**FINAL REPORT**  OCTOBER 2017

# Economic effects of the Commonwealth water recovery programs in the Murrumbidgee Irrigation Area

Report prepared for the Department of Agriculture and Water Resources

MARSDEN JACOB ASSOCIATES

Authors:   Gavan Dwyer
           gdwyer@marsdenjacob.com.au
           Matthew Clarke
           mclarke@marsdenjacob.com.au
           Rod Carr
           rcarr@marsdenjacob.com.au

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# Executive summary

This report estimates the local and regional economy effects of Australian Government water recovery programs intended to Bridge the Gap under the Basin Plan in the Murrumbidgee Irrigation Area (MIA) of New South Wales.

The investment of the Commonwealth in construction activities through PIIOP and OFIEP has a significant effect on local value added particularly the years during and immediately following the investments. The effects of the infrastructure investment continue to 'wash through' the local economy for many years. The ongoing on-farm productivity gains from the investments supplement these gains and collectively bolster the local economy.

The water purchases program is generally expected to be neutral in terms of its immediate first round economic effects. However if revenues from purchases were to 'leak' from the region in the form of capital transfers the effect of this would be relatively minor compared to the estimated size of gains from the PIIOP and OFIEP programs.

## Long term whole of regional economy gains

The modelling and analysis undertaken for this project identifies that between 2010 and 2034 based on long term average water availability these investments are likely to increase regional gross domestic product (or local value added) in the order of $470 million in real terms.

These estimates include:

- both past and proposed expenditures on off and on-farm irrigation infrastructure funded through the Private Irrigation Infrastructure Operators Program (PIIOP) and On-Farm Irrigation Efficiency Program (OFIEP);

- the likely *long term average on farm productivity* returns from on farm technologies invested in under PIIOP and OFIEP; and

- the extra farm production due to increased water availability from water saving sharing arrangements between the Australian Government and Irrigators under the PIIOP and OFEIP programs

The water purchases program is generally expected to be neutral in terms of its immediate first round economic effects. However, if revenues from purchases were to 'leak' from the region in the form of capital transfers the effect of this would be relatively minor compared to the estimated size of gains from the PIIOP and OFIEP programs.

Total long term average gains to the local economy in the MIA are estimated as the change in real gross domestic product and employment.

- During the construction phase (2010-2019), real GDP in the local economy increases by an estimated $178 million. The economy then experiences an ongoing net increase in real GDP of between $16-22 million annually due to the ongoing influence of productivity gains.

- Employment in the local economy rises from 168 full-time equivalent jobs to a peak of 298 jobs at the end of the construction phase to between 75 and 112 extra jobs annually under the implementation phases compared to the base case (Figure 9 and Table 18). We note these are annual net changes relative to the base case and are not additive annually.

The estimates above are generated using the dynamic general equilibrium model Victoria University TERM. Marsden Jacob has also estimated local value added using a static approach to provide greater transparency over the detailed effect of the expenditures and also to ensure that the VU TERM model accurately reflects the type of expenditures that are involved with PIIOP and OFIEP

## Short run local economy effects

Under the static approach, Marsden Jacob has undertaken 'first round' analysis of PIIOP and OFIEP expenditures via a forensic disaggregation of Australian Government program expenditures by program recipients. This approach involves disaggregating PIIOP and OFIEP expenditures to the MIA and the identifying expenditures which contribute to value added in the region.

Using the static approach, 46 per cent (or $178.7 million GST Exclusive) of the $387.9 million (GST Exclusive) spent on PIIOP and OFIEP goods and services is estimated to relate to 'first round' local value added (that is, excludes dynamic flow on-effects through the economy). Using this approach, local value added is estimated as the total value of the construction expenditure less the value of goods and services and intermediate inputs that are sourced from outside the MIA.

In terms of specific program expenditures, the static approach reveals that:

- PIIOP off-farm construction expenditure on goods and services is $251.5 million (GST Exclusive) of which 40 per cent is estimated to relate to local value added within the MIA.

- PIIOP on-farm construction expenditure on goods and services is $58.5 million (GST Exclusive) of which 62 per cent is estimated to relate to local value added within the MIA.

- OFIEP final construction expenditure on goods and services is $77.9 million (GST Exclusive) of which 54 per cent is estimated to relate to local value added within the MIA.

The effect of these expenditures varies across the programs. Under PIIOP, significant expenditures exited the local economy through the purchase of imported goods and services such as significantly transformed material and project management. In contrast, a great share of first round OFIEP expenditures occurred in the local economy given the large contribution of local contractors undertaking on farm works and the lower levels of imported materials that contributed to on-farm conversion. In part, this was due to much of OFIEP expenditures being directed to laser land forming and earth works to reconfigure flood irrigation layouts.

Short term average annual net increases in on-farm productivity directly due to on-farm technology investments under PIIOP and OFIEP are estimated be in the order of $3.8 million based on present day prices and yields.[1] This includes gains to: rice, cereals and cotton $2.8 million; and citrus $1.0 million. These estimates exclude increases in value added generated from extra production that results from water saving infrastructure that reduces evaporation and seepage losses. These water saving are estimated to be 21.8 GL LTAAY (long term average annual yield) per annum.

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[1]  This excludes the longer term gains in value added derived from the extra production due to the return of water savings to farmers under PIIOP and OFIEP. Note however the annual long term regional economic effects include the economic gains from these water savings.

## Limitations

The estimates of gains to the local and regional economies should not be equated to whole of economy gain. Additionally, this study is not a benefit cost assessment and as such does not consider the opportunity costs of investment.  Instead the focus is on what is the incremental difference to the local economy due to the Commonwealth investments. The analysis compares investment outcomes in the local economy to those if Commonwealth investments had not occurred.

# 1. Introduction

This project was commissioned by the Department of Agriculture and Water Resources (the Department) to assess the economic effects of the Australian Government's water recovery programs in the Murrumbidgee Irrigation Area (MIA) in the Murray-Darling Basin.

## 1.1 Background

There is concern in irrigation-dependent communities that Commonwealth water recovery programs associated with implementing the Murray-Darling Basin Plan are contributing to decline of their communities. Despite this concern, there are currently little empirical data regarding the positive and negative economic effects of the programs on Basin communities.

The consultancy complements and extends the existing work being undertaken by the Department to evaluate its water recovery programmes, communicate with key stakeholders and provide input to the Murray-Darling Basin Authority's (MDBA) reporting of the social and economic effects of the Basin Plan

## 1.2 Objective

The purpose of this consultancy is to assess the effects of the Government's water recovery programs on the regional economy of a major irrigation area in the Murray-Darling Basin.

## 1.3 Terms of reference

The Terms of Reference for this study require this report to:

- model and report on the flow-on effects to the local economy from Australian Government funded infrastructure upgrades (Private Irrigation Infrastructure Operators Program (PIIOP) and On-Farm Irrigation Efficiency Program (OFIEP) and water purchases (Restoring the Balance Program) in the area serviced by Murrumbidgee Irrigation;

- focus on flow-on effects to the local economy derived during the construction phase of irrigation upgrades and net changes in farm outputs, regional economic activity and employment levels post-programme completion; and

- identify and examine the flow-on effects, if any, on irrigators who have not participated in these programs – note this issue was not directly assessed in this report but implicitly captured in regional general equilibrium modelling that was undertaken.

## 1.4 Analytical modules

This project comprised a series of analytical modules, see Figure 1.

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**Figure 1: Modules**

| Economy Wide Benefits: | Module 1 – Regional Benefits Implementation Phase: | Module 3 – Term H2O |
|---|---|---|
| - Improvements to farm productivity from both on-farm and off-farm works (review PIIOP modelling)<br>- Water sales revenue (water purchase program) | - Value added on-farm (including gains that accrue from off-farm efficiency)<br>- Regional flow-on benefits from on-farm value added<br>- Regional flow-on benefits from water sales (water purchase program) | Include shocks derived from earlier steps in Term H2O to estimate the regional economic benefits. |

| Economy Wide Costs: | Module 2 – Regional Benefits Construction Phase: | |
|---|---|---|
| - On-farm water efficiency works (PIIOP and OFIEP)<br>- Off-farm water efficiency works (PIIOP)<br>- Other costs from efficiency improvement and water sales | - Value added from on-farm construction<br>- Regional flow-on from on-farm construction<br>- Value added from off-farm construction<br>- Regional flow on from off-farm construction<br>- Regional flow on impacts from water sales | |

## 1.5    Key tasks

Key tasks undertaken in this study are defined in Figure 2.

**Figure 2: Key project tasks**



Task 1: Inception meeting and meet with PIIOP team

Task 2: Review the PIIOP modelling to assess how the analysis can be included in the project and whether further analysis is required

Task 3: Meet with regional stakeholders to gather information on the construction phase expenditures

Task 6: Workshop initial results and methodology with the Department

Task 5: Preliminary analysis and results from the direct value add analysis:
- construction, and
- implementation phases.

Task 4: Workshop with the project Steering Committee to (as necessary) refine the analytical framework

Task 7: Estimate regional flow-on during the implementation phase using TERM.

Task 8: Brief PowerPoint results report. Meetings with Department and key regional stakeholders.

Task 9: Draft and Final Reports

*Source: Marsden Jacob Associates*

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## 1.6    Consultation and data assumptions

To complete this project Marsden Jacob Associates undertook multiple visits to the Griffith region and consultation with key stakeholders and representative including Murrumbidgee Irrigation, program delivery head contractors and field experts to guide the refinement of key project data and assumptions.

These consultations included structured workshops with stakeholders organised and led by the Department of Agriculture and Water Resources. The workshops included data gathering of program design and delivery features and development by the Department of some indicative on-farm responses using stylised farm water budgets and representative farm input and output responses.

Marsden Jacob Associates also independently consulted with a range of individual project managers and program deliverers, industry experts and on-farm advisors, to further extend these data and insights and considered available literature.

Murrumbidgee Irrigation provided detailed project budgets and assisted Marsden Jacob Associates with the categorisation of costs associated with off-farm investments. The Department of Agriculture and Water Resources provided detailed on-farm investment data and post investment water saving audit data.

Marsden Jacob Associates presented a preliminary draft of results to a stakeholder group in Griffith and incorporated feedback into this Final Report — this included providing further disaggregation and categorisation of project costs and refinement of longer term on-farm productivity assumptions.

## 1.7    Structure of report

The remainder of this report is organised into the following sections:

- Section 2: Geographical area of  focus
- Section 3: Australian Government infrastructure programs
- Section 4: Value added and goods and services
- Section 5: Static approach – local value added
- Section 6: Productivity benefits
- Section 7: Effects of water buy-back
- Section 8: Timing of first round effects
- Section 9: Estimating gains (dynamic approach)
- Section 10: References

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# 2. Geographical area of focus

This study focusses on expenditures that occurred within the Murrumbidgee Irrigation Area (MIA) region of New South Wales.

The region includes farms supplied by the irrigation supply network of Murrumbidgee Irrigation. This includes farms supplied with water for irrigation and also those that receive stock and domestic services.

## 2.1    Area included in the study

This study excludes irrigation areas outside of the Murrumbidgee Irrigation foot print including farms that have received PIIOP and OFIEP payment that are:

- river diverters;

- customers of Coleambally, Murray Irrigation; and

- on river systems other than the Murrumbidgee.

**Figure 3: Murrumbidgee Valley and Irrigation Area**



*Source: http://www.mirrigation.com.au/About-Us/Company-Overview*
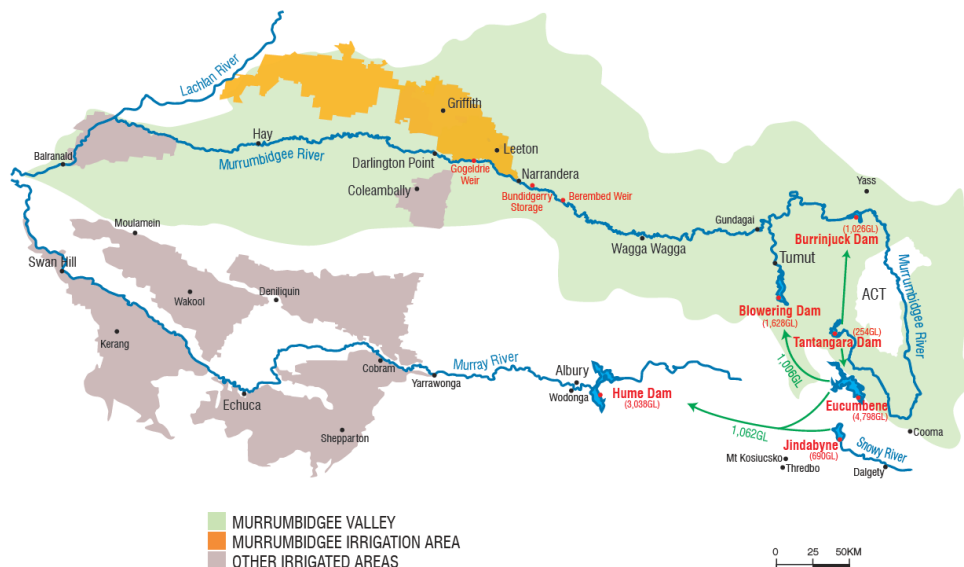
The area of the local economy in which the economic effect of Commonwealth recovery is measured is defined by VU Term Database statistical division Lower Murrumbidgee (zone 45) . The Lower Murrumbidgee Statistical Division is a reasonable geographical approximation for the Murrumbidgee Irrigation Area MIA) and incorporates irrigated and stock and domestic farms serviced by Murrumbidgee Irrigation. For the purposes of local economy value added analysis the Murrumbidgee region excludes all areas south of the Murrumbidgee River.[2] The

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[2]    Note in this study we exclude water recovered through the New South Wales Basin Pipes Project and NSW state programs.

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Lower Murrumbidgee statistical division incorporates all irrigated land within the Murrumbidgee Irrigation Area. It includes dryland farming areas bounded by the Murrumbidgee and Lachlan Rivers and the MIA. The zone excludes regional City of Wagga Wagga and nearby surrounding farm land.

## 2.2    Relative size of the economy

Gross domestic product of the MIA region is in the order of $2,646 million per annum. Agricultural industries (directly engaged in farming) account for approximately 21 per cent of the gross domestic product. Based on the 2011 Census total employment in the region is estimated at approximately 19,500 people. Agriculture industries (directly engaged in farming) accounted for just over 3,000 jobs. Utilities, communications, construction, hospitality, trades and business services accounted for just under 8,000 jobs.

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# 3. Australian Government infrastructure programs

The following sections focus on the Commonwealth expenditures in the Murrumbidgee regional economy that resulted from the:

- Private Irrigation Infrastructure Operators program — PIIOP; and

- On-Farm Irrigation Efficiency program — OFIEP.

Total PIIOP and OFIEP funding for projects in the MIA are estimated at $387.9 million (GST Exclusive).

Expenditures within the MIA and total water recovered by program are summarised in Figure 4. The remainder of this chapter addresses on and off farm infrastructure expenditures. The effects of the water buyback program (Restoring the Balance) are discussed in Section 7.

**Figure 4: MIA Commonwealth program summary**

| PIIOP | Funding (GST exclusive) | Total water recovered (LTAAY) |
|---|---|---|
| Round 1 (off farm) | $50m | 5.7GL |
| Round 2 (off and on-farm) | $175.1m | |
| on-farm | *$58.5m* | *11.1GL* |
| off-farm | *$116.6m* | *26.5GL* |
| Round 3 (off-farm)[3] | $84.9m | 9.5GL |
| **OFIEP** | | |
| Round 1 (on-farm) | $10.4m | 3.4GL |
| Round 3 (on-farm) | $23.9m | 7.7GL |
| Round 5 (on-farm) | $43.6m | 12.4GL |
| **Purchase** | $76.6m | 52.7GL |

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[3] This excludes an additional $37.3 million Commonwealth funding for off-farm works in the MIA under PIIOP Round 3 approved in July 2017.

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## 3.1  PIIOP

An estimated $310.0 million (excluding GST) has been spent or committed by the Commonwealth on PIIOP in the MIA. Murrumbidgee Irrigation will receive three rounds of PIIOP funding.

### 3.1.1  Round 1

Murrumbidgee Irrigation (MI) received funding of $50 million and will transfer water entitlements to the Commonwealth that will return 5,700 ML on average over the long-term every year to the Commonwealth to help bridge the gap in the Murrumbidgee catchment identified in the Murray Darling Basin Plan.

Construction commenced in May 2013 and was completed in November 2014.

This project involved:

- replacing a deteriorating concrete-lined channel supply system with an integrated water supply system of 13.8 km of new pipelines and 21.8 km of refurbished open channels (35.6 km in total);

- reinstatement of 81 farm outlet structures and replacement of 91 metered outlet structures with electromagnetic flow meters;

- installation of remote monitoring on 213 metered farm outlets; and

- automation of remaining open channels.

### 3.1.2  Round 2

MI is expected to receive funding of $175.1 million and will transfer water entitlements to the Commonwealth that will return 37,521 ML on average over the long-term every year to the Commonwealth to help bridge the gap in the Murrumbidgee catchment identified in the Murray Darling Basin Plan.

Construction commenced in March 2015 and is expected to be completed by June 2019.

This project involves:

- installation of a 455 km stock and domestic water supply system;

- conversion of approximately 243 km of channels to an automated channel control system, including automated control on 264 regulators made up of 322 gates, upgrade/replacement of 139 channel control system structures and new meters for 105 system structures;

- decommissioning approximately 5 km of channel;

- replacement of approximately 62 km of channels with a gravity pipeline system; and

- upgrades to water delivery infrastructure on approximately 207 properties.

### 3.1.3  Round 3

Under Round 3 MI is expected to receive $84.9 million to undertake a range of works to upgrade the delivery system. These investments are expected to return 9.4 GL LTAAY over the long term to help bridge the gap in the Murrumbidgee catchment.

Construction commenced in May 2017 and is expected to be completed by June 2019.

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This will include:

- channel lining and reforming earth and concrete channels;

- channel automation – including regulators and unmetered escapes;

- replacing inefficient channels with pipelines; and

- replacing Dethridge wheels with compliant meters.

### 3.1.4 Composition of PIIOP expenditures

PIIOP Round 1, 2 and 3 expenditures are made up of two components:

- upgrading Murrumbidgee Irrigation off farm supply systems ($251.5 million; and

- upgrading on-farm irrigation systems ($58.5 million).

More detail on the composition of this expenditure is contained in Appendix A.

**Table 1: Murrumbidgee region PIIOP expenditures GST Exclusive**

| Project | $ Million |
|---|---|
| **Off-farm** | |
| Round 1 | $50.0 |
| Round 2 | $116.6 |
| Round 3 | $84.9 |
| **Total off-farm** | $251.5 |
| **On-farm** | |
| Round 2 | $58.5 |
| **Total on-farm** | $58.5 |
| **Total off and on-farm** | **$310.0** |

*Source: Department of Agriculture and Water Resources.*

The majority of PIIOP off-farm expenditures have been directed to modernising the Murrumbidgee Irrigation supply system to national delivery standards. This has included, among others, installing automated total channel control technologies and metering, remediating sections of high loss channels and rationalising channels (removing and/or reconfiguring sections of channel). While most of the expenditure has been on the irrigation supply system, it has also been directed at improving stock and domestic systems.

On-farm PIIOP expenditures in the MIA have focussed primarily on improving the irrigation efficiency of participating farms — largely the conversion of flood and furrow irrigation to drip and sprinkler systems on wine grape and citrus farms. This has involved installing automated pressurisation and piping and valve systems to deliver water individually to each plant.

## 3.2 OFIEP

An estimated $77.9 million has been paid to farms or committed by the Commonwealth in the MIA through OFIEP Rounds 1, 3 and 5.

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There have been two rounds of OFIEP grants (Rounds 1 and 3) that have been completed within the MIA. Ricegrowers Australia has been the major delivery partner accounting for 100 per cent of expenditures. Expenditures by other delivery partners have included river diverters and irrigation farms in the Coleambally and Murray Irrigation Area that are excluded from this analysis.

The Department of Agriculture and Water Resources estimate likely expenditures of $43.6 million will occur in the MIA under Round 5. These investments will be similar in nature to previous OFIEP programs in the region and it is expected a large share of the investment will involve broad-acre landforming and farm reconfiguration. More detail on the composition of this expenditure is contained in Appendix A.

**Table 2: OFIEP program grants within the Murrumbidgee Irrigation Area GST Exclusive**

| Round | $ Million |
|---|---|
| Round 1 | $10.4 |
| Round 3 | $23.9 |
| Round 5 | $43.6 |
| **Total** | **$77.9** |

*Source: Department of Agriculture and Water Resources*

### 3.2.1   Composition of OFIEP expenditures

Unlike the PIIOP on-farm program that largely focussed on pressurisation systems on intensive horticulture farms, OFIEP in the MIA has predominantly focussed on improving the efficiency of broad scale flood irrigation systems.

Two broad classes of farm system conversion have accounted for most expenditure:

- Re-landforming with laser technology and installing bank-less channel systems — this system enables larger irrigation bay areas enabling more flexible and efficient machinery use and can eliminate return flows; and

- Re-landforming with laser technology and installing pumps to recycle water tailings — this system enables potential return flow water to be retained on farm.

A third class of conversion has also occurred on a small number of property with farms converting part or all of their property from flood to broad scale pressurisation using centre pivot or lateral moves. By definition, these areas of the farm have been converted from rice growing to other cropping enterprises. In most cases the enterprise change has been to winter cereals and cotton.

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# 4. Value added and goods and services

Economic contribution to the region is the estimated gross value added that has occurred in the MIA as a result of PIIOP and OFIEP. In this section, the methodology used to estimate local value added is defined for both the Static and Dynamic Approaches.

## 4.1    General model of local value added

In this study, Marsden Jacob has undertaken two approaches to estimate 'local value added' which could also be expressed as the contribution of PIIOP and OFIEP to the local MIA economy (Figure 5):

▪ Static Approach. Marsden Jacob has undertaken 'first round' analysis of PIIOP and OFIEP expenditures. This approach involves disaggregating PIIOP and OFIEP expenditures to the MIA and the identifying expenditures which contribute to value added in region.

▪ Victoria University TERM Model approach. This 'dynamic' approach involves the use of a general equilibrium dynamic and multi-period model which solves for both price and quantity. In effect, this approach involves 'multiple round' analysis until an equilibrium is achieved.

While the VU TERM model approach is preferred and forms the basis for the estimated local value added in this report, the static approach is useful to provide greater transparency over the detailed effect of the expenditures. Additionally, the assumptions in the VU TERM model have been adjusted based on the results of the static approach to ensure that the VU TERM model accurately reflects the type of expenditures that are involved with PIIOP and OFIEP.

**Figure 5: General model of local value added**
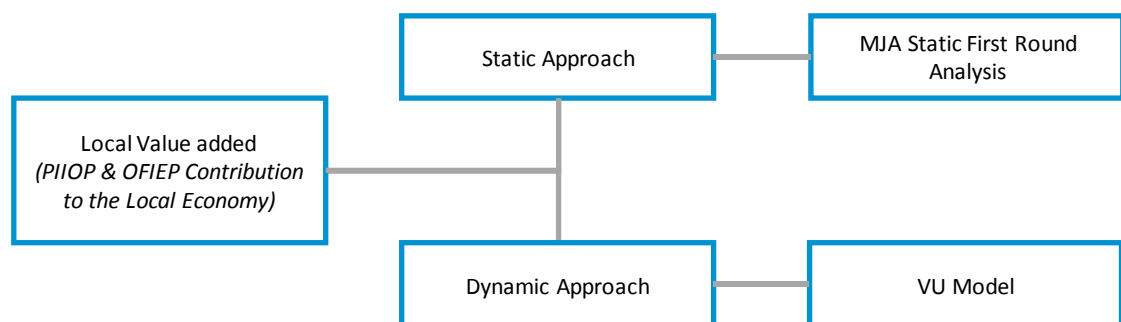


*Source: Marsden Jacob Associates*

## 4.2    Static approach

### 4.2.1    Components of local value added

Using the static approach, gross value added is calculated as:

> *GVA = Turnover (or sales) less the cost of bought in goods & services (excl. employee costs)*

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Gross value added in the supply chain is calculated in four separate components:

- Construction phase

    - PIIOP off-farm expenditure less the cost of bought in goods & services

    - PIIOP and OFIEP on-farm expenditure less the cost of bought in goods & services

- Implementation phase outputs

    - change in on-farm value added from the change in farm productivity less the cost of bought in goods & services

    - change in farm supply change value added linked to the increase in on farm productivity less the cost of bought in goods & services

### 4.2.2 Estimating local value added

The MJA first round static approach is illustrated in Figure 6. This approach involves estimating the value of local final inputs and local intermediate inputs:

- The value of local final inputs for the MIA relates to the value of goods and services that are purchased from businesses located within the MIA; and

- The value of local intermediate inputs relates to the value of inputs used to produce goods and services purchased from businesses located within the MIA.

Using this approach, static local gross value added is equivalent to the value of local intermediate inputs. Another way of expressing this is that local value added is equal to total MIA construction expenditures less intermediate expenditures that are sourced from outside the MIA.

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**Figure 6: Construction phase module**
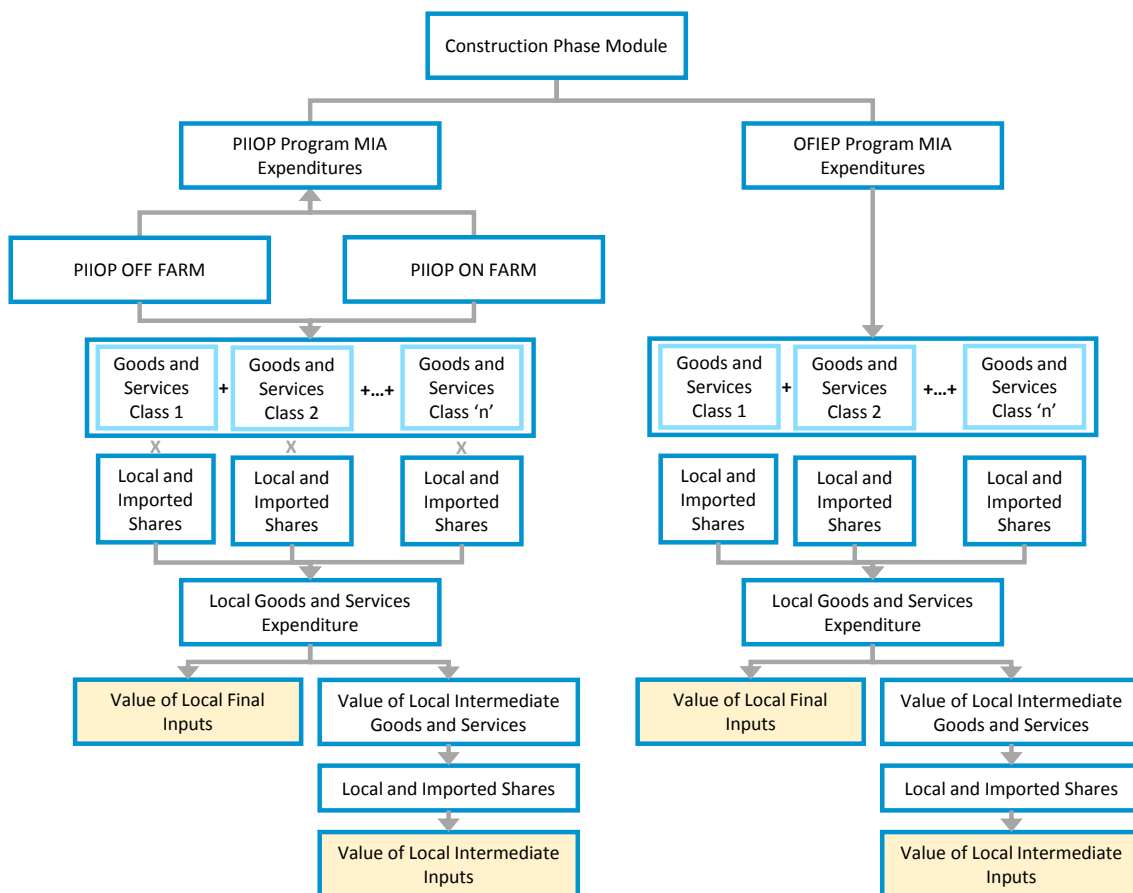


*Source: Marsden Jacob Associates*

Using this framework, the value of local final and intermediate inputs has been separated into three geographic zones:

- Within the MIA;

- Outside MIA but within Murray Darling Basin (MDB); and

- Outside of MDB.

Using these three zones, the static model assumes:

- PIIOP and OFIEP involve final goods and services that are sourced: directly from with the MIA (e.g. local labour for land-forming); outside the MIA but within the MDB (e.g. some specialised materials such as gates); and outside the MDB (such as project management and some specialised materials);

- Final goods and services may have been delivered or produced using intermediate goods and services from other geographic zones. For example, the final goods and services made or delivered within the MIA may involve intermediate goods and services that are made or delivered from: within the MIA; outside the MIA but within the MDB; or even outside the MDB.

Therefore, local value added within the MIA is equal to the value of PIIOP and OFIEP final goods and services purchased or delivered from businesses located within the MIA less the value of intermediate goods and services in the two other geographic zones (outside the MIA but within the MDB; and outside the MDB) used to deliver or produce these final goods.

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Similarly, local value added outside the MIA but within the MDB is equal to the value of PIIOP and OFIEP final goods and services less the value of intermediate goods and services outside the MDB used to deliver or produce these final goods.

### 4.2.3   Intermediate inputs from outside the MIA region

Expenditures by PIIOP and OFIEP projects are treated as turnover to local businesses who then source local and imported factors of productions including:

- capital inputs — manufactured goods such as meters, gates, pipes pumps;

- labour —excluding farm owner operator;

- fuel — including diesel fuel rebate;

- machinery and equipment depreciation — results in machinery parts maintenance and eventually replacement;

- other business costs; and

- business profit.

'Leakages' from the local economy through the purchase of imported goods and services to undertake construction activities are excluded from the estimate of local economic benefits. Key sources of leakage include imported capital inputs, fuel and machinery and equipment depreciation.

### 4.2.4   Treatment of taxes concessions and rebate

GST and income taxes are excluded from local expenditures in this study. However, the diesel fuel rebate is included as an expenditure in the region.

### 4.2.5   Defining goods and services

There are two type of expenditures:

- Final expenditures — are goods and services directly purchased by the contractor or project manager.

- Intermediate expenditures — are inputs sourced from other entities that form part of first round good or service purchase.

For these expenditure types, total PIIOP and OFIEP expenditures by project are disaggregated into key expenditure classes which define the type of good or service on which program expenditures occurred. The expenditure categories are different for PIIOP off-farm and PIIOP on-farm as data has been provided in different formats for these expenditure types by Murrumbidgee Irrigation.

### 4.2.6   Final expenditures

#### PIIOP off-farm goods and services classes

Six expenditure categories are used to define the type of PIIOP off-farm goods and service expenditure:

- labour;

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- project management, design and stakeholder management;
- material;
- fuel;
- plant; and
- other.

## PIIOP on-farm goods and services classes

Seven expenditure categories are used to define the type of PIIOP on-farm goods and service expenditure:

- drips;
- pipes;
- excavation;
- pumps;
- bores;
- soil moisture monitoring; and
- troughs.

## OFIEP on-farm goods and services classes

There are five types of on-farm changes which resulted from OFIEP expenditures, including the:

- redevelopment of surface irrigation systems (landforming) to bank-less channel irrigation systems;
- redevelopment of farm drain reuse (including pumping systems) and on-farm storage;
- conversion from surface to overhead irrigation or upgrade of existing overhead irrigation systems;
- conversion to drip-based irrigation systems or upgrade of existing drip-based irrigation systems; and
- introduction of fertigation systems into farming practices.

Using information and data from the Department of Agriculture and Water Resources on the costs of on-farm investments as part of OFIEP and taking into account the type of on-farm changes resulting from OFIEP, the major goods and services classes for OFIEP are defined as:

- planning and design;
- landforming (lasering);
- pipes and stops;
- pumps;
- earthworks for drains, channels and on-farm storage and pumps;
- travelling irrigator;
- telemetry and control system;

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- drip system;

- fertigation and soil moisture monitoring; and

- ricegrowers administration.

### 4.2.7    Intermediate expenditures

This study identifies key intermediate expenditures directly associated with goods and services used in PIIOP and OFIEP. Of interest is excluding intermediate inputs imported to the region that contribute to final goods and services expenditures.

Key intermediate inputs sourced from other entities include:

- fuel — e.g. diesel, petrol, gas;

- machinery and equipment — e.g. tractors, laser levelling equipment, earth work machinery;

- manufactured and semi manufactured products — e.g. pipes, valves, pumps;

- processed semi processed and raw materials — e.g. cement powder, lime, reinforcement, form work, steel.

Some of the key assumptions used where appropriate to estimate the local and imported shares of intermediate products are summarised in Table 3.

**Table 3: Key assumptions used to estimate local and imported shares of intermediate products**

| Key variable | Assumption | Source of assumption |
|---|---|---|
| Fuel cost as a % of land-forming and excavation costs | 23 per cent. | This is based on detailed analysis of actual OFIEP expenditures provided by the Department of Agriculture and Water Resources. |
| Machinery costs – local and regional % | 50 per cent | Assumes that half of the cost of machinery is repairs and maintenance which is sourced locally and half of the cost relates to new capital equipment which is imported into MIA and MDB. |
| Labour costs for installation – local and regional % | Mostly 100% | In most cases installation costs are assumed to be 100 per cent within the MIA. In some cases, some are located outside of the MIA but within the MDB. |
| Retail gross margin on materials – local/regional | 40 per cent | This takes into account the distributors gross margin as estimated in RBA (2012), Costs and Margins in the Retail Supply Chain, Bulletin, June Quarter 2012, page 16. A small deduction from the RBA figure (around 5%) is incorporated to allow for transport into the MIA/MDB region. |
| Fuel retail margin – local/regional | 5 per cent | This is based on Australian Institute of Petroleum (2016), Facts about the Australian Retail Fuel Market & Prices, http://www.aip.com.au/pricing/facts/Facts_About_the_Australian_Retail_Fuels_Market_and_Prices.htm, accessed August 2016. |

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## 4.3 Dynamic approach

The dynamic approach estimates local value added by taking into account the initial expenditures and the flow-on benefits for the local economy.

Flow-on benefits through the local economy can occur as businesses and households that receive payments for goods and services provided in the construction phases purchase other goods and services. This trickle down is often referred to as the multiplier effect. By definition this flow-on becomes smaller and smaller residuals of the original project value added. Care is required considering multiplier effects on the direct value added in the absence of accounting for wider economy effects, namely:

- opportunity costs to other parts of the economy need to be accounted for — simple multipliers can imply flow-on resource gains are costless when they are not; and

- flow-on effects through the economy can affect the relative prices of goods and services and these can lead to complex changes in the behaviours within the economy that can have both positive and negative effects on net economic outcomes.

To address these limitations, we apply the VU TERM model to trace the flow-on local economy benefits of the PIIOP and OFIEP programs. In this study, local gross value added estimates for PIIOP and OFIEP are imputed via 'shock' to the VU TERM model. The model then calculates the regional effects of the shock as second, third round and so forth exchanges occur through the economy. We note VU TERM also implicitly accounts for dynamic economy effects within the program first round expenditures (such as changes in input prices) estimates that cannot be accounted for in first round static estimates calculated in this study.

VU-TERM is an economy-wide computable general equilibrium (CGE) model that also includes small-region representation. Unlike an input-output model which solves either for quantities or for prices, but not both at once, VU TERM solves for both prices and quantities together.

CGE models can be either comparative static or dynamic. Comparative static models are easier to run than dynamic models. However, comparative static results are in some respects harder to explain. Results are reported as changes from a base case – at some point in the future. The only base case defined in a comparative static model is the initial database.

VU TERM is a dynamic model in which a forecast baseline is applied. This may include forecast increases in macroeconomic variables, technological change and taste changes. For example, agricultural productivity historically has grown by 1 to 2% per annum, so productivity growth of this magnitude is imposed on the forecast baseline.

In this study, results in a dynamic model are reported as cumulative deviations from the forecast baseline. That is, the modelled effects of a farm productivity study will be the marginal contribution of productivity shocks ascribed in addition to those of the forecast baseline. Dynamic models trace the effects of ascribed direct effects across time periods. The theoretical basis of dynamics is in linkages between investment and capital across time, and the balance of trade and net foreign liabilities. Investment and balance of trade outcomes are flows that are included in a comparative static model. Capital and net foreign liabilities are stocks that require a dynamic model.

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# 5. Static approach – local value added

In this section, local value added is estimated based on whether the final goods are sourced locally or imported into the local region. Consistent with section 4.2, the value of local value added is estimated as the value of intermediate goods and services inputs.

To undertake this analysis, three regions have been defined from where goods and services are sourced:

- within the MIA;

- outside MIA but within Murray Darling Basin (MDB); and

- outside the MDB.

The costs in this section have been presented as GST Exclusive since revenue from GST is collected by the federal government and will not stay in any region for the purposes of this analysis.

## 5.1    Key Findings

The total value of PIIOP and OFIEP goods and services is $387.9 million (GST Exclusive) of which 46 per cent ($178.7 million) is spent on intermediate goods and services within the MIA (Table 4 and Table 5):

- PIIOP off-farm goods and services is $251.5 million of which 40 per cent is spent on intermediate goods and services within the MIA;

- PIIOP on-farm goods and services is $58.5 million of which 62 per cent is spent on intermediate goods and services within the MIA; and

- OFIEP final goods and services is $77.9 million of which 54 per is spent on intermediate goods and services within the MIA.

There is a further $28.6 million (7 per cent of the total) of intermediate goods and services that has been sourced from outside the MIA but within the MDB.

More detail is contained in Appendix B.

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**Table 4: PIIOP and OFIEP final expenditure (GST Exclusive) $million**

| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
| --- | --- | --- | --- | --- |
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| PIIOP Off-farm Round 1 | $50.0 | $19.5 | $5.3 | $25.2 |
| PIIOP Off-farm Round 2 | $116.6 | $45.5 | $12.4 | $58.7 |
| PIIOP Off-farm Round 3 | $84.9 | $35.1 | $7.0 | $42.8 |
| PIIOP On-farm Round 2 | $58.5 | $36.3 | $1.7 | $20.5 |
| OFIEP Round 1 | $10.4 | $5.7 | $0.3 | $4.5 |
| OFIEP Round 3 | $23.9 | $13.0 | $0.7 | $10.3 |
| OFIEP Round 5 | $43.6 | $23.7 | $1.2 | $18.7 |
| **Total (PIIOP & OFIEP)** | **$387.9** | **$178.7** | **$28.6** | **$180.6** |
| Total PIIOP off-farm | $251.5 | $100.0 | $24.8 | $126.7 |
| Total PIIOP on-farm | $58.5 | $36.3 | $1.7 | $20.5 |
| Total OFIEP | $77.9 | $42.4 | $2.1 | $33.4 |

*Source: MJA estimates*

**Table 5: PIIOP and OFIEP final expenditure composition (%)**

| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
| --- | --- | --- | --- | --- |
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| PIIOP Off-farm Round 1 | 100% | 39% | 10% | 50% |
| PIIOP Off-farm Round 2 | 100% | 39% | 10% | 50% |
| PIIOP Off-farm Round 3 | 100% | 41% | 8% | 50% |
| PIIOP On-farm Round 2 | 100% | 62% | 3% | 35% |
| OFIEP Round 1 | 100% | 54% | 3% | 43% |
| OFIEP Round 3 | 100% | 54% | 3% | 43% |
| OFIEP Round 5 | 100% | 54% | 3% | 43% |
| **Total** | **100%** | **46%** | **7%** | **47%** |
| Total PIIOP off-farm | 100% | 40% | 10% | 50% |
| Total PIIOP on-farm | 100% | 62% | 3% | 35% |
| Total OFIEP | 100% | 54% | 3% | 43% |

*Source: MJA estimates*

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# 6. Productivity benefits

In this section, the ongoing productivity gains from the on-farm implementation of PIIOP and OFIEP investments are estimated.

## 6.1    Key Findings

Annual long term average net increases in on-farm productivity are estimated be in the order of $3.8 million per annum based on present day prices and yields. This includes gains to: the rice, cereals and cotton industries of $2.8 million; and the citrus industry of $1.0 million.

These estimates exclude increases in value added generated from extra production that results from water saving infrastructure that reduces evaporation and seepage losses. Water savings are estimated to be 21.8 GL. These volumes are assumed to generate further value added in the region and are incorporated in the economic modelling as a separate productivity shock.

## 6.2    Approach

Increases in gross value added in the implementation phase can occur as a result of utilising the off and on farm investments. This can occur through;

▪    increased value of output; and/or

▪    lower costs of inputs.

Productivity effects are estimated as long term average gains until 2033. This time frame enables:

▪    off and on-farm systems changes to become fully operational; and

▪    addresses risks of short term variation in water use and farm system operations;

The time frame also limits the scope of whole of life pricing effects, which are beyond the scope of this study. In this study, water delivery charges and cost of off farm irrigation system operation are treated as constant. Consequently, the study excludes any whole of life asset cost effects on productivity.

## 6.3    Source of productivity change

Both off and on farm construction changes can lead to productivity gains. Major gains include:

▪    a reduction in labour or other inputs per unit of output;

▪    improved quantity and quality of crop yield per unit of input; and

▪    improved flexibility of farm system enabling greater frequency and reliability of crop yield.

Investments that result in increases in farm value added without altering intermediate inputs results in net economic gains for the local economy. Not all change in input costs result in an increase in value added to the local economy. Changes in factor inputs such as labour and capital by MIA and farm businesses as a result of the PIIOP and OFIEP have a first-round

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neutral effect on local economic activity. This is because either savings or costs in the business are offset by equivalent income losses or gains for the associated local service providers.

An example of a neutral effect on first round local and regional value added is an improvement in on-farm labour productivity. In most cases, new on farm water saving technologies reduce the amount of labour required to undertake irrigation activities. This is because the technologies automate or semi-automate aspects of the irrigation process and enable a greater area of irrigated crop to be managed by a person. Examples include drip irrigation which enable automated timers and settings to schedule commencement and end of irrigation rates and sequence of irrigation.

Similarly, laser grading to bank-less channels enables larger areas to be irrigated from an off-take and for the irrigation to in-effect 'self-manage' the sequence of areas irrigated and completion.

This technology has enabled rice growers to significantly increase the economies of scale of a rice enterprise. Observations of field experts indicate there can be an approximately 3 to 5-fold increase in the area that can be effectively irrigated and managed by a rice-grower. First principles, in the very short run where labour does not move immediately into other activities, this structural adjustment has a neutral effect on value added. We account for the longer term productivity effects of labour in the VU model where labour can move within and outside of the region:

- total area of rice production remains the same —— excluding any yield effects that may occur; and

- the rice-grower earns extra income through savings in wages bills to employees.

### 6.3.1 PIIOP off-farm construction

PIIOP off-farm construction can lead to productivity changes within the MIA and on farms receiving water (Table 6):

Within MIA off farm productivity outcomes can include:

- lower labour operational costs — due to system automation; and

- delayed future asset replacement costs.

Modernisation of the delivery system can lead to *positive* on-farm productivity gains through:

- increased reliability of water delivery — able to meet peak crop demands and avoid heat stress;

- increase in water available for crop production by reducing system evaporation and seepage losses.

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**Table 6: Identifying and classifying sources of productivity from program investments**

| Program | Investment | Change in inputs | First round local economy effect | Explanation |
|---------|-----------|------------------|----------------------------------|-------------|
| PIIOP off farm | Automated ordering and water management | Lower labour costs | Neutral | Labour savings result in lower operational charges |
| | New delivery infrastructure | Lower repairs and maintenance costs | Neutral | Savings result in lower operational charges |
| | | Increase available water for productive use | Positive | Reduced evaporation and seepage in delivery system |
| | Improved timeliness and reliability of delivery | Lower on farm labour costs | Neutral | Labour savings result in higher farm income |
| | | Higher crop yield and quality | Positive | Avoided heat stressed of crop |

*Source: Marsden Jacob estimates*

PIIOP investment in new delivery infrastructure that has reduced system evaporation and seepage, and does not diminish the productive activity of other irrigators therefore creates additional water for productive use in the region. The Department estimates that the PIIOP investments result in around 1% increase in proportion of total diversions delivered to farm gate — after accounting for water savings returned to the Australian Government. This equates to approximately 7GL on average additional water delivered to the farm gate per annum. This estimate only includes PIIOP investments and excludes any prior modernisation works.

The Department of Agriculture and Water Resources estimates that PIIOP has also had a positive effect on the crop yield for citrus crops. New delivery infrastructure has reduced heat stress in the late stages of citrus crops and is estimated to contribute to 3 per cent extra crop yield (tonnes per hectare) across all citrus enterprises in the region.

We also note that infrastructure upgrades can:

- reduce ordering times — reduces ordering times enabling the capacity to more accurately time watering to crop needs;

- increase head and area of command — in some instances modernisation can increase volume of water that can be received and the area that water can be applied to; and

- avoid the incidence of on-farm expenditures on infrastructure such as turkey nests that address gaps in public infrastructure service levels. These circumstances are case by case and usually rare. In this study, we exclude any avoided private infrastructure intervention to address public infrastructure service level gaps[4].

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[4]    This includes for example private on farm investment (such as turkey nests) to enable private buffering of short run changes in system delivery timeliness and capacity.

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We assume that these gains are realised through optimising the productivity gains of the new irrigation technologies. Therefore, we do not count these extra benefits where on-farm productivity gains have already been accounted for and by definition have already been incorporated within the gain.

### 6.3.2   PIIOP and OFIEP on-farm construction

On-farm construction irrigation infrastructure investment can create ongoing on-farm productivity gains. These gains have a net positive effect on gross value added for the region.

On-farm technologies that have been invested in under PIIOP and OFIEP have predominantly included:

- pressurised irrigation systems such as in-situ drips and sprays on permanent plantings and lateral and centre pivots on annual crops such as cereals;

- lasering and channel and bank re-configuration earthworks; and

- farm dam and water recycling pump systems.

There has also been some stock and domestic investments that have increased quality and extent of pressurised water delivery to these properties.

#### Pressurised systems

Pressured systems include among others in-situ drip and spray systems that have enabled delivery of water to perennial plant root zone in wine grapes citrus and almonds. Lateral and centre pivots (overhead irrigation) are used in broader-acre annual crop systems such as cereals.

Most pressurised systems installed under PIIOP and OFIEP were drip systems on wine grapes and citrus (Table 7).

**Table 7 Crops and areas converted to pressurised systems**

| Farm system | Technology change | Hectares |
|---|---|---|
| Wine grape | Flood/furrow to drip | 576 |
| Citrus | Flood/Furrow to drip | 1,220 |
| Rice and cereals | Shift to overhead irrigation | 88 |

*Source Marsden Jacob estimates*

#### Laser grading for rice, cereals and cotton

Laser grading upgrades for irrigated annual cropping dominate OFIEP expenditures. We estimate 12,027 hectares of irrigated land used for rice and cereals production has been converted to improved laser levelled cropping area. Similarly, 391 hectares of land used for cotton production have been improved. The major form of up-grade has been to convert to bank-less channel systems that enabled terracing of larger irrigation bays that self-irrigate.

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### Return flow systems- Farm dam and water recycling pump systems

Under OFIEP, 22 landholders installed new or improved return flow systems as part of on farm irrigation systems upgrades. This could include investments such as new or improved pumps and new or improved drains for the pumping station.

### 6.3.3   Effects on local value added

Changes to on-farm water infrastructure can alter farm input use and/or outputs (Table 8).

The characteristics of these changes can have positive, negative or neutral effects in the very short run on first round local (and regional) economic activity. These effects are described in further detail below. Of interest in this project are productivity changes that have a positive net effect on local value added. These occur where the change results in a net increase in farm output or the value of farm output. Productivity changes that result in the shift of resources between one group to another are transfers and have a neutral first round effect on local value added.

**Table 8: On farm irrigation system changes under PIIOP and OFIEP**

| Program | Investment | Input or output effect | First round local economy effect[5] | Explanation |
|---|---|---|---|---|
| PIIOP On Farm | Drip | Increased quality of wine grapes | Positive | Higher farm income |
| | | Lower on farm labour costs | Neutral | Labour savings offsets lower farm costs |
| | | Lower on farm fertiliser costs | Neutral | Fertiliser savings offset lower farm costs |
| | | Lower water demand | Neutral | Higher farm income offsets losses in MIA revenues |
| OFIEP | Bank-less channels | Increased enterprise flexibility | Positive | Higher farm income |
| | | -Increased reliability of cereal yield | Positive | Higher farm income |
| | | -Increased reliability of rice yield | Positive | Higher farm income |
| | | Lower machinery operating costs | Neutral | Higher farm income |
| | | Lower water demand | Neutral | Higher farm income offsets |

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| Program | Investment | Input or output effect | First round local economy effect[5] | Explanation |
|---|---|---|---|---|
| | | | | losses inn MIA revenues |
| | Lateral/centre pivot | Increased fuel | Neutral | Higher farm costs offsets fuel value added |
| | | Lower on farm labour costs | Neutral | Higher farm costs offsets labour income |
| | Pump station and recycling systems | Increased fuel | Neutral | Higher farm costs offsets fuel value added |
| | | Lower water demand | Neutral | Higher farm income offsets losses inn MIA revenues |

*Source: Marsden Jacob estimates*

*Note: where effects are described as neutral we treat this as neutral in the first round only. In the longer term some of these effects are likely to be positive as factors of production adjust and are redeployed in the longer term. These longer term dynamic productivity effects are accounted for within the VU Term model.*

### 6.3.4   Retained water savings

Another outcome of on-farm PIIOP and OFIEP infrastructure investments is participating farmers can retain up to 50 per cent of on-farm water savings. Retained water savings that occur from reducing on-farm evaporation and seepage have an economic value that can contribute to the local economy by:

- expanding the area under production;
- selling as allocation or entitlement as excess of needs; or
- carrying over for use in future seasons

## 6.4   Measuring economic effects of OFIEP and PIIOP

In this section, we consider the positive productivity gains and estimate their likely first round value — each is discussed in further detail in following sub sections.

There are three key sources of productivity gain:

- increased citrus production across the region due to improved timeliness of system delivery;
- increased annual broad-acre cropping yield due to the improved on-farm flexibilities associated with border-less check irrigation technologies; and
- increased crop production from water savings associated with reduced seepage and evaporation.

Annual change in first round value added as a result of productivity gains are estimated to be in the order of $3.8 million per annum excluding the additional value added generated from the

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additional water availability of 21.8 GL LTAAY (Table 9).  We note that gains will vary from year to year depending upon seasonal circumstances. For simplicity, we assume the gain is an average annual gain.

**Table 9: Annual increase in local economy value added from on farm productivity gains (2016 dollars)**

| Source of productivity gain | Enterprise | Annual change in value added |
|---|---|---|
| Laser levelling | Rice and cereals (OFIEP) | $2,738,486 |
| | Cotton (OFIEP) | $103,420 |
| Improved delivery timeliness | Citrus (All growers) | $965,655 |

*Source Marden Jacob estimates*

### 6.4.1  Drip systems - wine grape productivity

Under PIIOP and OFIEP, a total of 576 hectares of wine grapes were converted from flood-furrow to drip configurations (a minor number installed low sprinkler systems).

Our consultations revealed some mixed views on the effect of precision irrigation on wine grape quality and the effect of this on economic value of the final product. On balance the feedback has been the effects are negligible or not discernible. In this evaluation we have excluded valuing any on farm productivity gain for wine grape growers within the OFIEP program.

### 6.4.2  Citrus productivity

Consultations by the Department of Agriculture and Water Resources with industry experts in the region indicate an approximately 3 per cent loss in citrus fruit due to delays in accessing water times of peak heat stress for orchards. There are approximately 9,000 hectares of citrus production in the region with estimated returns of $85,836 gross margin per farm. Based on these estimates, the first-round value of avoiding this heat stress is approximately $966,000 per annum (that is a gain in gross margin of $107 per hectare)

### 6.4.3  Laser grading — Rice and cereals

The overwhelming majority of OFIEP on-farm expenditures have been directed to reconfiguring rice and cereal farms to terraced bays with bank-less channels. Conversions to bank-less channels have been occurring since the early 2000s but increased at a pace as a result of OFIEP.

Bank-less channel layouts are perceived to have many advantages over conventional sloping furrow systems, including:

- ease of operation and amenability to automation;

- labour savings — for example 'The real benefit of the new layout was the labour savings, coming from three workers using three ute's full time for a solid three months of the year, to being able to irrigate over 500 hectares on my own was the real winner'[6];

- potential for water use efficiency; and

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6    Walker C 2013 'Bank-less channels save labour', *Productive Water*, Winter, NSW Irrigators Council.

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- greater flexibility in the farm systems to choose a wider range of numerous cropping options.[7]

Nonetheless, there are a number of limitations to bank-less channels including:

- greater difficulty in maintaining uniformity;

- over application of water can easily occur;

- more extensive earth works and movement of top soil is required; and

- high flow rates from supply channels are required.

Estimating the yield gain from converting to bank-less channels is complex. There are a variety of factors to consider, including among others the effect of lasering on the:

- area of irrigable land — lasering to bank-less channels can both increase and decrease the area under irrigation depending on individual farm circumstances;

- quality-evenness of irrigation across the irrigable land — lasering to bank-less channels tends to increase the evenness of irrigation and thereby other things equal decrease water logging and increasing the consistency of yield across the area lasered;

- ability to flexibly adapt the farm system and undertake more timely enterprise decisions and inventions.

There is limited empirical evidence of the yield effects from bank-less – most are based on individual sites or pilot paddocks. In this project, we have relied on insights from a range of technical experts in these land form systems. The key insights were that bank-less channels:

- primarily enable single farm operators to operate larger scale enterprises. There were mixed views on its effect on the area of irrigable land — that is they are predominantly labour and input saving technology and thereby a transfer for the purposes of this study. Some case-studies in cotton have reported saving in machinery costs of 20 to 25 per cent[8].

- have a minor to limited effect on yield by improving the evenness of irrigation — given the assumptions required and the limited effect we do not incorporate this gain in this project.

- appear to primarily improve the flexibility of annual cropping systems — including having more cropping choices including additional crop choices and increased options with crop rotations.

Grabham (2012) observed the system enables row-crops to be grown in rotation with rice, which requires inundation. For example, using a case study of a terraced bay bank-less channel system, Gibb (2015) observed crop options for the original irrigation layout were 'limited to a rice-winter cereal-winter pasture' crop rotation and that 'crop options for the new irrigation layout will increase for summer crops (rice, cotton, maize) and winter crop types: cereals (wheat); legumes (faba beans) and oilseeds (canola)'. Grabham (2012) noted that this can also have advantages for weed management, soil health and the versatility to exploit commodity markets without major reconfiguration of the irrigation system.

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[7] Grabham M 2012 *Performance evaluation and improvement of bank-less channel surface irrigation systems.* PhD Dissertation University of Southern Queensland

[8] Cotton Info 2014, Bankless Channels

http://www.cottoninfo.com.au/sites/default/files/documents/CottonInfo%20bankless%20channels%20case%20study%20-%20March%202014.pdf

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Our consultations with field experts also indicate that flexibility is improved through the ability to make and execute more timely cropping decisions. Among others, this occurs through enabling more rapid and accurate application of machinery and results in the yielding of successful crops in years where a crop might be otherwise marginal. Based on feedback of field experts (including program delivery head contractors and on-farm advisors), we assume that one year in ten an extra rice/cereal crop can be yielded than would otherwise be the case.

We assume gross margin of \$2,277 per hectare (based on 2011-12 gross margin produced by Booth Associates — note we use the gross margin as an indicator of the first-round value added effect[9]). Consequently, the annual productivity gain of bank-less channels used for rice and cereals production can be calculated as = \$2.7 million = 12,027 hectares x \$2,277/10. The productivity gains for cotton are estimated in the same way – the gain is calculated as \$103,420 = 391 hectares x \$2,645/10, where the gross margin is also sourced from Booth Associates.

### 6.4.4  Water savings

The Department of Agriculture and Water Resources returns 30 per cent of on-farm water savings to irrigators.

The Department estimate a net gain of 21.8 GL LTAAY has been returned to irrigators which is comprised of approximately:

- 14.8 GL of entitlement LTAAY from on-farm efficiency works (where irrigators retain 30 per cent of all on farm savings);

- 7 GL of entitlement LTAAY from off-farm delivery system efficiency investments by PIIOP.

This water is assumed to be a net increase in available water for productive purposes and is used as the basis for estimating net economic productivity gains to the region from the PIIOP and OFIEP investments in section 8.

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[9]  Note gross margins have a range of limitations in economic analysis — see Douglas Dwyer and Appels (2007). In this study, we use them as an average indicative estimate of return only.

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# 7. Effects of water buy back

This section considers the effect of the Australian Government water purchase program on the MIA.

## 7.1 Key Findings

- Precise analysis of the regional economic effects from the water purchase programs is confounded by numerous dynamic influences that affect water market performance and prices, and regional economic performance.

- Based on the available evidence, Marsden Jacob concludes that the economic effect of the purchase (buy-back) program on the MIA is very small if not neutral because the water was purchased at the prevailing market price.

- The first-round effects are neutral because the prices paid by the Australian Government were equivalent to those offered by other bidders and, therefore, sale income is equivalent to the value of forgone farm income.

- Consideration of the longer-term effects finds that the effect is neutral because goods and services that would have been locally purchased to support irrigation activity have been largely replaced with alternative purchases to support new farming activity or business activity.

- Assuming leakage of income from the region of 10 or even 20 per cent, the loss is substantially less than the increase in estimated *annual flow of income* generated from Commonwealth infrastructure investments on and off farm.

## 7.2 Background

The Australian Government has purchased 215,295 ML of water from the Murrumbidgee region comprised of:

- 4,515 ML High Security;

- 188,840 ML General Security; and

- 20,820 ML Supplementary entitlement[10] purchases — plus an additional 1,120 in long term average annual yield.

This water is held by the Commonwealth Environmental Water Holder.

Based on information provided by the Department of Agriculture and Water Resources of this amount the Australian Government have purchased 72,977 ML from within the MIA at a total cost of $76.6 million, comprised of 2,467 ML High Security and 70,510 ML General Security.

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[10]  http://agriculture.gov.au/water/markets/commonwealth-water-mdb/progress-water-purchases

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## 7.3 First round income effects

Some aspects of the first round effects of buyback are straight forward

- the sale of water generates income but this sale also foregoes on-farm production

- sale income can be used to purchase goods and services that flow on through the economy but the loss of farm production has negative effects on flow on through the economy.

First principles suggest that the first-round effect on local economy value added is neutral, because prices paid by the Australian Government are equivalent to those offered by other bidders and therefore sale income is equivalent to the value of forgone farm income or sales to other water users.

Over time the longer-term effect of buy back on value added to the local economy will depend on what goods and services, and their location, are purchased from water sales income compared to the good and services that would have been purchased to support the generation of farm income through the irrigation activity.

## 7.4 Flow-on effects

Although first round effects are in principle neutral — the relative comparative flow-on effects of no buyback compared to buyback are of interest. A key issue is the extent of the indirect effect on the economy through countervailing multipliers. In other words, once the first round effect of selling water occurs, then what happens through the economy? Of interest is whether negative or positive multiplier effects occur. To inform the assessment of the multiplier effects from the water purchase program we have considered prior analysis and literature, no primary data collection has been undertaken.

The indirect effect can be measured by negative multiplier effects associated with a contraction in the value-added of agriculture that reduces expenditures in the economy. However, we agree with Grafton (2009) that consumption-induced multipliers have not been included when assessing the effect of a water buyback because the negative consumption effects of the direct losses of the net returns in agriculture are very likely to be offset by any increases in consumption associated with the proceeds from the sale of water entitlements (page 8).

For example, Arche Consulting 2012 assumed 230 GL is recovered from the Griffith and Leeton areas and that:

> *70% of the total money from the buyback is retained by residents within the LGA and that in 2019, 5% of those total proceeds will be spent in an LGA resulting in increased household expenditure.*[11]

As a consequence, Arche Consulting 2012 estimated that the application of the Basin Plan and subsequent reduction in SDL through direct purchases would result in an annual decrease in the Gross Value of Irrigated Agricultural Production (GVIAP) of $36.5 million – note this assumed:

- short term stimulus from infrastructure investment of approximately $20 million in output for the Griffith and Leeton local government areas;

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[11]   Arche Consulting 2012, Assessing the socio economic impacts of Sustainable Diversion Limits and Water for the Future Investments: Assessment of short term impacts at a local scale, Final Report, Australian Government Canberra

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- a small increase in dryland agriculture GVIAP on properties where water had fully existed; and

- a range of limiting input-output modelling assumptions and excluded the dynamic effects of water trade.

To address the limitation of input output model multiplier analysis a number of authors have used dynamic economic models to understand the dynamic interplays within local economies and how they affect the outcomes of buyback taking into account these countervailing multipliers:

- Dixon et al. (2009, p. 25) estimated that even if all proceeds from a 1,500 GL buyback leaked from the regions where the entitlements were held there would still only be a very small impact on regional aggregate consumption. The negative multipliers associated with reduced agricultural net returns from lower water diversions are offset by positive multipliers associated with the investments made by farmers from the proceeds of their sales of water entitlements.

- Grafton et al. (2009) estimate that direct impact on on-farm incomes are fully compensated by the proceeds associated with the voluntary sale of water entitlements by farmers, whereas, there are possible indirect impacts to upstream and downstream industries and the regional economy. The indirect impacts could be measured by negative multiplier effects associated with a contraction in the value-added of agriculture that reduces expenditures in the economy.

Unfortunately, it is not possible to calculate the size of this offsetting effect of water sales without knowing how the proceeds are invested from water buybacks. The evidence from surveys of farmers that have sold water indicate proceeds from sales are commonly used to fund farm cash-flow and that farmers continue their contribution to the local economy either through existing enterprises, dry-land farming or other forms of local employment.

A survey of the 3150 farmers who sold water (Cheesman and Wheeler 2012) found 60 per cent sold part of their water entitlement and were still farming, 30 per cent sold all of their water entitlement and had left farming, and 10 per cent had sold all of their water and were dry-land farming, purchased more water or used groundwater.

- almost 50% of irrigators who sold part of their water entitlement and continued farming said selling water has had no consequences for farm production. Around 30% of irrigators surveyed who had sold all of their water on an entitlement and continued to farm said that selling the water had had no consequences for farm production. Some irrigators said it was too early to tell if their water sale would impact on production;

- many irrigators who sold part of their water and continued farming had eliminated all their surplus water and some of their productive water, with the main aim of reducing farm debt from water sales proceeds; and

- most of the 158 irrigators who sold their water and exited farming are now working in other employment in the region (51%) or have retired in the region (35%). Around 3% are currently unemployed.

Consistent with the findings of several earlier studies, Cheesman and Wheeler 2012, also found most irrigators said they sold water to the Commonwealth to generate cash-flow and continued contributing to the local economy in a variety of ways:

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- 342 irrigators (60%) who offered or sold water to the Commonwealth did so to generate cash-flow. Irrigators mainly used the cash-flow generated by their sale to reduce debt (30 per cent of all respondents who sold water);

- irrigators reported that much of the proceeds of their water sales remain in the local region. A total of 36% of respondents said that they had spent the proceeds of their water sales on their farm or in their region, compared to 5% who said their water sale proceeds had been spent outside the region. Many respondents said they had used the proceeds to reduce farm debt. This report considers why debt reduction will often result in more money staying in the region rather than less.

Taken together these insights indicate that buyback *on its own* is likely to have had a minor effect on the local MIA economy. These insights are supported by ABARES 2011 modelling that indicated that the effect of buy backs was expected to be relatively modest at the Basin level. We also note this report indicated that estimating the likely distribution of Basin Plan effects at a town or community level is 'inherently difficult'.

Given no primary data collection has been undertaken to support the neutral effect assumption for this project and the inherent degree of uncertainty around this question at a regional (as opposed to basin scale) level — one way to test significance of buyback is to consider the potential for leakage of income from water sales to the Australian Government and compare these to the order of magnitude gains from Commonwealth investments. Based on Department of Agriculture and Water Resources data we estimate total income to irrigators based on sales of *entitlement* to the CEWH to be in the order of $76 million (*total stock of income in net present value terms*). Assuming leakage of income from the region of 10 or even 20 per cent the loss ($7.6-15.2 million in total or a decrease in the annual flow of income of less than $1 million) is substantially less than the increase in estimated *annual flow of income* as a result of Commonwealth on and off-farm infrastructure investments (estimated in the following section).

## 7.5    Understanding dynamic influences

A key challenge in understanding the local economy effect of buyback is that it occurs in a dynamic economic setting where there many other factors influencing local economy effect and the relative effect of buyback, these include:

- relative water availability in the region and other parts of the southern connected systems;

- other water trades;

- relative current and outlooks for commodity prices;

- other productive uses of land; and

- underlying changes in farm enterprise productivity and competitiveness.

It is also important to separate the local economy effects of water buyback from other effect such as seasonal variations in water availability, drought, broader structural adjustment in farm enterprises and their supply chain.

The purchase of water by the Australian Government is just one part of a set of dynamic relationships that affected economic outcomes in the MIA. Thus, we note that:

- the purchase of water by the Australian Government increased the overall demand for water entitlements across the southern MDB and most water market experts agree that, other

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things being equal, this tended to increase the relative price of water which has offsetting economic effect on buyers and sellers;

- significant buybacks occurred during periods of low water availability but drought itself was not a contributing factor to local economy outcomes from buyback;

- when water traded out of some activities it was offset by purchases into the region by other enterprises;

- buybacks occurred during a period of low commodity prices and high exchange rates that affected the competitiveness of some sectors;

- buybacks largely occurred prior to the significant investment in on farm irrigation technologies through OFIEP and PIIOP, because the purchase programs were able to be activated more quickly. These infrastructure investments are having positive material influence on the relative competitiveness of broad-acre irrigation in the region that was a key source of general security water for the buyback; and

- buybacks can affect the terms of trade of irrigators

These influences make it important to consider the local economy effect of buyback within a whole of region and whole of basin context.

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# 8. Timing of first round effect

In this section, we describe our approach to, and estimation of, local economy gains over time. Our estimation approach is based on timings and values of key PIIOP and OFIEP events and expenditures. The approach in this section describes the gains using a static first round approach.

To be able to model using VU TERM over time we have identified the timings of these first-round effect.

## 8.1    Timing of PIIOP and OFIEP

A timeline of the PIIOP and OFIEP projects that occurred in the MIA is described below. PIIOP and OFIEP expenditures under individual rounds have occurred under reasonably narrow periods of time between 2010 and 2019 (Table 10). Rather than estimate local expenditure timing based on the timing of individual transactions, we derive a profile of expenditures based on the project start and completion dates and the timing of key contract deliverables.

**Table 10: Key PIIOP and OFIEP events timeline**

| Round | Construction start date | Construction completion date |
|---|---|---|
| **OFIEP Round** | | |
| Round 1 | October 2010 | December 2013 |
| Round 3 | December 2013 | September 2016 |
| Round 5 | January 2017 | March 2019 |
| **PIIOP Round** | | |
| Round 1 | May 2013 | November 2014 |
| Round 2 | March 2015 | June 2019 |
| Round 3 | May 2017 | June 2019 |

*Source Department of Agriculture and Water Resources*

Using this timeline and the prior analysis, we have estimated the value of local (within MIA) and regional value added (Outside of MIA but within MDB) over time in nominal and real dollar terms (Table 11 and Table 12).

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**Table 11: Estimate of local and regional value added from construction phase by year (nominal dollars $m) – Static Approach**

| Calendar year | Within MIA | Outside MIA but within MDB |
|---|---|---|
| 2010 A* | $1.4 | $0.1 |
| 2011 A | $1.4 | $0.1 |
| 2012 A | $1.4 | $0.1 |
| 2013 A | $14.4 | $2.9 |
| 2014 A | $13.0 | $2.8 |
| 2015 A | $19.6 | $3.0 |
| 2016 A | $19.6 | $3.0 |
| 2017 F | $35.9 | $5.6 |
| 2018 F | $35.9 | $5.6 |
| 2019 F | $35.9 | $5.6 |

*A: Actual: F: Forecast*

*Source: Marsden Jacob estimates*

**Table 12: Estimate of local and regional value added from construction phase by year (2016 dollars $m) – Static Approach**

| Calendar year | Within MIA | Outside MIA but within MDB |
|---|---|---|
| 2010 A* | $1.6 | $0.1 |
| 2011 A | $1.6 | $0.1 |
| 2012 A | $1.5 | $0.1 |
| 2013 A | $15.2 | $3.1 |
| 2014 A | $13.3 | $2.9 |
| 2015 A | $19.8 | $3.0 |
| 2016 A | $19.6 | $3.0 |
| 2017 F | $35.1 | $5.4 |
| 2018 F | $34.2 | $5.3 |
| 2019 F | $33.4 | $5.2 |

*A: Actual: F: Forecast*

*Source: Marsden Jacob estimates*

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## 8.2 Profile over time

In this report, we estimate the local economy gains from 2010 to 2033 commencing July 2010 (Table 13) using the static approach.

This includes the first-round static effects of:

- PIIOP and OFIEP infrastructure expenditures;
- on-farm productivity gains from the infrastructure investments; and
- a leakage over time of local expenditure as goods and service shift to outside of the region.

**Table 13: Estimated annual local economy contribution (nominal dollars $million) – Static Approach**

| Calendar Year | Value added (Within MIA) | On farm productivity* | Total |
|---|---|---|---|
| 2010 | $1.4 | | $1.4 |
| 2011 | $1.4 | | $1.4 |
| 2012 | $1.4 | $0.1 | $1.5 |
| 2013 | $14.4 | $0.1 | $14.5 |
| 2014 | $13.0 | $0.4 | $13.4 |
| 2015 | $19.6 | $0.7 | $20.3 |
| 2016 | $19.6 | $1.2 | $20.8 |
| 2017 | $35.9 | $1.6 | $37.6 |
| 2018 | $35.9 | $2.5 | $38.4 |
| 2019 | $35.9 | $3.3 | $39.3 |
| 2020 | | $4.2 | $4.2 |
| 2021 | | $4.3 | $4.3 |
| 2022 | | $4.4 | $4.4 |
| 2023 | | $4.5 | $4.5 |
| 2024 | | $4.6 | $4.6 |
| 2025 | | $4.8 | $4.8 |
| 2026 | | $4.9 | $4.9 |
| 2027 | | $5.0 | $5.0 |

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| | | |
|---|---|---|
| 2028 | $5.1 | $5.1 |
| 2029 | $5.2 | $5.2 |
| 2030 | $5.4 | $5.4 |
| 2031 | $5.5 | $5.5 |
| 2032 | $5.7 | $5.7 |
| 2033 | $5.8 | $5.8 |

*excluding value of production gains from water savings which are included in VU Term estimates*

*Source: Marsden Jacob estimates*

**Table 14: Estimated annual local economy contribution (2016 dollars $million)**

| Calendar Year | Value added (Within MIA) | On farm productivity* | Total |
|---|---|---|---|
| 2010 | $1.6 | | $1.6 |
| 2011 | $1.6 | | $1.6 |
| 2012 | $1.5 | $0.1 | $1.6 |
| 2013 | $15.2 | $0.1 | $15.3 |
| 2014 | $13.3 | $0.4 | $13.8 |
| 2015 | $19.8 | $0.7 | $20.5 |
| 2016 | $19.6 | $1.2 | $20.8 |
| 2017 | $35.1 | $1.6 | $36.6 |
| 2018 | $34.2 | $2.3 | $36.6 |
| 2019 | $33.4 | $3.1 | $36.5 |
| 2020 | | $3.8 | $3.8 |
| 2021 | | $3.8 | $3.8 |
| 2022 | | $3.8 | $3.8 |
| 2023 | | $3.8 | $3.8 |
| 2024 | | $3.8 | $3.8 |
| 2025 | | $3.8 | $3.8 |

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| | | |
|------|------|------|
| 2026 | $3.8 | $3.8 |
| 2027 | $3.8 | $3.8 |
| 2028 | $3.8 | $3.8 |
| 2029 | $3.8 | $3.8 |
| 2030 | $3.8 | $3.8 |
| 2031 | $3.8 | $3.8 |
| 2032 | $3.8 | $3.8 |
| 2033 | $3.8 | $3.8 |

*\* excluding value of production gains from water savings – which are included in VU Term estimates*

*Source: Marsden Jacob estimates*

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# 9. Estimating gains (dynamic approach)

Victoria University was engaged by Marsden Jacob to estimate local economy and regional economic effects from the PIIOP and OFIEP program in the MIA using the VU TERM Model.

TERM is used to estimate annual ongoing effects of both the construction and implementation phases. This model gives a fuller picture of the economic effects estimated than the previous sections because:

- local and regional employment effects can be estimated;

- follow-on valued added effects (commonly referred to as multipliers) from first round expenditures are included in net economic indicators; and

- first round estimates will over-estimate the net effects and the investments lead to changes in the prices of goods and services that creates further movements of labour and capital within and between region.

## 9.1 Key Findings

- During the construction phase (2010-2019), `real GDP in the local economy increases by an estimated $178 million. The economy then experiences an ongoing net increase in real GDP of between $16-22 million annually thereafter due to the ongoing influence of productivity gains.

- Additional employment in the local economy rises from 168 full-time equivalent jobs to a peak of 298 jobs at the end of the construction phase. This then steadies to around 100 as productivity gains flow on, before gradually declining to 75 extra jobs annually compared to the base case by 2034. We note these are annual net changes relative to the base case and are not additive annually.

## 9.2 Data and 'shocks' for the model

There are two shocks applied to VU TERM:

- an investment shock to account for the local economy effects of construction expenditures;

- a productivity shock to account for:

  - the increase in farm gate value added and its local economy effects that are generated by implementing the off and on farm investments (see table 9); and

  - the increase in farm gate value added and its local economy effects that are generated by 21.8 GL of water returned to irrigators under the PIIOP and OFIEP water saving sharing rules.

### Investment

Based on analysis developed in the previous sections VU TERM was 'shocked' with an increase in local investment (Table 15).

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**Table 15: Estimate of local investment in MIA (nominal dollars $million)**

| Year | Within MIA |
|------|-----------|
| 2010 A | $1.6 |
| 2011 A | $1.6 |
| 2012 A | $1.5 |
| 2013 A | $15.2 |
| 2014 A | $13.3 |
| 2015 A | $19.8 |
| 2016 A | $19.6 |
| 2017 F | $35.1 |
| 2018 F | $34.2 |
| 2019 F | $33.4 |

*A: Actual: F: Forecast*

*Source: Marsden Jacob estimates*

In Table 16 the specific capital stock shocks for the lower Murrumbidgee region industries in the VU TERM are summarised. Note in VU TERM is shocked by the change in aggregate expenditure rather than first round value added. This is because VU TERM internally estimates value added after accounting for all changes on factor input prices and their subsequent flow on effects through the economy. The shocks to the model differ in proportion to actual capital expenditures in order to account for real wage impacts of the investments on the local economy.

**Table 16: VU TERM Annual investment 'shocks' (dollars million)**

| Industry | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|------|------|------|------|------|------|
| Wheat | 1.97 | 1.4 | 1.38 | 1.37 | 19.21 | 18.74 |
| OthCerealHay | 0.99 | 0.7 | 0.69 | 0.68 | 9.6 | 9.37 |
| Rice | 6.91 | 4.91 | 4.84 | 4.79 | 67.23 | 65.59 |
| Cotton | 0.31 | 0.22 | 0.22 | 0.22 | 3.03 | 2.96 |
| Grapes | 1.19 | 0.84 | 0.83 | 0.82 | 11.56 | 11.28 |
| Fruit | 0.78 | 0.55 | 0.54 | 0.54 | 7.57 | 7.39 |
| Almonds | 0.19 | 0.14 | 0.14 | 0.13 | 1.89 | 1.85 |

*Source: Victoria University*

## Productivity

VU TERM was also 'shocked' to account for the ongoing productivity for the affected farm businesses as reported in the previous section these include the change in on farm productivity and the effect of returned water savings. They assume all farms with productivity gains in 2018 continue to achieve those gains and the MIA receives 64 per cent allocations per annum (based

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on LTAAY conversion factor) between 2018 and 2033. The consequent annual productivity shocks for VU TERM industries are summarised in Table 17.

**Table 17: VU TERM industry productivity shocks**

|  | Percentage change# | $ million |
|---|---|---|
| Wheat | -0.05 | $0.05 |
| Rice | -0.33 | $0.21 |
| Cotton | -0.17 | $0.02 |
| OthCerealHay | -0.17 | $0.01 |
| Grapes | -0.30 | $0.11 |
| Fruit | -0.30 | $0.2 |

*# negative implies improvement, as input requirement per unit of output falls*

*Source: Victoria University*

In rice and other cereals & hay production, the shocks are larger, reflecting improvements in water productivity. Since rice is more water-intensive than other crops, the overall productivity gains are larger.

## 9.3   Modelling issues

### 9.3.1   Accounting for labour markets responses

In the model, normal labour market responses (effects on wages and movement of labour) are softened to account for the short time period of construction, likely stickiness in the local labour market and local employment protocols established by Murrumbidgee Irrigation.

The net result is labour utilisation in the local economy increases and more wages are retained within the region.

The extra 298 jobs peak coincides with the peak in project-specific investments in 2019 and then falls to around 100 extra jobs on an ongoing basis. In net percentage terms, regional employment increases to just over 1.4 per cent at the peak of the construction phase (Figure 7).

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**Figure 7: Change in Murrumbidgee employment (per cent) due to investments**
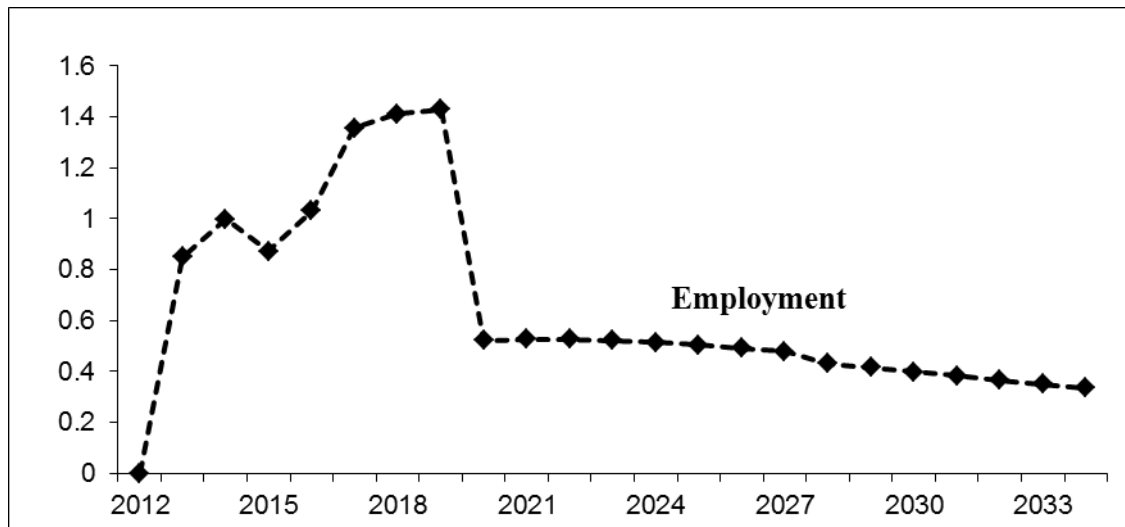


*Source: Victoria University*

### 9.3.2 Avoiding double counting

Some of the productivity gains are treated in VU TERM as factor quantity gains. This is because investment adds to the capital stock of each sector (the model includes a linkage between capital stocks in year t, and capital stocks plus investment in year t-1). Therefore, the ascribed productivity gains in the model should be somewhat smaller than the overall productivity gains so as not to double count.

## 9.4 Results

The total economic effect of the investment can be considered by two key indicators:

▪ real GDP — the value of all final goods and services produced in the regions – including consumption, investment and other government expenditures and exports and excluded imports — with inflation accounted for;

▪ employment — number of full time equivalent jobs created.

We report all results as net change relative to the counterfactual (the equilibrium state of the model prior to the construction and productivity 'shocks'

### 9.4.1 Local economy effects

During the construction phase (2010-2019), real GDP in the local economy increases by an estimated $141.2 million. The economy then experiences an ongoing net increase in real GDP of between $18-20 million annually thereafter given the ongoing influence of productivity gains (Figure 8 and Table 18 – these data report economy changes from 2013 reflecting negligible effects between 2010-2012

Employment in the local economy rises from 168 full-time equivalent jobs to a peak of 298 jobs at the end of the construction phase to between 75 and 110 plus extra jobs annually under the implementation phases compared to the base case (Figure 9 and Table 18). We note these are annual net changes relative to the base case and are not additive annually.

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**Figure 8: Estimated total local economy Real GDP impact of PIIOP and OFIEP in the Griffith region**
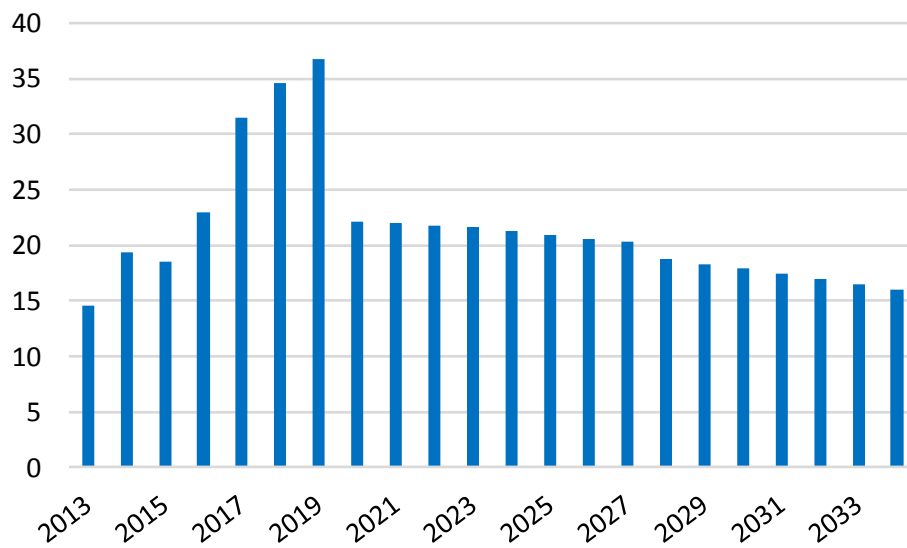


**Figure 9: Estimated total local economy employment impact of PIIOP and OFIEP in the Griffith region**



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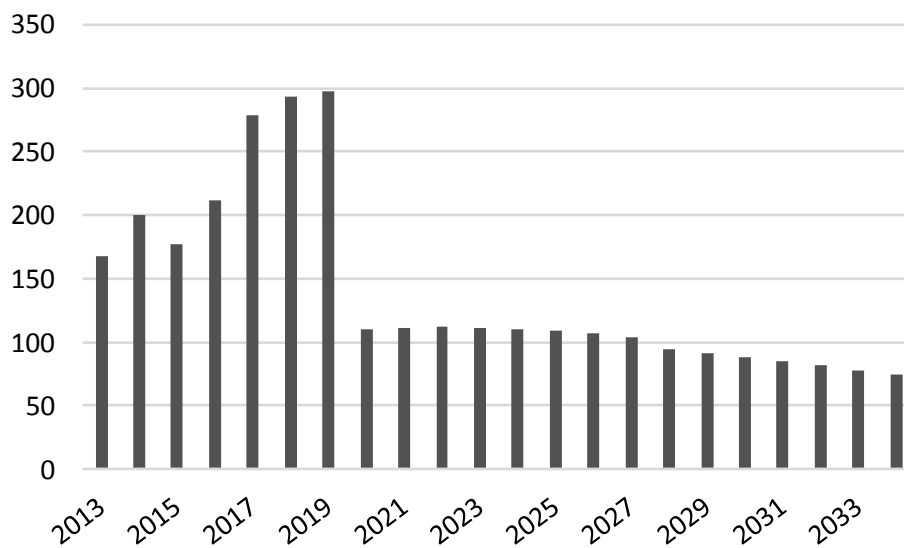
**Table 18: Estimated total local economy Real GDP impact of PIIOP and OFIEP in the Griffith region[12]**

| Year | Real GDP ($million) | Employment (Persons) |
|------|---------------------|----------------------|
| 2013 | 14.5 | 168 |
| 2014 | 19.3 | 200 |
| 2015 | 18.5 | 177 |
| 2016 | 22.9 | 212 |
| 2017 | 31.5 | 279 |
| 2018 | 34.6 | 293 |
| 2019 | 36.8 | 298 |
| 2020 | 22.1 | 110 |
| 2021 | 22.0 | 111 |
| 2022 | 21.8 | 112 |
| 2023 | 21.6 | 111 |
| 2024 | 21.3 | 110 |
| 2025 | 20.9 | 109 |
| 2026 | 20.6 | 107 |
| 2027 | 20.3 | 104 |
| 2028 | 18.8 | 94 |
| 2029 | 18.3 | 91 |
| 2030 | 17.9 | 88 |
| 2031 | 17.4 | 85 |
| 2032 | 16.9 | 82 |
| 2033 | 16.5 | 78 |
| 2034 | 16.0 | 75 |

*Source Victoria University TERM model estimates*

There are small differences between first round value added estimates in Section 5 and VU TERM results for real GDP. This can be expected because of:

- methodological differences between the measures;

- the granularity of representation of the construction sector — the VU TERM model is underpinned by regional input output tables that do not have fine degree of resolution of on-farm construction businesses; and

- effects of investments on input prices and substitution effects within the economy.

A key issue in the modelling VU TERM is to account for the likely value added differences in different forms of construction and investment activities. In section 5 highly granular expenditure data was used to estimate first-round value added estimates, in particular large investments in laser grading are assumed to generate more local value added than off farm

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[12] In 2016 dollars. Note we exclude reporting impacts in 2010-2012 given the small changes in indicators.

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construction activity simply because the latter utilises a higher proportion of imported goods and services. A challenge in VU TERM is the on-farm construction sector does not have this degree of granularity and as such assumes a higher proportion of imported goods and services are used than is likely to be the case for OFIEP investments in 2017-18. To address this problem the VU TERM model shocks were adjusted to account for a higher proportion of local goods and services in construction expenditures focussed on farm than would otherwise be the case.

### 9.4.2 Change in industry value added

The services sector in Griffith region is a key beneficiary during the construction phase. This includes the utilities (water gas electricity etc), construction services and trade service industries (plumbers, electricians etc) (Figure 10).

**Figure 10: Change in utility, construction services and trade value added ($million)\***
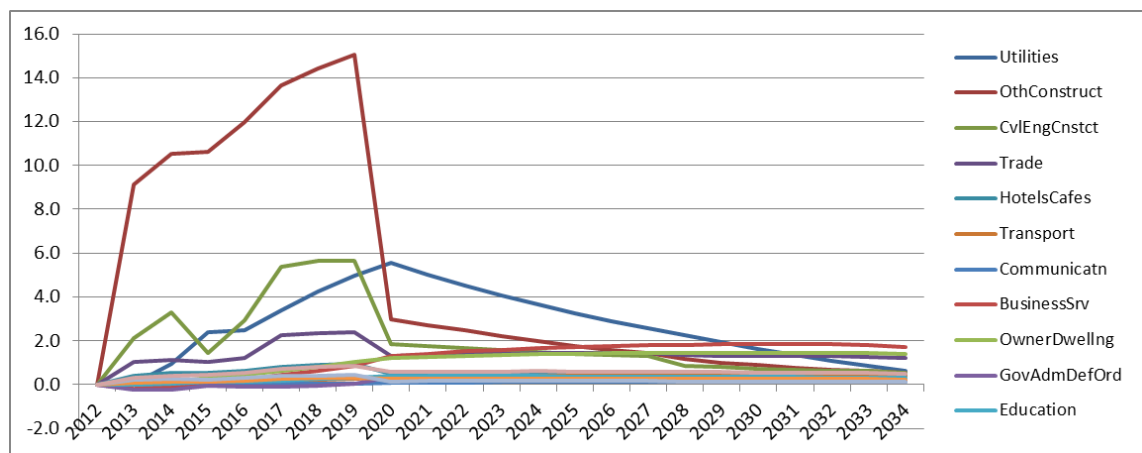


*\* See Appendix 2 for annual dollar value tables*

*Source Victoria University estimates*

We note that in the VU TERM Model, which reflects available regional economy data, there is limited representation of the construction services to farm development . Most of the expenditure in years 2017 and 2018 of OFIEP occur in laser grading on broad acre cropping. Many of these service providers are contractors in earth moving but some also operate as off farm enterprises to support farm households. In undertaking the VU TERM simulations we have adjusted VU TERM shocks and employment effects to account for this feature of the investment. The model also accounts for dynamic shifts in relative agricultural enterprise performance and this affects changes in aggregate industry value add performance.

Reflecting the relative water intensity, productivity and water savings gains result in the largest sustained gains in the rice industry (Figure 11).

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**Figure 11: Change in agricultural industry value added ($ million)***
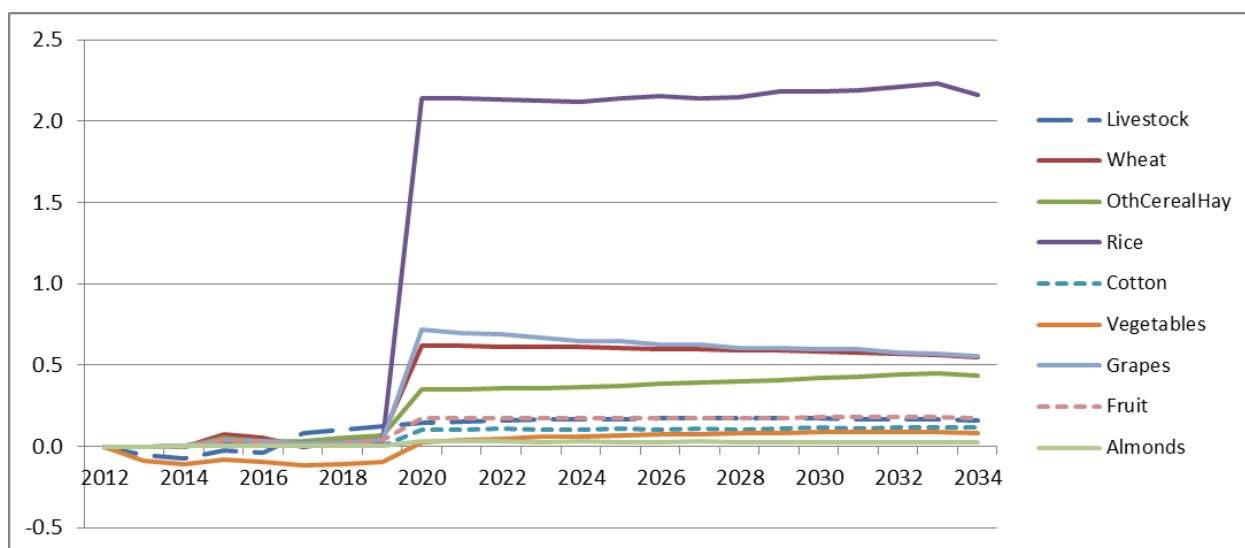


*\* See Appendix 2 for annual dollar value tables*

*Source Victoria University estimates*

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# 10. References

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# Appendix A: Total goods and services expenditures

Expenditures from the program were allocated to each goods and services class for each project based on a timeline of project events. The cost categories displayed in this section vary across PIIOP (on-farm and off-farm) and OFIEP as a result of differences in the categorisation of data provided.

## Goods and services — PIIOP off-farm

**Table 19: PIIOP off-farm expenditure Round 1 GST Exclusive $million**

| Cost category | Expenditure |
|---|---|
| Labour | $13.3 |
| Project management, design and stakeholder management | $5.8 |
| Material | $20.0 |
| Fuel | $0.0 |
| Plant | $6.5 |
| Other | $4.4 |
| **Total** | **$50.0** |

*Source: MJA estimates using information and data on forecast expenditures provided by Murrumbidgee Irrigation and the Department of Agriculture and Water Resources.*

**Table 20: PIIOP off-farm expenditure Round 2 GST Exclusive $million**

| Cost category | Expenditure |
|---|---|
| Labour | $31.1 |
| Project management, design and stakeholder management | $13.5 |
| Material | $46.7 |
| Fuel | $0.0 |
| Plant | $15.1 |
| Other | $10.2 |
| **Total** | **$116.6** |

*Source: MJA estimates using information and data on forecast expenditures provided by Murrumbidgee Irrigation and the Department of Agriculture and Water Resources.*

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**Table 21: PIIOP off-farm expenditure Round 3 GST Exclusive $million**

| Cost category | Expenditure |
|---|---|
| Labour | $20.2 |
| Project management, design and stakeholder management | $11.0 |
| Material | $35.7 |
| Fuel | $0.0 |
| Plant | $9.9 |
| Other | $8.1 |
| **Total** | **$84.9** |

*Source: MJA estimates using information and data on forecast expenditures provided by Murrumbidgee Irrigation and the Department of Agriculture and Water Resources.*

## Goods and services — PIIOP on-farm

**Table 22: PIIOP on-farm expenditure GST Exclusive $million**

| Cost category | Expenditure |
|---|---|
| Drips | $29.9 |
| Pipes | $1.3 |
| Excavation | $15.5 |
| Pumps | $8.9 |
| Bores | $0.1 |
| Soil moisture monitoring | $2.8 |
| Troughs | $0.1 |
| **Total** | **$58.5** |

*Source: MJA estimates using information and data on actual expenditures provided by Murrumbidgee Irrigation.*

## Goods and services — OFIEP on-farm

**Table 23: OFIEP expenditure – Round 1 GST Exclusive $million**

| Good and services class | Expenditure |
|---|---|
| Planning and design | $0.5 |
| Landforming | $5.9 |
| Pipes and stops | $1.6 |
| Pumps | $0.7 |
| Earthworks for drains, channels and on-farm storage and pumps | $1.0 |
| Travelling irrigator | $0.1 |
| Telemetry and control system | $0.1 |

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| Good and services class | Expenditure |
|---|---|
| Drip system | $0.0 |
| Fertigation and soil moisture monitoring | $0.0 |
| Ricegrowers administration cost | $0.6 |
| **Total** | **$10.4** |

*Source: MJA estimates based on Department of Agriculture and Water.*

**Table 24: OFIEP expenditure – Round 3 GST Exclusive $million**

| Good and services class | Expenditure |
|---|---|
| Planning and design | $0.4 |
| Landforming | $15.0 |
| Pipes and stops | $2.0 |
| Pumps | $2.1 |
| Earthworks for drains, channels and on-farm storage and pumps | $1.6 |
| Travelling irrigator | $0.0 |
| Telemetry and control system | $0.0 |
| Drip system | $0.8 |
| Fertigation and soil moisture monitoring | $0.3 |
| Ricegrowers administration cost | $1.7 |
| **Total** | **$23.9** |

*Source: MJA estimates based on Department of Agriculture and Water.*

**Table 25: OFIEP expenditure – Round 5 GST Exclusive $million**

| Good and services class | Expenditure |
|---|---|
| Planning and design | $1.1 |
| Landforming | $26.4 |
| Pipes and stops | $4.7 |
| Pumps | $3.5 |
| Earthworks for drains, channels and on-farm storage and pumps | $3.4 |
| Travelling irrigator | $0.1 |
| Telemetry and control system | $0.2 |
| Drip system | $1.0 |
| Fertigation and soil moisture monitoring | $0.4 |
| Ricegrowers administration cost | $2.9 |
| **Total** | **$43.6** |

*Source: MJA estimates based on Department of Agriculture and Water*

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# Appendix B: Value of intermediate goods and services inputs

## PIIOP off-farm final goods and services

The total value of PIIOP off-farm goods and services is $251.5 million. Based on expenditure to date, $100.0 million (40 per cent of the total) is estimated to be intermediate goods and services within the MIA. There is a further $24.8 million (10 per cent of the total) of intermediate goods and services that has been sourced from outside the MIA but within the MDB.

**Table 26: PIIOP off-farm All Rounds final expenditure (GST Exclusive) $ million**

| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
| --- | --- | --- | --- | --- |
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| Labour | $64.6 | $31.1 | $4.7 | $28.8 |
| Project management, design and stakeholder management | $30.3 | $17.9 | $0.0 | $12.4 |
| Material | $102.5 | $27.0 | $17.4 | $58.1 |
| Fuel | $0.0 | $0.0 | $0.0 | $0.0 |
| Plant | $31.4 | $9.8 | $2.7 | $19.0 |
| Other | $22.7 | $14.4 | $0.0 | $8.4 |
| **Total** | **$251.5** | **$100.0** | **$24.8** | **$126.7** |
| **% of total** | **100%** | **40%** | **10%** | **50%** |

*Source: MJA estimates using information and data on actual expenditures provided by Murrumbidgee Irrigation and the Department of Agriculture and Water.*

## PIIOP on-farm goods and services

The total value of PIIOP on-farm goods and services is $58.5 million of which $36.3 million (62 per cent of the total) is estimated to be intermediate goods and services within the MIA. There is a further $1.7 million (3 per cent of the total) of intermediate goods and services that has been sourced from outside the MIA but within the MDB.

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**Table 27: PIIOP on-farm goods and services (GST Exclusive) $million**

| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
|---|---|---|---|---|
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| Drips | $29.9 | $18.7 | $0.0 | $11.2 |
| Pipes | $1.3 | $0.9 | $0.1 | $0.3 |
| Excavation | $15.5 | $11.2 | $0.5 | $3.8 |
| Pumps | $8.9 | $3.8 | $1.1 | $3.9 |
| Bores | $0.1 | $0.0 | $0.0 | $0.0 |
| Soil moisture monitoring | $2.8 | $1.5 | $0.0 | $1.2 |
| Troughs | $0.1 | $0.1 | $0.0 | $0.0 |
| **Total** | **$58.5** | **$36.3** | **$1.7** | **$20.5** |
| **% of total** | **100%** | **62%** | **3%** | **35%** |

*Source: MJA estimates using information and data on actual expenditures provided by Murrumbidgee Irrigation and the Department of Agriculture and Water.*

## OFIEP goods and services

The total value of OFIEP final goods and services is $77.9 million of which $42.4 million (54 per cent of the total) is estimated to be intermediate goods and services within the MIA. There is a further $2.1 million (3 per cent of the total) of intermediate goods and services that has been sourced from outside the MIA but within the MDB.

**Table 28: OFIEP All Rounds goods and services (GST Exclusive) $million**

| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
|---|---|---|---|---|
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| Planning and design | $2.0 | $1.9 | $0.1 | $0.0 |
| Landforming | $47.2 | $25.3 | $1.1 | $20.7 |
| Pipes and stops | $8.4 | $3.0 | $0.7 | $4.7 |
| Pumps | $6.3 | $2.8 | $0.2 | $3.3 |
| Earthworks for drains, channels and on-farm storage and pumps | $6.0 | $3.2 | $0.1 | $2.6 |
| Travelling irrigator | $0.2 | $0.0 | $0.0 | $0.1 |
| Telemetry and control system | $0.3 | $0.1 | $0.0 | $0.2 |
| Drip system | $1.8 | $0.5 | $0.0 | $1.3 |

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| Type of cost | Total expenditures | Value of intermediate goods and services inputs | | |
|---|---|---|---|---|
| | | Within MIA | Outside MIA but within MDB | Outside MIA and MDB region |
| Fertigation and soil moisture monitoring | $0.6 | $0.2 | $0.0 | $0.4 |
| Administration | $5.2 | $5.2 | $0.0 | $0.0 |
| **Total** | **$77.9** | **$42.4** | **$2.1** | **$33.4** |
| **% of total** | **100%** | **54%** | **3%** | **43%** |

*Source: MJA estimates based on data provided by Murrumbidgee Irrigation and Department of Agriculture and Water.*

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# Appendix C: Annual change in industry value added

**Figure 12 Change in value added by agricultural industry in MIA (dollars million)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Livestock | 0.0 | -0.1 | -0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Wheat | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| OthCerealHay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Rice | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.1 |
| Cotton | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Vegetables | 0.0 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Grapes | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 |
| Fruit | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Almonds | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

*Source: VU Term*

**Figure 13 Change in value added by services and utility industries in MIA (dollars million)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilities | 0.0 | 0.0 | 0.9 | 2.4 | 2.5 | 3.4 | 4.3 | 5.0 | 4.6 | 4.2 | 3.9 | 3.5 | 3.2 | 3.0 | 2.7 | 2.5 | 2.3 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 |
| OthConstruct | 0.0 | 9.1 | 10.5 | 10.6 | 12.0 | 13.6 | 14.4 | 2.7 | 2.5 | 2.3 | 2.1 | 1.9 | 1.7 | 1.6 | 1.4 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 | 0.8 | 0.7 | 0.6 |
| CvlEngCnstct | 0.0 | 2.1 | 3.3 | 1.5 | 2.9 | 5.4 | 5.6 | 1.9 | 1.8 | 1.8 | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 | 1.6 | 1.2 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 |
| Trade | 0.0 | 1.0 | 1.1 | 1.0 | 1.2 | 2.3 | 2.4 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 |
| HotelsCafes | 0.0 | 0.4 | 0.5 | 0.5 | 0.6 | 0.8 | 0.9 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| Transport | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Communicatn | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| BusinessSrv | 0.0 | -0.2 | -0.1 | 0.1 | 0.2 | 0.4 | 0.6 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.5 |
| OwnerDwellng | 0.0 | 0.0 | 0.1 | 0.3 | 0.5 | 0.6 | 0.8 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 |
| GovAdmDefOr | 0.0 | -0.3 | -0.2 | -0.1 | -0.1 | -0.1 | 0.0 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 |
| Education | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Health | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 |
| CmmuntySrv | 0.0 | 0.2 | 0.3 | 0.2 | 0.3 | 0.4 | 0.4 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| OthServices | 0.0 | 0.3 | 0.4 | 0.4 | 0.5 | 0.7 | 0.8 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

*Source: VU Term*

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