Surface NMR combined with electromagnetic and resistivity testing, allows possible estimates of likely cover thickness and groundwater quality.

This is perhaps the most successful demonstration of the impact of the Goyder Institute and was the only New Policy Proposal in the environment portfolio to be granted renewed funding.

Stakeholder discussion 23 March 2018

Further funding enabled the Goyder Institute to pursue G-FLOWS 3. In addition, one of the significant outcomes of G-FLOWS 1 and 2 was the DEW's $1 million funding support provided to the Goyder Institute to support the APY Lands AEM data collection and analysis, a key input to G-FLOWS 3.

The refined data integration processes and the hydrogeological framework generated from this stage of the project are expected to improve the probability of successful drilling to provide water to remote communities in South Australia's arid regions. These techniques have been used to identify secure groundwater supplies for Indigenous communities and potential agricultural development in the Musgrave Province in the APY Lands.

From July 2015-November 2017 groundwater investigations were conducted by DEW for six aboriginal community water supplies. The sites were selected due to overlapping geophysical features; a broad east-west trending geophysical magnetic low identified by the regional total magnetic intensity (TMI) data and a deep (50m+) conductive AEM feature. A significant water supply was identified, and at one site reached 56m depth, deeper than previously experienced in the APY Lands.

The community water work was required to provide 1.32Ml/d and the investigations yielded 6.5ML/d. This finding has increased the security and availability of the water supplies, as water can now be sourced from deeper aquifers thereby reducing the demand on the more sensitive shallow aquifers.

AEM is a non-invasive and cost effective method for improving success rates on a regional scale particularly given the remote and relatively unexplored nature of the APY Lands… Based on this analysis future work will utilise the GFLOWS approach to groundwater investigation utilising AEM airborne data as the primary tool to design the drilling programs, as we expect this to reduce the overall costs and success rate in locating suitable water yields.

DEW

Researchers have built trusting relationships with local communities, which is critical for future potential research and development.

The G-FLOWS advances have reduced the exploration risks faced by potential developers and investors, allowing for faster and better-informed decision-making and more robust feasibility studies. The value to the mining industry of the newly developed processing and inversion strategy was recognised by Investigator Resources LTD in a statement to the Australian Stock Exchange on 4 March 2014, which stated that:

Using a state-of-the-art electromagnetic system, CSIRO and the State Government will not only provide valuable research on groundwater systems, they will also contribute to the upgraded mineral potential of the northern Eyre Peninsula.

Managing Director Mr John Anderson

G-FLOWS supports the South Australian Government's PACE initiative, the ongoing research and collaborative efforts of the Geological Survey of South Australia and the South Australian Copper Strategy, which aims to increase SA copper commodity exports. The success of the hydrogeological framework has stimulated industry exploration including:

- PepinNini is the current sole mineral explorer operating in the Musgrave Province (exploring for copper, nickel and silver). PepinNini has conducted exploration of the Musgrave Province (31,000km^2) in collaboration with CSIRO, Geoscience Australia, Goyder Institute, and the DSD. PepinNini identified three priority water targets requiring further investigation.
- Investigator Resources LTD is collaborating with the Goyder Institute (through G-FLOWS), CSIRO, DSD and DMITRE to conduct AEM surveys in the Eyre Peninsular. These surveys will improve the understanding of the region and aid in the prioritisation of silver, lead and copper targets. The 2014 Investigator Resources statement to the Australian Stock Exchange cited the Goyder Institute FLOWS project.
- The AEM data integrated during G-FLOWS includes SkyTEM surveying. SkyTEM has been shown to correlate with borehole and ground EM data in Ord Valley, and in the Gascoyne River region, both in Western Australia (WA).
- G-FLOWS has improved the conceptual understanding of the complexity of groundwater in the northern Eyre Peninsula, through analysis of isotopes/tracers. This suggests that local groundwater flow system processes are dominant in the region.

1.3.5 Adoption

The primary user of the Goyder Institute's research outputs is the South Australian Government (particularly DEW and DSD) and the mining industry (PepinNini, Investigator Resources Ltd). The research is fit-for-purpose and is likely to be easily adopted due to the demand-driven nature of the work and its alignment with government priorities. Current and future land-based exploration will continue to be used by Goyder Institute researchers to calibrate and refine the hydrogeological framework. This will assist its uptake by government and the mining industry.

Use of the hydrogeological framework currently requires the user to collaborate with the Goyder Institute and CSIRO. Commercialisation of the hydrogeological framework will necessitate the development of a self-contained package that is able to integrate data and produce results with little external supervision. There are no plans for the commercialisation of this package.

Recent drilling information obtained in the APY lands by DEW is intended to be made available to the water and mining sectors:

"As a proof of concept for application of the technology elsewhere to support the SA Copper Strategy and the Magnetite Strategy with direct application to the uranium industry, which utilises in-situ leach mining within palaeovalleys."

DEW

1.3.6 Impacts

The techniques and technologies developed through G-FLOWS has improved targeting of land-based exploratory drilling for water and minerals.[3] This will reduce impact to communities and the environment, and reduce the costs of mineral exploration. The 2015 business case suggested that G-FLOWS 1 resulted in $25 million reduction in drilling costs to the mining industry. A summary of the assumptions made is detailed in **Box 1**.

As discussed in Section 1.5, this case study assumes current annual drilling expenditure in Australia of $40 million and a 5 per cent growth in such expenditures each year. Assuming the G-FLOWS research results in a 10 per cent potential reduction in future drilling expenditures over the next 10 years, the present value of the projected reduction in future drilling expenditures is estimated at $20.3 million in 2017-18 dollars under a 7 per cent real discount rate.

BOX 1 THE ESTIMATED VALUE OF G-FLOWS 1 TO THE MINING INDUSTRY

The value of the research is based on the following assumptions:

- The research results in a 10% reduction in the number of wells drilled by mining companies in South Australia.
- The annual average drilling expenditure (direct costs) in South Australia (new mines only) is $40 million per annum. Thus, the research results in a maximum potential saving of $4 million per annum.
- The maximum adoption rate by is 75% (i.e. a benefit of $3 million per annum).

The net present value is $25 m over 15 years, at a discount rate of 5%.

SOURCE: THE GOYDER INSTITUTE FOR WATER RESEARCH FINAL BUSINESS CASE 16 APRIL 2015. DELOITTE TOUCHE TOHMATSU PTY LTD.

The research and development conducted by the Goyder Institute has provided a mechanism to improve the likelihood of discovering water resources. This will provide a huge benefit to mineral explorers, communities and the environment, including reducing the costs of delivering water to communities. In the APY Lands, a secure water supply was identified for remote communities using AEM data. This yielded 6.5ML/d, 4.9x the original objective of 1.32Ml/d. Currently, water in the APY Lands is sourced from fractured rock aquifers or shallow sediments to depth generally below 50m. This is used for town water (drinking, domestic and commercial uses), while bore water is used to support the developing cattle pastoral industry. These shallower sources are more dependent on annual rainfall recharge and therefore are more at risk to being depleted or providing lower supplies, which may not meet the communities water demands.

The newly identified larger supplies are deeper groundwater sources (around 100m) and provide more reliable annual supplies, including higher demand in summer and periods of lower annual rainfalls. Other than these sources, there are no other water sources available. If theses supplies could not be located (or the shallower sources dried up during low rainfall) then the water available to the communities would be constrained, reducing resulting in health and other quality of life issues.

The APY Lands region is also a prospective area for mineral exploration and potential mine development, both requiring water supplies. By understanding the local groundwater systems, the security of community water supply can be protected from the impact mining.

G-FLOWS is providing support to the PACE Copper initiative. This is a critical upstream component of South Australia's strategy to drive the discovery of the new high-quality copper resources. The initiative aims to increase South Australia's copper production from 283,098 tonnes, worth over $2 billion (2012-13) almost four-fold to 1 million tonnes per annum by 2030. The present value of this benefit of accelerated copper production over the next 10 years is estimated at $969.7 million in 2017-18 dollars (see Section 1.5).

[3] AEM data generated during G-FLOWS 3, namely using SkyTEM platform, can identify buried mineral systems. The resulting subsurface conductivity maps can inform drilling for minerals.

G-FLOWS has created benefits to universities, including research jobs and collaboration, publications, continued investment in research in this space.

1.3.7 Potential future impacts

The success of the G-FLOWS project has driven the South Australian Governments' interest in making further investment in water research.

This modelling technique can be adopted across Australia, particularly in regions where there is uncertainty about water resources and poor data availability currently prevents better prediction of drilling outcomes. ACIL Allen has assumed that improved data resolution and mapping in South Australia will reduce the need for exploratory drilling. Communities will also gain a better understanding about whether their water supply is secure and sustainable, and can plan accordingly.

1.4 Counterfactual and Attribution

1.4.1 Counterfactual

Had CSIRO not identified the need for future water research capabilities, and, in collaboration with the SA Chief Scientist, lobbied the South Australian Government to provide funding for the Goyder Institute, it is unlikely this research would have proceeded. This investment was crucial to the success of the Goyder Institute. A Goyder Institute official commented:

If it hadn't been for CSIRO there is a high probability that this work wouldn't have been done.

Stakeholder discussion 23 March 2018

The work of CSIRO Mineral Resources is highly regarded with good links to industry, companies and government agencies.

Goyder Institute Technical Report Series No. 15/49

1.4.2 Attribution

While, as noted above, the Goyder Institute is unlikely to have even be established without the work of CSIRO officials, others have contributed to both the establishment of the Institute and the research that it has done. We therefore propose to attribute 50 per cent of the benefits that flow from the outcomes from this project to CSIRO.

1.5 Evaluating the Impacts

1.5.1 Cost-Benefit Analysis

Costs

Based on the annual costs presented previously in **Table 1.1** (subsequently adjusted for inflation), the present value of total R&D costs for G-FLOWS Stages 1, 2 and 3 is $15.02 million in 2017-18 dollars under a 7 per cent real discount rate.

Benefits

ACIL Allen has analysed the benefits of the G-FLOWS R&D project in relation to a reduction in future drilling expenditures and to an acceleration of the PACE Copper initiative in stimulating additional copper production in South Australia. There is insufficient data to quantify and monetise the benefits of G-FLOWS in terms of delivering additional water to communities in the APY Lands.

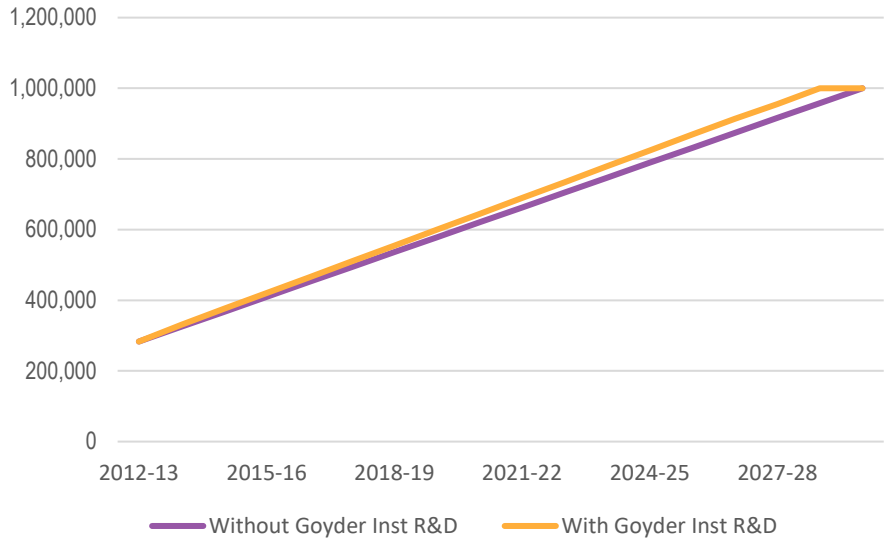
Reduction in drilling expenditures

Assuming current annual drilling expenditure in Australia of $40 million and a 5 per cent growth in such expenditures each year, and assuming that the G-FLOWS research results in a 10 per cent potential reduction in future drilling expenditures (of which 15 per cent of this reduction i.e. 1.5 per cent is realised in FY2018, 30 per cent in FY2019, 45 per cent in FY2020, 60 per cent in FY2021 and 75 per cent thereafter), the present value of the projected reduction in future drilling expenditures over the next 10 years that is attributable to the G-FLOWS research is estimated at $20.3 million in 2017-18 dollars under a 7 per cent real discount rate.

Acceleration of PACE Copper initiative

As discussed previously in Section **Error! Reference source not found.**, the PACE Copper initiative aims to increase South Australia's copper production from 283,098 tonnes in 2012-13 almost four-fold to 1 million tonnes per annum by 2030. It is assumed that this increase is linear and that the G-FLOWS research enables the expansion to be brought forward by one year (see **Figure 1.2**). The present value of this benefit of accelerated copper production over the next 10 years is estimated at $969.7 million in 2017-18 dollars under a 7 per cent real discount rate, assuming a copper value of $7,320 per tonne in 2017-18 dollars and that 20 per cent of the value of copper production is "leaked" out of the Australian economy due to foreign-sourced inputs..

FIGURE 1.2 COPPER PRODUCTION IN SOUTH AUSTRALIA UNDER PACE COPPER INITIATIVE, 2012-13 TO 2029-30 (TONNES)



SOURCE: ACIL ALLEN CONSULTING CALCULATIONS

Assessment of benefits against costs

The present value of total benefits from G-FLOWS Stages 1, 2 and 3 is projected to be $990 million in 2017-18 dollars under a 7 per cent real discount rate. The net present value (NPV) of G-FLOWS Stages 1, 2 and 3, obtained by subtracting the present value of costs from the present value of benefits, is thus projected to be $974.9 million in 2017-18 dollars under a 7 per cent real discount rate. The benefit-cost ratio (BCR), obtained by dividing the present value of benefits by the present value of costs, is estimated at 65.9.

Sensitivity analysis

In the central case of the cost-benefit analysis, it is assumed that drilling expenditure in Australia grows by 10 per cent a year. If the growth rate of drilling expenditure is 8 per cent a year instead, the BCR increases from 65.9 to 66.3. Conversely, if the growth rate is only 2 per cent a year, the BCR decreases to 65.7

In the central case of the cost-benefit analysis, it is assumed that G-FLOWS reduces annual drilling expenditure by 10 per cent. If G-FLOWS reduces annual drilling expenditure by 20 per cent instead, the BCR increases from 65.9 to 67.3. Conversely, if it reduces annual drilling expenditure by only 5 per cent, the BCR decreases to 65.2.

In the central case. It is assumed that G-FLOWS enables the expansion of copper production in South Australia under the PACE Copper initiative to be brought forward by one year. If the expansion is brought forward by two years as a result of G-FLOWS, the BCR increases very considerably from 65.9 to 139.1.

In the central case of the cost-benefit analysis, it is assumed that 20 per cent of the value of copper production in South Australia is "leaked" out of the Australian economy due to foreign-sourced inputs. If the leakage rate is 10 per cent instead, the BCR increases from 65.9 to 74.0. Conversely, if the leakage rate is 30 per cent, the BCR decreases to 57.8.

In the central case of the cost-benefit analysis, a 7 per cent real discount rate was used. The BCR increases from 65.9 to 93.0 under a 3 per cent real discount rate and decreases to 51.6 under a 10 per cent real discount rate.

1.5.2 Externalities or other flow-on effects on non-users

The community benefits of this work include improved water security and sustainability for remote Indigenous communities, economic benefit arising from agricultural development (cattle pastoral industry) and reduced environmental impacts associated with exploratory drilling.