GOULBURN-MURRAY WATER

Irrigation Farm Survey

2004/2005

Final

Date: 5/12/06

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

NORTH CENTRAL Catchment Management Authority

Acknowledgements

This project was funded through a cost sharing arrangement between Goulburn-Murray Water, Goulburn broken Catchment Management Authority and North Central Catchment Management Authority.

The project team would like to thank the Australian Bureau of Statistics and the Department of Primary Industries for their contribution to the Irrigation Farm Survey.

Executive Summary

The Irrigation Farm Survey (IFS) or Culture Census as it was previously known has been undertaken by Goulburn-Murray Water (G-MW) in various guises for approximately 20 years. Prior to 1993, the census was conducted annually. Then the IFS was undertaken approximately four yearly by G-MW in partnership with Catchment Management Authorities to gain an understanding of its customer base. The data provided a basis for predicting present and future irrigation water use and requirements, crop type and farm type.

With another census scheduled for the 2004/2005 irrigation season, an IFS Steering Committee (Steering Committee) decided to explore alternative survey options to overcome historical accuracy and response rate problems. The aim of the alternative option was to utilise existing data and data gathering technologies including Local Government land information and remote sensing to provide a comprehensive dataset of farm and crop types which can support the conduct of smaller statistically relevant surveys on an 'as needed basis'.

The objectives of the IFS project were to:

- Develop new methods to improve quality of data and statistical relevance;
- Explore methods that may innovatively enable the IFS and other surveys to be undertaken better;
- To undertake an assessment of irrigation culture and associated farm development within G-MW's region;
- Undertake IFS under shared cost arrangements with project stakeholders to a nominated budget;
- Analyse data collected;
- Integrate data from different sources;
- Develop a report on the survey and process.

The expected project outcomes included:

- An Irrigation Farm Survey adopted as a two part process;
- Execution of data sharing agreements between G-MW and Local Governments;
- Sharing of datasets between G-MW and Local Governments via a property number;
- Culture and other farm information will be available from this process in an aggregated format;
- The data supplied by data sharing and the Trial Survey will be analysed and a report will be written.

The original project proposal identified as an acceptable result the development of continuing data-sharing relationships with Local Government. It foreshadowed the benefit of collaboration, specifically that on-going data collection by Local Government contract valuation services might supply much of the information earlier sought in the IFS, and any future IFS might supplement that information through strategically focused surveys.

As the majority of the information required by G-MW and Catchment Management Authorities was already being obtained by Local Government, 'Information Sharing Agreements' were entered into with Local Government to share selected property

information, Water Right, and water use information, by property via a property number.
Advice was sought from the Office of the Privacy Commissioner, Victoria, to clarify that such an arrangement would not contravene the Information Privacy Act 2000.

Information sharing agreements were proposed by G-MW and presented to the following six Local Government:

- Shire of Campaspe
- Gannawarra Shire Council
- Loddon Shire Council
- Moira Shire Council
- Greater Shepparton City Council
- Swan Hill Rural City Council.

With the exception of Moira Shire Council, all entered into the information sharing agreements (Agreements). The Agreements provided a basis upon which Local Government and G-MW could share information and safeguard the interests of the parties, by setting out the terms and conditions underpinning the information process.

The IFS Steering Committee was mindful of the following factors and responded by deciding to trial a new survey process:

- Inadequacies of previous surveys;
- Opportunity to share information already being obtained by Local Government;
- Desire of Local Government to obtain water use at property level, and
- Australian Bureau of Statistics (ABS) survey techniques using the ABS Land Parcel Frame methodology and stratified sampling.

The Trial Survey process shared existing property information held by Local Government and water use information held by G-MW, and utilised new survey techniques developed by ABS. It was decided to conduct a Trial Survey utilising shared data, adopting in principle ABS Land Parcel Frame methodology and applying proven statistical techniques to survey design.

The Trial Survey was restricted to dairy properties in the Central Goulburn Irrigation Area and dairy and cropping and grazing properties in the Rochester Campaspe and Pyramid Boort Irrigation Areas.

The Trial Survey delivered the following outcomes:

- Processes for compiling surveys using information from Local Government, G-MW and DPI;
- A framework to enable surveys to be targeted to individual properties, with accompanying aerial photos to assist survey completion and accuracy of data;
- A cost effective methodology for future surveys;
- Useful and relevant information for immediate use.

Trial Survey findings are contained in Section 7.

It also tested the reliability of information obtained by Local Government and provided the basis for any refinement.

The project achieved all its objectives and the outcomes were generally as envisaged.

The conclusion from the combined data sharing, remote sensing and Trial Survey exercise is that utilising a combination of existing Local Government information and remote sensing will provide for G-MW, G-B-CMA and NC-CMA ongoing basic farm and crop type information needs.

The next steps of this data sharing and collection project will be to investigate collation of additional information into the existing information framework including the following attributes:

- Extended winter and seasonal crop types (gathered by valuation contractors);
- Integration of fixed horticulture information for SPC-Ardmona Horticulture census;
- Collection of improved property information (ie. Re-use, spray irrigation) from Local Government information.

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1 Background

The Irrigation Farm Survey (IFS) or Culture Census as it was previously known has been undertaken by Goulburn-Murray Water (G-MW) in various guises for approximately 20 years. Prior to 1993, the census was conducted annually. Then the IFS was undertaken approximately four yearly by G-MW in partnership with Catchment Management Authorities to gain an understanding of its customer base. The data provided a basis for predicting present and future irrigation water use and requirements, crop type and farm type.

The last comprehensive IFS was completed in 1996/1997. Its mail-out, mail-back format suffered poor response rates (approximately 60%) and data was subsequently in-filled with data from the 1991/1992 census.

In 2000/2001, the IFS was conducted using WaterLINE and an 'Interactive Voice Recording'. This method only yielded a 50% response rate. After data verification, the reliability was as low as 30%. Effectively, the exercise was not a true census but a self-selected survey, complete with all the risks (to data-reliability) associated with self-selection by respondents.

Therefore at the time this project commenced 13 to 14 year old data was being used to make strategic decisions about investment in irrigation and drainage infrastructure. Irrigation development in many areas had changed dramatically during that time, thus the data was largely obsolete.

With another census scheduled for the 2004/2005 irrigation season, IFS Steering Committee (Steering Committee) decided to explore alternative survey options to overcome the historical accuracy and response rate problems. The aim of the alternative option was to utilise existing data and data gathering technologies including Local Government land information and remote sensing to provide a comprehensive dataset of farm and crop types which can support the conduct of smaller statistically relevant surveys on an 'as needed basis'.

2 Objectives

The objectives of the IFS project were to:

- Develop new methods to improve quality of data and statistical relevance;
- Explore methods that may innovatively enable the IFS and other surveys to be undertaken better;
- To undertake an assessment of irrigation culture and associated farm development within G-MW's region;
- Undertake IFS under shared cost arrangements with project stakeholders to a nominated budget;
- Analyse data collected;
- Integrate data from different sources;
- Develop a report on the survey and process.

3 Expected Outcomes

3.1 General

The expected project outcomes included:

- An Irrigation Farm Survey adopted as a two part process;
- Execution of data sharing agreements between G-MW and Local Governments;
- Sharing of datasets between G-MW and Local Governments via a property number;
- Culture and other farm information will be available from this process in an aggregated format;
- The data supplied by data sharing and the Trial Survey will be analysed and a report will be written.

In the original project proposal it was stated that an acceptable result would see continuing relationships with Local Government, on-going collection of data sets by Local Government contract valuation services and the information supplied supplemented by strategically focused surveys.

3.2 Information Sharing

To develop a useful information dataset for use by G-MW, Department of Primary Industries (DPI) and the Goulburn Broken and North Central Catchment Management Authorities (CMAs), and to share information with Local Government it was expected that data sharing agreements between the parties would be required. It was considered that the agreement would specify that G-MW in conjunction with DPI, Local Government and their agents would share a property number for the purposes of sharing information from different sources and that the information shared could only be disclosed to outside parties in aggregated format.

In order to share data effectively and efficiently the following activities were considered necessary:

- Coding of each rated property with the G-MW property number;
- Referencing of the Local Government property number into G-MW customer base;
- A maintenance program established within G-MW to keep these links current.

The updates of dataset linkages would be undertaken manually at first, and then automated to reduce errors.

3.3 Trial Survey

The trial survey was initially intended to obtain information on land use, cultural, management and irrigation practices and social views across G-MW's entire gravity irrigation customer base.

The Steering Committee was mindful of the following factors and responded by deciding to trial a new survey process:

- inadequacies of previous surveys;
- the opportunity to share information already being obtained by Local Government;
- the desire of Local Government to obtain water use at property level, and
- the Australian Bureau of Statistics (ABS) survey techniques using the ABS Land Parcel Frame methodology and stratified sampling.

The planned Trial Survey process was to share existing property information held by Local Government and water use information held by G-MW, and to utilise new survey techniques developed by ABS. It was decided that a Trial Survey be conducted utilising shared data, adopting in principle ABS Land Parcel Frame methodology and applying proven statistical techniques to survey design.

The size of the Trial Survey was restricted to dairy properties in the Central Goulburn Irrigation Area and dairy and cropping and grazing properties in the Rochester Campaspe and Pyramid Boort Irrigation Areas.

The Steering Committee expected that the trial would delivery the following outcomes:

- A processes for compiling surveys using information from Local Government, G-MW and DPI;
- A framework to enable surveys to be targeted to individual properties, with accompanying aerial photos to assist survey completion and accuracy of data;
- An estimate of the reliability of information obtained by Local Government;
- Identification of the basis for any refinement;
- A cost effective methodology for future surveys;
- Useful and relevant information for immediate use.

4 Project Management

4.1 Steering Committee

The Steering Committee was formed in April 2004 and consisted of representatives from G-MW, DPI, GBCMA, NCCMA and ABS. Its membership is shown in Appendix 11.3. The Steering Committee provided a coordinated focus to the many project aspects. A Working Group was established to support the project. It comprised of key members of Steering Committee. Its membership is shown in Appendix 11.3.

4.2 Role of Stakeholders

4.2.1 G-MW

G-MW provided funding and a Project Manager.

Two groups were established within G-MW to provide direction, technical advice, and assistance in project delivery and to establish ongoing management arrangements. The groups were:

- G-MW 'Reference Group'. The Reference Group consisted of G-MW senior management who provided high level advice and direction to the Project Manager;
- G-MW 'Technical Group'. The Technical Group facilitated the introduction and maintenance of a 'Property Number' for each land parcel in the G-MW database. The technical group involved people from G-MW sections Property and Legal, Water Administration, Surveys, a representative from DPI and the Project Manager.

Membership of those Groups is shown in Appendix 11.3

4.2.2 DPI

The Tatura Spatial Sciences Group of DPI coordinated several activities as part of the IFS.

Activities included:

- Liaison with G-MW, ABS, Local Government and other groups as part of the Working Group;
- Alignment of G-MW 'service point' to Local Government 'property' and facilitation of information exchange between those groups;

- Providing data to ABS, outlining customer type and sufficient information to allow ABS to successfully provide a statistically useful sample of G-MW customer group selected;
- Printing 'property' maps after identifying the selected survey targets
- Facilitating information exchange between G-MW and DPI; G-MW and ABS; and G-MW and Local Government;
- Working with the consultants, LG Valuation Services, to reformat data to suit G-MW needs. The contribution by LG Valuation Services and their attendance at meetings was not directly costed to the project.

The above activities were not directly costed to the project and were undertaken by DPI because of their potential strategic value.

The Spatial Sciences and Practice Change Groups at Tatura and Bendigo compiled and analysed information received from the Trial Survey and report finding.

4.2.3 CMA's

Both Goulburn Broken and North Central Catchment Management Authorities provided funds for the Project and were represented on the Steering Committee.

4.2.4 Australian Bureau of Statistics (ABS)

ABS provided expertise toward the running of the Trial Survey. Its services included, (but were not restricted to) the following:

- Liaison with DPI and G-MW as part of the Working Group;
- Manipulation of datasets provided by DPI Tatura outlining customer type;
- Building a statistical framework for a Trial Survey;
- Providing a list of properties (survey targets) that when surveyed would provide a statistically useful sample of the chosen G-MW customer sub-groups (dairy and mixed irrigation farmers).

ABS was concurrently trialling a new survey methodology, known as a Land Parcel Frame (LPF) in different parts of Australia to gauge its effectiveness. The method has the following potential benefits:

- It allows more accurate regional data collection (i.e. can design for: biophysical regions, river catchments; human defined regions, policy and planning jurisdictions; and NRM regions such as NAP regions);
- Information can be more accurate at small geographic scales. Rather than reporting for all land associated with a single business unit (irrespective of location), land holders will report for exact parcel(s);
- The ability to stratify the survey design by land use, parcel size, enterprise and catchment boundaries etc.

The information generated by the Trial Survey will enable ABS and other organisations to conduct land and water management surveys on an ongoing basis that are statistically representative of the target populations. Senior ABS staff members were keen to pilot a survey of water information within northern Victorian irrigation areas using this methodology.

ABS staff subsequently attended Steering Committee meetings and joined the Working Group to provide advice on the potential use of LPF methodology and other survey techniques.

The contribution by ABS staff and their attendance at meetings was not directly costed to the project.

5 Methodology

5.1 Project Plan

The Project Plan consisted of four stages. They were:

- **Stage 1. Project Planning**- Complete Project Concept Proposal and gain endorsement from Steering Committee
- **Stage 2. Project Development**- Finalise agreements, complete data alignment and refine survey requirements
- **Stage 3. Trial Survey**- Finalise survey requirements, run survey and data sharing
- **Stage 4. Produce Report**- Collate and analyse returned data, write and publish report.

The project logic is shown in Figure 1.

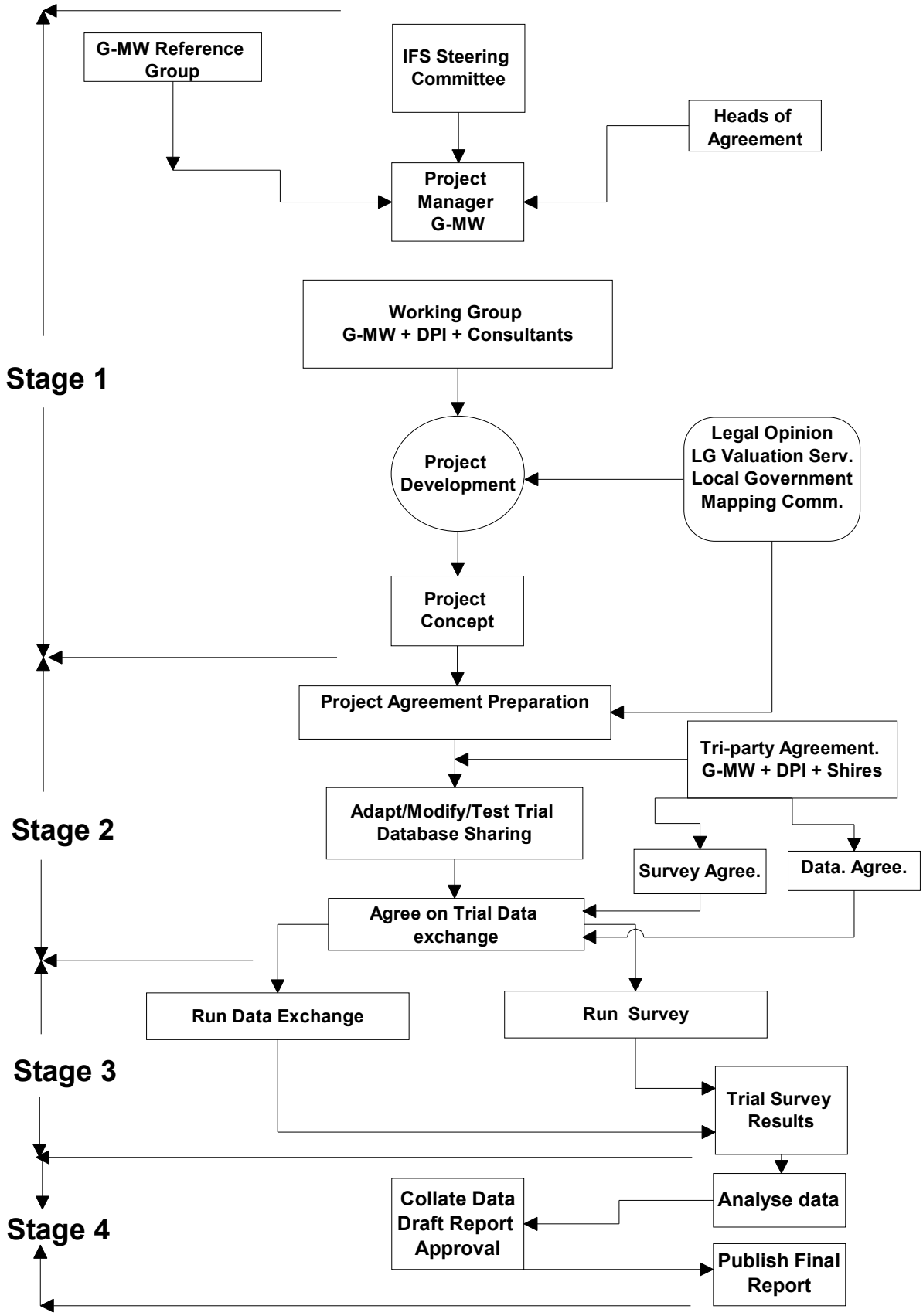


Figure 1. Project Development Logic

5.2 Survey Design

5.2.1 Survey Objectives

The objectives of the survey were to obtain information on land use, cultural, management and irrigation practices and social views related to dairy farmers within the Central Goulburn Irrigation Area and dairy and mixed farmers within the Rochester, Campaspe and Pyramid-Boort Irrigation Areas. That information will help to establish a benchmark against which the future can be compared. The Commonwealth and State Governments increasingly expect publicly funded programs (such as infrastructure reconfiguration initiatives and land and water management plans) to demonstrate results that can be clearly attributed to their investments.

Those objectives implicitly defined the *target population* (the population about which we wanted to make inferences):

- Content (All dairy farmers);
- Units (Operating dairy farms, or dairy and mixed farms);
- Extent (in Central Goulburn and Rochester, Campaspe and Pyramid-Boort Areas;
- Time Frame (for the financial year 2004-2005?).

Note that the *selection unit* was the farm and the *reporting unit* was the farmer.

5.2.2 Frames and Population

At this stage readers are introduced to the definition of a few statistical terms.

“Population” is the aggregate or collection of units about which the survey will be conducted.

There are two sub-sets of a population worth defining here:

- “Target population” is a term to describe the scope of the survey, for example, dairy farmers or mixed farmers;
- “Survey population” is a term to describe the individuals who are involved in the survey, or, i.e. the farmers who get the form.

Frame refers to the list of units in the survey population. As frames provide the means of accessing the population, their quality is important. Potential problems include duplicates, deaths, nil returns, typographical errors, definitions (i.e. G-MW and Local Government rate frame may define a “dairy farmer” differently), and frames that are out of date. The reliability of a sample can be markedly improved by using multiple frames in a way that enables one frame to validate the information in others.

The Trial Survey used multiple frames from different sources. This improved the knowledge and coverage of the population.

The frames used were:

- The Cadastre frame (land parcel information on size, location etc);
- The council rate information frame (people who own the land parcel/s);
- The G-MW client frame (water use information for each land parcel/s).

5.2.3 Errors in Statistical Data

There are two main types of error; Sampling error and Non-sampling error.

Sampling error reflects the difference in the estimate generated by a sample survey and a census. It is quantifiable. Factors that affect it include:

- Sample size;
- Sampling fraction;
- Sample design e.g. stratification can reduce sampling error;
- Population variability.

Non-sampling error is all other errors in the estimate and can occur at any stage e.g. failure to properly identify the target population, poor questionnaire design, respondent bias (such as occurs with low response rates when the sample is effectively a self-selected group within the population), timing bias, processing errors etc.

5.2.4 Stratified Sampling.

Stratification is the use of auxiliary information to partition the population. For example In this case we have used customer water use and Local Government rate information on farm industry to stratify the population. Stratification variables may be geographical (catchment, council, state, irrigation district etc) or non-geographical (size of farm, ML of water delivered, industry eg dairy, mixed farming).

Strata should cover all units of the target population, and each unit should belong to only one stratum. The boundaries between strata should be clear and unambiguous.

5.2.5 Allocation of Sample

There are 4 common methods of allocating samples to strata:

1. Equal allocation: Allocate the same number of units to each stratum;
2. Proportional Allocation: If we sample 20% of the population then we will take 20% of each stratum. Larger strata will obviously have larger samples;
3. Optimal Allocation: Optimal allocation takes into account the variability inherent within the strata;
4. Completely Enumerated: is where we sample the whole stratum (take a census).

5.2.6 Sample Size Issues and Determination

The sample size is affected by the:

- Population size and variability;
- Sample design;
- Resources;
- Accuracy required;
- Level of detail required;
- Likely level of non-response;
- Sampling methods used.

5.2.7 Final Sample Design

Table 1 shows the stratification that was recommended by ABS and used, as well as the final sample allocation with and without the response rate adjustment.

The expected residual standard error (RSE) of the design variable 'water-use' has also been included. It is the expected RSE under the given sample sizes and allows for a 70% response rate.
A total sample of 329 units was selected, with 100 from Central Goulburn, 121 from Pyramid-Boort and 108 from Rochester-Campaspe.

Table 1. Sample stratification and allocation of Survey sample

Irrigation Farm Area	Farm Type	Water Range ML	Stratum Code	Size Group Population	Sample Size	Sample Size with 70% non-resp adj.	Stratum Weight	Estimated RSE%
Central Goulburn	Dairy	150-400	111	422	44	63	6.698	3.77
	Dairy	400-750	112	149	20	29	5.138	3.44
	Dairy	>750	113	23	6	8	2.875	5.62
CG Total				594	70	100		2.41
Pyramid-Boort	Dairy	0	210	2	2	2	1	N/A
	Dairy	0-150	211	16	6	8	2	17.1
	Dairy	150-1000	212	49	8	12	4.083	11.28
	Dairy	>1000	219	2	2	2	1	N/A
	Other	0	220	39	6	8	4.875	N/A
	Other	0-300	221	361	37	53	6.811	11
	Other	300-1000	222	115	24	34	3.382	6.14
	Other	>1000	229	2	2	2	1	N/A
Pyramid-Boort Total				586	87	121		5
Rochester-Camp.	Dairy	150-600	311	205	27	39	5.256	6.21
	Dairy	>600	312	23	6	8	2.875	8.93
	Other	0	320	35	6	8	4.375	N/A
	Other	0-200	321	304	24	35	8.686	13.21
	Other	>200	322	59	13	18	3.278	9.79
Rochester-Campaspe Total				626	76	108		4.61
Sample Total				1806	233	329		2.17

Notes on Table 1:
(1) Residual Standard Error (RSE) is an accuracy measure that relates the variance and expected value of water use in each stratum. The reliability of the estimate decreases as RSE increases. A low RSE is desirable. Generally, anything under 10-15% is deemed as acceptable, but an RSE under 5% is ideal.

(2) Sampling weights refer to how many units in the stratum population were represented by the sampled unit in that stratum. For example, a unit sampled in stratum 111 has a weight of 6.698. Hence, the responses of the unit represent the responses of around 7 units in the stratum population. In the context of the survey questions, if a unit in stratum 111 responded 'yes' to the question "Has any of your property been laser graded?" for example, then it is expected that around 7 units in the entire population of stratum 111 had farms that had been laser graded.

The sampling weights were adjusted for non-response during analysis. Non-response caused the weights to increase.

5.3 Survey Question Composition

5.3.1 Survey Questions

The Trial Survey consisted of a statistical sample of dairy properties in the Central Goulburn Irrigation Area and dairy and cropping and grazing properties in the Rochester Campaspe and Pyramid Boort Irrigation Areas.

The agreed Trial Survey format consisted of quantitative (eg. area of permanent pasture), multiple choice (eg. strongly disagree….to…strongly agree) and qualitative (written sentences) type questions.

The Trial Survey 'kit' contained a:

- Covering letter from the G-MW Chief Executive;
- Irrigation Farm Survey 2005- (contained in Appendix 13.2);
- An aerial image defining the customer's 'property' to which the survey questions related;
- Reply Paid envelope.

5.3.2 Survey Distribution, Collection and Data Presentation

Following agreement by the Steering Committee and G-MW Reference Group on the Trial Survey questions and receipt of information from ABS, DPI completed individual aerial photos of the property of each customer in the sample. All information was forwarded to the survey consultants, NCS Pearson, who conducted the mail out, receipted returned surveys and collated survey data.

The key dates and achievements were:

- Survey mail-out 15 September 2005 (Total 329)
- Reminder letter sent 22-26 September 2005
- Follow up telephone calls 9-10 October 2005
- Follow up telephone calls 21-27 October 2005
- Duplicate 'survey kits' sent to 17 customers.
- Return rate 12/10/2005 103 (31.3%)
- Return rate 31/10/2005 158 (48%).

NCS Pearson observed that the response rates were in line with other types of survey. ABS strongly encouraged the Steering Committee to pursue additional responses because a 50% response rate would considerably limit the usefulness and type of analysis. In response, the Steering Committee agreed to deploy additional resources to increase the response rate to 70%. It recognised that alternative options would have involved as much work to generate lower quality results.

Considerable additional effort was directed at achieving the desired 70% return. Through the use of telephone surveys and duplicate survey kits the desired 70% return rate was achieved in all strata.

6 Agreements with Local Governments

6.1 Exchange of Information

Local Government valuation contractors indicated that Local Government collect property 'attributes' on all land parcels in the Local Government area at least every four years, for rating purposes. These attributes include information about farm type, crop cultures, management practices and Water Right which is obtained from G-MW as directed by the Valuer General Victoria. Local Government now also require water use information for valuation purposes.

Water Rights and water usage data are collected as an integral part of G-MW business. G-MW needs additional accurate information to better understand its present and future customer requirements to improve infrastructure planning. Historically, the collection of this additional information by mail out-mail back surveys has been expensive, time consuming for all involved parties and has had low response rates.

As the majority of the information required by G-MW was already being obtained by Local Government, 'Information Sharing Agreements' (Agreements) were entered into with Local Government to share selected property information, Water Right, and water use information, by property via a property number.

Data transfer arrangements were developed and implemented to facilitate the Trial Survey, in accordance with Figure 2. Signatories to Agreements anticipate that future data transfer will also accord with Figure 2.

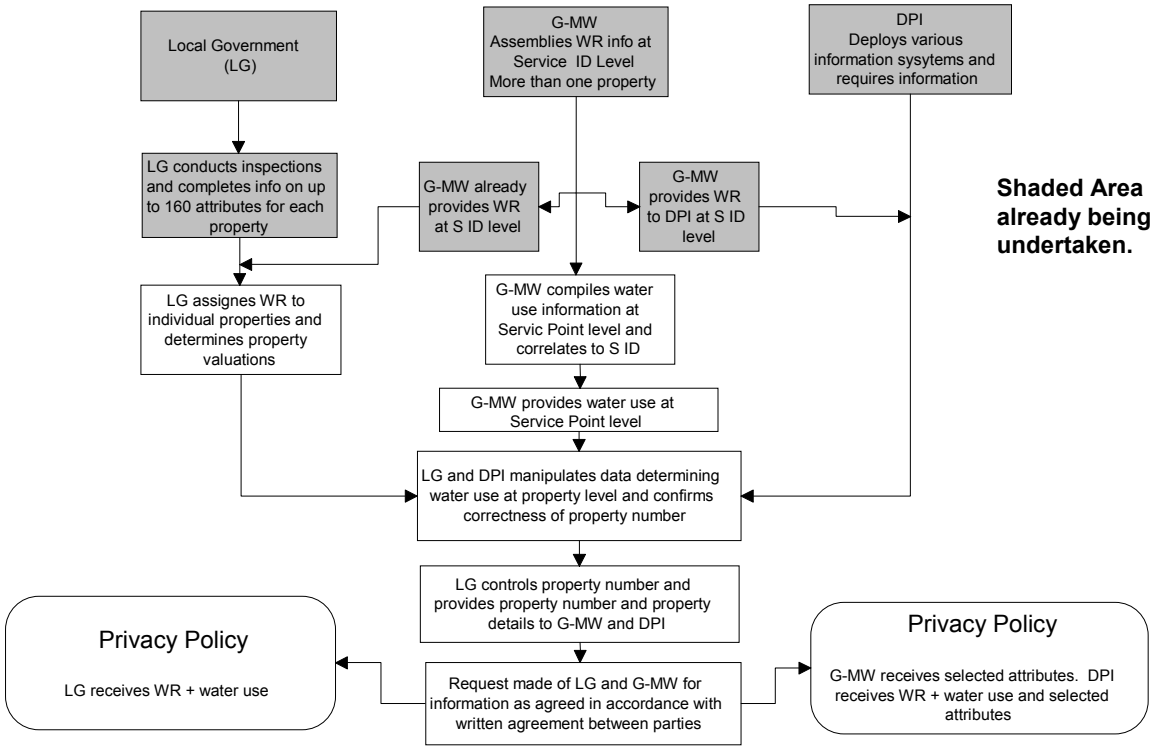


Figure 2. Data Transfer Arrangements

6.2 Agreements

Information sharing agreements were proposed by G-MW and presented to the following six Local Governments:

- Shire of Campaspe;
- Gannawarra Shire Council;
- Loddon Shire Council;
- Moira Shire Council;
- Greater Shepparton City Council;
- Swan Hill Rural City Council.

With the exception of Moira Shire Council, all entered into the information sharing agreements. The Agreements provided a basis upon which Local Government and G-MW could share information and safeguard the interests of parties, by setting out the terms and conditions underpinning the information process. A copy of generic of the Agreement is contained in Appendix 13.1).

6.3 Privacy Issues

Prior to the current IFS, data sharing occurred in an informal manner, with valuers assigning Service ID and Water Right as attributes for property valuations. The

introduction of the '*Information Privacy Act 2000* 'increased the need to formalise a written arrangement as a proper basis for sharing data into the future.

The initial alignment of the datasets required names and addresses to ensure the integrity of the alignment. Following the initial alignment, property numbers were used as the sole identifier of the dataset information.

There was a risk that data sharing could breach an individual's privacy. The '*Information Privacy Act 2000*' protects an individual's right to private information by preventing the identification of individuals using 'unique identifiers'. Representatives of the Working Group met with senior management of Privacy Victoria to outline the intentions and purposes of exchanging information between Local Government and G-MW. As a result of that meeting it was understood that G-MW and Local Government can legally share property information for purposes related to their statutory functions (ie rating and business planning) without breaching the *Information Privacy Act* 2000. It was further agreed that sharing property information via a property number would not offend Information Privacy Principle 7 IPP 7 which in part states '*an organisation must not assign unique identifiers to individuals unless the assignment of unique identifiers is necessary to enable the organisation to carry out any of its functions efficiently*', because property numbers are not a 'unique identifier' The meeting recognised that property can change ownership regularly and property numbers do not convey personal information. Therefore it was concluded that property information could be shared via use of a property number.

In response to those privacy issues, the following processes were applied to information received from the Trial Survey:

- G-MW owns the Trial Survey dataset and is responsible for its management;
- Trial Survey dataset was provided to DPI for analysis as required by G-MW, GBCMA and NCCMA;
- Dataset shared with DPI included a property number and no personal identifiers;
- Information generated by the Trial Survey will only be released in aggregate form, and
- DPI will return the Trial Survey dataset to G-MW when analysis was complete.

6.4 Irrigation Farm Survey Information System

To support the reporting of farm and crop types across the G-MW surface irrigation areas and to provide an information base upon which to conduct sample surveys such as the one outlined in the previous section a system has been developed that integrates a range of information from G-MW, Local Government, the horticulture industry and remote sensing technologies. The following section outlines the key information layers that support this system, their main characteristics and derivation and the linkages developed between Local Government land information and G-MW water information.

6.5 Information Layers and supporting datasets

6.5.1 Water Delivery Information Layers

The water delivery layers depict the features that support the delivery of water through GM-W channel systems to the farm. They also allow the mapping of water

use at a specific location (service point), linked to a range of spatial boundaries including properties or sub-catchments. There are 2 main components of this theme:

6.5.1.1.1 (i) Water asset infrastructure

Source: G-MW
Features: Channels and channel structures including service points and regulators etc.
Attributes: Asset identifiers, capacity (ML/day)
Currency: 2005
Scale: 1:25,000.

6.5.1.1.2 (ii) Water delivery and customer database

Source: G-MW
Features: Service points
Attributes: Annual water use and service (customer) level entitlements.
Currency: 2005
Scale: 1:25,000.

6.5.2 Land Use Information Layers

The land use layers describe land use and enterprise at both property and actual land cover extents. These are sourced from several organisations using various technologies and provide a temporally and spatially dynamic view of land use and land use change.

6.5.2.1.1 (i) Local Governmentl land use

Source: Local Government
Features: Local Government property boundaries for rating and valuation purposes
Attributes: Property numbers, Local Government land classifications, agricultural activity descriptions and capital improvements (VGV 2005)
Currency: This data is currently provided on request from Local Government in a data sharing arrangement between G-MW, Local Government and DPI. The database is updated on a rotating 4-year basis following valuation of all Local Government properties – data is therefore 4 years old at most. This exchange has now been made possible via the establishment of Agreements between G-MW and Local Government.
Scale: 1:25,000.

6.5.2.1.2 (ii) Industry land use

Source: SunRISE 21 & SPC-Ardmona
Features: Horticultural type at block level
Attributes: Fruit type and census number
Currency: This data is updated annually by SPC-Ardmona and on a 3 yearly basis by SunRISE 21.
Scale: 1:25,000.

6.5.2.1.3 (iii) Land cover

Source: Landsat 5 Information Mapper (TM) Satellite
Features: Pixel based (30m x 30m) multidate irrigation activity classification
Attributes: Date of satellite overpass and irrigated activity classification result
Currency: This data has been processed for the 2003-04 irrigation season featuring 6 satellite overpasses
Scale: 1:25,000.

6.5.3 Crop type Mapping and Irrigated Land cover Classification

This section describes the generation of satellite based land cover to classify the range of irrigated pasture types in the G-MW irrigation areas.

6.5.3.1 Satellite based irrigated Pasture Mapping

Fixed horticulture is mapped by SPC-Ardmona and SunRISE 21 on a regular basis by digitising aerial phototography. Irrigated pastures and seasonal crops are much more dynamic as a land cover and therefore required a different approach as described below.

The Landsat Information Mapper (Landsat TM) satellite captures the instantaneous response of the ground cover including vegetation, water and ground temperature. Standard image processing techniques convert satellite data into more meaningful information than visual interpretation alone can provide.

Satellite data was used to develop a seasonal profile of water use on a pixel by pixel basis and then to convert the seasonal information into land cover classes. A number of Landsat TM scenes were acquired for the 2003 – 2004 irrigation season to broadly represent Spring, Summer and Autumn. Each image was processed using remote sensing software to derive a vegetation index and a surface temperature index. The vegetation index described the proportion of green vegetation within the pixel area. The surface temperature index indicated the rate of evapotranspiration (recent irrigation or rainfall activity). Low surface temperature indices are associated with available soil water in the root zone.

The relationship between the vegetation index and land surface temperature is illustrated by the land cover classes in Figure 3. Each pixel of satellite data was classified as rating 1, 2, 3 or 4 according to the quadrant characteristics in Figure 3.

1 = Dry & No Vegetation
2 = Wet & No Vegetation
3 = Dry & Green Vegetation
4 = Wet & Green Vegetation

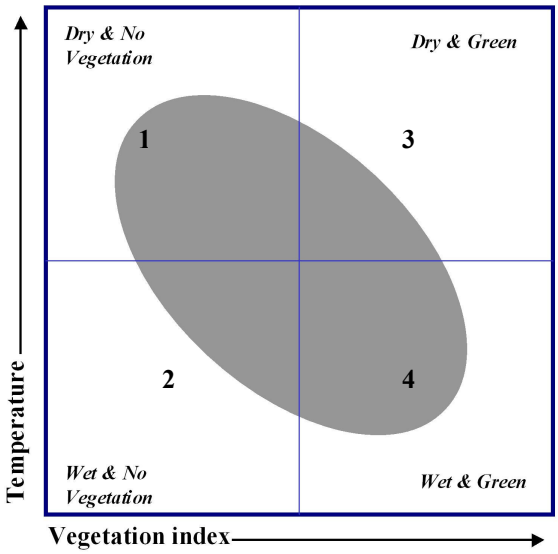


Figure 3. Sketch showing vegetation index and surface temperature plot (the shaded area indicates the spread of datum points).

A seasonal profile of water use in each pixel area was developed by analysing the change in the vegetation index and land surface temperature through Spring, Summer and Autumn. The nature of plant water use change between seasons was then classified into the 5 activity classes shown in Figure 4.

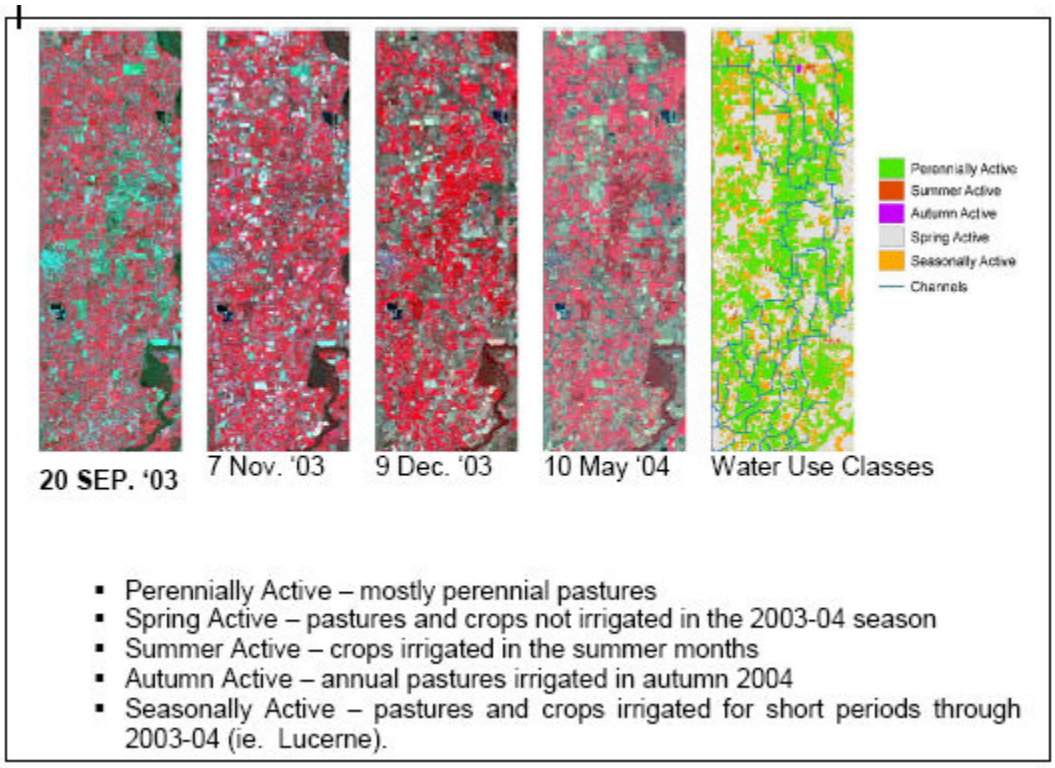


Figure 4. Seasonal satellite images and the derived water use classes 2003 – 04.

Band combination (RGB): NIR, Red, Green wavebands. Active vegetation appears red.

6.5.4 Data linkage

The main limitation of the current arrangement of water and land information is that they are not integrated. Therefore, it is difficult to report water use against land based data such as industry types, soils and agricultural land cover.

This project has successfully linked G-MW service points and customer service identifiers with cadastral and property identifiers used by Land Victoria and Local Government for the Pyramid Boort, Rochester and Central Goulburn Irrigation Areas. This alignment, shown in Figure 5, enables the building of relationships between land information held by organisations such as Local Government and water information held by G-MW. It also enables the spatial analysis of resource datasets such as soils and land cover in relation to this information, as there is a property boundary on which to base the analysis.

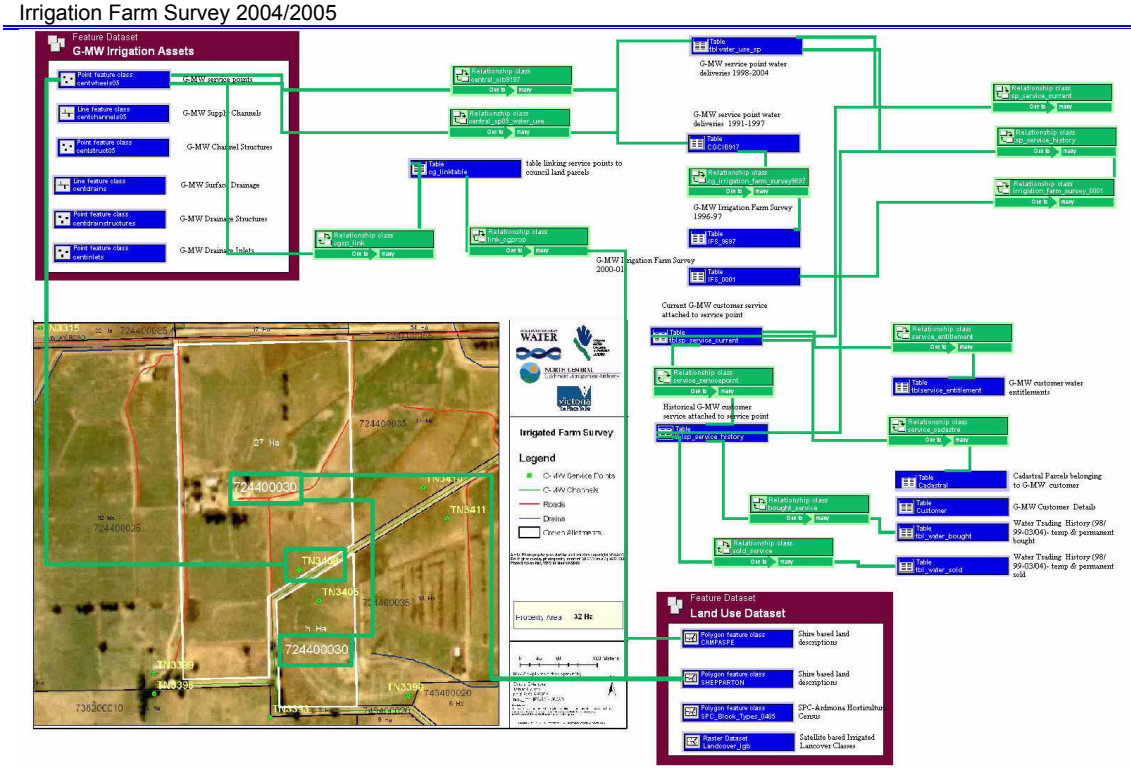


Figure 5. Geodatabase Structure.

6.6 Local Government Attributes

Local Government land information forms one of the key datasets in this information system. Local Government collects a range of attributes for the purposes of rating properties. These attributes are listed below. The reliability of these attributes currently varies across the local government areas with land classification being the most reliable. The other attributes have been reviewed as part of this study and initial comments are listed against the attributes in the Table 2.

Table 2. Attributes of Land Parcel Data from Local Government Areas.

Attributes of Land Parcel data from LGA,s	
Column Name	**Comment**
ALLOTMENT	The Crown allotment identifier, often used as part of the parcel identifier
BLOCK	The block reference to a parcel recorded during the subdivision of the State, oftenused as part of the parcel identifier
CREFNO	Council reference number
CROWN_STATUS	Reference code indicating status of crown parcels
DESC_TYPE	Sub type parcel information grouping parcels into Plan, crown and Multi lot
FEATURE_QUALITY_ID	Data Quality Pointer
FURTHER_DESCRIPTION	A general field where additional information is recorded to assist in identifying the parcel
LGA_CODE :	A unique code dentifying the nominal Local Government Area the parcel falls within.See Reference Table LGA.LGA_CODE
LOT_NUMBER	The number of the lot created on a plan of subdivision, often used as part of the parcel identifier
PARISH_CODE	4 digit parish code identifying the Parish (range2001-4005)
PART	Indication that the polygon represents part of the cadastral

	parcel
PFI	Persistent Feature Identifier
PFI_CREATED	The date the Persistent Feature Identifier was created
PLAN_NUMBER	A unique identifier for a plan, consisting of a plan type and number
PORTION	The Crown portion identifier, often used as part of the parcel identifier
PROPNUM	A unique Crown Land parcel identifier sourced from Crown Land Management Portal register
SEC	The section reference to a parcel, recorded by the appropriate Government Department during the subdivision of the State, often used as part of the parcel identifier.
SPI	Standard Parcel Identifier
SPI_CODE	A code to classify the SPI and identify their origin and by deduction the reliability of it.
STATUS	Indication whether the parcel is pre or post registration at Land Registry.
SUBDIVISION	The Crown subdivision identifier, often used as part of the parcel identifier
TOWNSHIP_CODE	4 digit code (5000-5909) or 5 character AT code (eg 1234A in Parish 1234) identifying the Township or AT
UFI	Database wide Unique Feature Identifier; 6 char State database, 9 char local ID
UFI_CREATED Date	UFI created DATE
UFI_OLD	UFI of feature prior to last edit
VIEW_PFI	Foreign Key to Parcel View table
LCC	Land Classification Code
LCC_DESC	Land Classification Description
ST_NO	Street no
ST_NAME	Street name
ST_TYPE	street type
TOWNSHIP_CODE	Town name
OWNER	owners names
AREA	Area of Title
CODE_1 - 10	40 attribute fields for recording items like soil type, land use, irrigation system
CODE _DESC 1 - 10	" " "
UNIT 1 - 10	" " "
UNIT_DESC ! - 10	" " "
ZONE	Council Planning Zone
MOD_DATE	Date modified

6.7 Ongoing Arrangements

The ongoing alignment of land and water information to enable reporting of combined land and water information will be captured within the Victorian Water Register (VWR). Negotiations with DSE have ensured that the necessary linkages are in place within the VWR to enable the ongoing integration of Local Government, G-MW, CMA and DPI information that will support the generation of land and water information on an ongoing basis.

In addition the Local Government contractor LG Valuations Services have undertaken work to improve their current data holdings to align more closely with CMA and G-MW requirements.

7 Trial Survey Findings

Readers are reminded that the size of the Trial Survey was restricted to dairy properties in the Central Goulburn Irrigation Area and dairy and cropping and grazing properties in the Rochester Campaspe and Pyramid Boort Irrigation Areas. Stratified samples of 329 farms were selected from an estimated parent population of 1806 farms. Under guidance from the ABS, the sample was increased to 335 during the survey to achieve an adequate response within each stratum. A total of 240 responses were received. Responses in each stratum were subsequently weighted to generate estimates for the parent population.

7.1 Data Cleaning and Linkage with Other Datasets

All variables from the survey were checked for outliers and illogical responses.

Responses were weighted for the stratified sample and for non-responses to the survey. Some analysis involved further weighting for non-response to individual variables.

Trial Survey data was linked to water trade data back to 1993. Data was linked to G-MW's Billing Information Customer Care System (BICCS) and Customer Information and Billing (CIB) datasets from a number of years between 1993 and 2005. Those datasets had been aggregated to approximate business structure rather than billing structure. That provided an indication of the extent of water trade associated with the sale and purchase of land.

Those investigations showed that by far the majority of water is still traded as part of land sales.

7.2 Treatment to Manage Missing Values

There were 240 survey responses out of a sample of 335. That gave an apparent response rate of 71 per cent. However, not all questions were answered for all 'completed' surveys. Six respondents answered very few questions, seeming to want to communicate only displeasure with G-MW. So for most questions the response rate was below 70 per cent. Further, the response rate to some questions was lower than the overall response rate. Where those questions were used to compare with alternative sources of data such as remote sensing and existing databases, individual question weights were calculated.

7.3 Observations on Sample Quality

Water trading data was used to test whether those who did not respond to the survey had different trading patterns from those who responded. It was not possible to compare the sample with water trading data for the full population because a comparison would require knowledge of all the trades made by people who had since quit irrigation.

The trading behaviour of respondents with non-respondents and found no significant differences. A difference would have suggested that the sample was not typical of the full population.

However, the results should be qualified. The figures suggest that respondents and non-respondents had a similar average change in Water Right and that the range in the scales of change was large. Results are shown in Table 3.

Table 3. Water trading behaviour of sample respondents and non-respondents

	respondents	N	Mean	Std. Deviation	Std. Error Mean
Net change in water right through trade	Not Responded	95	6.5158	122.81996	12.60106
	Responded to survey	240	-5.2375	103.40123	6.67452
Net temporary water purchase and sale	Not Responded	95	88.4021	1111.15907	114.00252
	Responded to survey	240	190.7113	909.31580	58.69608
Total number of trades	Not Responded	95	8.8737	15.37215	1.57715
	Responded to survey	240	11.6125	10.41542	.67231

How to read this table: There is a 95% probability that the mean of the parent population falls within a range that is centred on the mean of the sample (ie the column headed "Mean") and has a width that is 1.98 times the Mean Standard Error (ie the column headed "Std.Error Mean") of the surveyed sample.

So, the first row tells us that there are 95 chances in 100 that the mean of the "Not Responded" population falls within [6.5158 plus or minus 12.60106 =] 19.117 and (-)6.085; and the second row in this table tells us that there are 95 chances in 100 that the mean of the "Responded" population falls within [(-)5.2375 plus or minus 6.67425 =] (-)11.912 and (-)1.437.

A separate test (Student's Test) was used to show that there is insufficient difference between those two ranges to indicate that there are 95 chances in 100 that they differ from each other. In other words, using conventional statistical language, there is "no significant difference at the 95% confidence level" between the parent populations.

7.4 Land Use

This question was inadvertently structured in a way that made it impossible to distinguish a 'zero' response from a 'non-response', because both answers had no code. Six respondents reported no land use. Most people who did not respond to this question indicated antipathy to G-MW or to surveys. Their answers were treated as missing and the sample weights were adjusted accordingly for the land-use questions. That made only a marginal difference to the estimates.

Note that the reported horticultural responses can generally be taken to refer to vegetable production.

Tables 4 to 7 show estimates of land use after weighting the samples to account for non-responses. The ABS provided the sample weightings.

Similar statistics are used in many of the tables that follow:

N:	the total population for the region;
Minimum:	the lowest area reported (in all cases in this table it is zero);
Maximum:	the maximum area reported by any respondent;
Sum:	an estimate of the total area within the region under each culture;
Lower and Upper:	upper and lower bounds for this estimated total area, such that we are 95% confident that the true total lies within this range;
Mean:	an estimated mean (average) area of culture per farm;

Standard error:	the standard error for the mean. This is a measure of the potential variation in our estimate of the mean. This statistic is used to build confidence intervals and test whether there are statistical differences with estimates based on remotely sensed data; and
Lower and Upper:	upper and lower bounds for the mean estimate, based on a 95% confidence interval. We believe there is a 95% chance that the true mean is between these bounds.

Table 4 provides an estimate of the area of various types of irrigation culture for the region from which the sample was drawn.

Table 4. Estimates for full study area

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
PerennialPasture	1303	0.0	300.0	34862	32549	37175	26.7	0.9	25.0	28.5
AnnualPasture	1303	0.0	390.0	43296	39544	47048	33.2	1.5	30.3	36.1
IrrigatedLucerne	1303	0.0	202.0	9062	7598	10526	7.0	0.6	5.8	8.1
WinterGrain	1303	0.0	400.0	27325	24087	30564	21.0	1.3	18.5	23.4
Summer_Grain	1303	0.0	75.0	1713	1168	2257	1.3	0.2	0.9	1.7
Anyothercrops	1303	0.0	12.0	117	54	180	0.1	0.0	0.0	0.1
Tomatoes	1303	0.0	52.0	896	492	1299	0.7	0.2	0.4	1.0
Othervegetables	1303	0.0	7.0	56	19	93	0.0	0.0	0.0	0.1
Grapevines	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
CitrusFruits	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
StoneFruit	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
PomeFruit	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherPermanent	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
IrrigatedWood	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingstext	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	1303	0.0	11.0	112	49	174	0.1	0.0	0.0	0.1
LanewaysShed	1303	0.0	250.0	13640	11589	15690	10.5	0.8	8.9	12.0
Doublecrop	1303	0.0	52.0	720	430	1010	0.6	0.1	0.3	0.8
Othernonirrigated	1303	0.0	1260.0	39403	31580	47226	30.2	3.1	24.2	36.2
Valid N (listwise)	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0

Table 5. Estimates for Pyramid Boort

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
PerennialPasture	428	0.0	170.0	4838	4038	5638	11.3	1.0	9.4	13.2
AnnualPasture	428	0.0	390.0	22604	19336	25871	52.8	3.9	45.1	60.4
IrrigatedLucerne	428	0.0	202.0	6455	5259	7650	15.1	1.4	12.3	17.8
WinterGrain	428	0.0	400.0	20140	17494	22786	47.0	3.2	40.8	53.2
Summer_Grain	428	0.0	68.0	819	454	1183	1.9	0.4	1.1	2.8
Anyothercrops	428	0.0	12.0	117	54	179	0.3	0.1	0.1	0.4
Tomatoes	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Othervegetables	428	0.0	7.0	56	20	92	0.1	0.0	0.0	0.2
OtherIrrigatedPlantingsarea	428	0.0	11.0	94	35	153	0.2	0.1	0.1	0.4
LanewaysShed	428	0.0	250.0	4558	3069	6046	10.6	1.8	7.2	14.1
Doublecrop	428	0.0	52.0	448	174	721	1.0	0.3	0.4	1.7
Othernonirrigated	428	0.0	1260.0	29626	22288	36965	69.2	8.7	52.0	86.2
Valid N (listwise)	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
IrrigatedWood	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingstext	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	1303	0.0	11.0	112	49	174	0.1	0.0	0.0	0.1
LanewaysShed	1303	0.0	250.0	13640	11589	15690	10.5	0.8	8.9	12.0
Doublecrop	1303	0.0	52.0	720	430	1010	0.6	0.1	0.3	0.8
Othernonirrigated	1303	0.0	1260.0	39403	31580	47226	30.2	3.1	24.2	36.2
Valid N (listwise)	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0

Table 6. Estimates for Central Goulburn

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
PerennialPasture	435	5.0	300.0	20902	19455	22349	48.1	1.7	44.7	51.4
AnnualPasture	435	0.0	99.0	10779	9829	11729	24.8	1.1	22.6	27.0
IrrigatedLucerne	435	0.0	8.0	93	44	142	0.2	0.1	0.1	0.3
WinterGrain	435	0.0	30.0	1044	789	1300	2.4	0.3	1.8	3.0
Summer_Grain	435	0.0	75.0	687	294	1080	1.6	0.5	0.7	2.5
Anyothercrops	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Tomatoes	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Othervegetables	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
LanewaysShed	435	0.0	74.0	2503	2060	2947	5.8	0.5	4.7	6.8
Doublecrop	435	0.0	8.0	93	44	142	0.2	0.1	0.1	0.3
Othernonirrigated	435	0.0	387.0	3922	2550	5294	9.0	1.6	5.9	12.2
Valid N (listwise)	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
IrrigatedWood	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingstext	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	1303	0.0	11.0	112	49	174	0.1	0.0	0.0	0.1
LanewaysShed	1303	0.0	250.0	13640	11589	15690	10.5	0.8	8.9	12.0
Doublecrop	1303	0.0	52.0	720	430	1010	0.6	0.1	0.3	0.8
Othernonirrigated	1303	0.0	1260.0	39403	31580	47226	30.2	3.1	24.2	36.2
Valid N (listwise)	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0

Table 7. Estimates for Rochester

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
PerennialPasture	390	0.0	150.0	8568	7412	9724	21.9	1.5	19.0	24.9
AnnualPasture	390	0.0	240.0	8713	7516	9911	22.3	1.6	19.2	25.4
IrrigatedLucerne	390	0.0	120.0	2197	1486	2907	5.6	0.9	3.8	7.4
WinterGrain	390	0.0	150.0	5644	4393	6895	14.5	1.6	11.2	17.6
Summer_Grain	390	0.0	11.0	207	120	294	0.5	0.1	0.3	0.8
Anyothercrops	390	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Tomatoes	390	0.0	50.0	534	231	836	1.4	0.4	0.6	2.1
Othervegetables	390	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	390	0.0	5.0	18	-1	36	0.0	0.0	0.0	0.1
LanewaysShed	390	0.0	158.0	5256	4047	6466	13.5	1.6	10.4	16.5
Doublecrop	390	0.0	10.0	179	98	260	0.5	0.1	0.3	0.7
Othernonirrigated	390	0.0	184.0	4678	3393	5964	12.0	1.7	8.7	15.3
Valid N (listwise)	390	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
IrrigatedWood	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingstext	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
OtherIrrigatedPlantingsarea	1303	0.0	11.0	112	49	174	0.1	0.0	0.0	0.1
LanewaysShed	1303	0.0	250.0	13640	11589	15690	10.5	0.8	8.9	12.0
Doublecrop	1303	0.0	52.0	720	430	1010	0.6	0.1	0.3	0.8
Othernonirrigated	1303	0.0	1260.0	39403	31580	47226	30.2	3.1	24.2	36.2
Valid N (listwise)	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0

7.5 Irrigation Systems

Irrigators were asked to identify which irrigation method(s) they used between 01 July 2004 and 30 June 2005. Responses are shown in Table 8.

This question was inadvertently structured in a way that made it impossible to distinguish a ‘zero’ response from a ‘non-response’, because both answers had no code. 19 respondents reported no irrigation. Those responses where treated as missing rather than zero, and adjusted weights accordingly for the land use questions. That made a marginal difference to the estimates. An alternative explanation is that those people sold all their water temporarily and had no irrigation, but a scan of the trade data linked to the survey discounted all but one case from this explanation. Six non-respondents indicated antipathy to G-MW or to surveys.

Table 8. Irrigation method for study area

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Flood Irrigation	1303	0.0	680.0	108798	102577	115020	83.5	2.4	78.7	88.2
Furrow Irrigation	1303	0.0	50.0	484	190	779	0.4	0.1	0.1	0.6
Moveable Sprinklers	1303	0.0	1.0	7	2	12	0.0	0.0	0.0	0.0
Self Propelled Irrigators	1303	0.0	94.0	1121	546	1697	0.9	0.2	0.4	1.3
Fixed Sprinkler Systems	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Micro and mini	1303	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Drip or trickle	1303	0.0	110.0	1362	790	1935	1.0	0.2	0.6	1.5

Tables 9 to 11 show estimates of irrigation method after weighting the samples to account for non-responses.

Table 9. Irrigation method for Pyramid Boort

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Flood Irrigation	428	4.0	680.0	53692	48538	58846	125.4	6.1	113.3	137.3
Furrow Irrigation	428	0.0	5.0	31	11	52	0.1	0.0	0.0	0.1
Moveable Sprinklers	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Self Propelled Irrigators	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Fixed Sprinkler Systems	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Micro and mini	428	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Drip or trickle	428	0.0	5.0	43	17	70	0.1	0.0	0.0	0.2

Table 10. Irrigation method for Central Goulburn

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Flood Irrigation	435	10.0	200.0	30628	29124	32133	70.5	1.8	67.0	73.9
Furrow Irrigation	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Moveable Sprinklers	435	0.0	1.0	7	2	12	0.0	0.0	0.0	0.0
Self Propelled Irrigators	435	0.0	30.0	215	58	371	0.5	0.2	0.1	0.9
Fixed Sprinkler Systems	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Micro and mini	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Drip or trickle	435	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0

Table 11. Irrigation method for Rochester

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Flood Irrigation	389	0.0	400.0	22545	20270	24819	57.9	3.0	52.1	63.8
Furrow Irrigation	389	0.0	50.0	453	161	745	1.2	0.4	0.4	1.9
Moveable Sprinklers	389	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Self Propelled Irrigators	389	0.0	94.0	852	303	1401	2.2	0.7	0.8	3.6
Fixed Sprinkler Systems	389	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Micro and mini	389	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Drip or trickle	389	0.0	110.0	924	427	1421	2.4	0.7	1.1	3.6

7.6 Management Practices

7.6.1 Whole Farm Planning

Irrigators were asked whether they have a professionally prepared whole farm plan for the property.

10 completed survey forms had no answer to this question. Sample weightings were adjusted to account for them.

Table 12 shows estimates of the use of professionally prepared Whole Farm Plans after weighting the samples to account for non-responses.

Table 12. Use of a professionally prepared Whole Farm Plan

			Do you have a wfp?		Total
Irrigation Region	Central Goulburn'	Count	283		574
		% within Irrigation Region	49.3		100
		95% confidence interval	45.2	53.4	
	Pyramid-Boort	Count	347		581
		% within Irrigation Region	59.7		100
		95% confidence interval	55.7	63.8	
	Rochester	Count	270		599
		% within Irrigation Region	45.1		100
		95% confidence interval	41.0	49.1	
Total		Count	900		1754
		% within Irrigation Region	51.3		100
		95% confidence interval	48.9	53.7	

The response from Central Goulburn District of 49.3% reporting that they had a professionally prepared whole farm plan is lower than the number of whole farm plans prepared with assistance from the Whole Farm Plan Incentive Scheme. Financial incentives had been paid for the preparation of whole farm plans covering 60% of the irrigated area in the Central Goulburn Irrigation Area.

The lower response from the survey is likely to be from landowners who had bought properties after a whole farm plan had been prepared by the previous owner. It is also possible that landowners had forgotten that they had prepared a whole farm plan, because assistance had been available since 1987.

Similarly in the Rochester Irrigation Area, 45.1% reported having a whole farm plan yet around 70% of the area had received an incentive to prepare a plan.

7.6.2 Lasering

Irrigators were asked whether any of their property had been laser graded. Table 13 shows answers to the question.

35% of completed survey forms had no answer to this question, including three that, in a separate answer, recorded an area that had been laser graded. 35% is much too high to assume that the missing answers were true non-responses. Survey forms with no answer to this question (other than those three exceptions) were assumed to be negative answers – ie, the respondents' properties had not been laser graded.

Table 13. Laser Grading of Properties

			Have you laser levelled any land?		Total
Irrigation Region	Central Goulburn'	Count	520		556
		% within Irrigation Region	93.5		100
		95% confidence interval	91.5	95.6	
	Pyramid-Boort	Count	510		548
		% within Irrigation Region	93.1		100
		95% confidence interval	90.9	95.2	
	Rochester	Count	521		591
		% within Irrigation Region	88.2		100
		95% confidence interval	85.5	90.8	
Total		Count	1551		1695
		% within Irrigation Region	91.5		100
		95% confidence interval	90.2	92.8	

Irrigators were asked what area of their property had been laser graded, and how much had been laser graded more than once. Table 14 shows their responses

Similar statistics are used in many of the tables that follow:

N: Number in population;
Mean: Average area per respondent;
Sum: Total area of lasering in region.
Standard error: Measure of confidence of mean estimate. A confidence interval of 95% for the mean is defined by a distance of two standard errors either side of the mean. An estimate of a 95 per cent confidence interval for the sum can be calculated by multiplying the mean confidence intervals by N.

Table 14. Area laser graded once, and more than once

Irrigation_Area		Area lasered	Lasered twice
Central Goulburn	N	592	592
	Mean	49.4923	6.5438
	Std. Error of Mean	1.51961	.58225
	Sum	29287.93	3872.38
Pyramid-Boort	N	586	586
	Mean	110.0596	30.5291
	Std. Error of Mean	4.85103	3.32132
	Sum	64497.98	17890.91
Rochester	N	631	631

	Mean	53.8686	11.6025
	Std. Error of Mean	2.44342	1.46360
	Sum	34004.91	7324.13
Total	N	1809	1809
	Mean	70.6397	16.0788
	Std. Error of Mean	1.96297	1.22914
	Sum	127790.82	29087.43

7.6.3 Re-use Systems

Irrigators were asked whether the property had a re-use system, and if so, its catchment area.

Eleven of the 240 responses to this question were blank. Based upon the patterns of response to this and other questions a judgement was made that up to 6 of them were non responses. The other 5 were assumed to be negative responses that had not been coded. They were re-coded accordingly.

Installation of Re-use Systems

Table 15 shows estimates of the installation of irrigation re-use systems in each irrigation area after weighting the samples to account for non-responses.

Table 15. Installation of Irrigation Re-use Systems

Do you have a reuse system? * Irrigation_Area Crosstabulation

			Irrigation_Area			
			CG	PB	RO	Total
Do you have a reuse system?	No	Count	52	283	206	541
		% within Irrigation_Area	9.1%	49.5%	34.1%	30.9%
	Yes	Count	522	289	398	1209
		% within Irrigation_Area	90.9%	50.5%	65.9%	69.1%
Total		Count	574	572	604	1750
		% within Irrigation_Area	100.0%	100.0%	100.0%	100.0%

Average Area Served by Re-use Systems

Using the same weightings on samples, Table 16 shows that the estimated average area served by an irrigation re-use was between 82.9 Ha and 92.1 Ha, ranging from 8 Ha to 528 Ha. There are 95 chances in 100 that the estimated total area served by irrigation re-use schemes is between 99,234 Ha and 110,312 Ha.

Table 16. Catchment area of re-use systems for study area

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Reuse catchment area	1197	8.0	528.0	104773	99234	110312	87.5	2.4	82.9	92.1

Tables 17, 18 and 19 show comparable figures for each of the sampled irrigation areas.

Table 17. Catchment area of re-use systems at Central Goulburn

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Reuse catchment area	522	8.0	172.0	35243	33577	36909	67.5	1.6	64.3	70.7

The mean catchment area of reuse systems in the Central Goulburn Irrigation Area (reported to be 67.5 Ha) corresponds very well with data collected as a part of the project that provides financial incentives for the construction of reuse systems. In the Central Goulburn Irrigation Area the average size of the catchment for systems receiving an incentive is 61 Ha.

Table 18. Catchment area of re-use systems at Pyramid Boort

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Reuse catchment area	284	10.0	528.0	40759	36930	44589	143.7	6.9	130.2	157.1

Table 19. Catchment area of re-use systems at Rochester

	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Reuse catchment area	391	10.0	440.0	28770	25811	31729	73.5	3.9	66.0	81.0

In the Rochester Irrigation Area, the mean catchment area of reuse systems (reported to be 73.5 Ha) corresponds closely with those receiving incentives (average 70 Ha).

Landholders were asked how frequently they used their re-use systems, and given a range of qualitative answers to choose from. Five per cent of respondents did not answer the question. There was little point in adjusting the weighting to account for the small non-response rate, particularly because answers were qualitative.

Table 20 shows the answers after being aggregated into a single variable. Data analysts also added an estimate of the area of re-use catchment that is managed for each of those qualitative levels of commitment.

Table 20. Frequency of operation of re-use systems for whole study area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No reuse system	514	28.4	30.1	30.1
	Have reuse, but do not use it	177	9.8	10.4	40.5
	Use Re-use occasionally	327	18.1	19.2	59.7
	Use Re-use most irrigations	687	38.0	40.3	100.0
	Total	1705	94.3	100.0	
Missing	-1.00	104	5.7		
Total		1809	100.0		

Three or four times as many landholders in Central Goulburn District as in Pyramid-Boort and Rochester Irrigation Areas used their re-use scheme at every irrigation. Many fewer people in Central Goulburn Irrigation Area than in the other areas had a re-use scheme but did not use it. Details are given in Table 21.

Table 21. Frequency of operation of re-use systems by Irrigation Area

			Re-use system behaviour				
			No reuse system	Have reuse, but do not use it	Use Re-use occasionally	Use Re-use most irrigations	Total
Irrigation_Area	CG	Count	34	9	72	434	549
		% within Irrigation_Area	6.2%	1.6%	13.1%	79.1%	100.0%
	PB	Count	274	96	94	107	571
		% within Irrigation_Area	48.0%	16.8%	16.5%	18.7%	100.0%
	RO	Count	206	72	161	146	585
		% within Irrigation_Area	35.2%	12.3%	27.5%	25.0%	100.0%
Total		Count	514	177	327	687	1705
		% within Irrigation_Area	30.1%	10.4%	19.2%	40.3%	100.0%

Table 22 shows the estimated catchment area of re-use schemes in each sample area and how they are managed.

Table 22. Area of re-use catchment by frequency of operation by Irrigation Area

Irrigation Area	Re-use system behaviour	N	Sum (Hectares)
CG	Have reuse, but do not use it	9	491.22
	Use Re-use occasionally	72	4179.46
	Use Re-use most irrigations	416	29312.61
	Total	497	33983.28
PB	Have reuse, but do not use it	88	7494.48
	Use Re-use occasionally	89	14315.97
	Use Re-use most irrigations	107	18948.97
	Total	284	40759.42
RO	Have reuse, but do not use it	72	4142.85
	Use Re-use occasionally	161	12833.12
	Use Re-use most irrigations	146	11477.36
	Total	379	28453.33
Total	Have reuse, but do not use it	168	12128.55
	Use Re-use occasionally	322	31328.55
	Use Re-use most irrigations	669	59738.93
	Total	1159	103196.03

7.6.4 Automatic Irrigation

Irrigators were asked, “What area of your property is served by automatic irrigation controls?” Answers are shown in Table 23.

32% of completed survey forms included no answer to this question. 32% is much too high to assume that the missing answers were true non-responses. Survey forms with no answer to this question were assumed to be negative answers – ie, the respondents’ did not use automatic irrigation systems.

Table 23. Automatic irrigation system ownership by Irrigation Area

Irrigation Area * Automatic irrigation

		Autocontrol		Total
		No	Yes	
Central Goulburn'	Count	526	66	592
	% within Irrigation Region	88.85135	11.149	100
Pyramid-Boort	Count	559	27	586
	% within Irrigation Region	95.39249	4.6075	100
Rochester	Count	562	69	631
	% within Irrigation Region	89.06498	10.935	100
Total	Count	1647	162	1809
	% within Irrigation Region	91.04478	8.9552	100

Table 24 shows the estimated area of automatic irrigation in each sample area.

Table 24. Area commanded by automatic irrigation systems by Irrigation Area

Irrigation Area	N	Total area	Lower bound (95%)	Upper bound (95%)
Central Goulburn'	592	1662	1164	2159
Pyramid-Boort	586	1040	470	1609
Rochester	631	4326	3112	5540
Total	1809	7027	5586	8468

7.6.5 Environmental Works

Irrigators were asked the following questions:

- How many native plants have been planted on the property in the last five years?;
- Have you fenced off any areas of wetland to exclude stock? ("Y/N", and if "Y", then:) Approximately what area of wetland was fenced-off?;
- Have you fenced-off any areas along rivers and streams to exclude stock? ("Y/N", and if "Y", then:) Approximately what length of river/stream was fenced-off?;
- Have you fenced off areas of remnant vegetation to exclude stock? ("Y/N", and if "Y", then:) Approximately what area of remnant vegetation was fenced-off?;
- Have you fenced off saline soil areas? ("Y/N", and if "Y", then:) Approximately what area of saline soil was fenced-off?

Many completed survey forms had no answers to these questions. Again, the only tenable assumption was that the great majority of non-responses were negative responses. It was surmised that people only filled in these questions if they had something positive to report.

Table 25 shows the estimated answers to those questions after weighting the samples to account for non-responses:

Table 25. Farm Works to Improve the Environment

	N	Minimum	Maximum	Sum	Lower Bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Number of trees planted	1328	0.0	10000.0	845818	731059	960577	637.0	44.1	550.6	723.0
Area of wetland fenced	1796	0.0	100.0	1844	1271	2417	1.0	0.2	0.7	1.3
Length of stream fenced	1800	0.0	5000.0	176119	137940	214299	97.8	10.8	76.6	118.9
Area of remnant vegetation fenced	1788	0.0	100.0	2580	1949	3211	1.4	0.2	1.1	1.8
Area of salt-affected land fenced	1800	0.0	50.0	1959	1505	2414	1.1	0.1	0.8	1.3

Using the same weightings on samples to generate estimates for the parent population, Tables 26 to 34 show these results separated into each of the areas surveyed.

7.6.6 Number of Trees Planted by Irrigation Area

Table 26. Number of trees planted by Irrigation Area

Irrigation Area	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper Bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Central Goulburn'	472	0.0	5000.0	121376	97014	145738	257.0	26.3	205.4	308.3
Pyramid-Boort	446	0.0	10000.0	545673	447977	643369	1223.9	111.8	1004.8	1442.0
Rochester	410	0.0	5735.0	178769	132572	224965	436.3	57.5	323.5	548.4
Total	1328	0.0	10000.0	845818	731059	960577	637.0	44.1	550.6	723.0

Table 26 shows that

- There are 95 chances in 100 that the estimated average number of native plants established in the Central Goulburn Irrigation Area was between 205 and 308, ranging from zero to 5,000. There are 95 chances in 100 that the estimated total number of plants was between 97,014 and 145,738;
- There are 95 chances in 100 that the estimated average number of native plants established in the Pyramid-Boort Irrigation Area was between 1005 and 1442, ranging from zero to 10,000. There are 95 chances in 100 that the estimated total number of plants was between 447,937 and 643,369;
- There are 95 chances in 100 that the estimated average number of native plants established in the Rochester Irrigation Area was between 323 and 548, ranging from zero to 5,735. There are 95 chances in 100 that the estimated total number of plants was between 132,572 and 960,577.

7.6.7 Wetland Fencing by Irrigation Area

Table 27 shows that the estimated proportion of landholders who had fenced-off wetlands to exclude stock varied from about 5 or 6 % in the Rochester and Central-Goulburn Irrigation Areas to about 18 % in the Pyramid Boort Irrigation Area.

Table 27. Wetland fencing by Irrigation Area

Irrigation Area * Fenced wetland Cross tabulation

		Fenced wetland?		Total
		No	Yes	
Central Goulburn'	Count	559	33	592
	% within Irrigation Area	94.42568	5.574324	100
Pyramid-Boort	Count	480	106	586
	% within Irrigation Area	81.91126	18.08874	100
Rochester	Count	599	32	631
	% within Irrigation Area	94.92868	5.071315	100
	Count	1638	171	1809
	% within Irrigation Areas	90.54726	9.452736	100

Table 28 shows those results expressed for each of the surveyed areas.

Table 28. Area of wetland fenced by Irrigation Area

Irrigation Area	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Central Goulburn'	583	0.0	3.0	40	23	58	0.1	0.0	0.0	0.1
Pyramid-Boort	582	0.0	30.0	1072	830	1314	1.8	0.2	1.4	2.3
Rochester	631	0.0	100.0	732	216	1248	1.2	0.4	0.3	2.0
Total	1796	0.0	100.0	1844	1271	2417	1.0	0.2	0.7	1.3

- The estimated average area of wetland fenced-off in the Central Goulburn Irrigation Area was very small and probably unreliable because of the small number of responses. There are 95 chances in 100 that the estimated total area fenced was between 23 Ha and 58 Ha.
- There are 95 chances in 100 that the estimated average area of wetland fenced-off in the Pyramid-Boort Irrigation Area was between 1.4 Ha and 2.3 Ha, ranging from zero to 30 Ha. There are 95 chances in 100 that the estimated total area fenced was between 830 Ha and 1,314 Ha.
- There are 95 chances in 100 that the estimated average area of wetland fenced-off in the Rochester Irrigation Area was between 0.3 Ha and 2 Ha, ranging from zero to 100 Ha. There are 95 chances in 100 that the estimated total area fenced was between 216 Ha and 1,248 Ha.

7.6.8 Stream Fencing by Irrigation Area

Table 29 shows that the estimated proportion of landholders who had fenced-off any areas along rivers and streams to exclude stock varied from about 1.5 % at Central-Goulburn Irrigation Area to 8.4% in the Rochester and 11.1 % in the Pyramid-Boort Irrigation Areas.

Table 29. Stream fencing by Irrigation Area

Irrigation Area * Streamfenced Crosstabulation

		Stream fenced?		Total
		No	Yes	
Central Goulburn'	Count	583	9	592
	% within Irrigation Region	98.47973	1.52027	100
Pyramid-Boort	Count	521	65	586
	% within Irrigation Region	88.90785	11.09215	100
Rochester	Count	578	53	631
	% within Irrigation Region	91.60063	8.399366	100
	Count	1682	127	1809
	% within Irrigation Region	92.97955	7.020453	100

7.6.9 Length of Stream Fenced by Irrigation Area

Table 30 shows that

- The estimated average length of river/stream and estimated total length fenced-off in the Central Goulburn Irrigation Area could not be estimated because of insufficient data;
- There are 95 chances in 100 that the estimated average length of river/stream fenced-off in the Pyramid-Boort Irrigation Area was between 114.9 metres and 219 metres. Individual cases ranged from zero to 5,000 metres. There are 95 chances in 100 that the estimated total length fenced was between 67,316 metres and 128,501 metres;
- There are 95 chances in 100 that the estimated average length of river/stream fenced-off in the Rochester Irrigation Area was between 88.8 metres and 158.8 metres. Individual cases ranged from zero to 2,500 metres. There are 95 chances in 100 that the estimated total length fenced was between 56,087 metres and 100,335 metres.

Table 30. Length of stream fenced by Irrigation Area

Stream fence length	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Central Goulburn'	583	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Pyramid-Boort	586	0.0	5000.0	97908	67316	128501	167.1	26.6	114.9	219.0
Rochester	631	0.0	2500.0	78211	56087	100335	123.9	17.9	88.8	158.8
Total	1800	0.0	5000.0	176119	137940	214299	97.8	10.8	76.6	118.9

7.6.10 Fencing Remnant Vegetation to Exclude Stock

Table 31 shows that the estimated proportion of irrigators who had fenced-off areas of remnant vegetation to exclude stock varied from about 11.5% in the Central-Goulburn and Rochester Irrigation Areas to 18.6%in the Pyramid-Boort Irrigation Area.

Table 31. Remnant vegetation fencing by Irrigation Area

Irrigation Area * Rem veg fenced Cross tabulation

		Remnant veg fenced?		Total
		No	Yes	
Central Goulburn'	Count	525	67	592
	% within Irrigation Region	88.68243	11.31757	100
Pyramid-Boort	Count	477	109	586
	% within Irrigation Region	81.39932	18.60068	100
Rochester	Count	558	73	631
	% within Irrigation Region	88.43106	11.56894	100
Total	Count	1560	249	1809
	% within Irrigation Region	86.23549	13.76451	100

7.6.11 Area of Remnant Vegetation Fenced by Irrigation Area

Table 32 shows that

- There are 95 chances in 100 that the estimated average area of remnant vegetation fenced in the Central Goulburn District was between 0.1 Ha and 0.3 Ha. Individual cases ranged from zero to 10 Ha. There are 95 chances in 100 that the estimated total area of remnant vegetation fenced was between 65 Ha and 154 Ha.
- There are 95 chances in 100 that the estimated average area of remnant vegetation fenced in the Pyramid-Boort District was between 2.0 Ha and 3.1 Ha. Individual cases ranged from zero to 30 Ha. There are 95 chances in 100 that the estimated total area of remnant vegetation fenced was between 1,199 Ha and 1,825 Ha.
- There are 95 chances in 100 that the estimated average area of remnant vegetation fenced in the Rochester District was between 0.7 Ha and 2.4 Ha. Individual cases ranged from zero to 100 Ha. There are 95 chances in 100 that the estimated total area of remnant vegetation fenced was between 418 Ha and 1,499 Ha.

Table 32. Area remnant vegetation fenced by Irrigation Area

Irrigation District	N	Minimum	Maximum	Sum	Lower	Upper	Mean	Standard	Lower	Upper
					bound (95%)	bound (95%)		Error	bound (95%)	bound (95%)
Central Goulburn'	574	0.0	10.0	109	65	154	0.2	0.0	0.1	0.3
Pyramid-Boort	586	0.0	30.0	1512	1199	1825	2.6	0.3	2.0	3.1
Rochester	628	0.0	100.0	959	418	1499	1.5	0.4	0.7	2.4
Total	1788	0.0	100.0	2580	1949	3211	1.4	0.2	1.1	1.8

7.6.12 Fencing Saline Areas

Table 33 shows that the estimated proportion of irrigators who had fenced-off saline areas varied from about 1.0%in the Central-Goulburn Irrigation Area and about 2.0%in the Rochester Irrigation Area to 20% in the Pyramid- Boort Irrigation Area.

Table 33. Salt land fencing by Irrigation Area

Irrigation Area * Salt land fenced Cross tabulation

		Salt land fenced?		Total
		No	Yes	
Central Goulburn'	Count	585	7	592
	% within Irrigation Region	98.81757	1.182432	100
Pyramid-Boort	Count	468	118	586

	% within Irrigation Region	79.86348	20.13652	100
Rochester	Count	616	16	632
	% within Irrigation Region	97.46835	2.531646	100
	Count	1669	141	1810
	% within Irrigation Region	92.20994	7.790055	100

Table 34 shows that:

- there are 95 chances in 100 that the estimated average area of saline soil fenced-off in the Central Goulburn Irrigation Area was between zero and 0.1 Ha. Individual cases ranged from zero to six Ha. There are 95 chances in 100 that the estimated total area fenced-off was between 11 Ha and 74 Ha;
- there are 95 chances in 100 that the estimated average area of saline soil fenced-off in the Pyramid-Boort Irrigation Area was between 2.5 Ha and four Ha. Individual cases ranged from zero to 50 Ha. There are 95 chances in 100 that the estimated total area fenced-off was between 1,450 Ha and 2,322 Ha;
- there are 95 chances in 100 that the estimated average area of saline soil fenced-off in the Rochester Irrigation Area was between zero and 0.1 Ha. Individual cases ranged from zero to two Ha. There are 95 chances in 100 that the estimated total area fenced-off was between 16 Ha and 46 Ha.

Table 34. Area (Ha) of salt land fencing by Irrigation Area

Irrigation Area	N	Minimum	Maximum	Sum	Lower bound (95%)	Upper bound (95%)	Mean	Standard Error	Lower bound (95%)	Upper bound (95%)
Central Goulburn'	592	0.0	6.0	43	11	74	0.1	0.0	0.0	0.1
Pyramid-Boort	577	0.0	50.0	1886	1450	2322	3.3	0.4	2.5	4.0
Rochester	631	0.0	2.0	31	16	46	0.0	0.0	0.0	0.1
Total	1800	0.0	50.0	1959	1505	2414	1.1	0.1	0.8	1.3

7.6.13 Other Environmental Works

Irrigators were asked to describe any other protection works they had undertaken. Responses are shown in Table 35.

Table 35. Other environmental works-Ha

"FENCED OFF DRAINAGE CHANNELS	0.5
"FENCING	0.5
"PLANTED 3 TREE PLANTATIONS ALONG COMMISSION CHANNELS	0.5
"TREES PLANTED TO INTERCEPT GROUNDWATER	0.5
ACROSS MY PROPERTIES I HAVE PLANTED THOUSANDS OF TREES. THIS SURVEY IS SUPPOSED TO BE ABOUT IRRIGATION. IF THIS IS A SURVEY ON IRRIGATION PRACTICES WHY I AM BEING ASKED QUESTIONS ON ENVIRONMENTAL ISSUES.	0.5
DRAINAGE & TREE.	0.5
FENCED OFF CHECK BANKS AND PLANTED TREES ON THEM.	0.4
FENCED OFF DRAINES AND TREE LOTS.	0.4
FENCED OFF PLANTED TREES.	0.3
FENCED OFF A SECTION OF FLOODWAY.	0.5
FENCED OFF CHANNEL AREA	0.5
FENCED OFF COMMUNITY DRAINS & TREED AREAS	0.5
FENCED OFF GREY BOX & YELLOW BOX TREES FROM LIVESTOCK CARTED DIRT AROUND BOX TREES TO PREVENT WATER LYING.	0.2
FENCED OFF HILL TOPS.	0.5
FENCED OFF NATURAL DEPRESSIONS.	0.1
FENCED OFF PLANT TREE SPECIES.	0.5
FENCED OFF PLANTED TREES.	0.2
FENCED OFF SERPINTINE CREEK PLANTED 7000 NATIVE PLANTS. FENCED OFF 6 TREE PLANTATIONS. FENCED OFF I NATURAL REGENERATION.	0.5
FENCED OFF SHELTER BELTS	0.2
FENCED OFF TREE AREAS & LINES.	0.3
FENCED OFF TREE PLANTATIONS & NATIVES.	0.2
FENCED OFF TREE PLANTATIONS.	0.8

FENCED OFF TREES & CHANNELS.	0.5
FENCED OFF TREES.	0.2
FENCED OFF W.W CHANNEL.	0.2
FENCED SOME TREES.	0.4
FENCED TREES ON ROADSIDE FARMS	0.1
HAS A SPEARPOINT SYSTEM TO CONTROL WATERTABLE.	0.2
I HAVE ANSWERED THIS SURVEY ON BEHALF OF MY MOTHER. MY MOTHER DOES NOT OWN 273HA AS STATED. SHE OWNS 141.47HA. NEITHER MEMBERS OF OUR FAMILY HAVE EVER OWNED 130HA SHOWN ON FIMMEL RD. ALSO MOTHER'S PROPERTY ON WHARPARILLA RD SHOWS 131HA SHOULD BE 130HA.	0.7
IN REGARD TO THIS PROPERTY- IT HAS NOW BEEN LEASED TO MR (Name and Address) FOR OVER 12 MTHS AND ANY INFORMATION SHOULD REALLY COME FROM THE LEASEES.	0.3
INSTALLED 2 DRAINS ACROSS PROPERTY TO DRAIN EXCESS WATER.	0.5
INSTALLED A SPEAR POINT BORE SYSTEM TO LOWER THE WATER TABLE AND CONTROL THE AREA OF SALINE DAMAGE. TREE PLANTING.	0.4
INTRODUCE LOCAL NATIVES BACK ON PROPERTY.	0.5
LAID FOX BAITS.	0.5
LEVEL BANKS RAISED. 100 YEARS.	0.5
N/A	0.4
PLANTED SALT BUSH & TREES.	0.2
REMOVED BOXTHORNS AND PLANTED BIRD FRIENDLY TREES	0.5
SAVING COUNTRY DOWN TO LUCERNE AND IMPROVING SOIL WITH AIRATION PLOUGHING.	0.5
SOURCED AND CARTED 300 TONNE OF LOGS & HABITATE. BACK INTO RENOVATE FOREST.	0.5
SOWED ANNUAL. PASTURES	0.2
SOWN SALINE COMPATIBLE PASTURE.	0.7
SPEAR POINT- SALINITY REDUCTION.	0.4
SPEAR POINT BORE TO LOWER WATER TABLE	0.2
SPEED IRRIGATION AREAS. EG. 12 MTH STREAMS/BAY.	0.2
SPRAYING OF BLACKBERRY BUSHES.	0.5
TREE LINES	0.2
WE HAVE PLANTED LOTS OF TREES TO KEEP WATER TABLE & SALINITY DOWN. WE HAVE ESTABLISHED A BIG RE USE SYSTEM TO KEEP NUTRIENTS ON FARM. WE HAVE LASERED FOR WATER EFFICIENCY.	0.5
WHEN LASERING HAVE BUILT UP A BANK OF SOIL AROUND THE BASE OF OLDER GREY BOX GUM TREES.	0.4
WINDBREAK PLANTATION (NATIVES). DRAINAGE CREEK RE VEG.	0.2

7.7 Changes to Irrigation Practise

The following section deals with irrigators' planned water management improvements. No confidence intervals are provided as these responses were not used for comparing answers with data available through DPI Tatura. Readers wishing to calculate a standard error of the percentage can make a close estimate using the formula:

$$\sigma P = \sqrt{P(100-P)/N}$$

Where:
σP is the standard error of a percentage
P is the observed percentage
N is the sample size (335).

A 95% confidence interval for a percentage is defined by a range of two standard deviations either side of the observed percentage. This interval estimate will be a little larger than a more sophisticated estimate that takes account of the stratified sample structure.

7.7.1 Irrigation Application Techniques

Irrigators were asked whether they intended to introduce more efficient irrigation application techniques in the year ending 30 June 2006. Answers are shown in Table 65.

The term 'Count" refers to the number of people who would provide each answer from the survey sample to produce an estimate for the whole population in the Irrigation Area.

Table 36. Plans to introduce more efficient irrigation application techniques by Irrigation Area

			Plan efficient water application		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	463	129	592
		% within Irrigation Region	78.2%	21.8%	100.0%
	Pyramid-Boort	Count	478	108	586
		% within Irrigation Region	81.6%	18.4%	100.0%
	Rochester	Count	501	130	631
		% within Irrigation Region	79.4%	20.6%	100.0%
Total		Count	1442	367	1809
		% within Irrigation Region	79.7%	20.3%	100.0%

7.7.2 Irrigation Scheduling

Irrigators were asked whether they intended to implement more efficient irrigation scheduling in the year ending 30 June 2006. Answers are shown in Table 37.

Table 37. Plans for more efficient irrigation scheduling by Irrigation Area

			Plan irrigation scheduling		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	468	123	591
		% within Irrigation Region	79.2%	20.8%	100.0%
	Pyramid-Boort	Count	531	55	586
		% within Irrigation Region	90.6%	9.4%	100.0%
	Rochester	Count	545	86	631
		% within Irrigation Region	86.4%	13.6%	100.0%
Total		Count	1544	264	1808
		% within Irrigation Region	85.4%	14.6%	100.0%

7.7.3 Installation of Pipes or Covered Open Channels

Irrigators were asked whether they intended to install piping or covered open channels in the year ending 30 June 2006, to reduce water loss. Answers are shown in Table 38.

Table 38. Plans to install piping water or covered open channels by Irrigation Area

			Plan piping water		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	574	18	592
		% within Irrigation Region	97.0%	3.0%	100.0%
	Pyramid-Boort	Count	563	23	586
		% within Irrigation Region	96.1%	3.9%	100.0%
	Rochester	Count	606	25	631
		% within Irrigation Region	96.0%	4.0%	100.0%
Total		Count	1743	66	1809
		% within Irrigation Region	96.4%	3.6%	100.0%

7.7.4 Drainage

Irrigators were asked whether they intended to construct drains in the year ending 30 June 2006 to improve irrigation water efficiency. Answers are shown in Table 39.

Table 39. Plans to construct drains by Irrigation Area

			Plan drains		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	486	106	592
		% within Irrigation Region	82.1%	17.9%	100.0%
	Pyramid-Boort	Count	483	103	586
		% within Irrigation Region	82.4%	17.6%	100.0%
	Rochester	Count	560	71	631
		% within Irrigation Region	88.7%	11.3%	100.0%
Total		Count	1529	280	1809
		% within Irrigation Region	84.5%	15.5%	100.0%

7.7.5 Laser Grading

Irrigators were asked whether they intended to laser level areas in the year ending 30 June 2006 to improve irrigation water efficiency. Answers are shown in Table 40.

Table 40. Plans to laser level to improve irrigation efficiency by Irrigation Area

			Plan laser leveling		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	382	209	591
		% within Irrigation Region	64.6%	35.4%	100.0%
	Pyramid-Boort	Count	380	206	586
		% within Irrigation Region	64.8%	35.2%	100.0%
	Rochester	Count	477	154	631
		% within Irrigation Region	75.6%	24.4%	100.0%
Total		Count	1239	569	1808
		% within Irrigation Region	68.5%	31.5%	100.0%

7.7.6 Re-use or Recycling

Irrigators were asked whether they intended to introduce irrigation water re-use or recycling in the year ending 30 June 2006. Answers are shown in Table 41.

Table 41. Plans to introduce irrigation re-use or recycling by Irrigation Area

			Plan -re-use system		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	534	57	591
		% within Irrigation Region	90.4%	9.6%	100.0%
	Pyramid-Boort	Count	503	83	586
		% within Irrigation Region	85.8%	14.2%	100.0%
	Rochester	Count	567	64	631
		% within Irrigation Region	89.9%	10.1%	100.0%
Total		Count	1604	204	1808
		% within Irrigation Region	88.7%	11.3%	100.0%

7.7.7 Soil Moisture Monitoring

Irrigators were asked whether they intended to introduce farm soil moisture monitoring in the year ending 30 June 2006. Answers are shown in Table 42.

Table 42. Plans to introduce farm soil moisture monitoring by Irrigation Area

			Plan moisture monitoring		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	556	36	592
		% within Irrigation Region	93.9%	6.1%	100.0%
	Pyramid-Boort	Count	569	17	586
		% within Irrigation Region	97.1%	2.9%	100.0%
	Rochester	Count	607	25	632
		% within Irrigation Region	96.0%	4.0%	100.0%
Total		Count	1732	78	1810
		% within Irrigation Region	95.7%	4.3%	100.0%

7.7.8 Farm Planning

Irrigators were asked whether they intended to develop a farm plan in the year ending 30 June 2006. Answers are shown in Table 43.

Table 43. Plans to develop a farm plan by Irrigation Area

			Plan to do WFP		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	545	47	592
		% within Irrigation Region	92.1%	7.9%	100.0%
	Pyramid-Boort	Count	549	37	586
		% within Irrigation Region	93.7%	6.3%	100.0%
	Rochester	Count	611	20	631
		% within Irrigation Region	96.8%	3.2%	100.0%
Total		Count	1705	104	1809
		% within Irrigation Region	94.3%	5.7%	100.0%

7.7.9 Other Irrigation Improvements

Irrigators were asked whether thay had plans for other improvements to irrigation practices. Answers are shown in Table 44.

Table 44. Plans for other improvements by Irrigation Area

			Plan other irrigation efficiencies		
			No	Yes	Total
Irrigation Region	Central Goulburn'	Count	554	38	592
		% within Irrigation Region	93.6%	6.4%	100.0%
	Pyramid-Boort	Count	571	15	586
		% within Irrigation Region	97.4%	2.6%	100.0%
	Rochester	Count	602	30	632
		% within Irrigation Region	95.3%	4.7%	100.0%
Total		Count	1727	83	1810
		% within Irrigation Region	95.4%	4.6%	100.0%

7.8 Barriers to Changing Irrigation Practices

7.8.1 Significant Barriers

Irrigators were asked to select items from the following list in response to the question, “What are the significant barriers to changing your irrigation management practices?

- Inadequate water quality
- Uncertainty of water allocation
- Lack of financial resources
- Lack of time
- Insufficient or inadequate information
- Doubts about likely success
- Age or poor health
- Inadequate water availability
- Other barriers (please specify)
- No barriers.”

Answers are shown in Table 45.

Table 45. Reason for inability to undertake water efficiency works

Reason for inability to undertake water efficiency works	
Financial resources	50.2%
Allocation uncertainty	47.1%
Lack of time	20%
Inadequate water resources	19.3%
Age and health	12.9%
Doubt success	12.1%
Insufficient information	3.6%
Poor water quality	2.3%
Other	8.6%

7.8.2 Impact of Water Trade

Irrigators were asked whether they had bought or sold water in the past five years, and if so, whether they felt that selling or buying water had affected their:

- Ability to make a profit;
- Ability to plan and implement a water budget; and
- Ease of operation.

Approximately 30% of respondents did not answer these questions. The non-respondents were statistically different from the respondents. They were less active in the water market, and their activity was more likely to be selling water. It was reasonable to conclude that the useable repsonses to these questions are more reprentative of water purchasers than sellers and irrigators who were inactive in the marketplace. For those reasons, the non-responses were ignored. Sample weights were adjusted to account for the non responses.

7.8.2.1 Ability to Make Profit

The relationship between beliefs about trade impact on profit and trade behaviour is not simple. Irrigators with extreme beliefs about the impact of trade (positive and negative) were more likely to have traded large amounts of water.

Table 46 shows respondents’ attitudes towards the impact of water trade on their ability to make a profit. More than two-thirds of respondents felt that water trade

made a positive impact, including one-quarter who felt it made a large positive impact. About one in ten people felt that water trading made a negative impact on their ability to make a profit.

Table 46. Impact of water trade on ability to make a profit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large negative impact	42	2.2	3.2	3.2
	Slight negative impact	155	8.2	11.9	15.1
	No impact	203	10.7	15.6	30.7
	Slight positive impact	554	29.3	42.5	73.2
	Large positive impact	349	18.5	26.8	100.0
	Total	1303	68.9	100.0	
Missing	System	589	31.1		
Total		1893	100.0		

7.8.2.2 Ease of Operation

Irrigators were asked whether they felt that trading in water affected their ease of operation. Table 47 shows their responses. About two-thirds of respondents felt that water trading had made a positive impact, and only about one in nine respondentd felt that it had a negative impact.

Table 47. Impact of water trade on ease of operation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large negative impact	61	3.2	4.7	4.7
	Slight negative impact	85	4.5	6.5	11.2
	No impact	320	16.9	24.7	36.0
	Slight positive impact	469	24.8	36.2	72.2
	Large positive impact	360	19.0	27.8	100.0
	Total	1296	68.5	100.0	
Missing	System	597	31.5		
Total		1893	100.0		

7.8.2.3 Ability to Budget Water

Irrigators were asked whether they felt that trading in water affected their ability to plan and implement a water budget. Table 46 shows their responses. About one half of respondents felt that it had made a positive impact and one in seven felt that it had made a negative impact.

Table 48. Impact of trade on ability to budget water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large negative impact	58	3.0	4.5	4.5
	Slight negative impact	128	6.8	10.0	14.4
	No impact	423	22.4	32.9	47.3
	Slight positive impact	423	22.3	32.9	80.2
	Large positive impact	255	13.5	19.8	100.0
	Total	1287	68.0	100.0	
Missing	System	606	32.0		
Total		1893	100.0		

7.9 Comparison of Beliefs on Water Trade Between Irrigation Areas

Table 49 shows a mean score for attitudes to water trade. It compares this score across the Irrigation Areas. The scores were allocated as follows:

1 Large negative
2 Slight negative
3 No impact
4 Slight positive
5 Large positive.

There are some statistically significant differences between Irrigation Areas, but the scale of the differences is small. Pyramid-Boort Irrigation Area is the most positive about the positive impact of trade on water budgeting. Rochester Irrigation Area is most positive about the impact of trade on the ability to make a profit. There are no differences in beliefs about impact on ease of operation.

Table 49. Comparison of water trading beliefs between Irrigation Areas

Irrigation Area		Impact of trading on ability to make profit	Impact of trading on ability to budget water	Impact of trading on ease of operation
Central Goulburn'	Mean	3.7000	3.3939	3.7468
	N	440	440	440
	Std. Deviation	1.23793	1.27607	1.13468
Pyramid-Boort	Mean	3.6476	3.6850	3.7374
	N	428	431	441
	Std. Deviation	1.01418	.79454	.97420
Rochester	Mean	3.9872	3.5316	3.7940
	N	435	416	415
	Std. Deviation	.88736	1.01493	1.10962
Total	Mean	3.7787	3.5359	3.7587
	N	1303	1287	1296
	Std. Deviation	1.06712	1.05526	1.07388

7.10 Beliefs About the Future Operation of the Property

Irrigators were asked to share their thoughts, feelings and aspirations for a range of questions relating to social issues. Those questions received a relatively high response rate. Several clear trends emerged.

- Half of the irrigators surveyed did not expect to be on the farm in 10 years time.
- One quarter did not expect to be there in 5 years time.

This is consistent with the patterns of adjustment in Australian agriculture over the past 30 years. Five per cent of farmers leave farming in any one year but there are important differences between industries.

In 2001, a third of dairy farmers expected to leave the industry within 5 years. This survey found that dairy farmers' expectations of leaving the industry in the next 5 years remain high, despite a spate of exits precipitated by a shortage of irrigation water in 2003-04.

Irrigators' plans to leave the farm within 5 years were strongly associated with their low expectations of inter-generational transfer, and with people who are in the later

stages of family life - when children are independent. This survey found no obvious relationship between plans to quit and irrigators' water trading behaviour.

Irrigators were asked to respond to the statement, "I think this property will be irrigated in five years' time", by choosing between "strongly disagree", "slightly disagree", "undecided", "slightly agree", and "strongly agree". It is notable that very few irrigators were willing to nominate their property as being unirrigated in 5 years time. However, a quarter of respondents could be characterised as being undecided about that eventuality. Those people were significantly more likely to have sold irrigation water on the temporary and permanent market. The average "undecided" respondent had sold 300 ML on the temporary market, whereas the average "strongly agree" respondent had purchased 200ML on the temporary market.

A separate question asked, "How long do you expect to keep operating this property?" Responses are shown in Table 50.

Table 50. Expected period of operating the property

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5 years or less	490	27.1	29.6	29.6
	6-10 years	407	22.5	24.6	54.2
	More than 10 years	757	41.9	45.8	100.0
	Total	1654	91.4	100.0	
Missing	System	155	8.6		
Total		1809	100.0		

Answers to that question were aligned with respondents' description of their farm type to check for differences between industries. The results are shown in Table 51.

Table 51. Industry by expectations of period of farm operation

			Main farm industry			Total
			Dairy	Crop, livestock		
How long plans to operate farm	5 years or less	Count	286	191	13	490
		% within Main farm industry	35.5%	23.2%	59.1%	29.6%
	6-10 years	Count	170	236	0	406
		% within Main farm industry	21.1%	28.6%	.0%	24.6%
	More than 10 years	Count	350	398	9	757
		% within Main farm industry	43.4%	48.2%	40.9%	45.8%
Total		Count	806	825	22	1653
		% within Main farm industry	100.0%	100.0%	100.0%	100.0%

7.11 Intergenerational Transfer

Irrigators were asked whether they expected to pass their land on to someone in the family when they cease operating the property. Responses are shown in Table 52.

Table 52. Plans for inter-generational transfer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Answer	196	10.8	11.0	11.0
	Yes	823	45.5	46.2	57.2
	No	762	42.1	42.8	100.0
	Total	1781	98.5	100.0	
Missing		28	1.5		
Total		1809	100.0		

The subject of inter-generational transfer is likely to involve much uncertainty. 11% of respondents did not answer this question. Data analysts thought that possibly half of the non-response reflected the inability to indicate uncertainty when responding to the question.

Respondents showed high optimism for farm succession; 46% believed it would happen. However, further exploration of their expectations and answers to other questions suggested that their expectations might be quite optimistic:

- Dairy farmers were much less likely than mixed farmers to believe that they would achieve farm succession;
- Expectations for farm succession were highest amongst people who believed that they would be operating the farm for more than 10 years. Those closer to ending their farm career were generally less optimistic. This is consistent with other studies of farm-succession expectations – people are generally more optimistic when the date for probable succession is much further into the future;
- Better educated farmers were much less optimistic about farm succession occurring. This is probably a reflection of two consequences of education: (1) greater awareness of the possibilities beyond farming, and (2) an awareness of the future trends in farmers' terms of trade;
- There was some evidence that those who had been permanently selling water right and purchasing temporary water were less likely to believe that there would be farm succession.

Table 53 shows the relationships between expectations for family succession and respondents' description of their farm type.

Table 53. Relationship between industry and expectations of family succession

			When you cease operating the property, do you expect to pass the land on to another in your family?		
			Yes	No	Total
Main farm industry	Dairy	Count	332	477	809
		% within Main farm industry	41.0%	59.0%	100.0%
	Crop, livestock	Count	470	286	756
		% within Main farm industry	62.2%	37.8%	100.0%
Total		Count	802	763	1565
		% within Main farm industry	51.2%	48.8%	100.0%

Table 54 shows the relationships between respondents' expectations for family succession and their plans for the period that they wished to keep operating their property.

Table 54. Relationship between expectations of farm operation period and property succession

			When you cease operating the property, do you expect to pass the land on to another in your family?		
			Yes	No	Total
How long plans to operate farm	5 years or less	Count	124	339	463
		% within How long plans to operate farm	26.8%	73.2%	100.0%
	6-10 years	Count	162	236	398
		% within How long plans to operate farm	40.7%	59.3%	100.0%
	More than 10 years	Count	508	176	684
		% within How long plans to operate farm	74.3%	25.7%	100.0%
Total		Count	794	751	1545
		% within How long plans to operate farm	51.4%	48.6%	100.0%

Table 55 shows the relationships between respondents' expectations for family succession and the highest level of education that they had completed.

Table 55. Relationship between education and expectations of property succession

			When you cease operating the property, do you expect to pass the land on to another in your family?		
			Yes	No	Total
education	Secondary	Count	477	399	876
		% within education	54.5%	45.5%	100.0%
	Trade	Count	252	213	465
		% within education	54.2%	45.8%	100.0%
	University	Count	73	121	194
		% within education	37.6%	62.4%	100.0%
Total		Count	802	733	1535
		% within education	52.2%	47.8%	100.0%

7.12 Expectations of Future Irrigation of the Property

Very few farmers were willing to indicate that their property would not be irrigated in five years time. Twenty-five per cent had some degree of uncertainty that it would be irrigated five years.

- Mixed farmers were twice as likely as dairy farmers to be unsure of future irrigation status. A third of mixed farmers were uncertain;
- Those with dependent children were slightly more certain that their property would remain irrigated in the future. Although statistically significant, this was not a strong relationship;
- Those expecting to be operating the property in ten years time were much more likely to believe that the property would be irrigated in 5 years time;

- Those with lower education were less certain about future irrigation. It is possible that they were likely to be older farmers considering ending their farming career;
- Those who were uncertain about their property's future irrigation status were more likely to have sold water on the permanent and temporary markets.

Table 56 shows irrigators' responses when asked to respond to this statement: "I think this property will be irrigated in five years time."

Table 56. Expectations of future irrigation of the property

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	26	1.4	1.5	1.5
	slightly disagree	11	.6	.7	2.2
	undecided	176	9.7	10.3	12.5
	slightly agree	233	12.9	13.6	26.1
	strongly agree	1263	69.8	73.9	100.0
	Total	1709	94.5	100.0	
Missing	System	100	5.5		
Total		1809	100.0		

Table 57 shows the relationships between respondents' description of their farm type and respondents' expectations of future irrigation of their farm.

Table 57. Relationship between expectations of future irrigation of property and industry.

			Property will be irrigated in five years time					
			strongly disagree	slightly disagree	undecided	slightly agree	strongly agree	Total
Main farm industry	Dairy	Count	8	7	36	91	691	833
		% within Main farm industry	1.0%	.8%	4.3%	10.9%	83.0%	100.0%
	Crop, livestock	Count	18	4	140	142	550	854
		% within Main farm industry	2.1%	.5%	16.4%	16.6%	64.4%	100.0%
Total		Count	26	11	176	233	1241	1687
		% within Main farm industry	1.5%	.7%	10.4%	13.8%	73.6%	100.0%

Table 58 shows the relationships between respondents' plans for operating their property into the future and their expectations of future irrigation of their farm.

Table 58. Relationship between expectations of future irrigation of the property and expectations of future operation of the property

			Property will be irrigated in five years time					
			strongly disagree	slightly disagree	undecided	slightly agree	strongly agree	Total
How long plans to operate farm	5 years or less	Count	17	7	58	95	313	490
		% within How long plans to operate farm	3.5%	1.4%	11.8%	19.4%	63.9%	100.0%
	6-10 years	Count	0	4	49	74	279	406
		% within How long plans to operate farm	.0%	1.0%	12.1%	18.2%	68.7%	100.0%
	More than 10 years	Count	9	0	56	43	630	738
		% within How long plans to operate farm	1.2%	.0%	7.6%	5.8%	85.4%	100.0%
Total		Count	26	11	163	212	1222	1634
		% within How long plans to operate farm	1.6%	.7%	10.0%	13.0%	74.8%	100.0%

Table 59 shows the relationships between respondents' water trading behaviour and their expectations of future irrigation of their farm.

Table 59. Relationship between water trade behaviour and expectations of future irrigation of the property.

Property will be irrigated in five years time		Net change in water right through trade	Net temporary water purchase and sale	Total number of trades
strongly disagree	Mean	.0000	-631.9340	11.2430
	N	26	26	26
slightly disagree	Mean	.0000	188.7092	2.2498
	N	11	11	11
undecided	Mean	-33.2366	-297.7194	11.7348
	N	176	176	176
slightly agree	Mean	7.0264	-102.0843	13.2608
	N	233	233	233
strongly agree	Mean	-.8022	201.5331	10.7424
	N	1263	1263	1263
Total	Mean	-3.0493	95.9618	11.1393
	N	1709	1709	1709

7.13 Participation in Community Groups

- There was no difference in involvement between dairy and mixed farming
- Those with dependents were more likely to be involved in many organisations
- Those expecting to be operating their farm for more than 10 years were more likely to be heavily involved in community groups
- Those less optimistic about succession were less involved in community groups
- Those expecting the property to be irrigated in 5 years time were more likely to be involved in community groups
- Those less involved in community groups were more likely to be selling water. Those more involved were more likely to be purchasing water.

Irrigators were asked to identify which of the following groups they had participated in during the previous year:

- Landcare
- Church
- CFA
- Farmer groups (eg. VFF)
- Sport
- Service clubs (eg Rotary, Lions, CWA)
- Other.

Table 60 shows the range of community group involvement by respondents.

Table 60. Number of community groups involved with

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	350	19.4	19.4	19.4
	1.00	418	23.1	23.1	42.4
	2.00	410	22.6	22.6	65.1
	3.00	274	15.2	15.2	80.3
	4.00	229	12.6	12.6	92.9
	5.00	104	5.7	5.7	98.6
	6.00	20	1.1	1.1	99.8
	7.00	4	.2	.2	100.0
	Total	1809	100.0	100.0	

Irrigators were asked how often they participated during the previous year. Table 61 shows their responses.

Table 61. Extent of participation in community groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	350	19.4	20.0	20.0
	1 to 5 times per year	159	8.8	9.1	29.1
	6 to 10 times per year	196	10.8	11.2	40.4
	11 to 20 times per year	277	15.3	15.9	56.3
	More than 20 times per year	764	42.2	43.7	100.0
	Total	1747	96.6	100.0	
Missing	System	62	3.4		
Total		1809	100.0		

7.14 Satisfaction with the Local Community

Irrigators were asked how satisfied they were, overall, with the quality of life in their local area. Answers are shown in Table 62.

Table 62. Satisfaction with local community

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very disatsified	21	1.2	1.3	1.3
	Disatisfied	162	8.9	9.7	11.0
	Neutral	228	12.6	13.8	24.7
	Satisfied	877	48.5	52.8	77.5
	Very satisfied	373	20.6	22.5	100.0
	Total	1661	91.8	100.0	
Missing	System	148	8.2		
Total		1809	100.0		

Irrigators were generally satisfied with their community. Those who were involved with fewer community groups and those with higher education tended to be less satisfied.

Mixed farmers were twice as likely as dairy farmers to be very satisfied with their community. This perhaps reflects the more settled community structure of mixed farming areas. People with dependent children also tended to be more satisfied with the community.

Details are shown in Tables 63 and 64.

Table 63. Relationship between industry and community satisfaction

			Satisfaction with community					
			Very disatsified	Disatisfied	Neutral	Satisfied	Very satisfied	Total
Main farm industry	Dairy	Count	17	66	151	449	111	794
		% within Main farm industry	2.1%	8.3%	19.0%	56.5%	14.0%	100.0%
	Crop, livestock	Count	4	83	78	428	253	846
		% within Main farm industry	.5%	9.8%	9.2%	50.6%	29.9%	100.0%
Total		Count	21	149	229	877	364	1640
		% within Main farm industry	1.3%	9.1%	14.0%	53.5%	22.2%	100.0%

Table 64. Relationship between community satisfaction and community involvement

			Satisfaction with community					
			Very disatsified	Disatisfied	Neutral	Satisfied	Very satisfied	Total
involvement	Uninvolved	Count	0	37	43	121	39	240
		% within involvement	.0%	15.4%	17.9%	50.4%	16.3%	100.0%
	Shallow involvement	Count	12	80	86	319	106	603
		% within involvement	2.0%	13.3%	14.3%	52.9%	17.6%	100.0%
	Deep involvement	Count	0	38	82	281	125	526
		% within involvement	.0%	7.2%	15.6%	53.4%	23.8%	100.0%
	Promiscuous and deep involvement	Count	9	7	8	120	94	238
		% within involvement	3.8%	2.9%	3.4%	50.4%	39.5%	100.0%
Total		Count	21	162	219	841	364	1607
		% within involvement	1.3%	10.1%	13.6%	52.3%	22.7%	100.0%

7.15 Expectations of Change in Community Life in next 5 years

Irrigators were asked whether they expected the overall quality of community life in their local area to change in the next five years. Answers are shown in Table 65.

Table 65. Expectations of change in the quality of community life in five years time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Much worse	103	5.7	6.1	6.1
	Worse	383	21.2	22.6	28.7
	Unchanged	908	50.2	53.6	82.3
	Better	263	14.5	15.5	97.8
	Much better	37	2.0	2.2	100.0
	Total	1693	93.6	100.0	
Missing	System	116	6.4		
Total		1809	100.0		

Twenty-nine per cent of irrigators believed that the quality of their local community would decline in the following 5 years. People with more education were more likely to believe that the community will change, for better or for worse.

Those who were dissatisfied with the community were much more likely to expect that the quality of community life would decline in future. Details are shown in Tables 66 and 67.

Table 66. Relationship between education and expectations of community life change

			Change in community quality in 5 years					
			Much worse	Worse	Unchanged	Better	Much better	Total
education	Secondary	Count	82	199	500	108	18	907
		% within education	9.0%	21.9%	55.1%	11.9%	2.0%	100.0%
	Trade	Count	3	104	298	83	9	497
		% within education	.6%	20.9%	60.0%	16.7%	1.8%	100.0%
	University	Count	9	77	67	72	9	234
		% within education	3.8%	32.9%	28.6%	30.8%	3.8%	100.0%
Total		Count	94	380	865	263	36	1638
		% within education	5.7%	23.2%	52.8%	16.1%	2.2%	100.0%

Table 67. Relationship between satisfaction with community life and expectations of changed community quality in 5 years

			Change in community quality in 5 years					
			Much worse	Worse	Unchanged	Better	Much better	Total
Satisfaction with community	Very disatsified	Count	9	4	0	8	0	21
		% within Satisfaction with community	42.9%	19.0%	.0%	38.1%	.0%	100.0%
	Disatisfied	Count	36	86	33	0	0	155
		% within Satisfaction with community	23.2%	55.5%	21.3%	.0%	.0%	100.0%
	Neutral	Count	0	90	115	24	0	229
		% within Satisfaction with community	.0%	39.3%	50.2%	10.5%	.0%	100.0%
	Satisfied	Count	16	147	573	132	9	877
		% within Satisfaction with community	1.8%	16.8%	65.3%	15.1%	1.0%	100.0%
	Very satisfied	Count	22	55	187	90	19	373
		% within Satisfaction with community	5.9%	14.7%	50.1%	24.1%	5.1%	100.0%
Total		Count	83	382	908	254	28	1655
		% within Satisfaction with community	5.0%	23.1%	54.9%	15.3%	1.7%	100.0%

8 Local Government and Remote Sensing Data Validation

The following section outlines the comparisons between the Trial Survey-Local Government and remote sensing datasets derived for this project. The anticipated outcome for this analysis is the ongoing utilisation of Local Government and remote sensing information to provide a basic set of farm and crop type information to support ongoing G-MW and CMA needs.

8.1 Farm Type

The following table describes the comparison between the survey farm type findings and those provided by Local Government.

Table 68. Local Government and Irrigation Farm Survey Farm Type comparison

Local Government Enterprise	Total Of Type	IFS Dairy	IFS Horticulture	IFS Mixed Farm	% correct
Dairy	111	94		17	84.7
Mixed Farm	103	13	5	85	87.4

Table 68 indicates that local government derived information correctly identified the farm type in at least 85% of cases and is a reliable indicator of farm type across the 3 Irrigation Areas studied.

Figure 6 and 7 illustrates the basic value of integration of G-MW previous culture census, water use data and Local Government information in providing G-MW and CMAs with a picture of enterprise types and their water use.

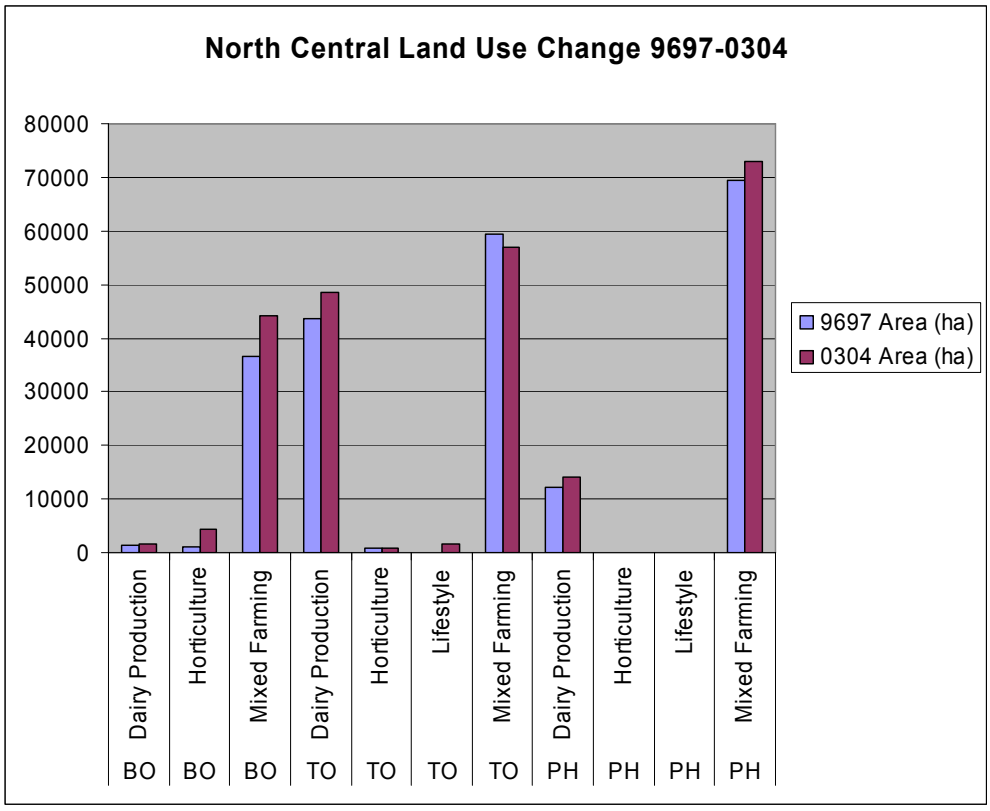


Figure 6. Graph showing area change in farm types for Boort, Torrumbarry and Pyramid Hill.

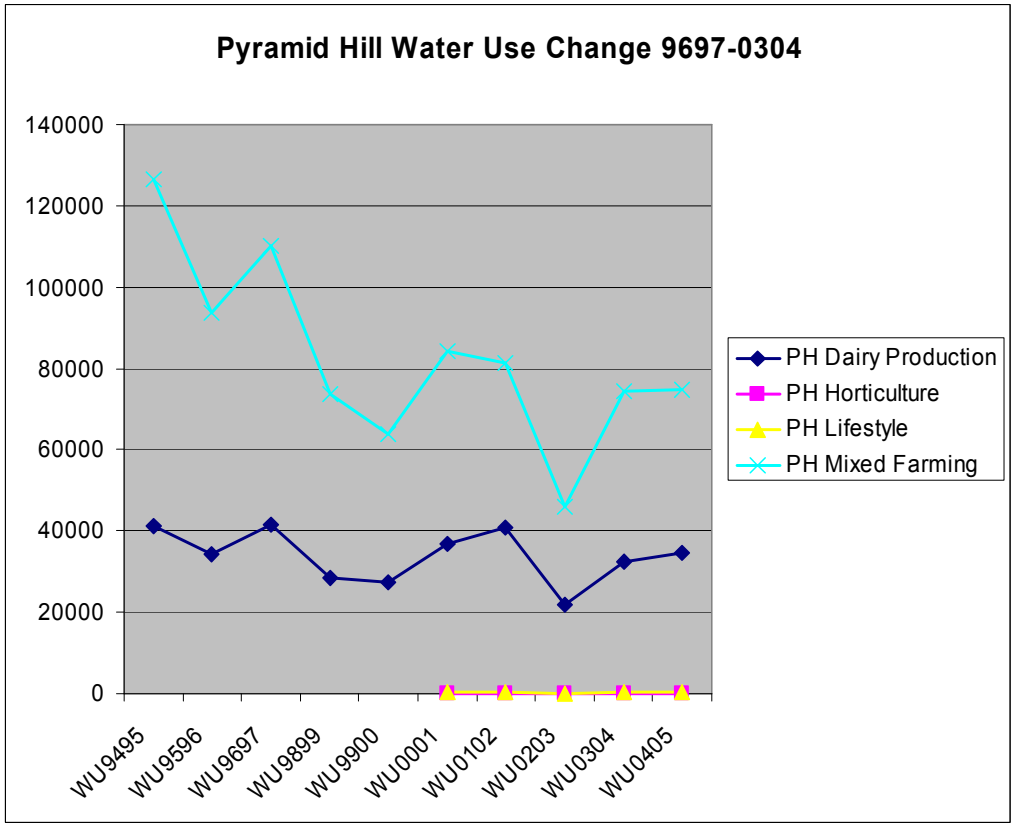


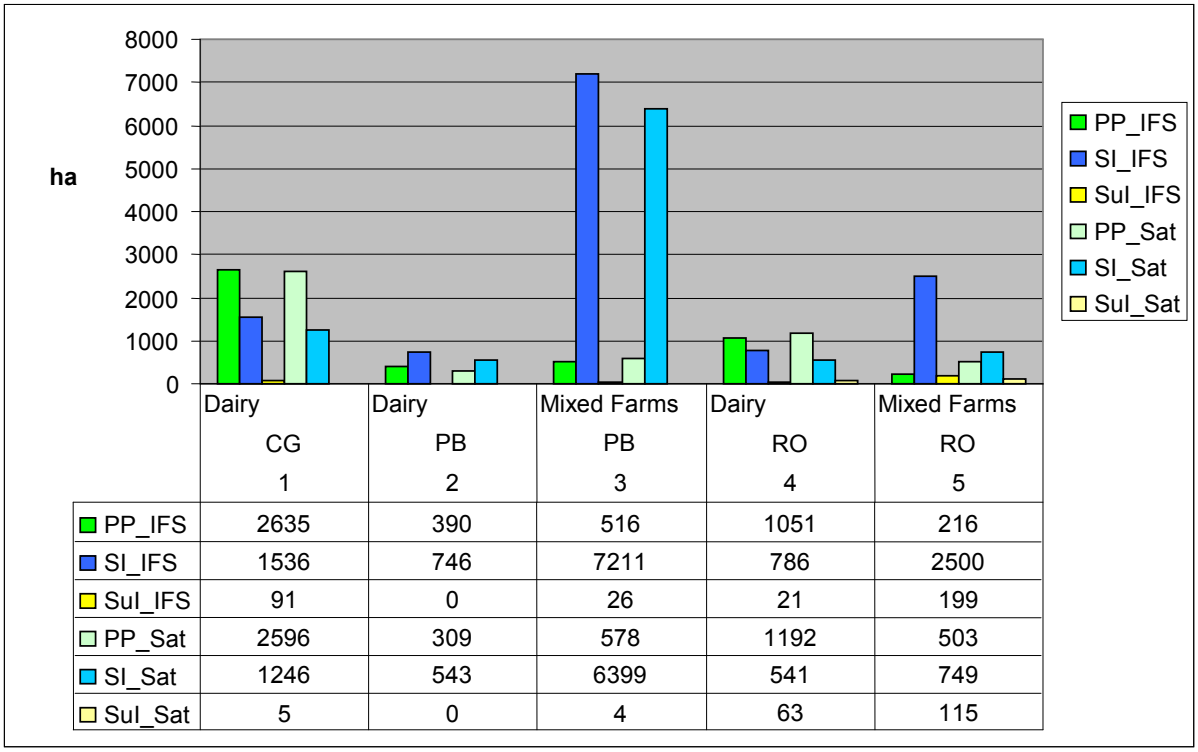
Figure 7. Water Use by Irrigation Farm Type for Pyramid Hill (excluding Boort).

8.2 Crop Types

The following tables contained within Figures 8 and 9 describe the comparisons between the survey findings and the Local Government and remote sensing derived crop types. The results are a direct comparison of the total culture areas derived from survey returns against the data derived for those properties from remote sensing and Local Government data.

Figure 8 shows the comparison between the remote sensing derived dataset and Local Government. The data is expressed as categories of Perennial Pasture (PP_IFS & PP_Sat), Seasonal Irrigation (SI_IFS & SI_Sat - which includes the annual, winter cropping and lucerne categories from the census) and summer Irrigation (SuI_IFS & SuI_Sat - which includes summer cropping and tomatoes from the census).

The table within Figure 8 indicates that the remote sensing information provides a reliable prediction of both perennial and seasonal irrigation across most of the sectors analysed except for mixed farming within the Rochester Irrigation Area. Although the categories identified from remote sensing are broadly grouped the advantages of this technology is that it will support comprehensive mapping of these crop types.



	Dairy CG 1	Dairy PB 2	Mixed Farms PB 3	Dairy RO 4	Mixed Farms RO 5
PP_IFS	2635	390	516	1051	216
SI_IFS	1536	746	7211	786	2500
SuI_IFS	91	0	26	21	199
PP_Sat	2596	309	578	1192	503
SI_Sat	1246	543	6399	541	749
SuI_Sat	5	0	4	63	115

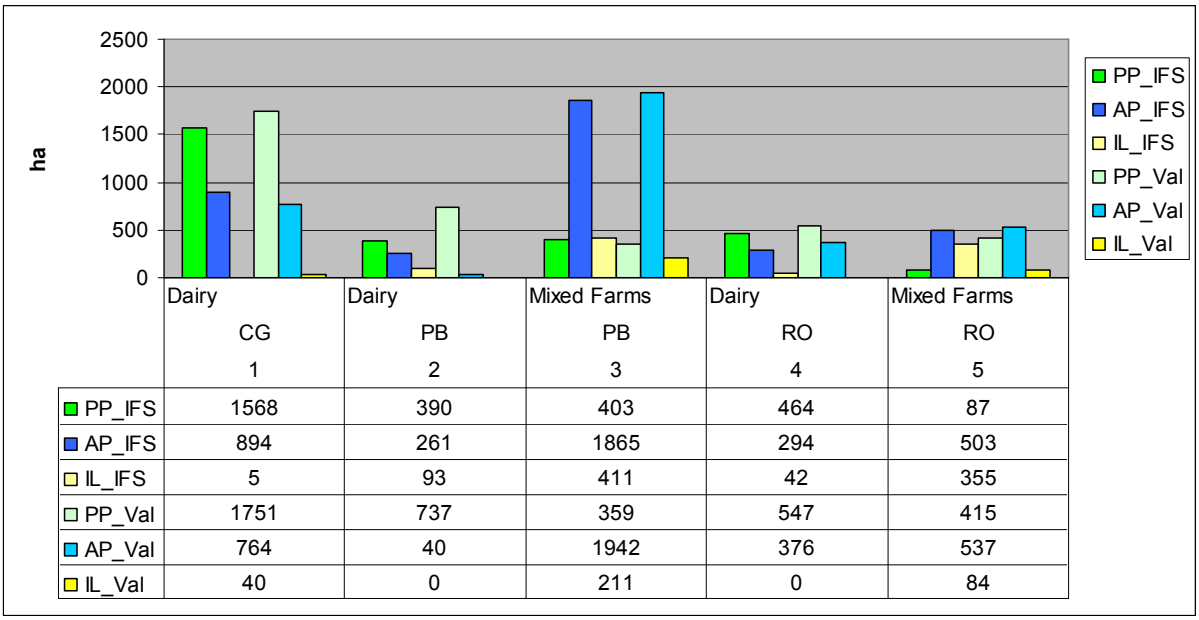
Figure 8. Comparison of total areas(Ha) of culture reported by Trial Survey returns against estimated area (Ha) from satellite.

Figure 9 shows the comparison between total areas of culture reported by Trial Survey returns against areas reported by Local Government. The data from the 2 sources is compared for Perennial Pasture (PP), Annual Pasture (AP) and Lucerne

(IL) as these are the 3 culture categories (excepting fixed horticulture) that Local Government currently collects.

The table within Figure 9 shows that comparable data for Perennial and Annual Pastures can be sourced from Local Government with Rochester Mixed farming again being the category that doesn't align as well. The results for lucerne are mixed indicating the data from Local Government still needs improvement. The main drawback in the current use of Local Government information for estimating culture is the incompleteness of the dataset with many properties providing no estimates of culture. Of the 187 farms linked back to the Local Government information 95 had reporting of culture types.

As part of the current data sharing activities, the valuation contractors have undertaken work to improve the consistency and reporting of their dataset and will be providing an update of data in 2006.



	Dairy CG 1	Dairy PB 2	Mixed Farms PB 3	Dairy RO 4	Mixed Farms RO 5
PP_IFS	1568	390	403	464	87
AP_IFS	894	261	1865	294	503
IL_IFS	5	93	411	42	355
PP_Val	1751	737	359	547	415
AP_Val	764	40	1942	376	537
IL_Val	40	0	211	0	84

Figure 9. Comparison of total areas (Ha) of culture reported by Trial Survey returns against areas (Ha) reported by local government.

8.3 Conclusions

The conclusion from the combined data sharing, remote sensing and Trial Survey exercise is that utilising a combination of existing local government information and remote sensing will provide for G-MW, G-B-CMA and NC-CMA ongoing basic farm and crop type information needs. The next steps of this data sharing and collection project will be to investigate collation of additional information into the existing information framework including the following attributes:

- Extended winter and seasonal crop types (gathered by valuation contractors);
- Integration of fixed horticulture information for SPC-Ardmona Horticulture census;
- Collection of improved property information (ie. Re-use, spray irrigation) from Local Government information.

9 Project Costs

9.1 Estimates and Funding

The original estimated cost of the project is $180,000 as detailed in Table 69.

The estimated cost as detailed excludes ABS and LG valuations input and some DPI involvement.
The project is being funded as follows:

- G-MW - 50%
- GBCMA - 25%
- NCCMA - 25%

Table 69. Irrigation Farm Survey Budget by Stage

Stage	Task	Cost ($)
1	Complete Project Concept Proposal and gain endorsement from IFSSC.	20,000
2	Finalise agreements, complete data alignment and refine survey requirements	35,000
3	Finalise survey requirements, run survey and data sharing.	45,000
4	Collate and analyse returned data, write and publish report.	40,000
5	Contingency	40,000
	Total	180,000

9.2 Project Expenditure

The project cost was $177,000.

10 Project Summary

This section will only provide information in relation to the project objectives and expected outcomes and other significant matters related to the development and on going management of information sharing with Local Government and the virtues of the Trial Survey

The objectives of the IFS project were to:

- Develop new methods to improve quality of data and statistical relevance;
- Explore methods that may innovatively enable the IFS and other surveys to be undertaken better;
- To undertake an assessment of irrigation culture and associated farm development within G-MW's region;
- Undertake IFS under shared cost arrangements with project stakeholders to a nominated budget;
- Analyse data collected;
- Integrate data from different sources;
- Develop a report on the survey and process.

The expected project outcomes included:

- An Irrigation Farm Survey adopted as a two part process;

- Execution of data sharing agreements between G-MW and Local Governments;
- Sharing of datasets between G-MW and Local Governments via a property number;
- Culture and other farm information will be available from this process in an aggregated format;
- The data supplied by data sharing and the Trial Survey will be analysed and a report will be written.

10.1 Information Sharing Arrangements

Initially, in order to establish a useful information dataset for use by G-MW, DPI and CMAs and to share information with Local Government 'Information Sharing Agreements' (Agreements) were intended to be entered into between G-MW and six Local Governments:

- Shire of Campaspe
- Gannawarra Shire Council
- Loddon Shire Council
- Moira Shire Council
- Greater Shepparton City Council
- Swan Hill Rural City Council.

With the exception of Moira Shire Council, all entered into an Agreement.

The Agreements allow the sharing of selected property information already being obtained by Local Government, Water Right and water use information, by property via a property number. Potential privacy issues surrounding the sharing of information via the use of a unique identifier were allayed following discussion with Privacy Victoria and it is now understood that G-MW and Local Government can legally share property and water information for purposes related to their statutory functions. It is further understood that sharing of information can be undertaken using property numbers as property numbers are not a 'unique identifier'. Property and water information is currently being shared in accordance with the Agreements via use of a property number.

The Agreements provided a basis upon which Local Government and G-MW could share information and safeguard the interests of parties, by setting out the terms and conditions underpinning the information sharing process.

The Agreements also allow DPI access to property and water information in aggregate form.

10.2 Integration of Information

To support the reporting of farm and crop types across the G-MW irrigation areas and to provide an information base upon which to conduct sample surveys a system has been developed that integrates a range of information from G-MW, Local Government, the horticulture industry and remote sensing technologies. The key information layers that support this system are as follows:

10.2.1 Water Delivery Information Layers

The water delivery layers depict the features that support the delivery of water through GM-W channel systems to the farm. They also allow the mapping of water use at a specific location (service point), linked to a range of spatial boundaries including properties or sub-catchments. There are 2 main components of this theme:

- Water asset infrastructure
- Water delivery and customer database.

10.2.2 Land Use Information Layers

The land use layers describe land use and enterprise at both property and actual land cover extents. These are sourced from several organisations using various technologies and provide a temporally and spatially dynamic view of land use and land use change the details of which are:

- Council land use. Source Local Government
- Industry land use. Source SunRISE 21 and SPC-Ardmona
- Land cover. Source Landsat 5 Information Mapper (TM) Satellite.

10.2.3 Crop type Mapping and Irrigated Land cover Classification

Fixed horticulture is mapped by SPC-Ardmona and SunRISE 21 on a regular basis by digitising aerial photography. Irrigated pastures and seasonal crops are much more dynamic as a land cover and therefore required a different approach as described below.

The Landsat Information Mapper (Landsat TM) satellite captures the instantaneous response of the ground cover including vegetation, water and ground temperature. Standard image processing techniques convert satellite data into more meaningful information than visual interpretation alone can provide.

Satellite data was used to develop a seasonal profile of water and then to convert the seasonal information into land cover classes.

10.2.4 Data linkage

The main limitation of the current arrangement of water and land information is that they are not integrated. Therefore, it is difficult to report water use against land based data such as industry types, soils and agricultural land cover.

This project has successfully linked G-MW service points and customer service identifiers with cadastral and property identifiers used by Land Victoria and Local Government for the Pyramid Boort, Rochester and Central Goulburn Irrigation Areas. This alignment enables the building of relationships between land information held by organisations such as Local Government and water information held by G-MW. It also enables the spatial analysis of resource datasets such as soils and land cover in relation to this information, as there is a property boundary on which to base the analysis.

Local Government collects a range of attributes for the purposes of rating properties, land information forms one of the key datasets in this information system. The reliability of these attributes currently varies across the Local Government areas with land classification being the most reliable.

The ongoing alignment of land and water information to enable reporting of combined land and water information will be captured within the Victorian Water Register (VWR). Negotiations with DSE have ensured that the necessary linkages are in place within the VWR to enable the ongoing integration of Local Government, G-MW, CMA and DPI information that will support the generation of land and water information on an ongoing basis.

In addition the Local Government contractor LG Valuations Services has undertaken to improve their current data holdings to align more closely with catchment management and water authority requirements.

10.3 Trial Survey

Initially, it was intended to obtain information on land use, cultural, management and irrigation practices and social views across G-MW's entire gravity irrigation customer base.

Mindful of the inadequacies of previous surveys; the opportunity to share information already being obtained by Local Government, the desire of Local Government to obtain water use at property level and the Australian Bureau of Statistics (ABS) new survey techniques the opportunity was taken to trial a new survey process.

The planned Trial Survey process was to share existing property information held by Local Government and water use information held by G-MW, and to utilise new survey techniques developed by ABS. It was decided to conduct a Trial Survey utilising shared data, adopting in principle ABS Land Parcel Frame methodology and applying proven statistical techniques to survey design.

The size of the Trial Survey was restricted to dairy properties in the Central Goulburn Irrigation Area and dairy and cropping and grazing properties in the Rochester Campaspe and Pyramid Boort Irrigation Areas.

10.3.1 Trial Survey Design

The Trial Survey was directed at property level and consisted of 40 questions seeking information on land use, irrigations systems, management practices, changes to irrigation practices, barriers to changing irrigation practices and social aspects.

The Trial Survey format consisted of quantitative (eg. area of permanent pasture), multiple choice (eg. strongly disagree….to…strongly agree) and qualitative (written sentences) type questions.

Aerial photos of the property of each customer in the sample were included with the Trial Survey. For the first time, in culture related surveys conducted by G-MW, respondents were asked to report for the actual property (not enterprise or farm) provided with the Trial Survey All information was forwarded to the survey consultants, NCS Pearson, who conducted the mail out, receipted returned surveys and collated survey data.

Stratified samples of 329 farms which allowed for a 70% response rate were selected from an estimated parent population of 1806 farms. Under guidance from the ABS, the sample was increased to 335 during the survey to achieve an adequate response within each stratum. A total of 240 responses were received. Responses in each stratum were subsequently weighted to generate estimates for the parent population.

Considerable additional effort was directed at achieving the desired 70% return. Through the use of telephone surveys and duplicate survey kits the desired 70% return rate was achieved in all strata.

Trial Survey finding are contained in Section 7.

10.3.2 Data Validation

Comparison of information from the Trial Survey and Local Government indicates that Local Government derived information correctly identified the farm type in 85% of cases and is a reliable indicator of farm type.

Comparison of remote sensing derived dataset and Local Government indicates that remote sensing provides a reliable prediction of crop types (perennial and seasonal irrigation) across most of the most of the sectors analysed except for mixed farming within the Rochester Irrigation Area.

Similar results were obtained when comparing when comparing the total areas of culture reported by the Trial Survey against Local Government data in that comparable data can be sourced from Local Government with Rochester Irrigation Area again being the category that doesn't align as well.

The Trial Survey delivered the following outcomes:

- Established processes for compiling surveys using information from Local Government, G-MW and DPI;
- Established a framework to enable surveys can be targeted to individual properties, with accompanying aerial photos to assist survey completion and accuracy of data;
- Determined the reliability of information obtained by Local Government and provide the basis for any refinement;
- Provided a cost effective methodology for future surveys;
- Delivered useful and relevant information for immediate use.

10.3.3 Conclusion

The conclusion from the combined data sharing, remote sensing and Trial Survey exercise is that utilising a combination of existing local government information gathering and remote sensing will provide for G-MW, G-B-CMA and NC-CMA ongoing basic farm and crop type information needs. The next steps of this data sharing and collection project will be to investigate collation of additional information into the existing information framework including the following attributes:

- Extended winter and seasonal crop types (gathered by valuation contractors);
- Integration of fixed horticulture information for SPC-Ardmona Horticulture census;
- Collection of improved property information (ie. Re-use, spray irrigation) from Local Government information.

11 Glossary of Terms

This section defines the terms used throughout the document.

Term/Acronym	Description
Domestic and Stock	Water supplied for the use of domestic and stock. Often abbreviated to D & S.
Holding	The land shown in a single entry in the register (see register). Can be a continuous parcel of land or a number of separated parcels of land. BICCS refers to a holding as a service.
Irrigation Districts	An area with defined geographic boundaries within which water is allocated for irrigation under the control of a State Body or Authority. (Also see Section 230 Water Act).
Parish	A Crown description for a larger administrative area identified and surveyed by the State's early government surveyors as a means of rational sub-division, settlement and alienation of Crown Land. EG: Parish of Cornella.
Property	A parcel of land or a number of contiguous parcels of land normally in common ownership or worked as the one farming financial entity. The term property is not formally used by G-MW, where it has been replaced by 'Service'.
Register	A register of all lands in an irrigation district. It must show all holdings within the district, the owner or occupier of each holding, domestic and stock allowance attached to the holding and any other matters that the Authority considers necessary. Section 230 of the Water Act refers to as "the register of lands."
Regulated System	Flow systems, where the flow of water is regulated through the operation of large dams or weirs.
Service (non-water based)	A term used for things such as works licence, boat licences, jetty licences and leasing of perimeter lands around reservoirs. Services in BICCS have a distinct number called a Service ID.
Service (water based)	A parcel of land or a number of parcels of land that are shown in the register as one holding and to which a water entitlement and customer are attached. The service also contains the land description and the works associated with supply of the water entitlement. Services in BICCS have a distinct number called a Service ID
Service Point	The physical works associated with the supply of water such as meter wheels, pumps, open outlets, bores etc. Service points are attached to a service.
Water Allocation	The seasonal amount of water actually made available expressed as a percentage of the water entitlement (see term), attached to the holding in a given irrigation season or financial year. Usually set after the assessment of the available resources. The percentage is announced at various times during the year.
Water Entitlement	The total amount of water that is attached to a holding and must be made available for supply to the owner or occupier of the land. The same principle is used for diversions from streams and groundwater.

Appendices

11.1 Information Sharing Agreement.

Date

INFORMATION SHARING AGREEMENT

GOULBURN-MURRAY WATER

and

Information Sharing Agreement

DATE / /2006

BETWEEN

GOULBURN-MURRAY WATER
of 40 Casey Street, Tatura

(**G-MW**)

AND

(insert council's name and address)

(**Council**)

RECITALS

A. G-MW is a water authority established under the *Water Act* 1989. G-MW collects and holds, as part of its functions, water right and water usage information (**water information**).

B. Council is a municipal council within the meaning of the *Local Government Act* 1989. Council collects and holds, as part of its role, property information, including information about farm type, crop cultures and management practices (**property information**).

C. G-MW wishes to access the property information to assist it in its infrastructure and business planning .

D. Council wishes to access the water information for valuation purposes.

E. The sharing of the water information and property information is likely to be via a common property number. The parties also intend to provide the Department of Primary Industries and Australian Bureau of Statistics (ABS) with access to the water information and property information in aggregate form.

F. The parties wish to enter into this Agreement in order to facilitate the sharing of the information and ensure this occurs in accordance with the *Information Privacy Act* 2000.

OPERATIVE PROVISIONS

1. TERM

This Agreement commences on **[insert date]** and continues until terminated in accordance with clause 5, or by agreement.

2. PROVISION OF INFORMATION

2.1 G-MW agrees, subject to the terms of this Agreement, to provide the water information to Council in a format as agreed from time to time, which may without limitation be via an agreed property number, on an annual basis or as and when agreed.

2.2 Council agrees, subject to the terms of this Agreement, to provide the property information to G-MW in a format as agreed from time to time, which may without

limitation be via an agreed property number, on an annual basis or as and when agreed.

2.3 Both parties agree to use their best endeavours to supply accurate and relevant information, but neither party warrants the accuracy or completeness of the information supplied. A party using or relying upon such information does so at its own risk, and the supplying party will bear no responsibility or liability (including any liability in negligence) for any errors, defects or omissions in the information provided to the other party.

3. USE OF INFORMATION

3.1 Subject to clause 3.2, both parties warrant that they have sought access to the other party's information for the purposes specified in the Recitals, and that they will not use or disclose the information for any other purpose without the prior written approval of the other party, or as required by law.

3.2 The parties may provide the water information and property information to the Department of Primary Industries in aggregate form.

4. PRIVACY

4.1 In this clause, "Personal Information" and "Information Privacy Principles" and have the meaning accorded to these terms under the *Information Privacy Act* 2000.

4.2 The parties must, in respect of Personal Information accessed under this Agreement, comply with the Information Privacy Principles with respect to any act done, or practice engaged in, by the parties, their employees and agents.

5. TERMINATION

If a party fails to carry out its obligations or duties under this Agreement, the party not in breach may, by notice in writing, specify the breach and request that it be remedied within 14 days. If the defaulting party fails to remedy the breach, then the Agreement may be terminated by the other party.

6. INDEMNITY

6.1 The parties will be personally and solely responsible for any loss or damage arising out of that party's use and handling of the information.

6.2 To the extent permitted by law, Council indemnifies and holds harmless G-MW, its employees and agents against any and all actions, suits and claims of any nature which are, or are capable of being, made against G-MW in respect of, or in any way arising out of, G-MW's provision of the water information to Council under this Agreement.

6.3 To the extent permitted by law, G-MW indemnifies and holds harmless Council, its employees and agents against any and all actions, suits and claims of any nature which are, or are capable of being, made against Council in respect of, or in any way arising out of, Council's provision of the property information to G-MW under this Agreement.

7. DISPUTES

7.1 If any dispute arises in relation to this Agreement, either party may, by notice to the other, refer the dispute to mediation. If the parties are unable to agree upon the

choice of mediator, then the dispute shall be referred to a mediator nominated by the President of the Law Institute of Victoria.

7.2 If mediation does not resolve the dispute, either party may refer the dispute to an expert for expert determination. Such expert shall be appointed by agreement between the parties, and, in default of agreement, by a person nominated by the President of the Law Institute of Victoria. The expert shall act as an expert and not as an arbitrator, and any determination made by the expert shall be binding upon the parties.

8. OTHER MATTERS

8.1 The parties acknowledge that the rights and duties created by this Agreement are personal to the parties.

8.2 No rights or obligations under this Agreement shall be waived except upon written acknowledgment signed by each party.

8.3 The rights and obligations of the parties under clauses 3, 4 and 6 shall survive the termination or expiry of the Agreement.

8.4 This Agreement shall be construed in accordance with the laws of the State of Victoria.

EXECUTED by the parties

SIGNED by an authorised representative of Goulburn- Murray Water in the presence of:)
)
) .....
Name:
Title:

.....
Witness

SIGNED by and on behalf of the [**insert name**] Council, in accordance with an Instrument of Delegation made on . . . . . , by the member of council staff occupying the position or title of or acting in the position of Chief Executive Officer) .....

.....,
Witness

#1524736 v2 - irrigation farm survey - information sharing agreement - maddocks - 10 february 2005

11.2 Irrigation Farm Survey

GOULBURN-MURRAY WATER

Irrigation Farm Survey 2005

IMPORTANT – PLEASE READ

Only report for the actual property shown on the attached plan.

The property shown on the attached plan has been selected randomly to be included in this Survey. If you own or lease other properties, do not report for these unless you have also received a separate survey for those properties.

Answers are to be made in hectares (Ha). For conversion purposes, 1 hectare (Ha) equals approximately 2.5 acres.

INSTRUCTIONS

- Use a blue/black ballpoint pen or 2B pencil
- Do not use red or felt tip pens
- Make no stray marks

Please MARK LIKE THIS: ○■○○

PROPERTY DESCRIPTION

1 For the period between 1 July 2004 and 30 June 2005, what farm type best describes the property? Please indicate one type only.

○ Dairy
○ Horticulture
○ Cropping & Grazing
○ Grazing only
○ Other (please specify): _____

2 For the period between 1 July 2004 and 30 June 2005, what area of the property was irrigated? _____ Ha

3 For the period between 1 July 2004 and 30 June 2005, please classify the area of the property by the following categories.

Land Use	Ha
Perennial pasture (pasture irrigated through the summer)	
Annual pasture (pasture irrigated in spring and/or autumn)	
Irrigated Lucerne	
Winter grain or fodder crop (eg. wheat, barley, canola, faba beans, oats)	
Summer grain or fodder crop (eg. maize, millet, sorghum, soybean)	
Any other irrigated crops or irrigated fallow	
Tomatoes	
Other vegetables and annual fruit crops (eg. melon, lettuce)	
Grapevines	
Citrus fruits of all types	
Stone fruit (eg. apricot, peach, nectarine)	
Pome fruit (eg. apples, pears)	
Other permanent orchard species (eg. Kiwi fruits, berries, avocados, nut crops)	
Irrigated wood lots (not shelter belts)	
Other irrigated plantings (please specify): _____	
Laneways, sheds, dairy and areas of the property not irrigated for the survey period	
How much of the property has been double cropped	
Other non-irrigated areas	

GOULBURN-MURRAY WATER

Irrigation Farm Survey 2005

IMPORTANT – PLEASE READ

Only report for the actual property shown on the attached plan.

The property shown on the attached plan has been selected randomly to be included in this Survey. If you own or lease other properties, do not report for these unless you have also received a separate survey for those properties.

Answers are to be made in hectares (Ha). For conversion purposes, 1 hectare (Ha) equals approximately 2.5 acres.

INSTRUCTIONS

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Please MARK LIKE THIS:

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Citrus fruits of all types	
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Pome fruit (eg. apples, pears)	
Other permanent orchard species (eg. Kiwi fruits, berries, avocados, nut crops)	
Irrigated wood lots (not shelter belts)	
Other irrigated plantings (please specify): _____	
Laneways, sheds, dairy and areas of the property not irrigated for the survey period	
How much of the property has been double cropped	
Other non-irrigated areas	

24 Please describe the protection works you have undertaken.

CHANGES TO IRRIGATION PRACTICES

25 Which of the following changes to your irrigation practices do you intend to introduce to the property in the year ending 30 June 2006?

- ○ Introduce more efficient irrigation application techniques
- ○ Implement more efficient irrigation scheduling
- ○ Install piping or covered open channels to reduce water loss
- ○ Construct drains to improve irrigation water efficiency
- ○ Laser level areas to improve irrigation efficiency
- ○ Introduce irrigation water re-use or recycling
- ○ Introduce farm soil moisture monitoring
- ○ Develop a farm plan
- ○ Other (please specify):
- ○ No intended changes

BARRIERS TO CHANGING IRRIGATION PRACTICES

26 What are the significant barriers to changing your irrigation management practices?

- ○ Inadequate water quality
- ○ Uncertainty of water allocation
- ○ Lack of financial resources
- ○ Lack of time
- ○ Insufficient or inadequate information
- ○ Doubts about likely success
- ○ Age or poor health
- ○ Inadequate water availability
- ○ Other barriers (please specify):
- ○ No barriers

27 Have you bought or sold water in relation to this property over the last five years? ○ **Yes (GO TO Q28)** ○ **No (GO TO Q29)**

28 Do you feel that permanently or temporarily selling and buying water has:

	Large negative impact	Slight negative impact	No impact	Slight positive impact	Large positive impact
Affected your ability to make a profit?	○	○	○	○	○
Affected your ability to plan and implement a water budget?	○	○	○	○	○
Affected your ease of operation?	○	○	○	○	○

29 Please respond to this statement: "I think this property will be irrigated in five years' time".

○ Strongly disagree ○ Slightly disagree ○ Undecided ○ Slightly agree ○ Strongly agree

SOCIAL

30 Overall, how satisfied are you with the quality of community life in your local area?

○ Very dissatisfied ○ Dissatisfied ○ Neutral ○ Satisfied ○ Very satisfied

31 Over the next five years, do you expect the overall quality of community life in your local area to become:

○ Much worse ○ Worse ○ No change ○ Better ○ Much better

32 Which of the following groups have you participated in during the past year? Indicate all that apply.

- ○ Landcare
- ○ Church
- ○ CFA
- ○ Farmer groups (eg. VFF)
- ○ Sport
- ○ Service clubs (eg. Rotary, Lions, CWA)
- ○ Other
- ○ None

33 In the last year, how often did you participate in these groups?

○ Not applicable ○ 1 to 5 times ○ 6 to 10 times ○ 11 to 20 times ○ More than 20 times

34 How many years have you been operating this property? **Years**

SOCIAL (continued)

35 How long do you expect to keep operating this property?

- ○ 0 to 5 years
- ○ 6 to 10 years
- ○ More than 10 years

36 Do you have children? ○ Yes (GO TO Q37) ○ No (GO TO Q38)

37 At what stage are your children? ○ Pre-school and primary school ○ Secondary school and tertiary students ○ My children are independent

38 When you cease operating the property, do you expect to pass this land on to another person in the family? ○ Yes (GO TO Q39) ○ No (GO TO Q40)

39 Do you have a professionally prepared succession plan that documents those arrangements? ○ Yes ○ No

40 What is the HIGHEST level of education you have completed?

- ○ Secondary school
- ○ Trade / Technical qualification / TAFE Certificate
- ○ University undergraduate / University post-graduate

FEEDBACK

41 Please provide an estimate of the time taken to complete the survey (including time spent reading instructions, working on the questions, and time spent by all employees obtaining the information).

☐☐ Hours ☐☐ Minutes

42 Please provide comments on any questions that caused problems.

43 Please provide comments if you would like to suggest improvements to the survey

11.3 Group and Committee Members

Technical Group

Kevin Linton-Convenor
Terry Court- TJC Solutions assisting G-MW
Andy McAllister- DPI
Paul Kenny
Paul Kerrins
Geoff Coburn

G-MW Reference Group

Garry Smith
Ian Moorhouse
John Ginnivan
Terry Hunter

Steering Committee

Ken Sampson- GBCMA
Tim Shanahan –NCCMA
Kevin Linton-G-MW Project Manager
Steve Lottkowitz-DPI
David Lawler-DPI
Chris Nicholson-DPI
Andy McAllister-DPI
Richard Maxwell-DPI
Terry Court- TJC Solution assisting G-MW
ABS-Representatives;
John Ovington and Kim Hawthorne