Murrumbidgee Irrigation

ANNUAL COMPLIANCE REPORT 2017

Growing our future together

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Murrumbidgee Irrigation Limited
Annual Compliance Report
2016/17

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Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
BBSW	Barren Box Storage and Wetland
CSIRO	Commonwealth Scientific Investigation and Research Organisation
DPI Water	Department of Primary Industries, Water
EC	Electrical Conductivity
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ETo	Reference crop evapotranspiration
GIS	Geographic Information System
ha	Hectare(s)
LTA	Long-term average
MI	Murrumbidgee Irrigation Limited
MIA	Murrumbidgee Irrigation Area
µS/cm	Micro Siemens per centimetre
µg/L	Micrograms per litre
ML	Megalitre
OEH	Office of Environment and Heritage
SOP	Standard Operating Procedure
t	Tonnes
LAG	EPL Point 4 - Gogeldrie Main Drain at Gooragool Lagoon
GMSRR	EPL Point 5 - Gogeldrie Main Southern Drain River Road
YMS	EPL Point 6 - Yanco Main Southern Drain
ROCUDG	EPL Point 7 - Point Cudgel Creek Roaches Escape
MIRFLD	EPL Point 15 - Mirrool Creek Floodway Wyvern Station

COMBINED WATER SUPPLY WORK APPROVAL AND WATER USE APPROVAL

1 Statement of Compliance

Murrumbidgee Irrigation (MI) has met the conditions of the Combined Water Supply Work Approval and Water Use Approval 40CA403245 (Combined Approval) in 2016/17. A summary of the compliance requirements are cross referenced to this report and listed in Table 1. Quality assurance and control procedures are in place to guarantee data integrity and to ensure that all compliance obligations are met. This includes using a NATA accredited laboratory for water sample analysis and contracting an external hydrological service provider to manage and maintain automated monitoring stations. Internal Standard Operating Procedures (SOPs) are reviewed regularly.

MI did not change or modify the condition of the existing authorised water supply works or authorised discharge works listed in the Combined Approval during 2016/17. MI did not construct new works that would allow further discharge from the area of operations during 2016/17. In 2016/17, the boundary of MI's Area of Operations increased by 13,242 hectares which is identified in Figure 1.

Table 1 Combined Water Supply Work Approval and Water Use Approval (40CA403245) reporting summary

Licence section	Requirement	Report Section
Plans of the Area of Operations, Authorised Works, Monitoring Sites and Water Management Infrastructure	12.1	2. Plan of Operations and Works
	12.2	
Statement of Compliance	12.3	1. Statement of Compliance
Presentation of Data and Analyses	12.4	Section 1 - 6
	12.5	
	12.6	
	12.7	Provided on USB
	12.8	1. Statement of Compliance
New Measures to Limit Groundwater Recharge and Discharge of Salt	12.9	7. New Measures to Limit Groundwater Recharge and Discharge of Salt
Reporting on Water Management	12.10	3.3 Diversions and Water Allocation
	12.11	3.5 Water discharged from Area of Operation
	12.12	3.9 Water Balance
	12.13 (a) (b)	3.1 Climate Conditions
	(c) – (j)	4. Water Use
Reporting on Salinity and Salt load	12.14	5. Salinity and Salt load
	12.15	
	12.16	
Reporting on Groundwater Conditions	12.17	6. Groundwater Conditions

2 Plan of Operations and Works

MI's area of operations, storages and major supply and drainage channels are presented in Figure 1. The Murrumbidgee Irrigation Area (MIA) is supplied by water stored in Burrinjuck and Blowering dams and released to the Murrumbidgee River. Water is diverted from the Murrumbidgee River in accordance with the conditions of the Combined Approval, via two authorised supply works (Figure 2):

- NARREG - Narrandera Regulator (after diversion from Berembed Weir via Bundidgerry Creek and regulator)
- STURT - Sturt Regulator (after diversion from Gogeldrie Weir)

There are five (5) sites which have the ability to discharge water outside MI's area of operations, which are presented in Figure 2. These sites are monitored in accordance with MI's Combined Approval and Environmental Protection Licence (EPL) 4651. MI's five discharge monitoring points are:

- LAG – Gogeldrie Main Drain at Gooragool Lagoon
- ROCUDG – Cudgel Creek Roaches Escape
- YMS – Yanco Main Southern Drain
- GMSRR – Gogeldrie Main Southern Drain River Road
- MIRFLD – Mirrool Creek Floodway Wyvern Station

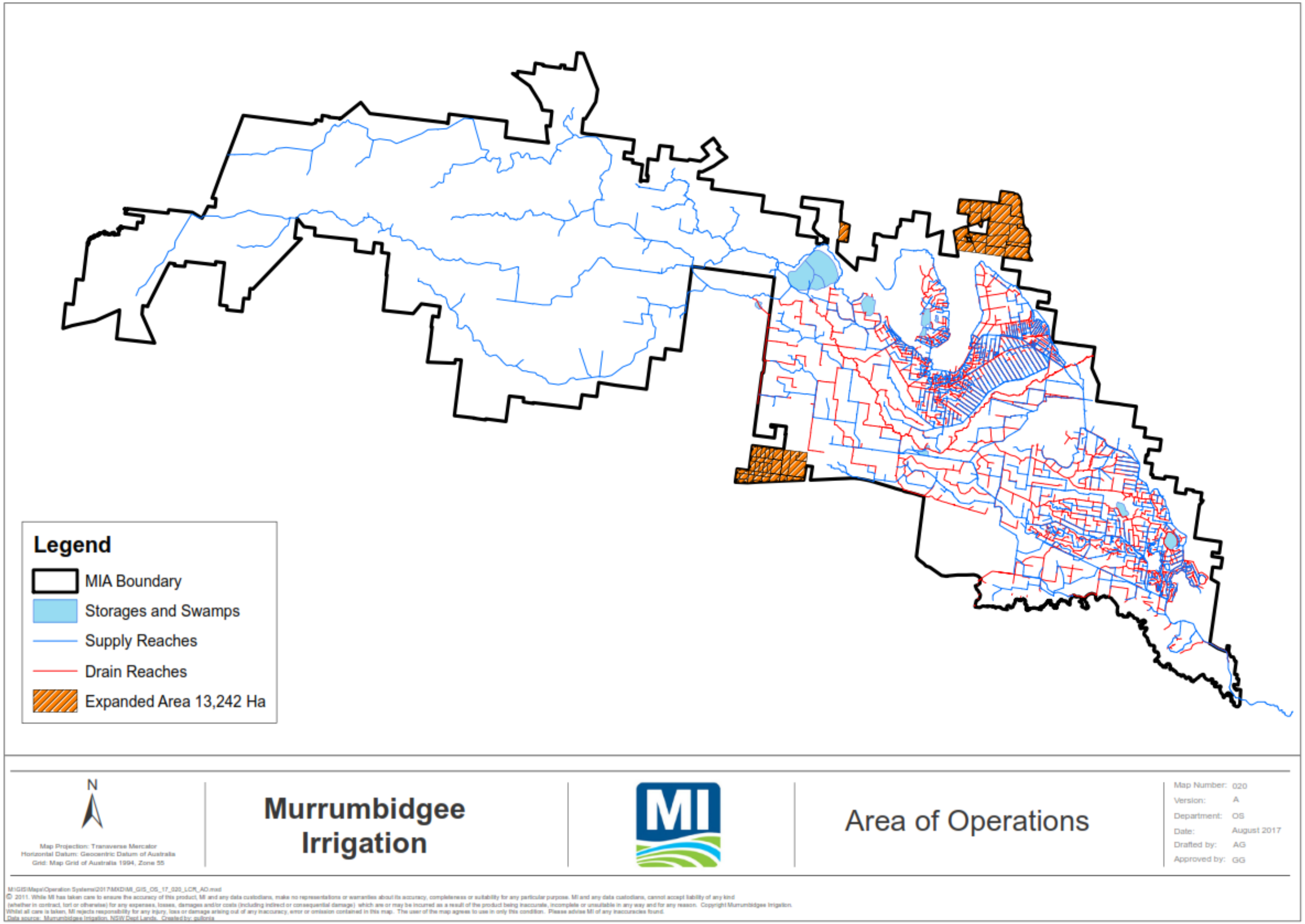

Figure 1 Murrumbidgee Irrigation's Area of Operation, identifying areas of expansion

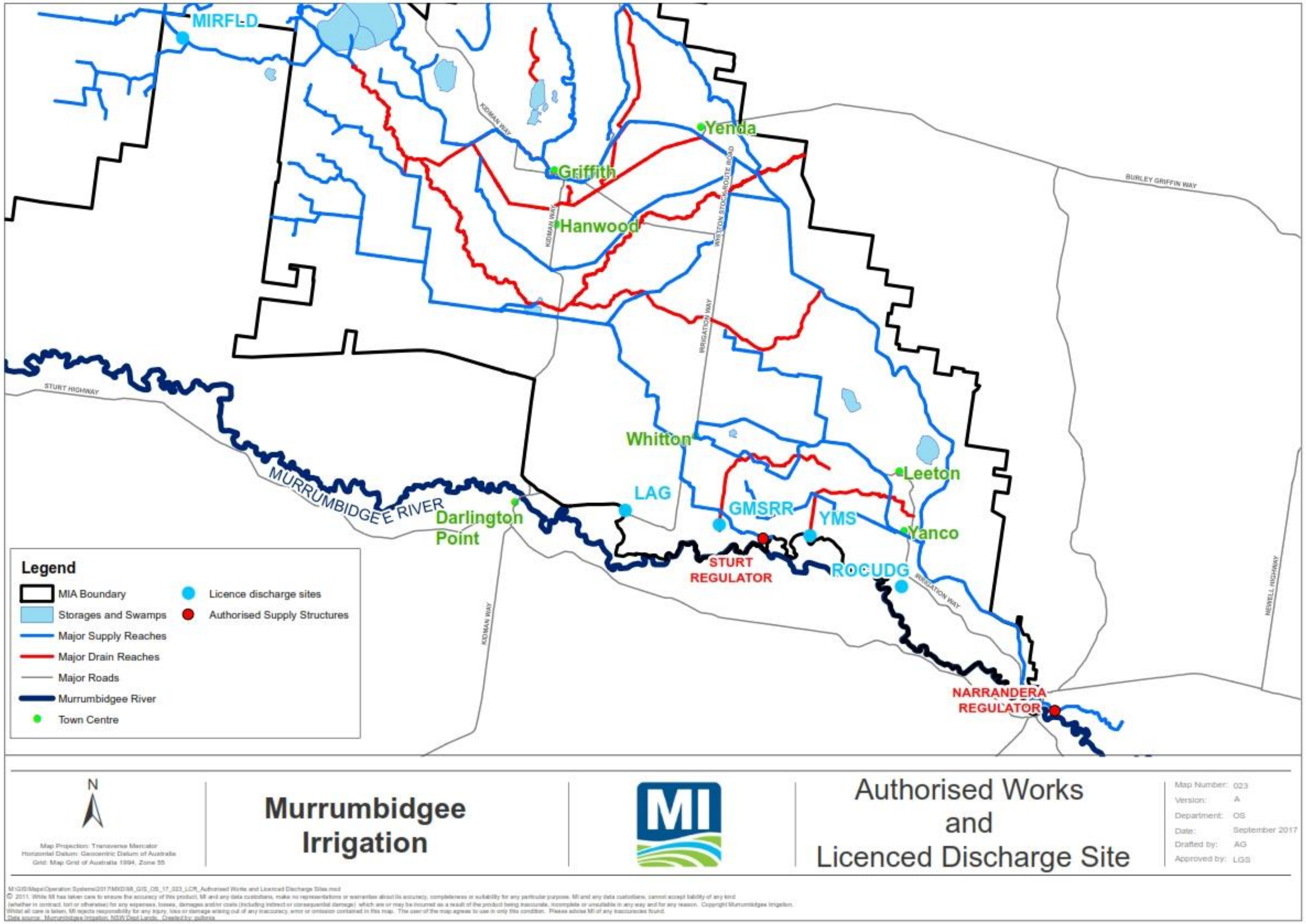

Figure 2 Location of authorised supply works and licence discharge points

3 Reporting on Water Management

3.1 Climate conditions

Rainfall and evapotranspiration (ETo) data recorded at the Griffith CSIRO weather station is presented in Table 2 and Barren Box Storage and Wetland (BBSW) weather station is presented in Table 3. A 1/150-year flood event spanned across 2015/16 and 2016/17 reporting periods, which explains the high rainfall recorded for both years. The timing and amount of rainfall received in the upper catchment resulted in 100% allocation for general and high security for 2016/17.

Table 2 Griffith CSIRO weather station rainfall and ETo

Year	Total rainfall (mm)	Total ETo (mm)
2016/17	556	1593
2015/16	529	1712
2014/15	348	1776
2005/06	357	1935

Table 3 Barren Box Storage and Wetland weather station rainfall and ETo

Year	Total rainfall (mm)	Total ETo (mm)
2016/17	450	1516
2015/16	445	1975
2014/15	299	2099
2005/06	Not installed	

3.2 Calibration Report for Main Canal and Sturt Canal AFFRA Units

The calibration reports for Narrandera Regulator (NARREG) and Sturt Canal offtake (STURT) AFFRA units have been provided by Ventia as part of the contract with MI to ensure flow measurements meet the conditions of Combined Approval 40CA403245. The calibration report summary for the NARREG AFFRA is presented in Table 4 and the STURT AFFRA presented in Table 5. The full calibration report is included with the submission of this report.

Table 4 Main Canal at NARREG (410127) calibration report

Date	Time	Calibration Measurements:	AFFRA Sensor:	Deviation
16/08/2016	12:50	561	564	-0.50%
10/11/2016	13:41	2352	2398	-1.92%
25/01/2017	14:21	4192	4385	-4.40%
16/03/2017	8:59	1858	1812	2.54%

Table 5 Sturt Canal at STURT (410129) calibration report

Date	Time	Calibration	AFFRA Sensor:	Deviation
16/11/2016	13:17	569	528	7.69%*
16/11/2016	14:18	556	506	9.96%*
1/12/2016	13:40	1265	1281	-1.25%
15/02/2017	11:29	1110	1136	-2.29%
6/04/2017	15:36	156	159	-2.00%

* There were high winds during these measurements, so they have been disregarded for calibration purposes. Another measurement was carried out at this site at the next available time during flow conditions (1/12/2016) where the calibration deviation was confirmed to be within the required range.

3.3 Diversions and Water Allocation

A monthly summary of gross water diverted from the Murrumbidgee River is presented in Table 6. These volumes represent gross diversions entering the supply system via MI's two authorised water supply works at NARREG and STURT. The total diversion volume of 780,083 ML includes an environmental water diversion volume of 986 ML diverted for the Office of Environment and Heritage (OEH). Deliveries to customers does not include 49,225 ML of captured water delivered, which is outlined further in the water balance in section 3.7 of this report.

Table 6 Monthly summaries of water diversions (ML) deliveries to customers (ML), 2016/17

Month	STURT	NARREG	Total diversion	Deliveries to customers
Jul-16	1,091	3,409	4,500	4,500
Aug-16	1,229	7,440	8,669	2,047
Sep-16	170	627	797	1,459
Oct-16	11,167	21,227	32,394	22,202
Nov-16	27,878	80,518	108,396	87,941
Dec-16	28,057	95,936	123,993	99,852
Jan-17	44,198	140,342	184,540	151,841
Feb-17	33,758	106,624	140,382	120,076
Mar-17	16,045	62,363	78,408	65,190
Apr-17	11,746	37,043	48,789	26,260
May-17	20,352	28,172	48,524	32,978
Jun-17	543	148	691	6,748
Total	**196,234**	**583,849**	**780,083**	**621,094**

Table 7 compares water allocations, diversions, total deliveries and climate data from the 2016/17 reporting year to previous years. Although announced allocations determine much of the irrigation demand, rainfall and ETo can significantly affect the total diversions for the year. Above average rainfall was recorded throughout the catchment in 2016/17, resulting in a 100% allocation announcement for general and high security water.

When low rainfall years are coupled with high ETo rates, as seen in 2005/06, water supply demand increases dramatically. However, it must be noted flows for that year were supplemented by the Snowy Hydro borrows, which added just over 100,000ML of water to the available water pool.

Table 7 Water allocation, total diversions and deliveries 2016/17 compared to previous years

Year	Announced Allocation (%) General / High	Diversions (ML)	Deliveries (ML)	Rainfall (mm) Griffith AWS	ETo (mm) Griffith AWS
2016/17	100/100	780,083	621,094	556	1,593
2015/16	37/95	643,957	526,278	529	1,712
2014/15	53/95	878,614	730,016	349	1,776
2005/06	54/95	1,036,519	829,990	367	1,935

3.4 Environmental diversions

At the request of OEH, 986 ML of environmental water was delivered to three locations as shown in Table 8.

Table 8 Environmental water diversions for 2016/17

Month	Yanco Ag	Nericon Swamp	Campbell's Swamp
Jul-16	0	0	0
Aug-16	0	0	0
Sep-16	0	0	0
Oct-16	0	0	0
Nov-16	0	0	0
Dec-16	240	0	0
Jan-17	144	0	0
Feb-17	0	0	0
Mar-17	0	0	0
Apr-17	0	126	292
May-17	0	108	77
Jun-17	0	0	0
Total	384	234	368

3.5 Water discharged from Area of Operations

Monthly discharge volumes for each discharge monitoring point listed under the Combined Approval are shown in Table 9. A total of 122,091 ML was discharged from MI's area of operations in 2016/17 with 121,363 ML released to the Mirrool Creek Floodway (MIRFLD) in response to floodwater flows from the upper catchment.

Table 9 Monthly water volumes (ML) discharged from the MIA

Month	LAG (41010940)	ROCUDG (41010005)	YMS (410083)	GMSRR (41010921)	MIRFLD (41010163)
Jul-16	65.1	0	0	11.8	640
Aug-16	11.5	73.7	0	0	0
Sep-16	66.7	5.1	0	0	57,180
Oct-16	0	0	0	2.4	63,543
Nov-16	28.6	11.8	0	6.2	0
Dec-16	50.7	58.6	0	12.5	0
Jan-17	6.7	13.1	0	15.1	0
Feb-17	8.4	0	0	10.1	0
Mar-17	34.6	0	0	9.2	0
Apr-17	31.4	13.4	0	8.3	0
May-17	85.8	60.3	0	1.2	0
Jun-17	14.4	12.3	0	0	0
Total	**403.9**	**248.1**	**0**	**76.8**	**121,363**

Table 10 shows total discharge volumes from MI's Area of Operation compared to previous years. The total volume discharged in 2016/17 was significantly higher when compared to all other years due to the floodwater diverted to the MIRFLD.

Table 10 Annual water volumes (ML) discharged from the MIA

Year	Total discharged (ML)
2016/17	122,092
2015/16	1,079
2014/15	671
2005/06	8,570

3.6 Supply efficiency

Table 11 illustrates the simple efficiency of MI's supply system to be at 80% for 2016/17. The simple efficiency provides insight into how the supply system is managed under the season's climatic conditions, whilst balancing irrigation demand and minimising system losses. The water balance on page 15 of this report reconciles the losses and gains of the system and takes into account drainage reuse volumes for 2016/17.

Table 11 Supply efficiency from 2016/17 and previous years

Year	Sturt Canal	Main Canal	Environment Diversions	NET TOTAL Irrigation Diversions	Deliveries (ML)	Conveyance (ML)	Simple Efficiency (%)
2016/17	196,23	583,849	986	779,097	621,094	158,003	80%
2015/16	141,08	505,845	2,977	643,957	526,278	117,679	82%
2014/15	219,27	661,814	2,472	878,614	738,814	139,800	84%
2005/06	233,38	805,277	2,146	1,036,519	829,990	206,529	80%

3.7 Water balance

Table 12 shows the Annual Water Balance for MI's network. For the 2016/17 reporting year, the annual water balance has been refined to provide a clearer representation of system operations.

Total gross diversions of 780,083 ML for 2016/17 were used to generate water deliveries of 621,094 ML. High rainfall received in the local and upper catchment caused large volumes of water to enter MI's Area of Operation via upper Mirrool Creek or via overland flow. An estimated 198,200 ML of flood water entered MI's drainage works, with 121,363 ML released to the Mirrool Creek Floodway and an additional 49,225 ML delivered to customers. Therefore, the total volume of water delivered to customers for 2016/17 was 670,319 ML.

Table 12 Annual Water Balance (ML)

Incoming Diversions	**2016/17**	**2015/16**	**2014/15**	**2005/06**
River diversions	780,083	643,957	881,086	1,036,519
Internal storage diversions	2,218	0	0	Unknown
Captured flood water	198,200	0	0	0
Total	**980,501**	**643,957**	**881,086**	**1,036,519**
Outgoing				
Deliveries to customers (river and storages)	621,094	526,278	730,016	829,990
Deliveries to customers (captured flood water)	49,225	0	0	0
Environmental water diversions (EWR)	986	2,629	2,472	Unknown
Net change in storages	30,043	13,421	4,864	Unknown
Conveyance	127,960	101,629	143,734	206,529
Floodway discharges	121,363	0	0	
Overland flood discharge	25,600	0	0	0
Customer flood discharge	4,230	0	0	0
Total	**980,501**	**643,957**	**881,086**	**1,036,519**

4 Water Use

4.1 Crop statistics

For each water order customers are required to nominate their water use to a particular crop or use. This data is not validated at the farm level and is therefore an estimate only. Table 13 shows water deliveries and estimated crop water use for 2016/17. It is important to note the water use data presented for the total area of crop are also influenced by rainfall, ETo and irrigation practices, which are not considered in these figures.

Table 13 Summary of water deliveries for major crop groupings 2016/17

Crop/Purpose	Area (ha)	Volume Delivered(ML)	Crop Water Use (ML/ha)
Citrus	7,858	35,820	4.6
Cotton	11,957	82,004	6.9
Industrial	27	6,442	-
Other crops	413	6,566	-
Other fruits	1,261	5,261	4.2
Plantation	2,843	1,255	0.4
Rice	27,424	304,200	11.1
Stock & domestic	267	10,347	-
Summer cereals	2,229	12,524	5.6
Summer oilseeds	1,234	5,940	4.8
Summer pasture	2,608	11,016	4.2
Town supplies	-	9,844	-
Vegetables	2,324	10,129	4.4
Vines	18,323	68,176	3.7
Winter cereals	24,835	34,308	1.4
Winter oilseeds	2,744	4,708	1.7
Winter pasture	7,085	15,014	2.1
Not Defined	-	46,764	-
Total	**113,432**	**670,319**	-

A comparison of crop water use for 2016/17 with previous years is presented in Table 14. Rice growing was the predominant crop type grown in the MIA and accounted for the highest portion of total water delivered per crop type (45%). The 100% allocation and internal surplus water available to customers in 2016/17 provided opportunity for customers to increase their area of non-permanent plantings.

Table 14 Total deliveries to major crop types 2016/17 compared to previous years

Year	Rice	Pasture	Cereal and Oil Seeds	Vegetables	Citrus + Vines + Other Fruits	Other Crops + Plantations	S&D + Towns + Industrial	Cotton
2016/17	304,200	26,030	57,479	10,129	109,257	71,376	9,844	82,004
2015/16	136,805	19,449	96,851	10,011	128,789	22,729	31,832	79,812
2014/15	255,384	32,206	171,645	12,216	149,045	20,547	28,295	60,678
2005/06	355,254	65,878	181,641	27,588	142,025	9,481	48,123	n/a

Note: Cotton was included in 'other crops and plantations' for 2005/06

4.2 Irrigation intensity

Irrigation intensity is displayed in Figure 3 by water use (ML/ha) at a property level. This map identifies locations of landholdings using between 0 and 4 ML/ha, 4 and 4.1-8 ML/ha and above 8.1 ML/ha.

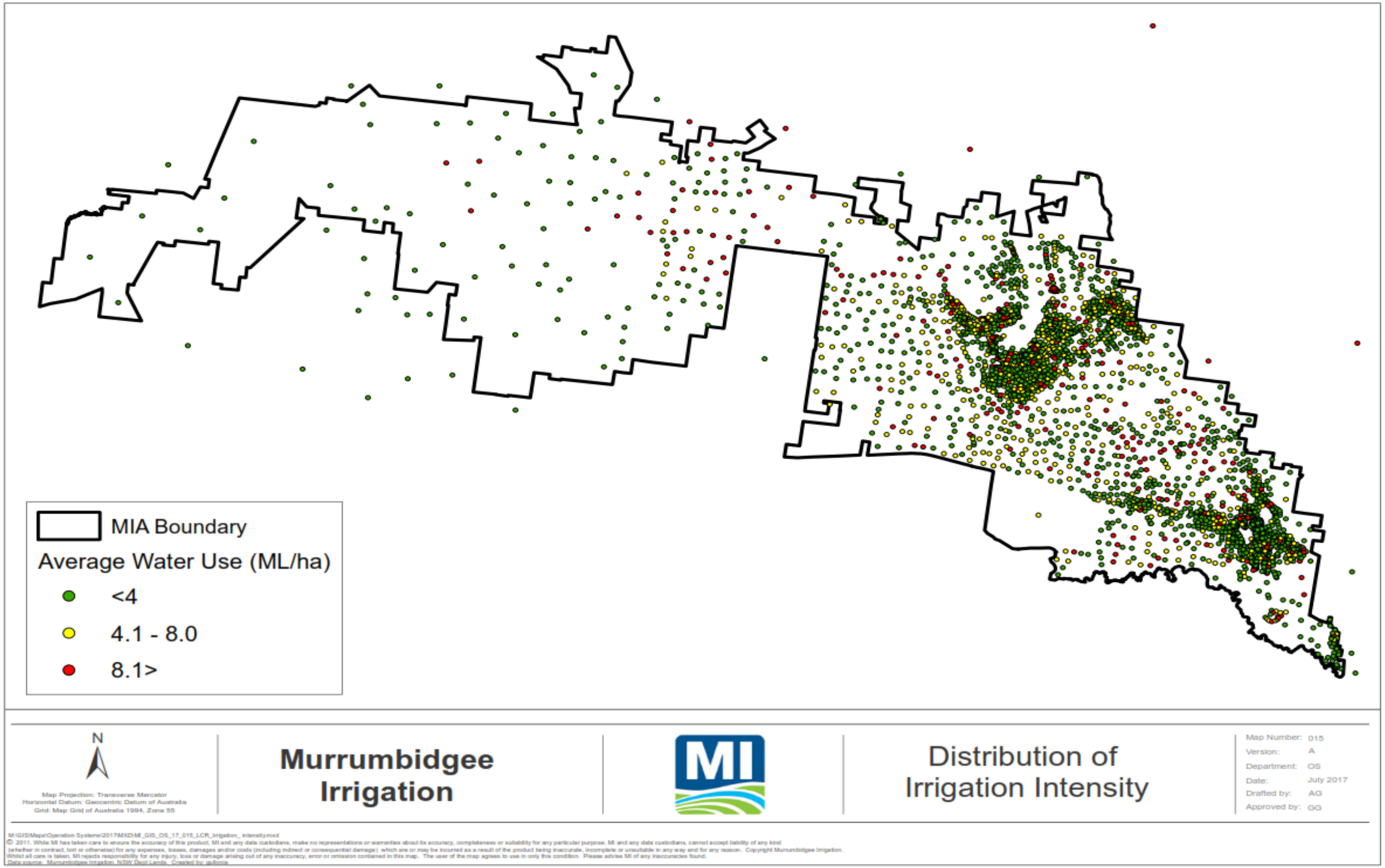

Figure 3 Distribution of irrigation intensity across the MIA

5 Salinity and Salt Load

5.1 Extracted salt-load

The salt load for NARREG and STUR are calculated using flow data reported by Ventia and salinity data from DPI Water monitoring site 410001, which is the closest monitoring point on the Murrumbidgee River to MI's offtakes. Monthly mean salinity values from site 410001 were used for salt load calculations for both NARREG and STUR. The mean electrical conductivity (EC) values and extracted salt loads are presented in Table 15.

Table 15 Total extracted salt load for 2016/17

Month	Site 410001 mean EC (µS/cm)	STUR (t)	NARREG (t)	Total salt load extracted
Jul-16	158	110	345	455
Aug-16	149	117	711	828
Sep-16	138	15	55	70
Oct-16	95	679	1,290	1,969
Nov-16	84	1,499	4,329	5,828
Dec-16	82	1,474	5,040	6,515
Jan-17	81	2,296	7,289	9,584
Feb-17	62	1,331	4,205	5,536
Mar-17	90	922	3,582	4,503
Apr-17	121	910	2,871	3,781
May-17	175	2,285	3,162	5,447
Jun-17	242	84	23	107
Total		**11,722**	**32,903**	**44,625**

Table 16 presents the total extracted saltloads for 2016/17 and previous years. During 2016/17, an estimated 44,625 tonnes of salt entered MI's area of operation from the Murrumbidgee River. Generally, the amount of salt is relative to the volume of water diverted from the river, however the 2016/17 saltload is lower than 2015/16, even though an extra 130,000 ML was diverted.

Table 16 Extracted salt-load (t) for 2016/17 compared to previous years

Year	Diversions (ML)	Extracted salt load		
		STUR	NARREG	Total
2016/17	780,083	11,722	32,903	44,625
2015/16	643,957	10,939	39,758	50,696
2014/15	878,614	14,587	44,270	58,858
2007/08	393,973	1,778	26,816	28,594

5.2 Discharged salt load

There are five discharge monitoring points that have the ability to discharge water out of MI's area of operation. The locations of these sites are shown in Figure 2 of this report. Flow, EC and salt load data for these sites is presented in Table 18 with previous year comparison presented in Table 17.

An estimated 34,230 tonnes were discharged from MI's Area of Operation in 2016/17. The majority of salt was discharged to the MIRFLD, which corresponds to the large volume of water discharged at this site. Due the flood experienced in 2016/17 and the large volume of water discharged to MIRFLD, this total volume discharged from MI's area of operation cannot be compared to previous years.

Table 17 Discharged salt load 2016/17 compared to previous years

Year	Water discharged (ML)	Discharged Salt load (t)
2016/17	122,092	34,230
2015/16	1,620	201
2014/15	675	96
2005/06	8,570	1,887

Table 18 Monthly summary of flow, EC and salt loads at monitoring points for 2016/17

Month	Flow (ML)	Mean EC (µS/cm)	Min.EC (µS/cm)	Max. EC (µS/cm)	Salt load (t)	Flow (ML)	Mean EC (µS/cm)	Min.EC (µS/cm)	Max. EC (µS/cm)	Salt load (t)
Yanco Main Southern Escape (YMS) 410083						**Gooragool Lagoon Escape (LAG) 41010940**				
Jul-16	0.00	-	-	-	0.0	65.14	313	221	600	2.0
Aug-16	0.00	-	-	-	0.0	11.54	851	245	3930	4.0
Sep-16	0.00	-	-	-	0.0	66.69	373	139	4280	13.0
Oct-16	0.00	-	-	-	0.0	0.00	-	-	-	0.0
Nov-16	0.00	-	-	-	0.0	28.55	363	114	1360	6.0
Dec-16	0.00	-	-	-	0.0	50.65	788	170	3370	12.0
Jan-17	0.00	-	-	-	0.0	6.71	511	333	813	2.0
Feb-17	0.00	-	-	-	0.0	8.35	319	81.4	703	1.0
Mar-17	0.00	-	-	-	0.0	34.63	398	168	554	8.0
Apr-17	0.00	-	-	-	0.0	31.41	273	106	444	4.0
May-17	0.00	-	-	-	0.0	85.84	282	160	521	15.0
Jun-17	0.00	-	-	-	0.0	14.36	192	22.2	334	2.0
Total	**0.00**				**0.0**	**403.87**				**69**
Gogeldrie Main Southern Escape (GMSRR) 41010921						**Cudgel Creek Escape (ROCUDG) 41010005**				
Jul-16	11.78	150	98	193	1.0	0.00	-	-	-	0.0
Aug-16	0.00	-	-	-	0.0	73.66	164	148	184	8.0
Sep-16	0.00	-	-	-	0.0	5.11	167	49	195	0.0
Oct-16	2.35	193	141	296	0.0	0.00	-	-	-	0.0
Nov-16	6.2	267	207	337	1.0	11.77	335	191	512	3.0
Dec-16	12.52	275	133	424	2.0	58.61	366	203	573	10.0
Jan-17	15.11	252	75	350	2.0	13.07	154	123	217	1.0
Feb-17	10.09	200	0	373	1.0	0.00	-	-	-	0.0
Mar-17	9.16	280	179	353	2.0	0.00	-	-	-	0.0
Apr-17	8.34	245	189	332	1.0	13.35	311	292	366	2.0
May-17	1.23	263	181	326	0.0	60.26	254	175	294	8.0
Jun-17	0.00	-	-	-	0.0	12.26	158	143	176	1.0
Total	**76.77**				**10**	**248.09**				**33**
Mirrool Creek Floodway (MIRFLD) 41010163										
Jul-16	640	-	-	-						
Sep-16	57,180	-	-	-						
Oct-16	63,543	-	-	-						
Total	**121,363**	Mean EC 439 (during flow)			**34,118**					

5.3 Salt load summary

The salt loads presented in Table 19 suggest that of the 44,625 tonnes of salt received through diversions recorded at MI's authorised supply works (NARREG and STURT) 34,230 tonnes was discharged and an estimated 10,395 tonnes were retained within the MIA. It is important to note that this is a simple annual salt balance that considers salt loads entering and leaving via authorised works, as per MI's Combined Approval and does take into account other factors that impact total salt loads in the MIA.

Table 19 Salt load summary for 2016/17

Extracted	**Salt load (t)**
STUR	11,722
NARREG	32,903
Total extracted	**44,625**
Discharged	**Salt load (t)**
YMS	0.0
GMSRR	76.77
LAG	403.87
ROCUDG	248.09
MIRFLD	34,118
Total discharged	**34,230**
Retained	**10,395**

5.4 Salinity targets

As set out in our Network Service Plan (pg.7, *2.4 Water Quality)* MI endeavours to supply water to Wah Wah customers with EC levels below 700 µS/cm. This target was not met for 2016/17 with monitoring data suggesting that water exceeding 700 EC may have been supplied to customers for 11 days between 18/02/2017 – 04/03/2017, with EC reaching a maximum 732 µS/cm. The monitoring data has been submitted with this report.

6 Groundwater Conditions

6.1 Groundwater Monitoring and Reporting

A total of 641 piezometers are listed in Schedule 2 of the Combined Approval and the locations of these bores are displayed in Figure 4. In September 2016/17, 582 piezometers were monitored, which equates to 90.7% of the total piezometer network. High rainfall and associated localised flooding caused 28 piezometers to be inaccessible.

Table 20 Groundwater piezometer status summary (September 2016)

Total bores	Total destroyed	Total dry	Total read	Total unable to read
641	31	12	582	59*

*Includes 28 flooded, inaccessible piezometers

Groundwater levels and salinity (reported as EC) are measured in September to give insight into groundwater levels prior to the irrigation season and again in March to identify regional groundwater trends. The network consists of piezometers in the shallow and deep Shepparton Formation and a smaller monitoring network in the Calivil Formation. In 2015, DPI Water approved a rationalised monitoring network of 641 piezometers. In consultation with DPI Water, an alternative presentation format for requirement 1 of Attachment 2 of the Combined Approval was approved for 2016/17. Depth to water table and salinity are reported on one map for each formation for September and March for previous year, except for the historical reference years.

Depth to water table is reported for 2016/17, 2015/16, 2014/15, and 2005/2006. The 2005/06 reporting year was chosen for reference for depth to water table to coincide with the peak of the millennium drought for the MIA. Groundwater salinity is reported for 2016/17, 2015/16, 2014/15, 2002 and 1980. Due to the limited data sets from 2005/06, data from 2002 and 1980 was chosen to represent suitable comparisons for salinity changes from a historical perspective.

Table 21 Number and percent of total piezometers read within each depth range

Year	Number <2M of surface	Number 2-4M of surface	Number >4M of surface	% <2M of surface	% 2-4M of surface	% >4M of surface	Total
2016	78	123	363	14%	22%	64%	564
2015	76	121	368	13%	21%	65%	565
2014	55	176	506	7%	24%	69%	737
2005	55	225	342	9%	36%	55%	622

6.2 Groundwater salinity

The number of piezometers read within salinity ranges for September are shown in Table 22 and the percent of total piezometers measured within each range are presented in Table 23. The data identifies similar groundwater salinity trends throughout years reported for the Shallow Shepparton, Deep Shepparton and Calivil formations, including benchmark year 1980. In 2015, the lower number of total piezometers monitored for EC was a result of equipment failure during the monitoring program. DPI Water was notified and additional equipment was purchased.

Table 22 Number of piezometers read within each salinity range

Year	0-2000 (µS/cm)	2001-5000 (µS/cm)	5001-10000 (µS/cm)	10001-20000 (µS/cm)	20001-30000 (µS/cm)	30001-40000 (µS/cm)	>40000 (µS/cm)	Total
2016	247	126	86	57	19	5	1	541
2015	165	92	65	48	16	7	3	396
2014	267	232	124	57	18	7	2	707
1980	250	211	180	152	47	2	1	843

Table 23 Percent of total piezometers read within each salinity range

Year	0-2000 (µS/cm)	2001-5000 (µS/cm)	5001-10000 (µS/cm)	10001-20000 (µS/cm)	20001-30000 (µS/cm)	30001-40000 (µS/cm)	>40000 (µS/cm)	Total
2016	46%	23%	16%	11%	4%	1%	0%	541
2015	42%	23%	16%	12%	4%	2%	1%	396*
2014	38%	33%	18%	8%	3%	1%	0%	707
1980	30%	25%	21%	18%	6%	0%	0%	843

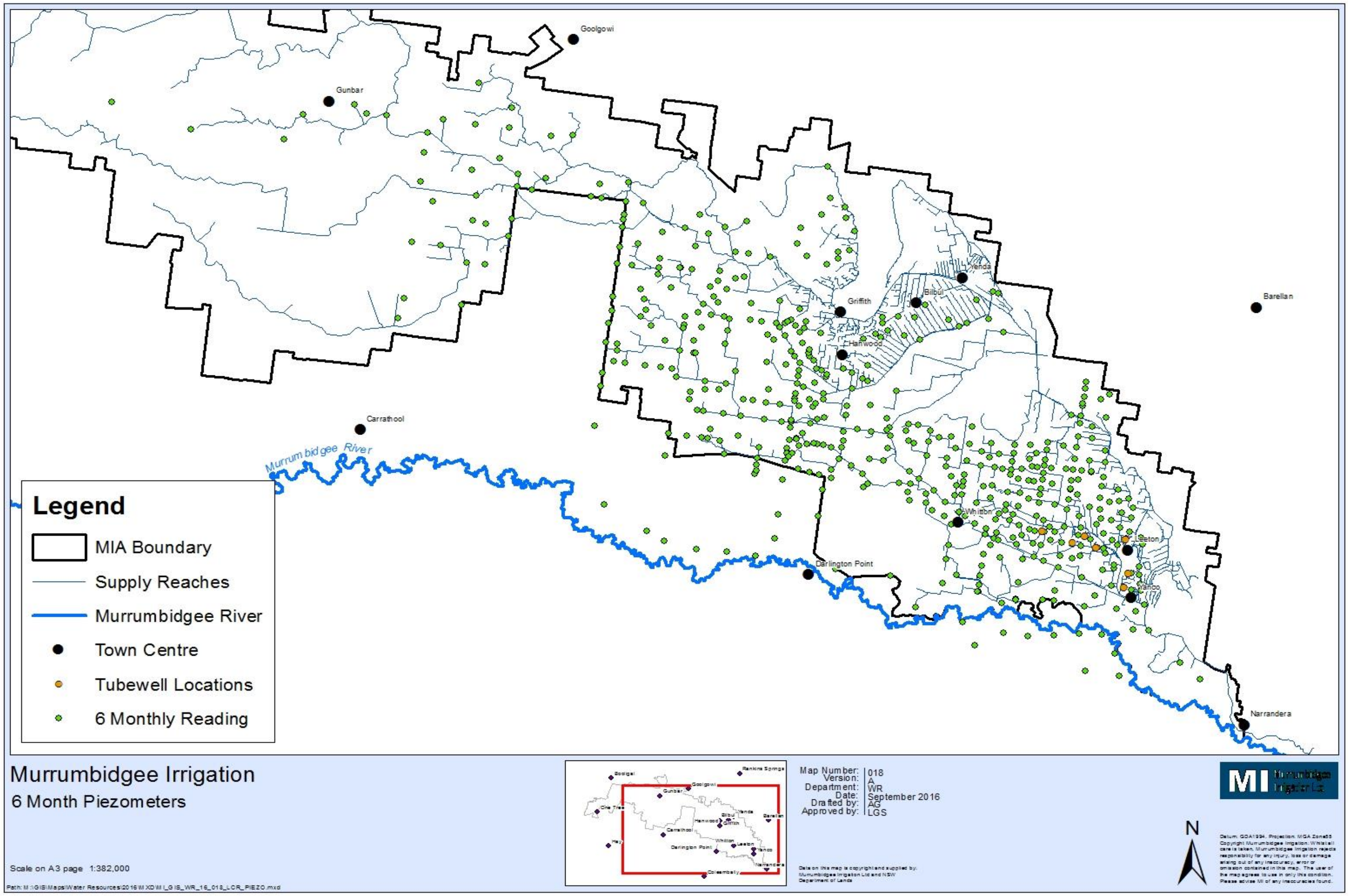

Figure 4 Location of piezometers and tubewells in the MIA 2016/17

6.3 Shallow Shepparton Formation

Depth to water table and salinity maps for piezometers in the shallow Shepparton Formation are presented in Figures 5 to 14. Groundwater levels in this formation are expected to be highly influenced by seasonal rainfall, geology and irrigation. This is indicated by the comparing maps from September to March for each reporting year, which identify a marginal rise in groundwater levels. This is particularly evident when comparing Figure 6 and Figure 5, with an increase in groundwater level and reduction of salinity exhibited in March 2017 (Figure 5). This is likely the lag effect following high rainfall experienced towards the end of 2016.

General salinity changes in the Shallow Shepparton Formation from September to March for each reporting year show decreases in EC values across the MIA. These areas of reduced salinity correlate with an increase in groundwater levels, highlighting potential recharge areas.

When compared to recent years, 2005/06 groundwater levels (Figure 11 and 12) appear to be deeper across the MIA, with fewer piezometers within 2m from surface level. This is likely a result of reduced recharge from rainfall, as a result of drought conditions.

2016/17

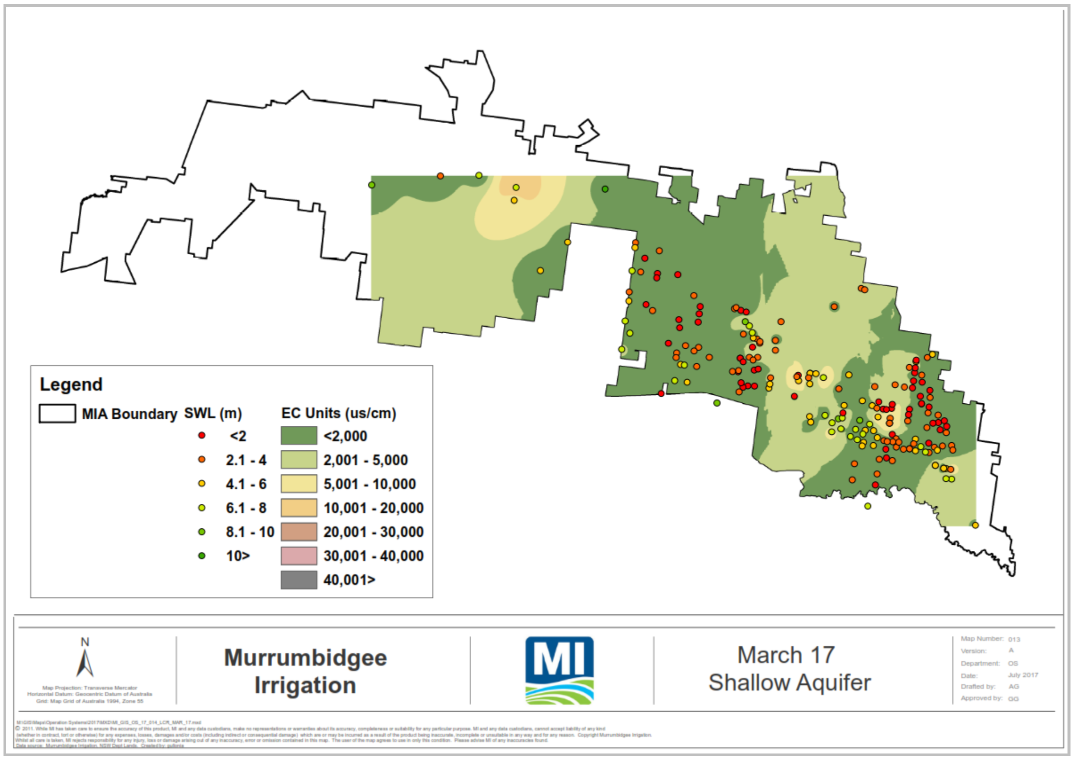

Figure 5 Shallow Shepparton Formation- depth to water table and salinity, March 2017

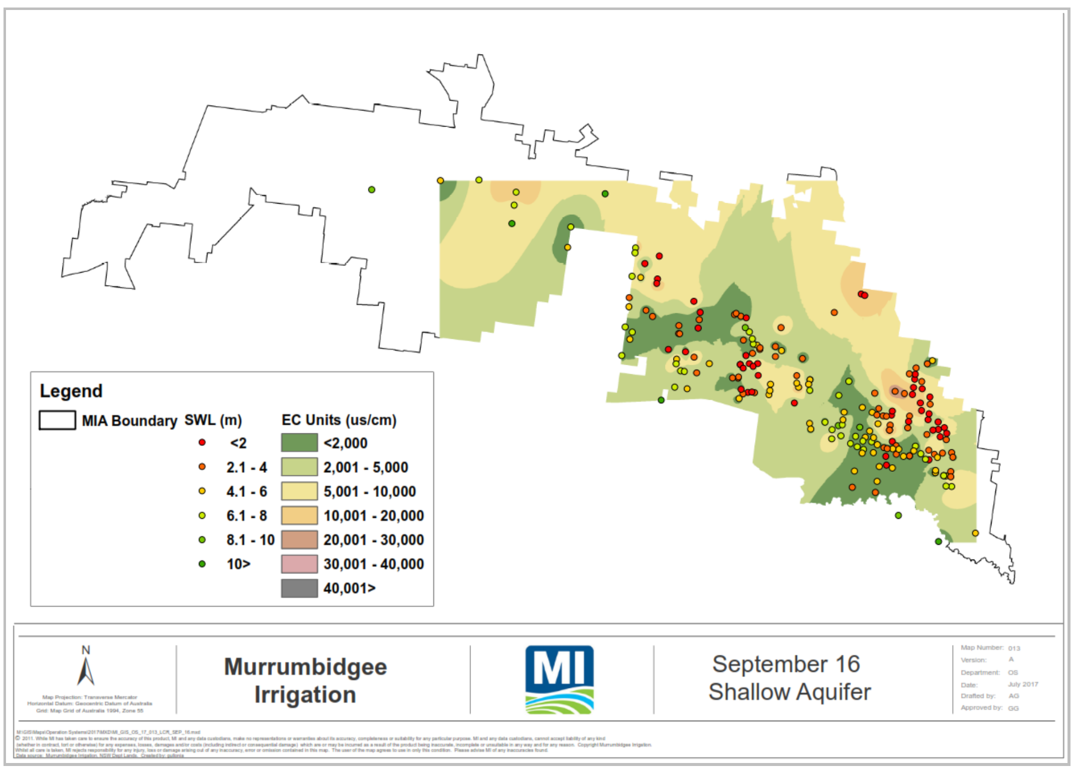

Figure 6 Shallow Shepparton Formation- depth to water table and salinity, Sep 2016

2015/16

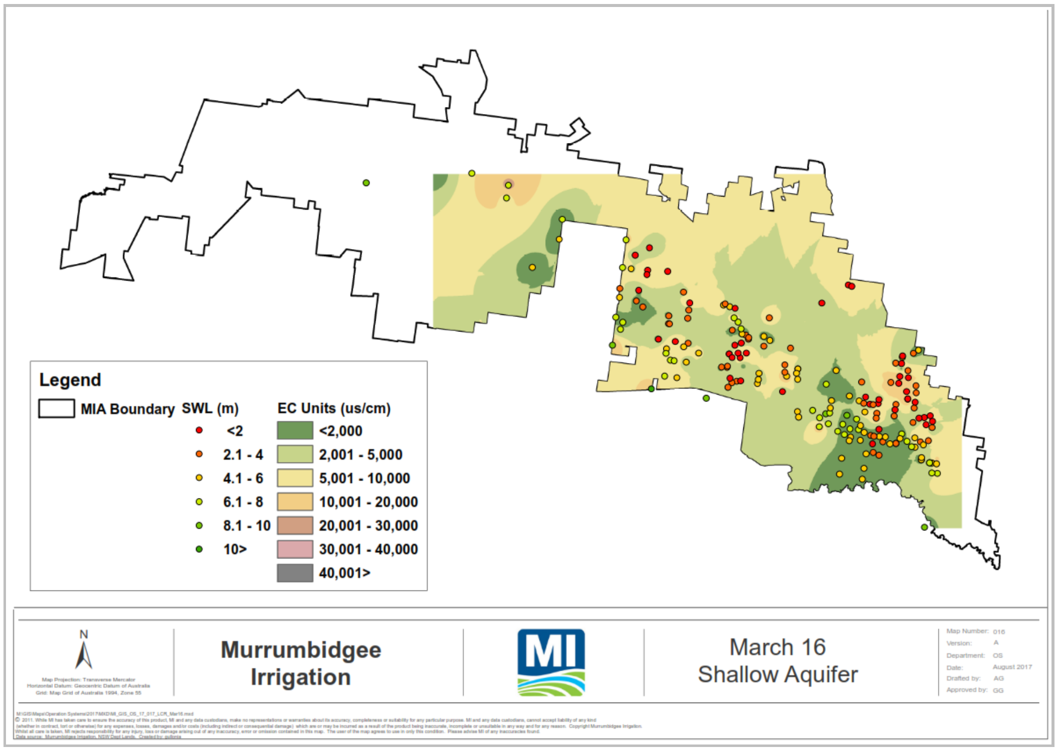

Figure 7 Shallow Shepparton Formation- depth to water table and salinity, March 2016

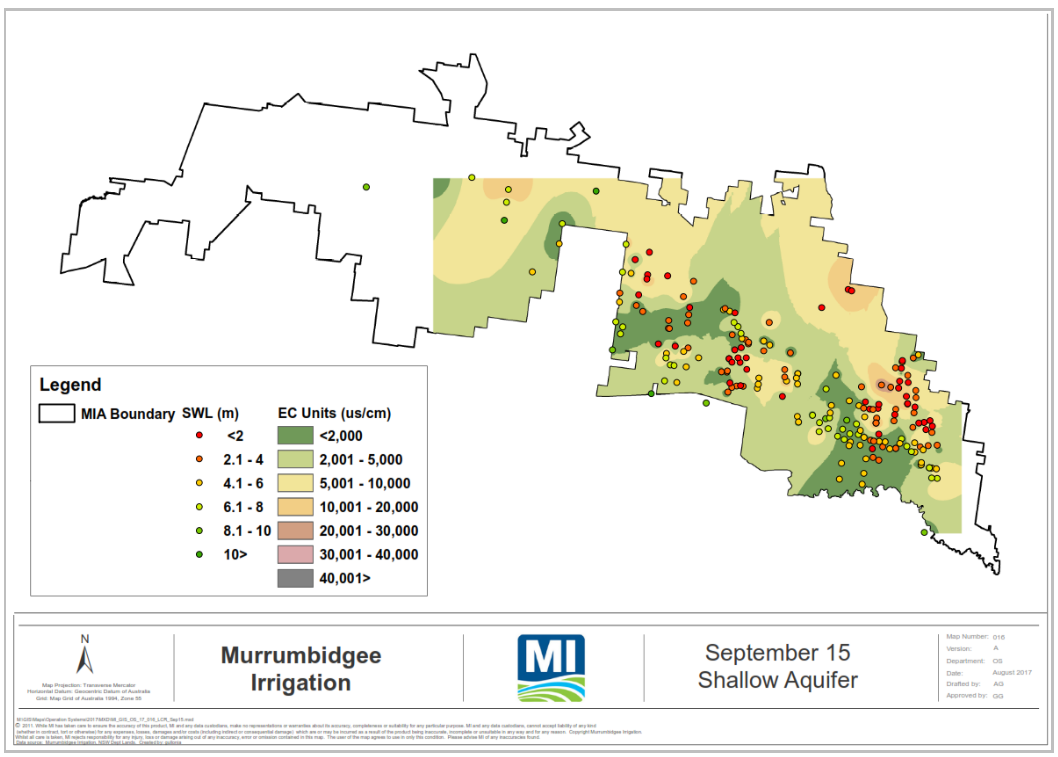

Figure 8 Shallow Shepparton Formation- depth to water table and salinity, Sep 2015

2014/15

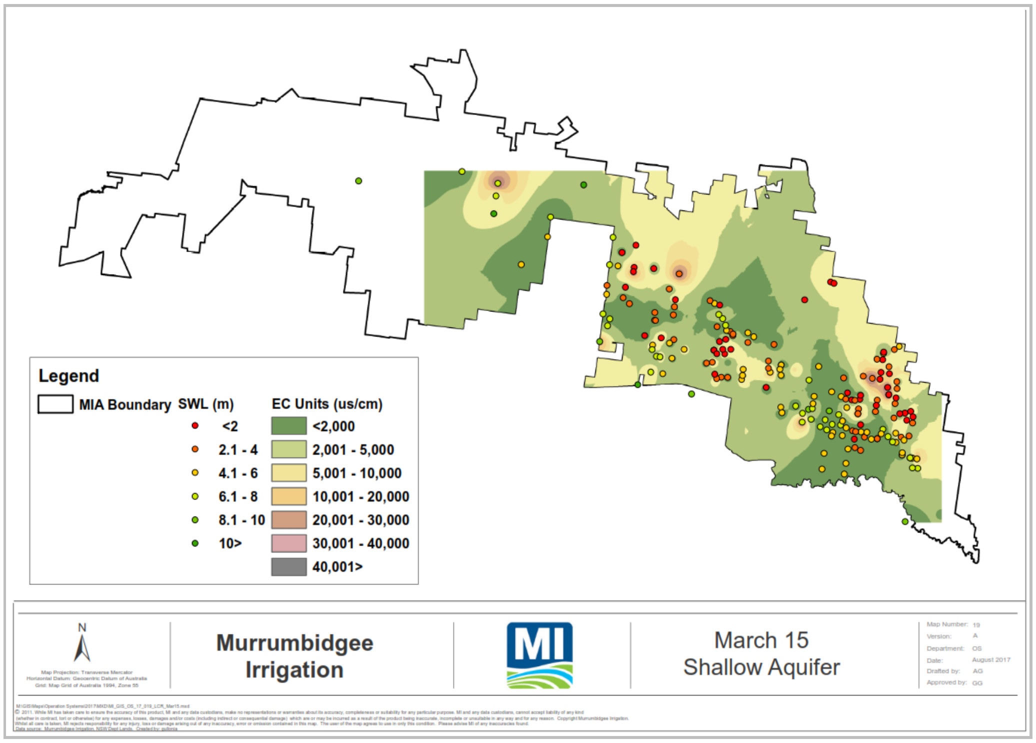

Figure 9 Shallow Shepparton Formation- depth to water table and salinity, March 2015

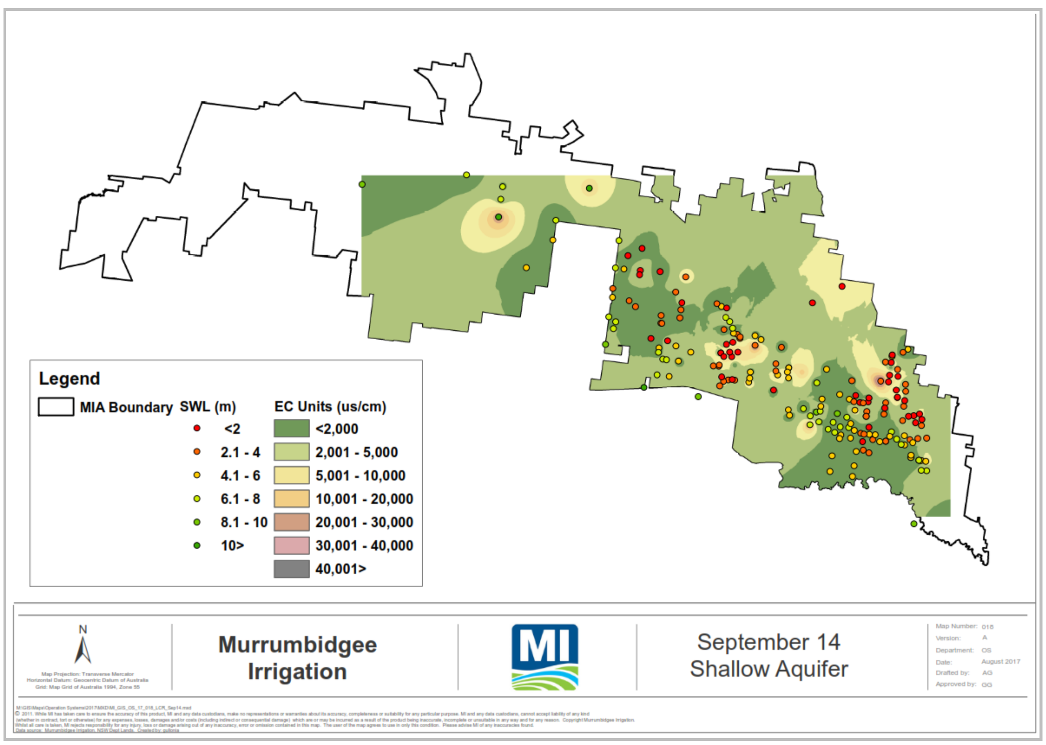

Figure 10 Shallow Shepparton Formation- depth to water table and salinity, Sep 2014

2005/06

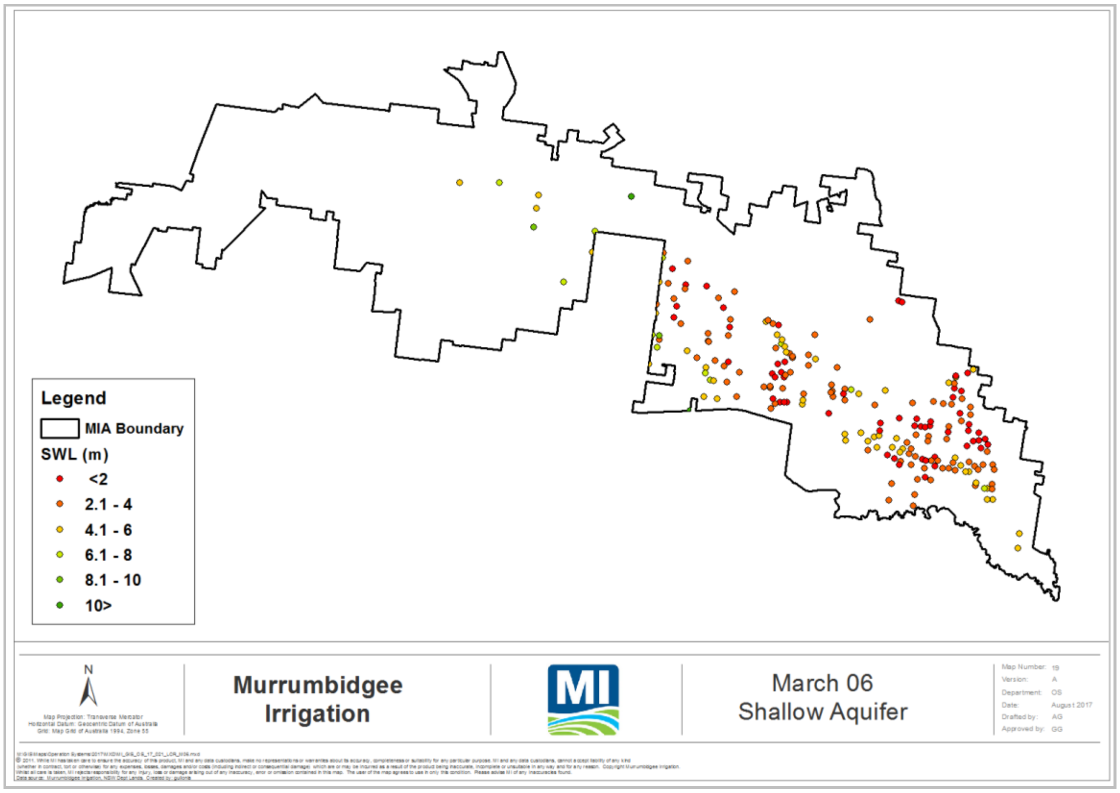

Figure 11 Shallow Shepparton Formation - depth to water table, March 2006

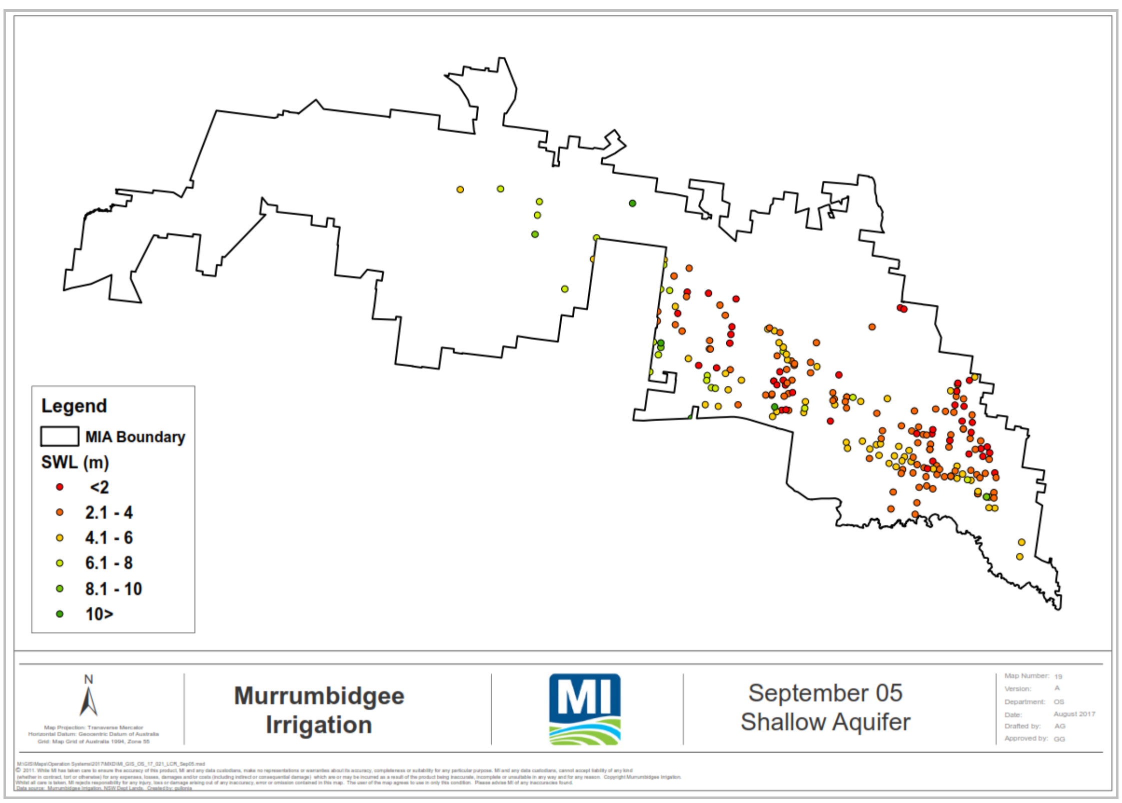

Figure 12 Shallow Shepparton Formation - depth to water table, Sep 2005

1980/2002

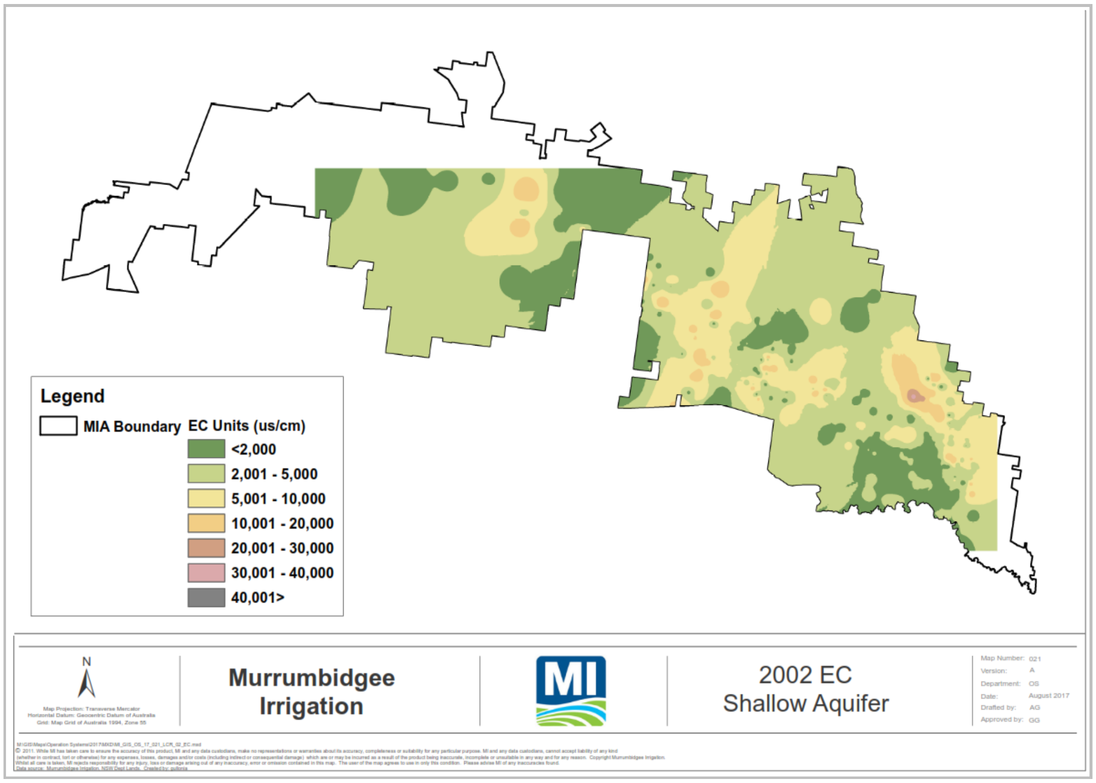

Figure 13 Shallow Shepparton Formation, groundwater salinity, Sep 2002

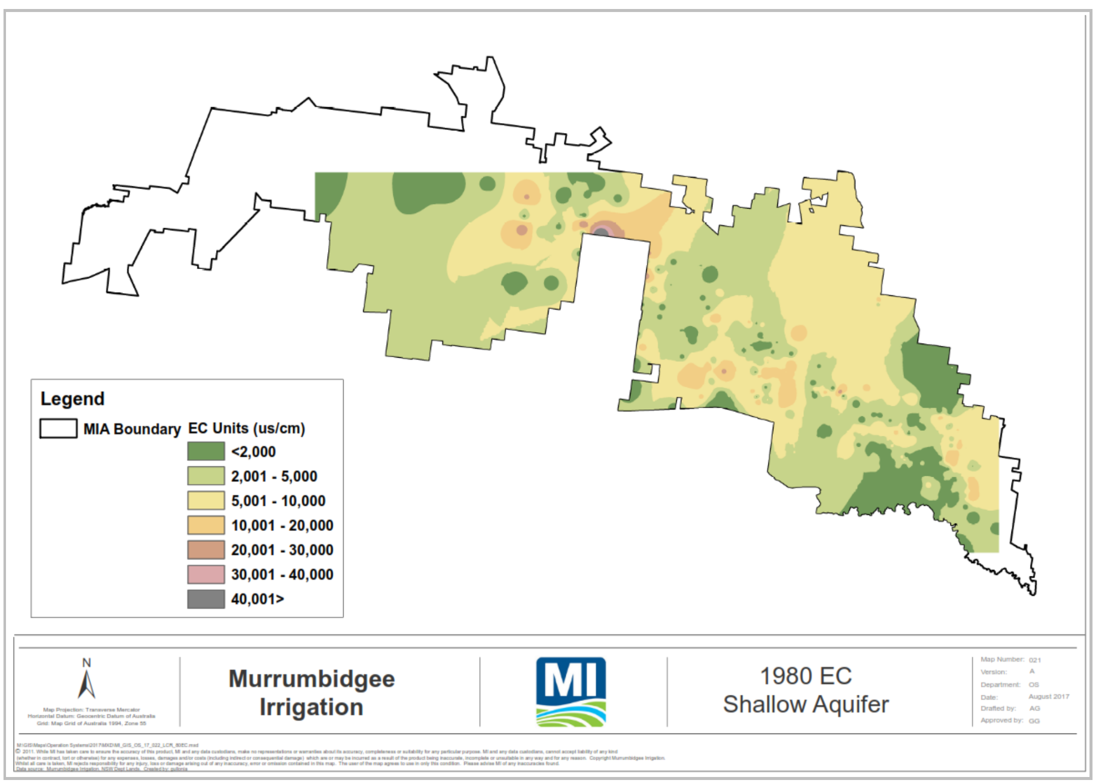

Figure 14 Shallow Shepparton Formation – groundwater salinity, Sep 1980

6.4 Deep Shepparton Formation

Depth to water table and salinity maps for piezometers in the deep Shepparton Formation are presented in Figures 15 to 24. Groundwater levels and salinity trends in the deep Shepparton Formation can be influenced by connectivity with the shallow Shepparton Formation, therefore the trends observed in the shallow Shepparton Formation also evident in the deep Formation.

Due to the attenuation time for groundwater to infiltrate through layers or for gradient movement across the MIA, groundwater changes can be seen long after a flood event has occurred. This can be seen with decrease in groundwater salinity in March 2017 (Figure 15) compared to September 2016 (Figure 16), which is likely attributed to the high rainfall received at the end of 2016.

2016/17

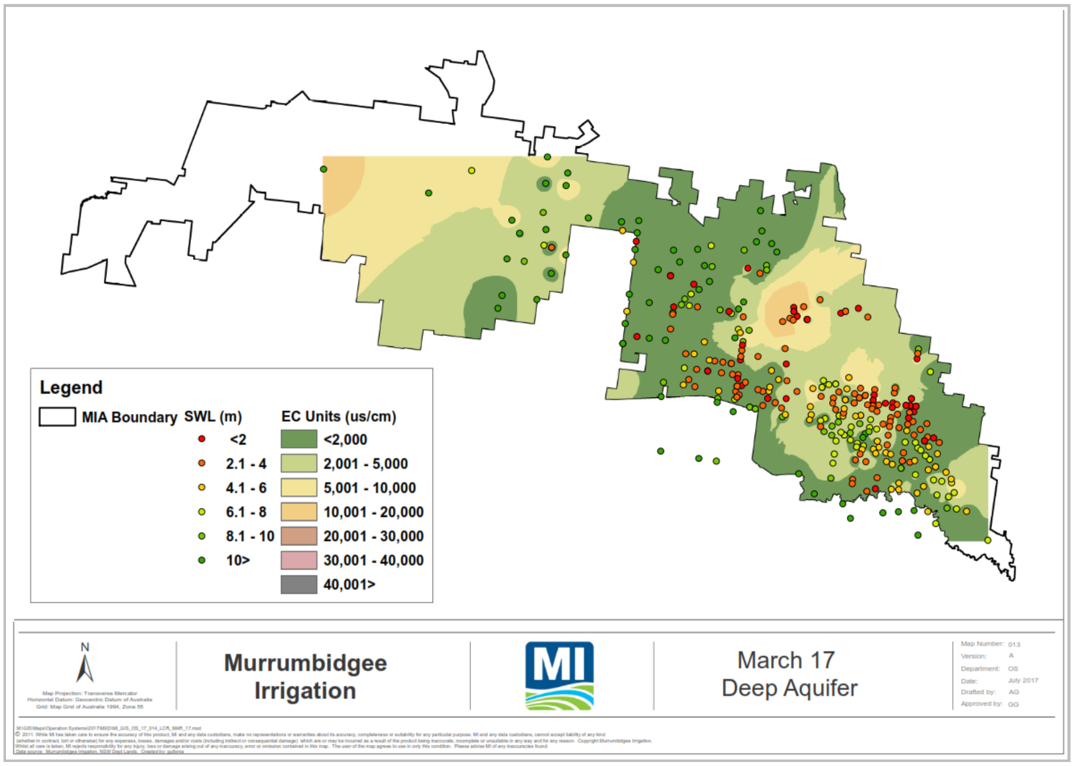

Figure 15 Deep Shepparton Formation- depth to water table and salinity, March 2017

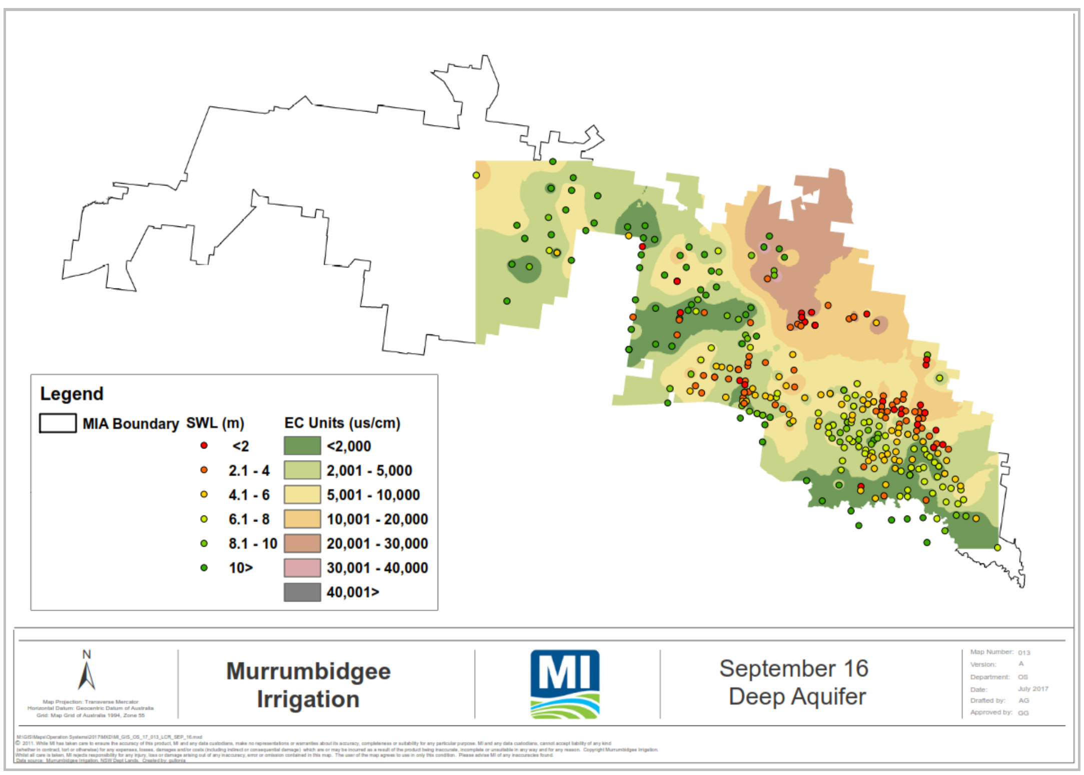

Figure 16 Deep Shepparton Formation- depth to water table and salinity, September 2016

2015/16

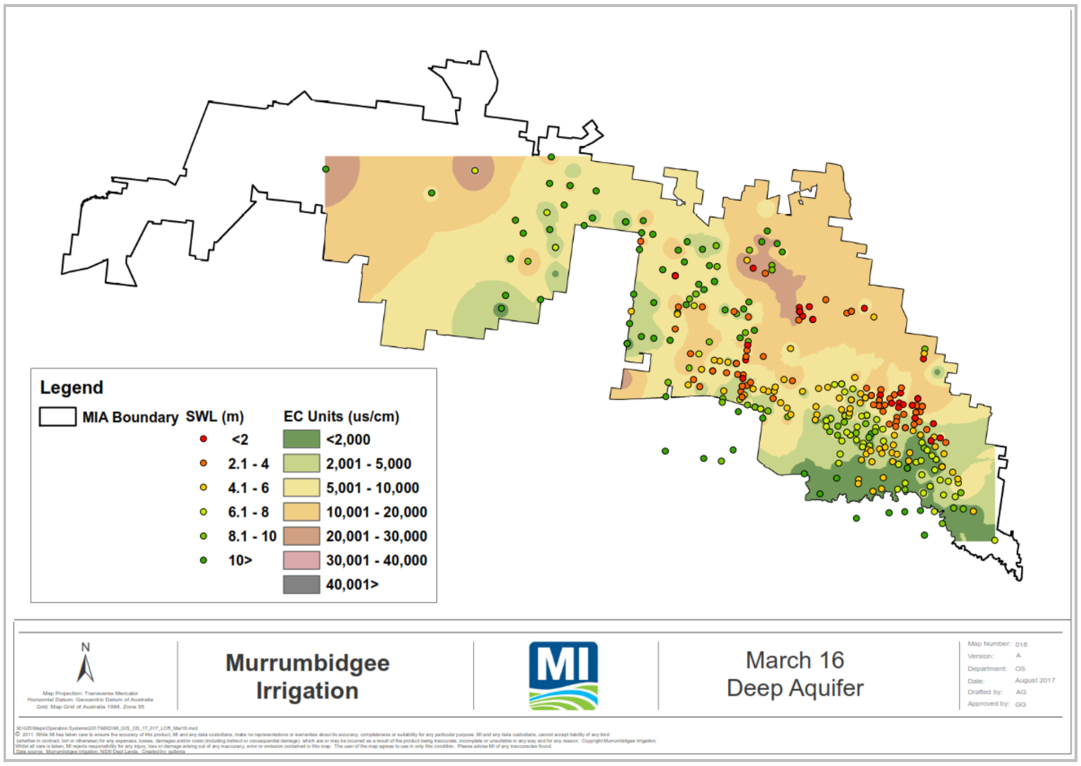

Figure 13 Deep Shepparton Formation- depth to water table and salinity, March 2016

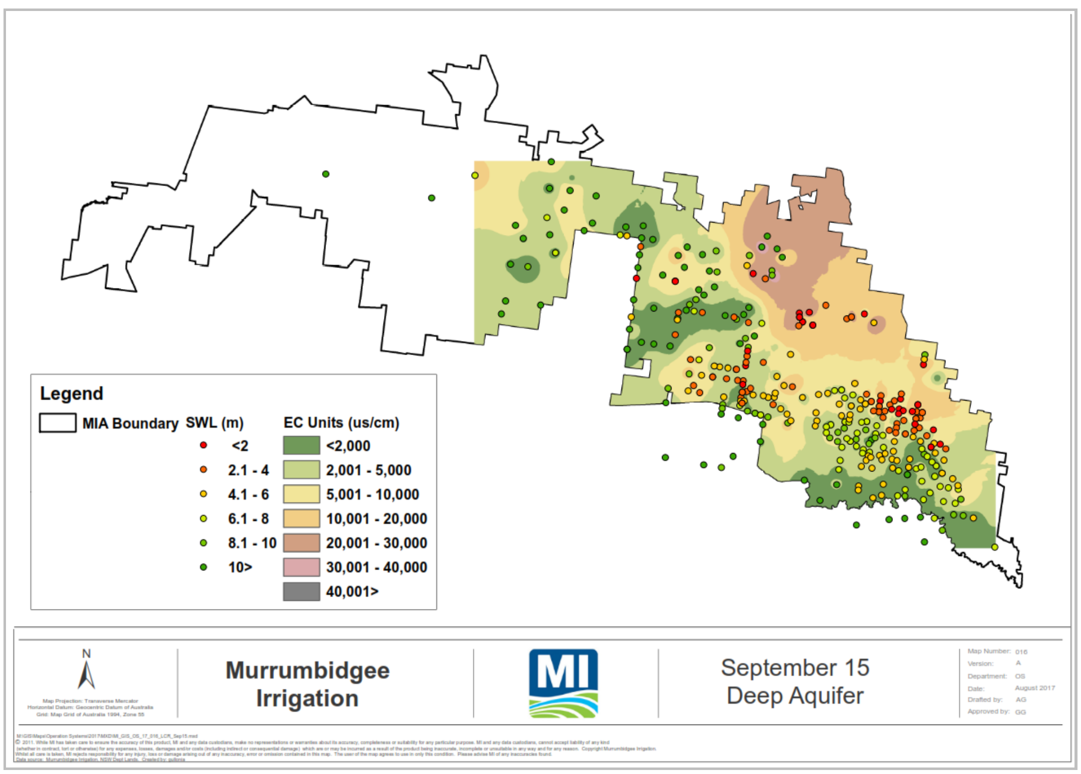

Figure 18 Deep Shepparton Formation- depth to water table and salinity, September 2015

2014/15

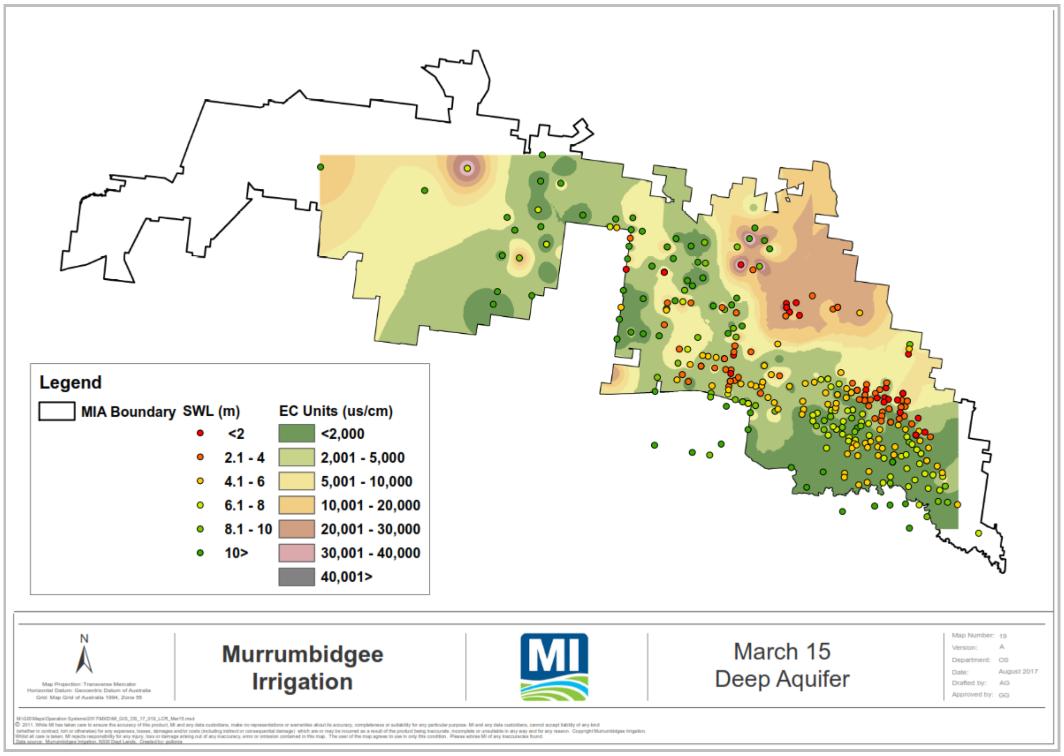

Figure 19 Deep Shepparton Formation- depth to water table and salinity, March 2015

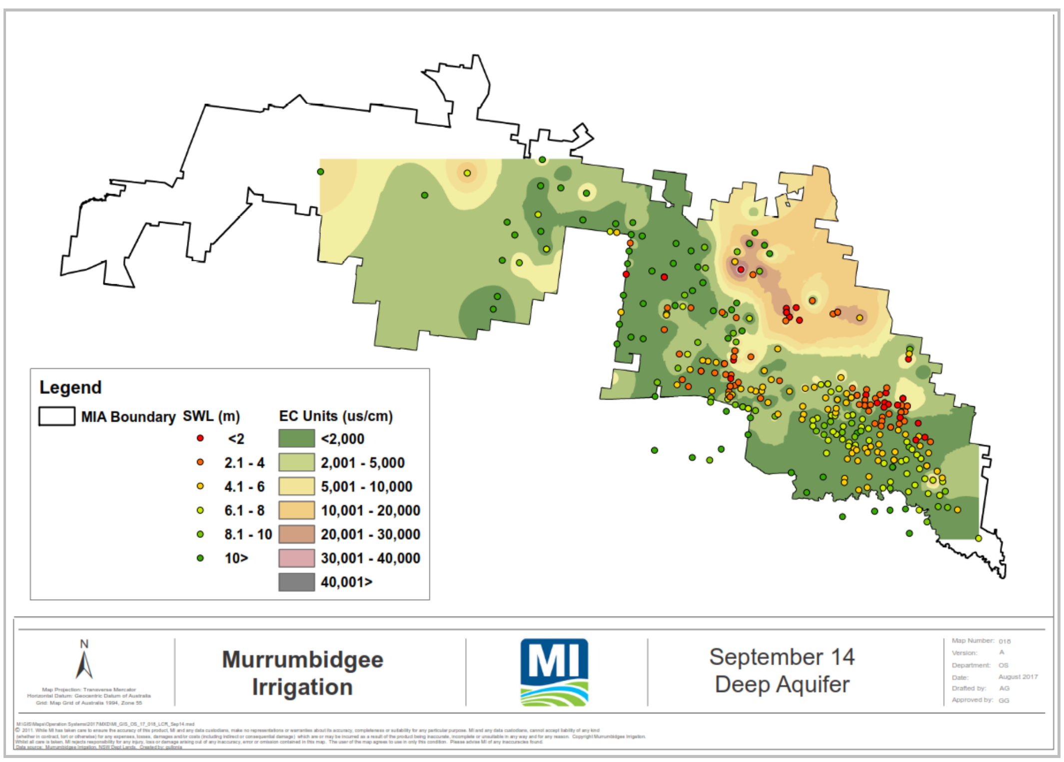

Figure 20 Deep Shepparton Formation- depth to water table and salinity, September 2014

2005/06

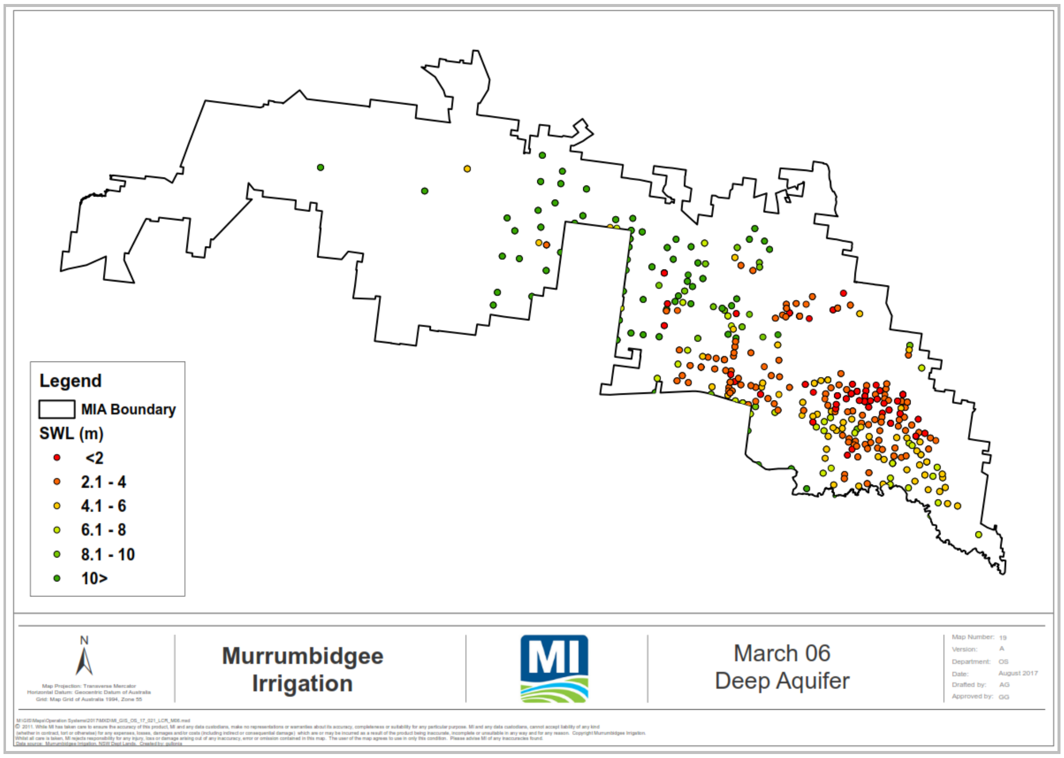

Figure 21 Depth (m) to water table and groundwater salinity (µS/cm) in the Deep Shepparton Formation, March 2006

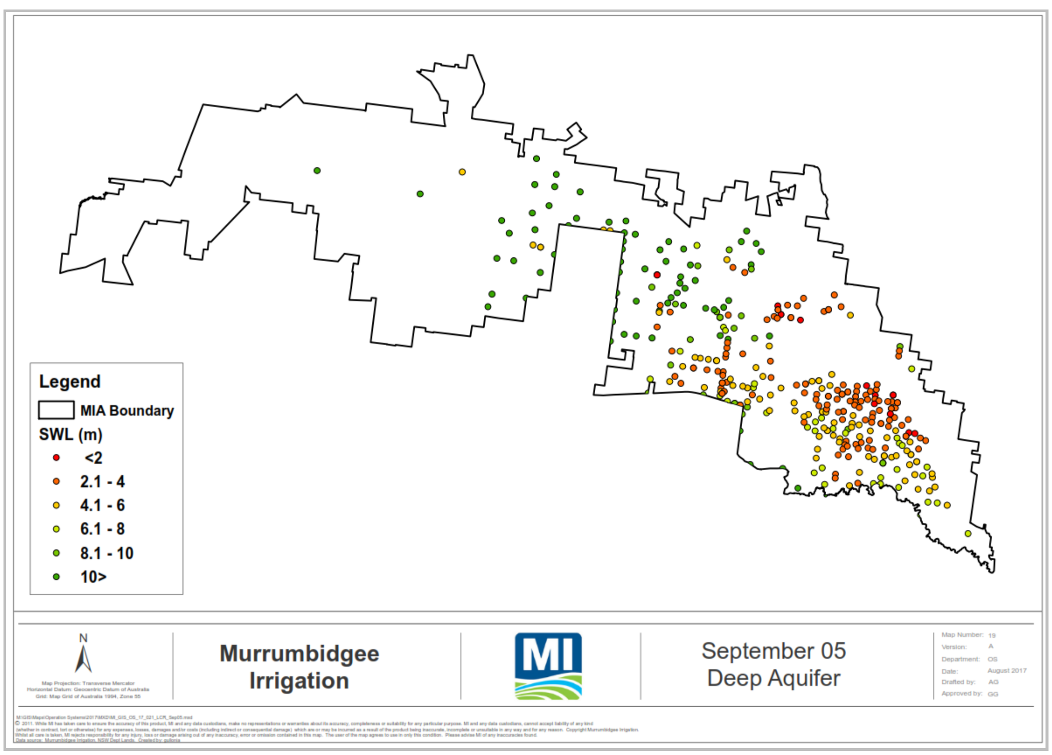

Figure 22 Depth (m) to water table and groundwater salinity (µS/cm) in the Deep Shepparton Formation, September 2005

1980/2002

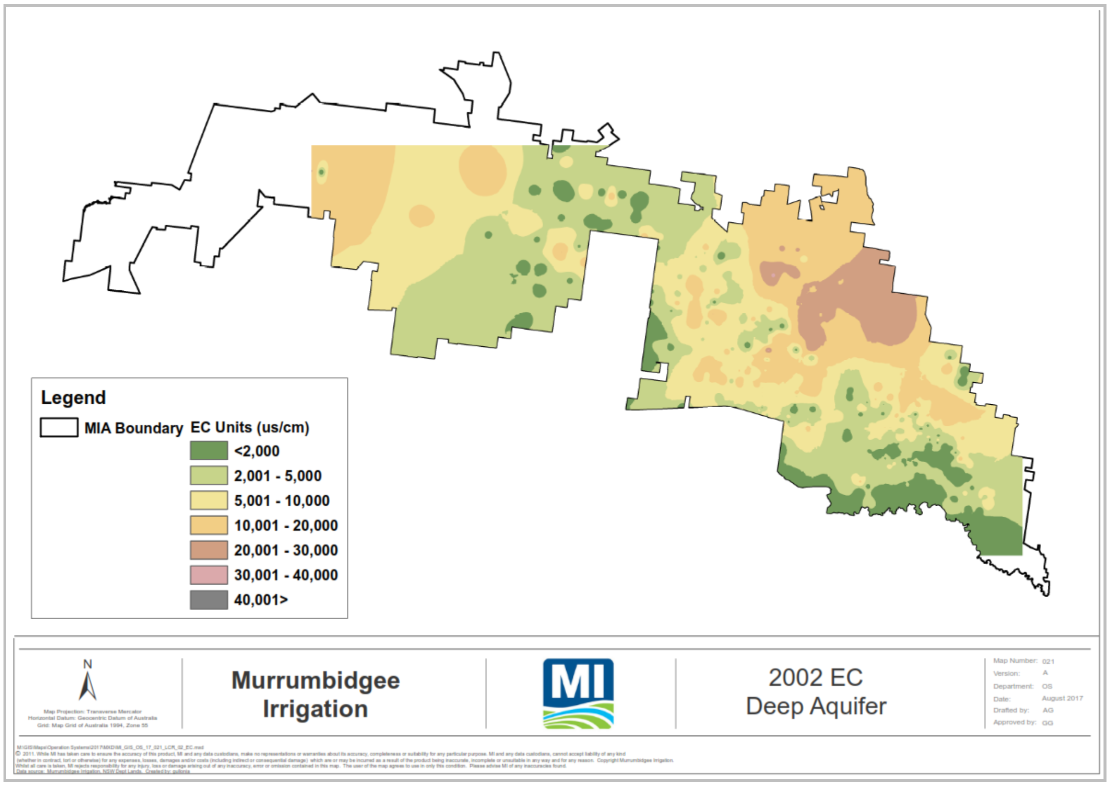

Figure 23 Deep Shepparton Formation - groundwater salinity, September 2002

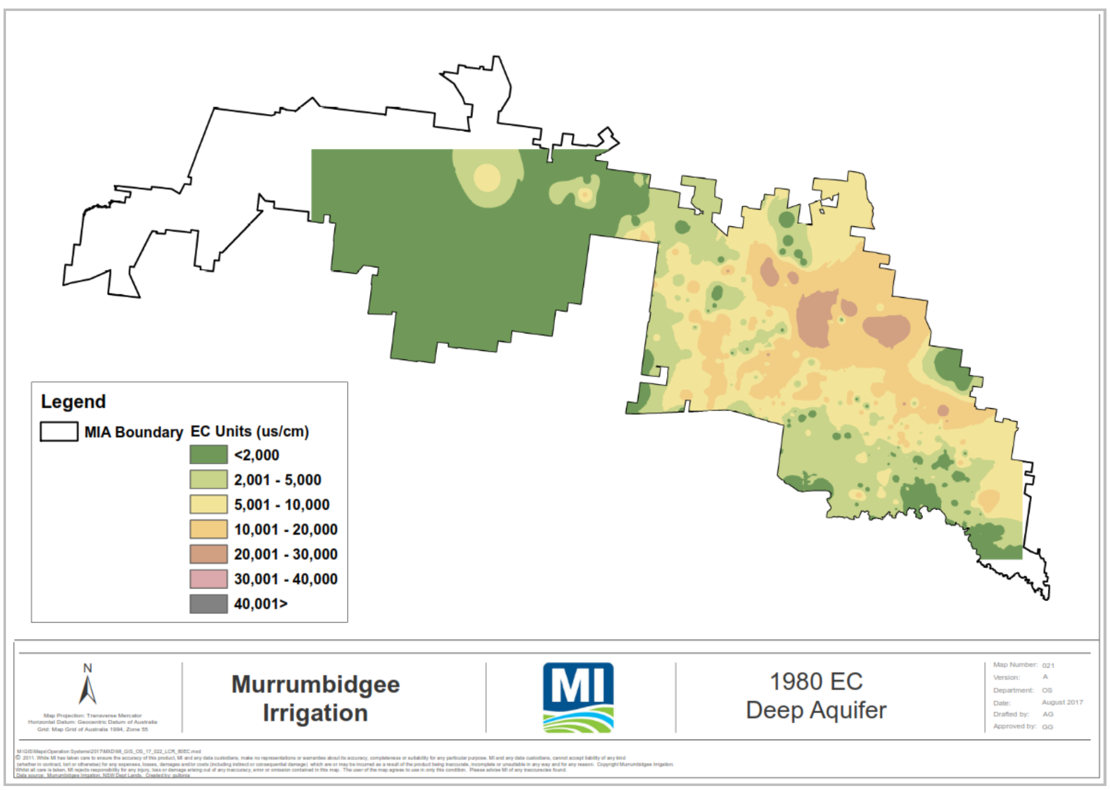

Figure 24 Deep Shepparton Formation - groundwater salinity, September 1980

6.5 Calivil Formation

Depth to water table and salinity maps for piezometers in the Calivil Formation are presented in Figures 25 to 34. Level trends in this formation generally represent drawdown from shallow aquifers. As seen in the upper formations, piezometers measured in the deep formation March 2017 (Figure 25) exhibit low salinity. This suggests that the Calivil Formation may be influenced by large flooding events, either through direct recharge, aquifer exchange or, to a lesser degree, vertical seepage from the above Shepparton Formation. However, due to the dynamic nature of groundwater aquifers, it is difficult to ascertain the true origin and significance of level changes with any confidence. Levels in this aquifer remain consistent for all reporting years, with the majority with a depth of more than 10m.

2016/17

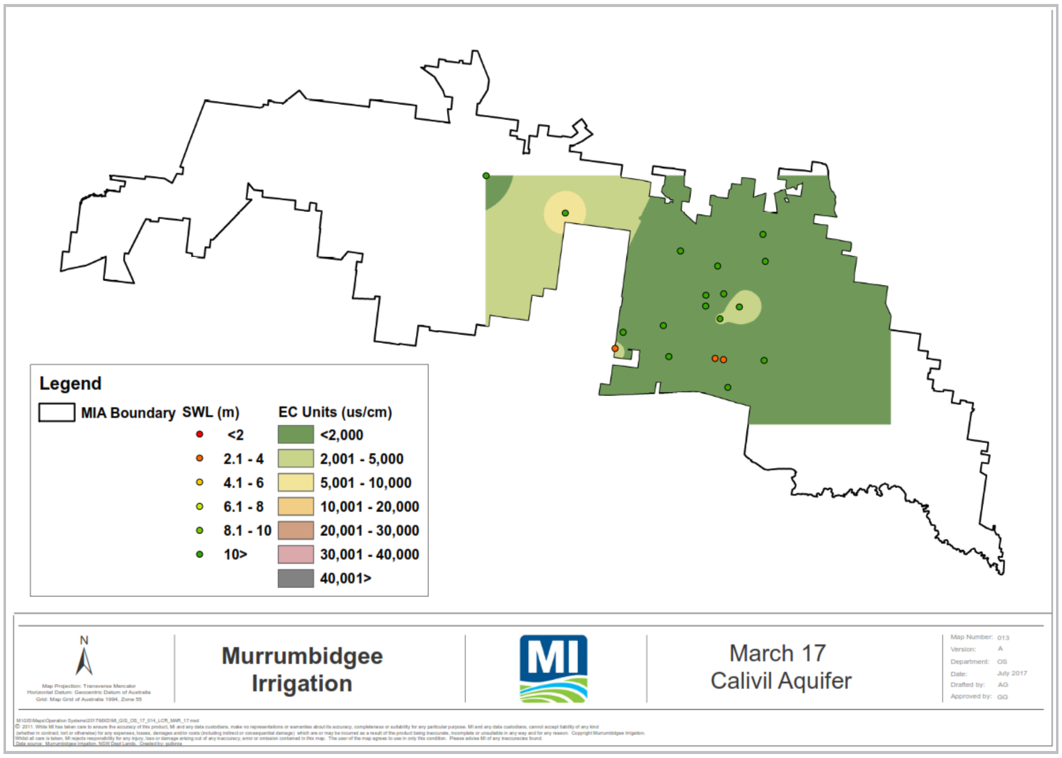

Figure 25 Calivil Formation - depth to water table and salinity, March 2017

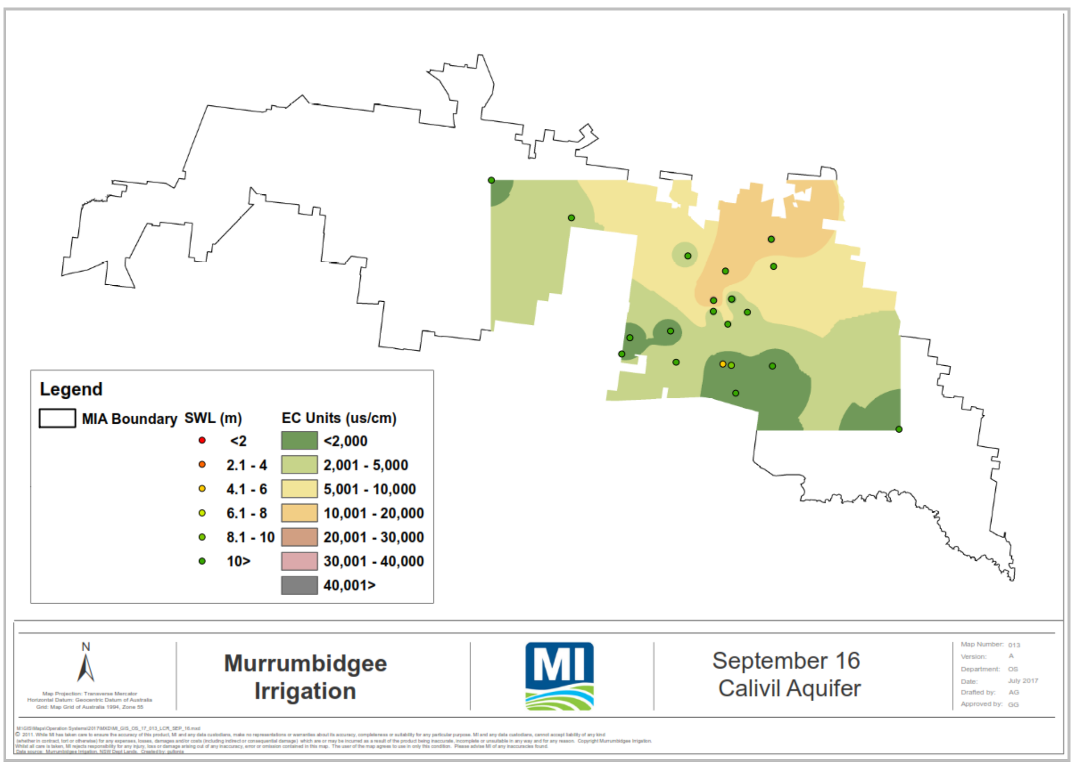

Figure 26 Calivil Formation - depth to water table and salinity, September 2016

2015/16

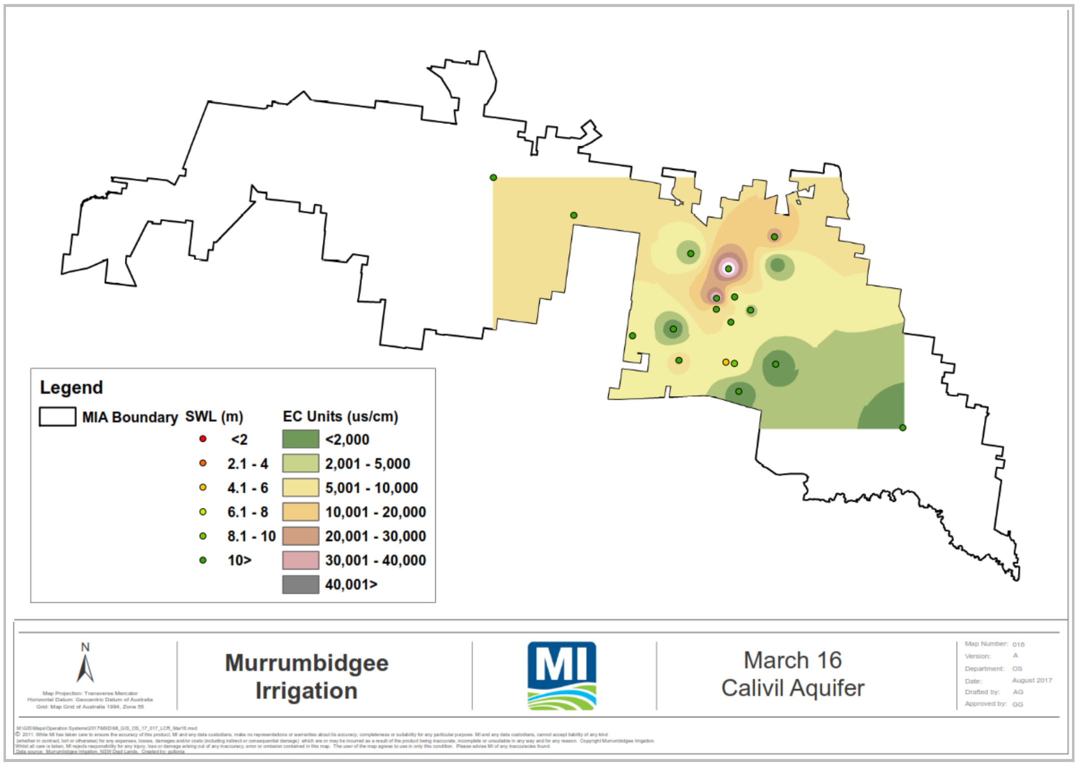

Figure 27 Calivil Formation - depth to water table and salinity, March 2016

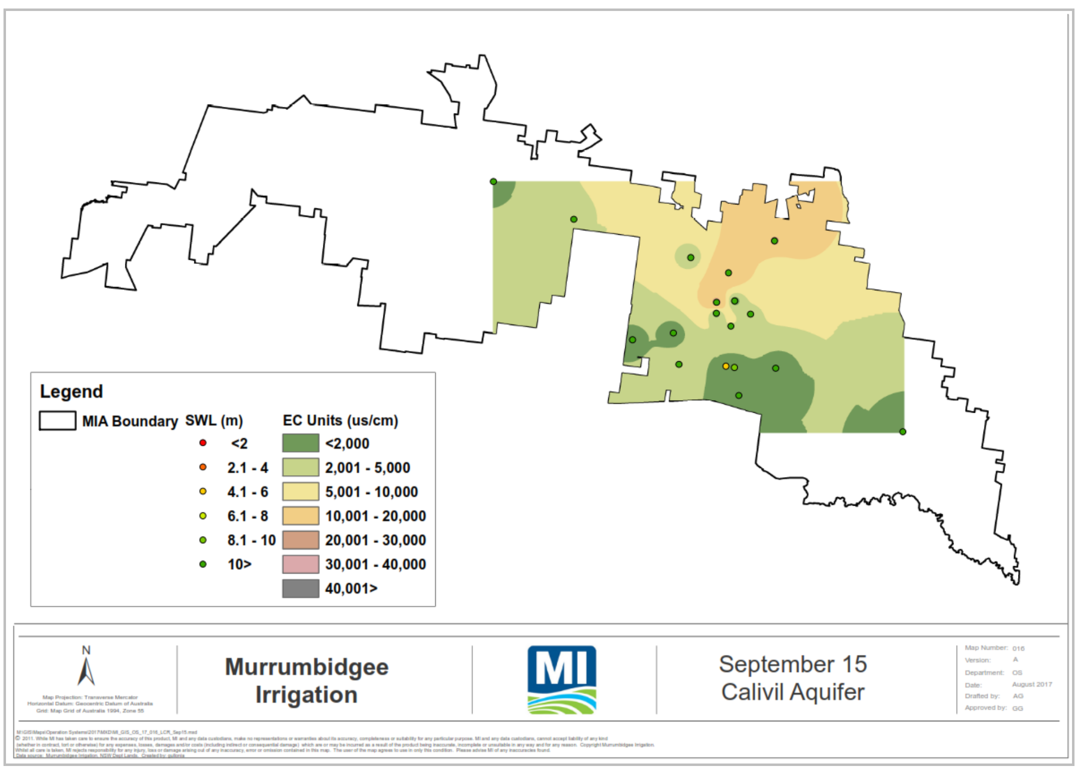

Figure 28 Calivil Formation - depth to water table and salinity, September 2015

2014/15

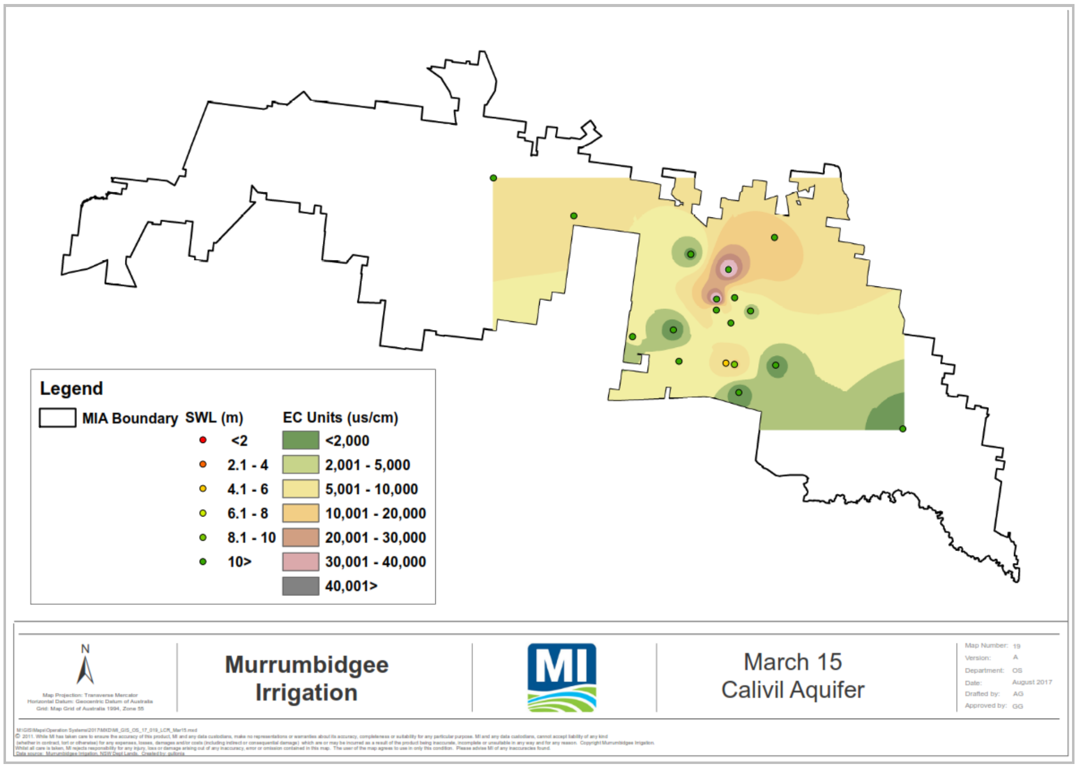

Figure 29 Calivil Formation - depth to water table and salinity, March 2015

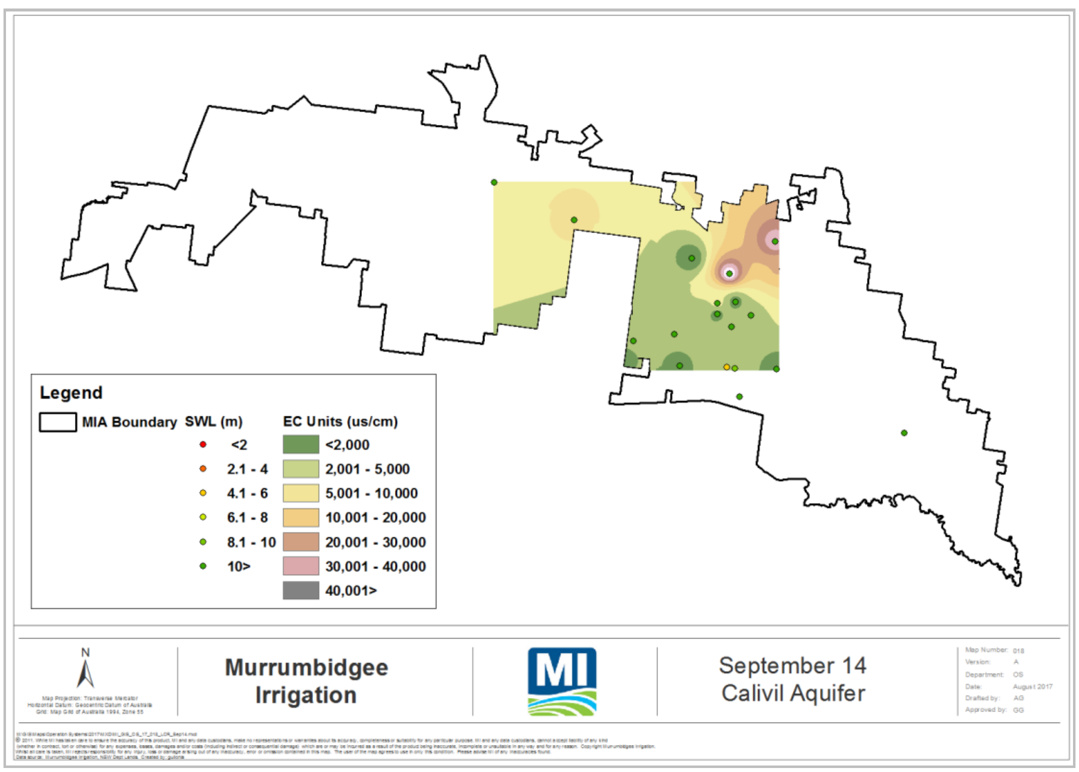

Figure 30 Calivil Formation - depth to water table and salinity, September 2014

2005/06

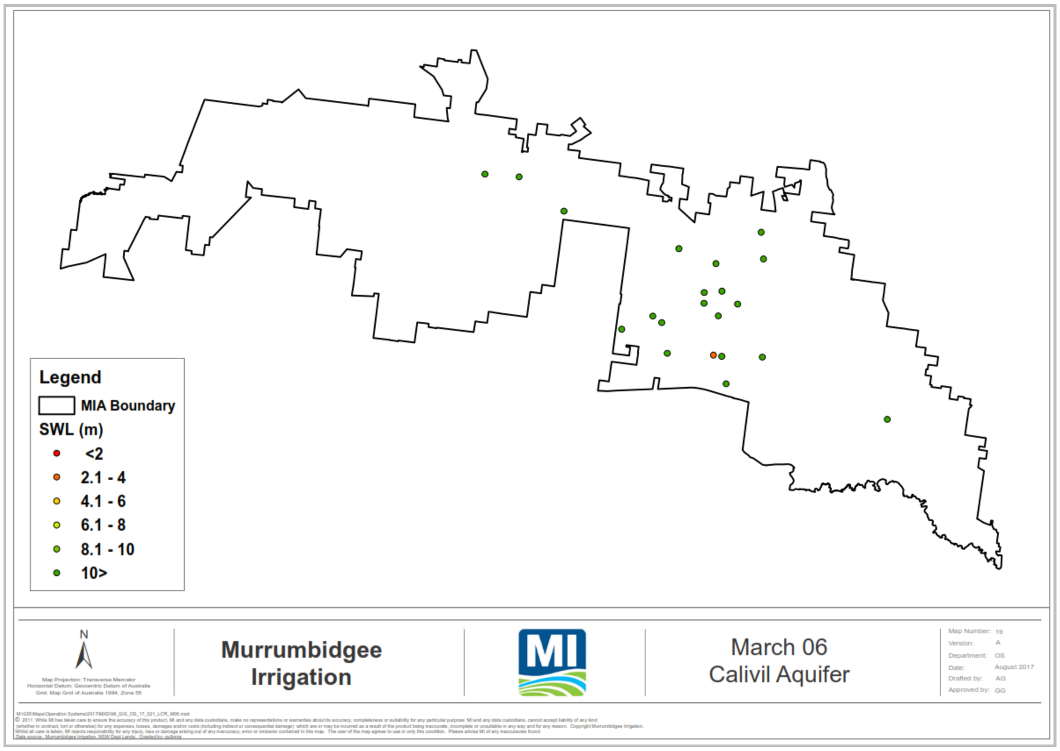

Figure 14 Calivil Formation - depth to water table and salinity, March 2006

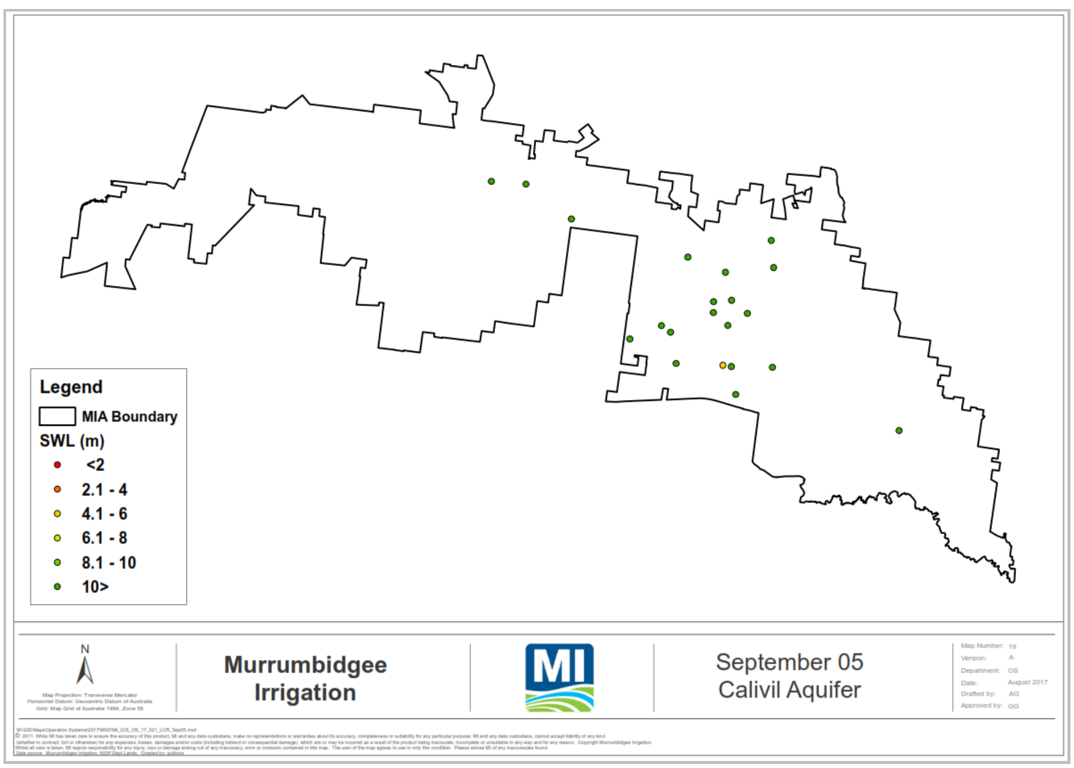

Figure 15 Calivil Formation - depth to water table and salinity, September 2005

1980/2002

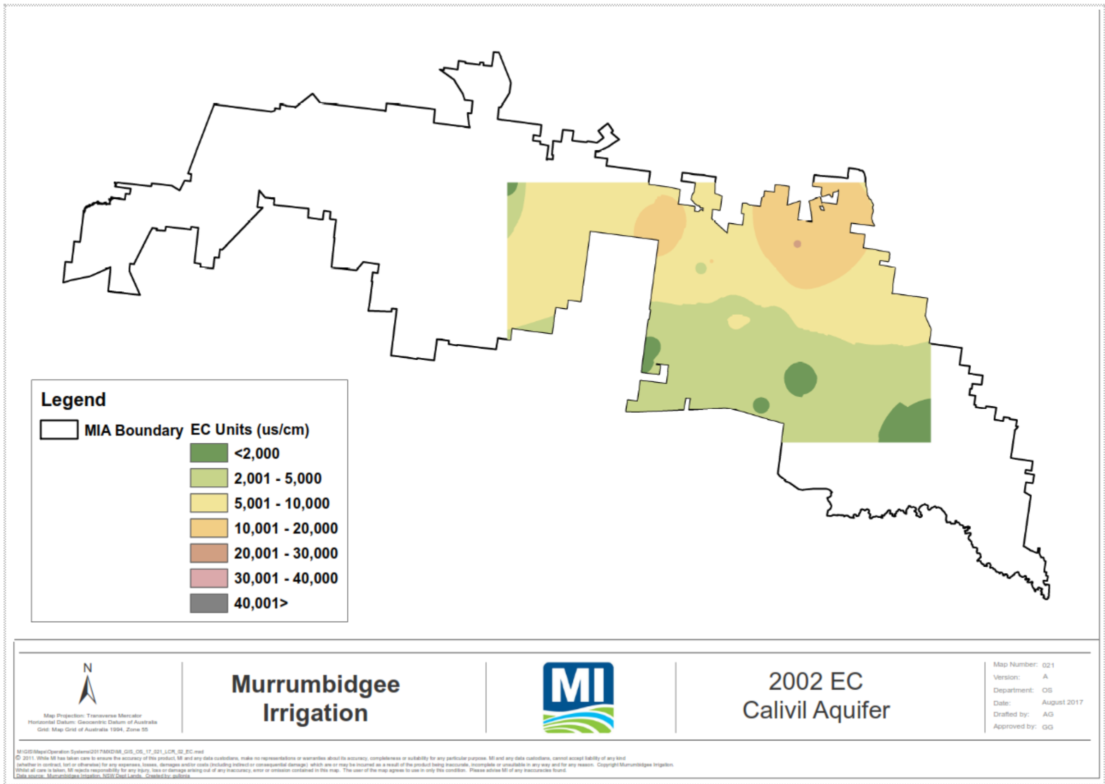

Figure 16 Calivil Formation - groundwater salinity, September 2002

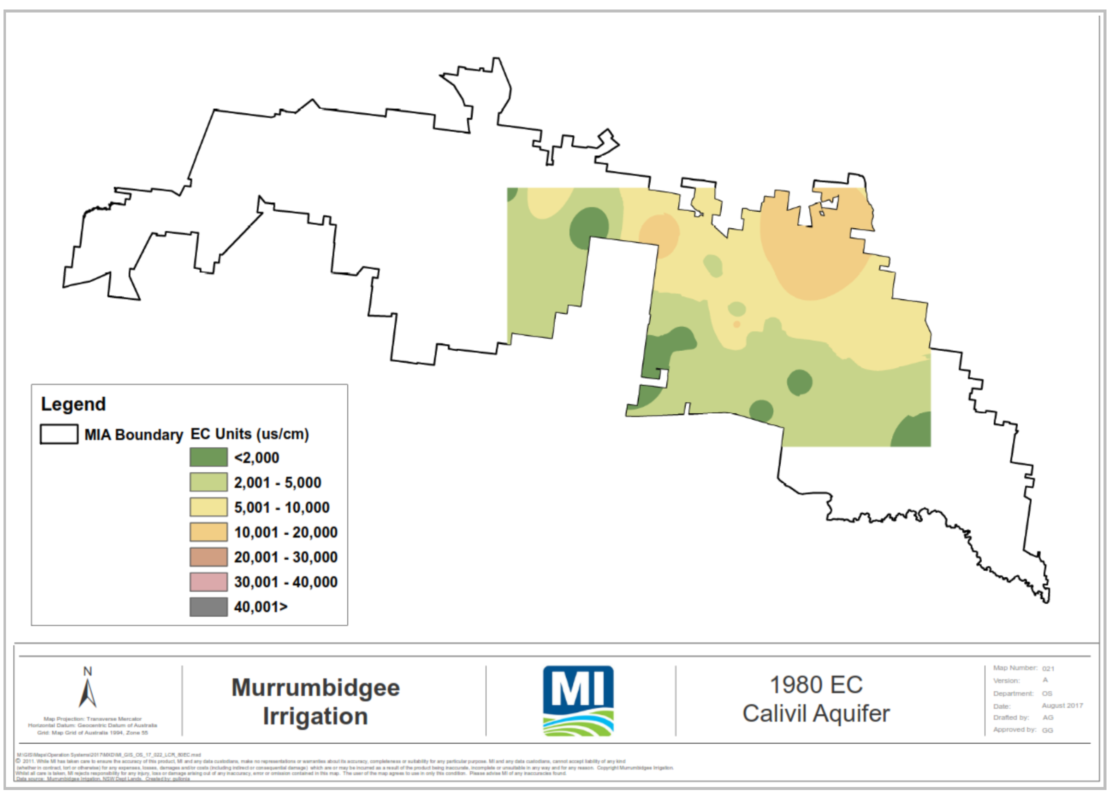

Figure 17 Calivil Formation - groundwater salinity, September 1980

7 Tubewells

MI monitors the volume of water and salt load pumped from seven tubewells within the MIA. The location of the tubewells are shown in Figure 4. Table 24 shows the total volumes and salt discharged from tubewells for 2016/17 and previous years. EC was measured in July 2017 and used to calculate salt loads. EC measurements were unable to be measured at Five Bridges and South Leeton tubewells in 2016/17 due to mechanical failure and therefore the inability to access a water sample. To allow the data to be comparable to other years reported in this table, a three year average EC reading was used to calculate saltload for 2016/17. A total volume of 1,816 ML and 2829 tonnes of salt was discharged from tubewells for 2016/17. The tubewell located at Baulch's has not been operational since 2010.

Table 24 Tubewell monitoring data 2016/17 compared to previous years

2016/17			2015/16		
Location	**Volume (ML)**	**Salt load (t)**	**Location**	**Volume (ML)**	**Salt load (t)**
Five Bridges	324	180*	Five Bridges	658	357
Gil Gil	518	1061	Gil Gil	412	755
Yanco West	284	513	Yanco West	274	680
South Leeton	191	816*	South Leeton	261	1,090
Baulch's	0	0	Baulch's	0	0
Wamoon	238	128	Wamoon	175	88
East Wamoon	261	129	East Wamoon	93	40
Total	**1816**	**2829**	**Total**	**1,873**	**3,012**
2014/15			**2006/07**		
Location	**Volume (ML)**	**Salt load (t)**	**Location**	**Volume (ML)**	**Salt load (t)**
Five Bridges	777	394	Five Bridges	707	489
Gil Gil	585	1088	Gil Gil	266	353
Yanco West	262	411	Yanco West	305	404
South Leeton	0	0	South Leeton	76	118
Baulch's	0	0	Baulch's	137	52
Wamoon	351	166	Wamoon	384	200
East Wamoon	97	43	East Wamoon	778	454
Total	**2,072**	**2,102**	**Total**	**2,653**	**2,070**

*no EC data available. Three year average used to calculate saltload

8 New Measures to Limit Groundwater Recharge and Discharge of Salt

MI continues to deliver water saving projects through automation, gravity piping, conversion to pressurised pipeline and the channel lining of sections of the supply system under the Private Irrigation Infrastructure Operations Program (PIIOP). The modernisation programs implemented over the 2016/17 year include refurbishment and automation of MI's Main Canal, Division 3 (Whitton), Yenda, Widgelli, Benerembah and Bilbul systems, increasing operational efficiency and reducing groundwater recharge.

The PIIOP works have also helped reduce impacts of losses through channel seepage to groundwater systems at Lake Wyangan, Hanwood, Yenda and Tharbogang which has included the replacement of ageing earthen channels with channel lining or gravity pipelines as well as channel automation and on-farm water saving initiatives.

9 Environmental Protection and Management

9.1 Discharge of noxious aquatic weeds

During 2016/17 irrigation year, there was no known potential or actual discharge of Class 1, 2 or 3 declared noxious aquatic weeds from MI's Area of Operation.

9.2 Discharge of Blue-Green Algae

All Blue Green Algae results from water sampled during discharge from MI's area of operation were reported to the Minister's nominated contact officer within 24 hours of receiving results.

ENVIRONMENTAL PROTECTION LICENCE 4651

10 Statement of Compliance

MI has fulfilled the compliance requirements as set out in EPL 4651 for 2016/17. A summary of the compliance requirements is cross referenced to this report and listed in Table 25.

Quality assurance and control procedures are in place to guarantee data integrity and to ensure that all compliance obligations are fulfilled. This includes using a NATA accredited laboratory for water sample analysis and contracting an external hydrological service provider to manage and maintain automated monitoring stations. Internal Standard Operating Procedures (SOPs) are reviewed and updated regularly.

MI is able to receive complaints from members of the public in relation to MI's activities via the business telephone number. Direction on how to make a complaint can be found on MI's website (www.mirrigation.com.au/Contact-Us).

Table 25 Environmental Protection Licence (EPL 4651) Monitoring and Reporting Requirements

Licence section	Requirement	Compliant	Report Section
Administrative Conditions	1	Yes	N/A
Discharges to Air and Water and Applications to Land	2	Yes	N/A
Limit Conditions	3	Yes	N/A
Operating Conditions	4	Yes	N/A
Maintain a Chemical Contingency Plan	O3.1	Yes	www.mirrigation.com.au/Environment/Water-Quality
Maintain a Chemical Control Plan	O3.5	Yes	
Maintain Pollution Incident Response Management Plan	Required for all EPL holders under the *Protection of Environment Operations Act 1997*	Yes	
Monitoring and Recording Conditions	5	Yes	
Monitoring Records	M1	Yes	Available upon request from EPA
Requirement to monitor concentration of pollutants discharged	M2	Yes	11. EPL Monitoring and Reporting
Testing Methods	M3	Yes	Internal documents
Recording of pollution complaints	M4	Yes	Available upon request from EPA
Telephone complaints line	M5	Yes	1. Statement of Compliance
Requirement to monitor volume or mass	M6	Yes	11. EPL Monitoring and Reporting
Other Monitoring and recording conditions	M7	Yes	8.1. Noxious Weed Management
Annual return documents	R1		Submitted August 2017
Notification of environmental harm	R2	Yes	N/A
Written Report (of an event)	R3	Yes	N/A
Annual system performance report	R4	Yes	Full Report
Other reporting conditions	R5	Yes	Section 10

11 EPL Monitoring and Reporting

Under MI's EPL 4651, five points (Figure 3) are licenced to allow water to be discharged outside MI's Area of Operation, with the condition that all flows are recorded and specified water quality parameters are measured during flow or rainfall events. These monitoring points are referred to throughout this section.

11.1 System performance

Table 26 presents total diversions into the MIA and total water discharged from the MIA for 2016/17 compared to previous years. In 2016/17, 122,092 ML was discharged, which included 121,363 ML that was diverted to Mirrool Creek Floodway in response to well above average rainfall and subsequent floodwater entering MI drainage networks from catchments in and outside of the MIA.

In 2005/06 MI's drainage reuse system was not complete, which explains the high discharge volumes recorded in this year. MI does not discharge irrigation waste water directly to ground waters in or outside the area of operations.

Table 26 Total water volumes (ML)

Year	Diversions	Discharged
2016/17	780,083	122,092
2015/16	643,957	1,079
2014/15	878,614	671
2005/06	1,036,519	8,570

11.2 Water Quality Monitoring

Monthly summaries for each monitoring point are presented in Table 27 - 31. Monitoring consisted of 38 sampling events, with 24 notification or action level detections, all of which were reported to the EPA in accordance with R5.1. The results were also made available on MI's website in line with legislative requirements.

Chemical detections were found at all sites except for Point 6 - YMS where all flow was diverted to MI's internal reuse system. High rainfall in the catchment from July to September 2016 caused the release of drainage water from farms into MI works that would normally be retained and recycled on farm. This had the greatest impact at Point 4 – LAG (Table 27), with 21 sampling events and 17 detections. Diuron, Simazine and Metolachlor were the only chemicals detected in 2016/17.

Table 27 Monitoring results for Point 4 - LAG

Point 4 – LAG				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-16	65.1	3	4	6/7/16 Action level Diuron (8.57µg/L), 18/7/16 Action level Diuron (25.0µg/L) and Notification level Simazine (3.38µg/L), 20/7/16 Action level Diuron (22.4µg/L)
Aug-16	11.5	2	2	1/8/16 Action level Diuron (8.51µg/L), 2/8/16 Notification level Diuron (4.46µg/L)
Sep-16	66.7	3	7	1/9/16 Action level Diuron (7.47µg/L) and Notification level Metolachlor (0.021µg/L), 5/9/16 Notification level Diuron (2.2µg/L), Notification level Metolachlor (0.032µg/L), Notification level Simazine (5.68µg/L), 12/9/16 Notification level Diuron (1.3µg/L), Notification level Metolachlor (0.02µg/L),
Oct-16	0.0	0	0	-
Nov-16	28.6	2	0	-
Dec-16	50.6	2	0	-
Jan-17	6.7	1	0	-
Feb-17	8.4	0	0	-
Mar-17	34.6	2	0	-
Apr-17	31.4	1	0	-
May-17	85.8	5	4	12/5/17 Notification level Diuron (3.11µg/L), 18/5/17 Action level Diuron (5.16µg/L), 19/5/17 Notification level Diuron (1.42µg/L), 31/5/17 Action level Diuron (24.4µg/L)
Jun-17	14.4	0	0	-
Total	403.9	21	17	

Table 28 Monitoring results for Point 5 - GMSRR

Point 5 – GMSRR				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-16	11.8	2	4	6/7/16 Action level Simazine (25.1µg/L) and Notification level Diuron (3.63µg/L), 11/7/16 Notification level Simazine (4.86µg/L) and Notification level Diuron (3.58µg/L)
Aug-16	0.01	0	0	-
Sep-16	0.03	1	0	-
Oct-16	2.4	0	0	-
Nov-16	6.2	0	0	-
Dec-16	12.5	1	0	-
Jan-17	15.1	0	0	-
Feb-17	10.1	0	0	-
Mar-17	9.2	1	0	-
Apr-17	8.3	1	0	-
May-17	1.2	0	0	-
Jun-17	0.0	0	0	-
Total	76.8	6	4	

Table 29 Monitoring results for Point 6 - YMS

Point 6 – YMS				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-16	0.0	0	0	-
Aug-16	0.0	0	0	-
Sep-16	0.0	0	0	-
Oct-16	0.0	0	0	-
Nov-16	0.0	0	0	-
Dec-16	0.0	0	0	-
Jan-17	0.0	0	0	-
Feb-17	0.0	0	0	-
Mar-17	0.0	0	0	-
Apr-17	0.0	0	0	-
May-17	0.0	0	0	-
Jun-17	0.0	0	0	-
Total	0.0	0	0	

Table 30 Monitoring results for Point 7 - ROCUDG

Point 7 – ROCUDG				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-16	0.0	2	0	-
Aug-16	73.7	2	1	12/8/16 Notification level Metolachlor (0.046µg/L)
Sep-16	5.1	0	0	-
Oct-16	0.0	0	0	-
Nov-16	11.8	0	0	-
Dec-16	58.6	1	0	-
Jan-17	13.1	0	0	-
Feb-17	0.0	0	0	-
Mar-17	0.0	0	0	-
Apr-17	13.4	0	0	-
May-17	60.3	2	0	-
Jun-17	12.3	0	0	-
Total	248.1	7	1	

Water was released to Point 15 – MIRFLD in September and October during flood conditions. During these conditions, access to this point was limited due to safety risks and samples were collected at a number of sites upstream. These results are available if requested by the EPA or DPI Water.

Table 31 Monitoring results for Point 15 - MIRFLD

Point 15 – MIRFLD				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-16	640	1	1	10/7/16 Action level Metolachlor (0.132µg/L)
Aug-16	0.0	0	0	-
Sep-16	57,180	2	1	12/9/16 Notification level Metolachlor (0.029µg/L)
Oct-16	63,543	1	0	-
Nov-16	0.0	0	0	-
Dec-16	0.0	0	0	-
Jan-17	0.0	0	0	-
Feb-17	0.0	0	0	-
Mar-17	0.0	0	0	-
Apr-17	0.0	0	0	-
May-17	0.0	0	0	-
Jun-17	0.0	0	0	-
Total	121,363	4	2	