

2019 ANNUAL COMPLIANCE REPORT This document is the property of Murrumbidgee Irrigation Limited. The data contained in this Annual Compliance Report is for the sole purpose of meeting MI's licence compliance reporting requirements. MI does not guarantee the accuracy, reliability or suitability of excerpts of this data for any other purpose.

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Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
BBS	Barren Box Storage
CSIRO	Commonwealth Scientific Investigation and Research Organisation
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical Conductivity
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ЕТо	Evapotranspiration (crop reference)
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
NRAR	Natural Resources Access Regulator
OEH	Office of Environment and Heritage
SOP	Standard Operating Procedure
t	Tonnes
WAL	Water Access Licence
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

Preface

The Annual Compliance Report 2018/19 has been prepared to meet the reporting requirements of the licences held by Murrumbidgee Irrigation (MI). MI operates under a Combined Water Supply Work Approval and Water Use Approval 40CA403245 (Combined Approval) issued by the NSW Department of Planning, Industry and Environment (DPIE) and regulated by the Natural Resources Access Regulator (NRAR). MI also holds an Environment Protection Licence (EPL) 4651 issued by the NSW Environment Protection Authority (EPA).

MI is committed to achieving organisational excellence through operating safely, efficiently and effectively, all of which contribute towards the measure of MI's compliance performance.

COMBINED WATER SUPPLY WORK APPROVAL AND WATER USE APPROVAL

1 Statement of Compliance

Murrumbidgee Irrigation (MI) has met the conditions of the Monitoring and Reporting Plan for our Combined Approval in 2018/19. The compliance requirements are cross referenced within this report and listed in Table 1. MI has quality assurance and control procedures 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 our licensed supply and discharge points.

There were no significant events in 2018/19 that required notification to the Minister.

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 2018/19. MI did not construct new works that would allow further discharge from the Area of Operations. In 2018/19, the boundary of MI's Area of Operations decreased by 192,202 hectares (Figure 1), with the project finalisation and handover of the Gunbar Private Water Supply District.

Table 1 Combined Approval (40CA403245) reporting summary

Licence section	Condition	Report Section		
Notification of events	10	1. Statement of Compliance		
Plans of the Area of	12.1			
Operations, Authorised				
Works, Monitoring Sites and	12.2	2. Plan of Operations and Works		
Water Management				
Infrastructure				
Statement of Compliance	12.3	1. Statement of Compliance		
	12.4			
Procentation of Data and	12.5	Sections 1 - 6		
	12.6			
Analyses	12.7	Provided on USB		
	12.8	1. Statement of Compliance		
New Measures to Limit		8. New Measures to Limit		
Groundwater Recharge and	12.9	Groundwater Recharge and		
Discharge of Salt		Discharge of Salt		
	12.10	3.3 Diversions and Water Allocation		
	12 11	3.5 Water discharged from Area of		
Reporting on Water	12.11	Operation		
Management	12.12	3.9 Water Balance		
	12.13 (a) (b)	3.1 Climate Conditions		
	(c) — (j)	4. Water Use		
	12.14			
Reporting on Salinity and Salt	12.15	5. Salinity and Salt load		
1080	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 potential 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 MI's area of exclusion



Figure 2 Location of authorised supply works and licence discharge points

3 Reporting on Water Management

MI's water management information is presented below. There are no internal benchmarks or targets that are relevant to this report.

3.1 Climate conditions

Rainfall and evapotranspiration (ETo) data recorded at the Griffith CSIRO weather station is presented in Table 2. Below average rainfall was recorded in 2018/19, comparable to rainfall recorded during the millennium drought in 2005/06. The high rainfall recorded in 2016/17 was the result of a 1/150-year flood event.

Table 2 Griffith CSIRO weather station rainfall and ETo

Year	Total rainfall (mm)	Total ETo (mm)
2018/19	337	1,914
2017/18	315	1,894
2016/17	556	1,593
2005/06	357	1,935

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 unit is presented in Table 3 and the STURT AFFRA unit presented in Table 4. The full calibration report is included with the submission of this report.

Date	Time	Calibration	AFFRA Sensor:	Deviation
15/08/2018	1439	1459	1407	3.73%
16/09/2018	1641	1666	1715	-2.86%
16/09/2018	1607	1703	1713	-0.60%
17/10/2018	1048	1255	1265	-0.79%
20/11/2018	728	1060	1041	1.89%
26/01/2019	636	3556	3582	-0.73%
20/02/2019	853	1970	1946	1.23%

Table 3 Main Canal at NARREG (410127) calibration report

Table 4 Sturt Canal at STURT (410129) calibration report

Date	Time	Calibration	AFFRA Sensor:	Deviation
13/08/2018	1544	479	482	-0.57%
17/09/2018	1614	685	698	-1.81%
15/10/2018	1317	855	891	-4.01%
25/01/2019	837	830	856	-3.04%
19/02/2019	1137	389	392	-0.77%

3.3 Diversions and Water Allocation

A monthly summary of gross water diverted from the Murrumbidgee River is presented in Table 5. These volumes represent diversions entering the supply system via MI's two authorised water supply works at NARREG and STURT. The total diversion volume of 586,752 ML includes an environmental water diversion volume of 2,996 ML diverted on behalf of the Office of Environment and Heritage (OEH).

Month	STURT	NARREG	Total diversion	Deliveries to customers
Jul-18	0	4,547	4,547	2,859
Aug-18	14,306	37,013	51,319	38,276
Sep-18	15,925	43,275	59,200	52,313
Oct-18	16,866	49,370	66,236	59,012
Nov-18	5,939	35,179	41,118	32,242
Dec-18	19,580	80,876	100,456	81,318
Jan-19	26,652	100,853	127,505	105,604
Feb-19	10,618	53,581	64,199	56,541
Mar-19	6,822	39,046	45,868	38,171
Apr-19	755	17,797	18,572	12,129
May-19	0	4,303	4,303	6,234
Jun-19	0	3,429	3,429	2,505
Total	117,483	469,269	586,752	487,204

Table 5 Monthly summaries of water diversions (ML) deliveries to customers (ML), 2018/19

Table 6 compares water allocations, diversions, total deliveries and climate data from the 2018/19 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. Below average rainfall was recorded throughout the catchment in 2018/19, resulting in 7% allocation for General Security and 95% allocation for High Security allocation announcement. Total diversions and deliveries to customers were reduced compared to the previous reporting year in line with reduced allocations. However, 487,204ML delivered is higher than would be expected in a 7% General Security allocation season, with customers utilising substantial carry over from the previous 2017/18 season allocation.

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.

The volume of water extracted under each of MI's Water Access Licences are shown in Table 7.

Year	AnnouncedDiversionsAllocation (%)(ML)General / High		Deliveries (ML)	Rainfall (mm) Griffith AWS	ETo (mm) Griffith AWS	
2018/19	7/95	586,752	487,204	337	1,914	
2017/18	45/95	945,805	800,963	315	1,894	
2016/17	100/100	780,083	621,094	556	1,593	
2005/06	54/95	1,036,519	829,990	367	1,935	

Table 6 Water allocation, total diversions and deliveries 2018/19 compared to previous years

Table 7 Diversions - Water Access Licences (WALs)

Year	WAL 1 HS	WAL 2 GS	WAL 3 Towns	WAL 4 S&D	WAL 5 Other	
2018/19	269,817	161,433	19,699	7,345	128,458	

3.4 Environmental diversions

At the request of OEH, 2,996ML (including 20% conveyance) of environmental water was delivered in 2018/19 as shown in Table 8. This volume is accounted for in total Diversions and Deliveries.

Month	Gooragool	Tuckerbill	Fivebough	Turkey	Yanco	Nericon	Campbell's	30	BBS	Total
	Lagoon	Swamp	Swamp	Flats	Ag	Swamp	Swamp	Mile	Wetlands	
Jul-18	0	0	0	0	0	0	0	0	0	0
Aug-18	0	0	0	0	0	0	0	0	0	0
Sep-18	0	0	0	0	0	0	0	0	0	0
Oct-18	0	410	252	17	470	0	263	0	0	1,412
Nov-18	0	0	27	104	55	0	136	0	0	322
Dec-18	0	0	257	64	178	0	0	0	0	499
Jan-19	0	0	0	60	187	0	0	0	0	247
Feb-19	0	133	0	60	0	0	0	0	0	193
Mar-19	0	0	256	0	0	0	0	0	0	256
Apr-19	0	0	0	0	0	0	0	0	0	0
May-19	0	66	0	0	0	0	0	0	0	66
Jun-19	0	0	0	0	0	0	0	0	0	0
Total (ML)	0	610	792	305	891	0	398	0	0	2,996

Table 8 Environmental water diversions for 2018/19

3.5 Water discharged from Area of Operations

Monthly discharge volumes for each discharge monitoring point are shown in Table 9. A total of 642 ML was discharged from MI's Area of Operations in 2018/19 with 150 ML of this total released to the Mirrool Creek Floodway (MIRFLD) to facilitate required operational works.

Month	LAG	ROCUDG	YMS	GMSRR	MIRFLD
	(41010940)	(41010005)	(410083)	(41010921)	(41010163)
Jul-18	16.8	16.6	102	104.6	150
Aug-18	19.5	66.1	0	67.5	0
Sep-18	11.9	7.6	0	0.0	0
Oct-18	24.1	6.9	0.3	0.0	0
Nov-18	5.9	0.0	0	0.0	0
Dec-18	28.3	0.0	0	0.0	0
Jan-19	4.6	1.8	0	0.0	0
Feb-19	0.0	0.2	0	0.0	0
Mar-19	0.0	0.0	0	0.0	0
Apr-19	0.0	0.0	0	0.0	0
May-19	7.5	0.0	0	0.0	0
Jun-19	0.0	0.0	0	0.0	0
Total	118.6	99.20	102.3	172.1	150

Table 9 Monthly discharge volumes (ML) recorded at monitoring points

Table 10 shows total discharge volumes from MI's Area of Operation compared to previous years. The total volume discharged in 2018/19 was significantly lower compared to previous years. It must be noted that in 2016/17 121,363ML was diverted to the MIRFLD as a means of flood risk mitigation.

Table 10 Total volumes discharged from the MIA

Year	Total discharged (ML)
2018/19	642
2017/18	4,471
2016/17	122,092
2005/06	8,570

3.6 Supply efficiency

Table 11 illustrates the simple efficiency of MI's supply system to be at 83% for 2018/19. 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.

Year	Diversions (ML)	Deliveries (ML)	Conveyance (ML)	Simple Efficiency (%)
2018/19	586,752	487,204	99,548	83%
2017/18	945,805	800,963	144,842	85%
2016/17	780,083	621,094	158,003	80%
2005/06	1,036,519	829,990	206,529	80%

Table 11 Supply efficiency from 2018/19 and previous years

3.7 Water balance

The annual water balance in Table 12 has been produced to meet condition 2.12 of the Combined Approval Monitoring and Reporting Plan. To assist with interpretation of this water balance, each line has been referenced to the specific requirements of Condition 2.12.

The conveyance volumes represented in this water balance account for seepage, evaporated water (in channel and storage) and general conveyance required to deliver water to customers. With reference to Condition 2.10 (c) and 2.11(b), no water was extracted or discharged for environmental or river operational purposes as directed by Water NSW or the Minister. Overland flood losses in 2016/17 refers to overland flows from bank cuts or breaches during peak flood periods.

Total gross diversions of 586,752 ML for 2018/19 were used to generate water deliveries of 487,204 ML including 2,996 ML Environmental water diversions. There were no flood events resulting in captured flood water deliveries during 2018/19, therefore the total volume of water delivered to customers for 2018/19 was sourced from river diversions and internal storage.

Conditio n	Sources	2018/19	2017/18	2016/17	2015/16	2005/06
2.10 (a) (b)	River diversions	586,752	945,805	780,083	643,957	1,036,519
2.12 (c)	Internal storage volume (July 1)	25,256	32,318	29,042	15,621	N/A
2.12 (b)	Water captured (measured)	0	5,007	171,376		0
	Total	612,008	983,131	980,501	659,578	1,036,519
	Applications					
2.10 (d)	Deliveries to customers (river and storages)	484,208	800,963	621,094	526,278	829,990
2.10 (d)	Deliveries to customers (captured flood water)	0	1,602	49,225	0	0
2.12 (b) delivered	Environmental water diversions	2,996	600	986	2,629	N/A
2.12 (b) loss	Conveyance	121,728	151,904	127,960	101,629	206,518
2.12 (c)	Internal storage volume (June 30)	2,434	25,256	32,318	29,042	N/A
2.11 (a)	Discharges out of area of operation	642	4,471	121,363		11
2.12 (b) loss	Overland flood discharge	0	0	25,600		0
2.12 (b) loss	Customer flood discharge	0	0	1,955		0
	Total	612,008	983,131	980,501	659,578	1,036,519

Table 12 Annual Water Balance (ML)

4 Water Use

4.1 Crop statistics

Customers are required to nominate the intended water use to a crop or purpose when placing water orders. 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 2018/19. It is important to note the water use data presented for the total area of crop is influenced by seasonal rainfall, ETo and irrigation practices.

The 'Not Defined' category refers to water taken by MI customers without placing an order. This information is obtained after the meter is read and does not provide opportunity to allocate the water to a use.

Crop/Purpose	Area (ha)	Volume Delivered (ML)	Crop Water Use (ML/ha)
Citrus	8,301	42,664	5.1
Cotton	12,319	113,443	9.2
Industrial	-	6,006	-
Other crops	186	1,967	10.6
Other fruits	1,327	6,150	4.6
Plantation	97	365	3.8
Rice	2,783	37,171	13.4
Stock & domestic	257	3,862	15.0
Summer cereals	2,384	22,928	9.6
Summer oilseeds	190	618	3.3
Summer pasture	1,476	5,851	4.0
Town supplies	-	12,306	-
Vegetables	1,914	10,518	5.5
Vines	17,887	81,903	4.6
Winter cereals	27,817	63,722	2.3
Winter oilseeds	670	1,700	2.5
Winter pasture	3,291	6,902	2.1
Not Defined*	-	69,128	-
Total	80,898	487,204	-

Table 13 Summary of water deliveries for major crop groupings 2018/19

*No crop type assigned by customer at time of use

A comparison of crop water use for 2018/19 with previous years is presented in Table 14. Reduced general security allocation dramatically reduced seasonal summer cropping deliveries in 2018/19. As a result, the combined permanent plantings of citrus, vines and other fruits accounted for the highest volume of water deliveries in the MIA, otherwise cotton was the highest user.

Table	14 To	otal	deliveries	to maior	crop types	2018/19	compared	to previous	vears (ML)
10010		, cai	achiteries	co major	ciop cypes	2010/15	comparea	to premous	, cai 5 (iiii)

Year	Rice	Pasture	Cereal and Oil Seeds	Vegetables	Citrus + Vines + Other Fruits	Other Crops + Plantations	S&D + Towns + Industrial	Cotton
2018/19	37,171	12,753	88,968	10,518	130,716	71,460	22,174	113,443
2017/18	220,423	37,952	123,439	10,940	134,046	76,864	24,123	174,778
2016/17	304,200	26,030	57,479	10,129	109,257	71,376	9,844	82,004
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 monthly mean EC values and extracted salt loads are calculated using electrical conductivity (EC) sensors at MI's two river offtake sites NARREG and Sturt and presented in Table 15.

Month		STUR		NARREG			
	Flow	mean EC	STUR	Flow	Mean EC	NARREG	
	(ML)	(µS/cm)	Salt (t)	(ML)	(µS/cm)	Salt (t)	
Jul-18	0	222	0	4,547	159	424	
Aug-18	14,306	149	1,083	37,013	125	2,620	
Sep-18	15,925	100	965	43,275	81	2,087	
Oct-18	16,866	76	717	49,370	67	2,000	
Nov-18	5,939	76	291	35,179	76	1,591	
Dec-18	19,580	83	1,022	80,876	76	3,836	
Jan-19	26,652	84	1,306	100,853	81	4,861	
Feb-19	10,618	161	1,001	53,581	152	4,846	
Mar-19	6,822	123	547	39,046	104	2,462	
Apr-19	755	116	20	17,797	182	1,748	
May-19	0	173	0	4,303	214	678	
Jun-19	0	201	0	3,429	207	415	
Total	117,483	-	6,952	469,269	-	27,570	

Table 15 Total extracted salt load for 2018/19

Table 16 presents the total extracted salt loads for 2018/19 and previous years. During 2018/19, an estimated 34,522 tonnes of salt was imported into 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, which is evident for all reporting years.

Year	Diversions	Extracted salt load (t)					
	(ML)	STUR	NARREG	Total			
2018/19	586,752	6,952	27,570	34,522			
2017/18	945,805	14,920	50,030	64,950			
2016/17	780,083	11,722	32,903	44,625			
2007/08	393,973	1,778	26,816	28,594			

Table 16 Extracted salt-load (t) for 2018/19 compared to previous years

5.2 Discharged salt load

There are five discharge monitoring points that can 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 and totals from previous years are compared in Table 17. An estimated 98 tonnes was discharged from MI's Area of Operation through the five discharge monitoring points in 2018/19.

Year	Water discharged (ML)	Discharged Salt load (t)
2018/19	642	98
2017/18	4,471	854
2016/17	122,092	34,230
2005/06	8,570	1,887

 Table 17 Discharged salt load 2018/19 compared to previous years

Month	Flow	Mean EC	Min EC	Max EC	Salt load	Flow	Mean EC	Min EC	Max EC	Salt load
WOILI	(ML)	(µS/cm)	(µS/cm)	(µS/cm)	(t)	(ML)	(µS/cm)	(µS/cm)	(µS/cm)	(t)
		Yanco Main Sou	uthern Escape (YI	VIS) 410083			Goorage	ool Lagoon Esca	pe (LAG) 41010940	
Jul-18	102	985.8	985.8	985.8	38.6	16.8	403.0	234.0	572.0	3.0
Aug-18	-	-	-	-	-	19.5	299.0	68.0	418.0	3.0
Sep-18	-	-	-	-	-	11.9	251.0	204.0	332.0	2.0
Oct-18	0.3	192.7	192.7	192.7	0.0	24.1	247.0	154.0	660.0	4.0
Nov-18	-	-	-	-	-	5.9	292.0	8.0	345.0	1.0
Dec-18	-	-	-	-	-	28.3	375.0	242.0	449.0	6.0
Jan-19	-	-	-	-	-	4.6	386.0	258.0	528.0	1.0
Feb-19	-	-	-	-	-	0.0	-	-	-	0.0
Mar-19	-	-	-	-	-	0.0	-	-	-	0.0
Apr-19	-	-	-	-	-	0.0	-	-	-	0.0
May-19	-	-	-	-	-	7.5	211.0	6.0	262.0	1.0
Jun-19	-	-	-	-	-	0.0	-	-	-	0.0
Total	102.3				38.6	118.6				21.0
	Gog	geldrie Main Sou	thern Escape (GN	/ISRR) 41010921		Cudgel Creek Escape (ROCUDG) 41010005				
Jul-18	104.6	121.0	71.0	170.0	8.0	16.6	139.0	114.0	179.0	1.0
Aug-18	67.5	175.0	0.0	216.0	7.0	66.1	141.0	115.0	173.0	5.0
Sep-18	0.0	-	-	-	-	7.6	167.0	131.0	205.0	1.0
Oct-18	0.0	-	-	-	-	6.9	142.0	109.0	218.0	1.0
Nov-18	0.0	-	-	-	-	0.0	-	-	-	0.0
Dec-18	0.0	-	-	-	-	0.0	-	-	-	0.0
Jan-19	0.0	-	-	-	-	1.8	241.0	215.0	281.0	0.0
Feb-19	0.0	-	-	-	-	0.2	232.0	200.0	262.0	0.0
Mar-19	0.0	-	-	-	-	0.0	-	-	-	0.0
Apr-19	0.0	-	-	-	-	0.0	-	-	-	0.0
May-19	0.0	-	-	-	-	0.0	-	-	-	0.0
Jun-19	0.0	-	-	-	-	0.0	-	-	-	0.0
Total	172.1				15.0	99.20				8.0
		Mirrool Creek F	loodway (MIRFLE) 41010163						
Jul-18	150	163.8	163.8	163.8	15.7					
Total	150				15.7					

Table 18 Monthly summary of flow, EC and salt loads at monitoring points for 2018/19

5.3 Salt load summary

The salt loads presented in Table 19 show that of the 34,522 tonnes of salt received through diversions recorded at MI's authorised supply works (NARREG and STURT), 98 tonnes was discharged from the Area of Operations and an estimated 34,424 tonnes was 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 and does not consider other factors that impact total salt loads in the MIA.

No additional data is held by MI that is relevant to the assessment of salinity impacts under the Murray Darling Basin Salinity Management Strategy. There are no benchmarks, management plans or strategies relevant to MI's salinity or salt load monitoring data.

Extracted	Salt load (t)
STUR	6,952
NARREG	27,570
Total extracted	34,522
Discharged	Salt load (t)
YMS	39
GMSRR	15
LAG	21
ROCUDG	8
MIRFLD	16
Total discharged	98
Retained	34,424

Table 19 Salt load summary for 2018/19

6 Groundwater Conditions

6.1 Groundwater Monitoring and Reporting

A total of 641 piezometers are monitored and reported as per Attachment 2 of the Monitoring and Reporting Plan. The locations of these bores are displayed in Figure 4. In September 2018/19, 595 piezometers were monitored, which equates to 93% of the total piezometer network.

Table 20 Groundwater piezometer status summary (September 2018)

Total bores	Total destroyed	Dry, Flooded or Blocked	Total read
641	45	55	596

Groundwater levels and salinity (reported as EC) monitoring occurs in September to give insight into groundwater levels prior to the irrigation season. The network consists of piezometers in the shallow and deep Shepparton Formation and a smaller monitoring network in the Calivil Formation.

Depth to water table data is reported for 2018/19, 2017/18, 2016/17 and 2005/2006. The 2005/06 reporting year was chosen for reference as it represents a time period that includes the millennium drought in the MIA. Groundwater salinity is reported for 2018/19, 2017/18, 2016/17, 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.

The number of piezometers read within depth ranges for September are shown in Table 21.

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
2018	23	151	367	4%	28%	68%	541
2017	65	163	339	11%	29%	60%	567
2016	78	123	363	14%	22%	64%	564
2005	55	225	342	9%	36%	55%	622

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



Figure 4 Location of piezometers and tubewells in the MIA 2018/19

6.2 Groundwater salinity

The number of piezometers read within salinity ranges for September is shown in Table 22 and the percentage of total piezometers measured within each range is 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.

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
2018	481	49	11	0	0	0	0	541
2017	287	157	85	34	4	0	0	567
2016	247	126	86	57	19	5	1	541
1980	250	211	180	152	47	2	1	843

Table 22 Number of piezometers read within each salinity range

Table 23 Percentage 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
2018	89%	9%	2%	0%	0%	0%	0%	541
2017	51%	28%	15%	6%	1%	0%	0%	567
2016	46%	23%	16%	11%	4%	1%	0%	541
1980	30%	25%	21%	18%	6%	0%	0%	843

6.3 Shallow Shepparton Formation

September 2018 depth to water table and salinity maps for piezometers in the shallow Shepparton Formation are presented in Figures 5 to 10. Groundwater levels in this formation are expected to be highly influenced by seasonal rainfall, geology and irrigation. Ongoing drought conditions have resulted in groundwater levels in the Shallow Shepparton formation deeper in comparison with the previous years. This relates to well below average rainfall and associated reduced recharge, along with reduced allocations and water availability.

General salinity changes in the Shallow Shepparton Formation show progressive decreases in EC values across the MIA from the benchmark year 1980.

When compared to 2005/06 (Figure 17 and 18), recent groundwater levels appear to be deeper across the MIA, with fewer piezometers within 2m from surface level. An indication of the severity and influence of the ongoing drought conditions.

2018/19



Figure 5 Shallow Shepparton Formation- depth to water table, Sep 2018



Figure 6 Shallow Shepparton Formation- Groundwater Salinity, Sep 2018





Figure 7 Shallow Shepparton Formation- depth to water table, March 2018



Figure 8 Shallow Shepparton Formation- depth to water table, Sep 2017



Figure 9 Shallow Shepparton Formation- Groundwater Salinity, March 2018



Figure 10 Shallow Shepparton Formation- Groundwater Salinity, Sep 2017





Figure 11 Shallow Shepparton Formation- depth to water table, March 2017



Figure 12 Shallow Shepparton Formation- depth to water table, Sep 2016



Figure 13 Shallow Shepparton Formation- Groundwater Salinity, March 2017



Figure 14 Shallow Shepparton Formation- Groundwater Salinity, Sep 2016





Figure 15 Shallow Shepparton Formation - depth to water table, March 2006



Figure 16 Shallow Shepparton Formation - depth to water table, Sep 2005

1980/2002



Figure 17 Shallow Shepparton Formation, groundwater salinity, Sep 2002



Figure 18 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 19 to 32. 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.

Groundwater levels and salinity appear to have decreased in the deep Shepparton Formation influenced by the ongoing below average rainfall drought conditions, resulting low allocations and reduced water availability.

2018/19



Figure 19 Deep Shepparton Formation- depth to water table, Sept 2018



Figure 20 Deep Shepparton Formation- Groundwater Salinity, Sep 2018





Figure 21 Deep Shepparton Formation- depth to water table, March 2018



Figure 22 Deep Shepparton Formation- depth to water table, Sep 2017



Figure 23 Deep Shepparton Formation- depth to water table, Mar 2018



Figure 24 Deep Shepparton Formation- Groundwater Salinity, Sep 2017





Figure 25 Deep Shepparton Formation- depth to water table, March 2017



Figure 26 Deep Shepparton Formation- depth to water table, Sep 2016



Figure 27 Deep Shepparton Formation- Groundwater Salinity, March 2017



Figure 28 Deep Shepparton Formation- Groundwater Salinity, Sep 2016





Figure 29 Deep Shepparton Formation – Depth to water table, March 2006



Figure 30 Deep Shepparton Formation – Depth to water table, September 2005

1980/2002



Figure 31 Deep Shepparton Formation - groundwater salinity, 2002



Figure 32 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 33 to 46. Level trends in this formation generally represent drawdown from the shallow and deep Shepparton aquifers. As seen in the upper formations, piezometers measured in the deep formation September 2018 (Figure 34) exhibit low salinity. This suggests that the Calivil Formation may be influenced by previous years' 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.





Figure 33 Calivil Formation - depth to water table, Sep 2018



Figure 34 Calivil Shepparton Formation- groundwater salinity, Sep 2018





Figure 35 Calivil Formation - depth to water table, March 2018



Figure 36 Calivil Formation - depth to water table, Sep 2017



Figure 37 Calivil Formation- groundwater salinity, March 2018



Figure 38 Calivil Shepparton Formation- groundwater salinity, Sep 2017





Figure 39 Calivil Formation - depth to water table, March 2017



Figure 40 Calivil Formation - depth to water table, September 2016



Figure 41 Calivil Formation- groundwater salinity, March 2017



Figure 42 Calivil Formation- groundwater salinity, Sep 2016

2005/06



Figure 43 Calivil Formation - depth to water table, March 2006



Figure 44 Calivil Formation - depth to water table, Sep 2005





Figure 45 Calivil Formation - groundwater salinity, September 2002



Figure 46 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 is shown in Figure 4. Table 24 shows the total volumes and salt discharged from tubewells for 2018/19 and previous years. Only three tubewells operated, intermittently during 2018/19 and therefore, EC field measurements could not be measured at these sites. Salt loads for 2018/19 have been calculated using a three year EC average for each site. A total volume of 376 ML and 574 tonnes of salt was discharged from tubewells for 2018/19.

	2018/19		2017/18			
Location	Volume (ML)	Salt load (t)	Location	Volume (ML)	Salt load (t)	
Five Bridges	0	0	Five Bridges	0	0	
Gil Gil	213	406	Gil Gil	378	696	
Yanco West	63	122	Yanco West	321	528	
South Leeton	0	0	South Leeton	0	0	
Baulch's	0	0	Baulch's	0	0	
Wamoon	0	0	Wamoon	111	50	
East Wamoon	101	45	East Wamoon	96	39	
Total	376	574	Total	906	1313	
	2010/17		2006/07			
	2016/17			2006/07		
Location	Volume (ML)	Salt load (t)	Location	2006/07 Volume (ML)	Salt load (t)	
Location Five Bridges	Volume (ML) 324	Salt load (t) 180	Location Five Bridges	2006/07 Volume (ML) 707	Salt load (t) 489	
Location Five Bridges Gil Gil	Volume (ML) 324 518	Salt load (t) 180 1,061	Location Five Bridges Gil Gil	2006/07 Volume (ML) 707 266	Salt load (t) 489 353	
Location Five Bridges Gil Gil Yanco West	Volume (ML) 324 518 284	Salt load (t) 180 1,061 513	Location Five Bridges Gil Gil Yanco West	2006/07 Volume (ML) 707 266 305	Salt load (t) 489 353 404	
Location Five Bridges Gil Gil Yanco West South Leeton	Volume (ML) 324 518 284 191	Salt load (t) 180 1,061 513 816	Location Five Bridges Gil Gil Yanco West South Leeton	2006/07 Volume (ML) 707 266 305 76	Salt load (t) 489 353 404 118	
Location Five Bridges Gil Gil Yanco West South Leeton Baulch's	Volume (ML) 324 518 284 191 0	Salt load (t) 180 1,061 513 816 0	Location Five Bridges Gil Gil Yanco West South Leeton Baulch's	2006/07 Volume (ML) 707 266 305 76 137	Salt load (t) 489 353 404 118 52	
Location Five Bridges Gil Gil Yanco West South Leeton Baulch's Wamoon	Z016/17 Volume (ML) 324 518 284 191 0 238	Salt load (t) 180 1,061 513 816 0 128	Location Five Bridges Gil Gil Yanco West South Leeton Baulch's Wamoon	2006/07 Volume (ML) 707 266 305 76 137 384	Salt load (t) 489 353 404 118 52 200	
Location Five Bridges Gil Gil Yanco West Yanco West South Leeton Baulch's Wamoon East Wamoon	Volume (ML) 324 518 284 191 0 238 261	Salt load (t) 180 1,061 513 816 0 128 129	Location Five Bridges Gil Gil Yanco West South Leeton Baulch's Wamoon East Wamoon	2006/07 Volume (ML) 707 266 305 76 137 137 384 778	Salt load (t) 489 353 404 118 52 200 454	

Table 24 Tubewell monitoring data 2018/19 compared to previous years

8 New Measures to Limit Groundwater Recharge and Discharge of Salt

No new measures were implemented for 2018/19.

9 Environmental Protection and Management

9.1 Discharge of noxious aquatic weeds

During 2018/19 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

No Red alert level Blue Green Algae was detected from water sampled during discharge from MI's area of operation.

ENVIRONMENTAL PROTECTION LICENCE 4651

10 Statement of Compliance

MI has fulfilled the compliance requirements as set out in EPL 4651 for 2018/19A 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 at discharge points. Internal Standard Operating Procedures (SOPs) are reviewed and updated regularly.

MI has in place a process 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 (<u>www.mirrigation.com.au/Contact-Us</u>).

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	03.1	Yes	
Maintain a Chemical Control Plan	03.5	Yes	
Maintain Pollution Incident Response Management Plan	Required for all EPL holders under the Protection of Environment Operations Act 1997	Yes	www.mirrigation.com.au/En vironment/Water-Quality
Monitoring and Recording Conditions	5	No	1. Statement of Compliance
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

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

11 EPL Monitoring and Reporting

Under MI's EPL 4651, five points (Figure 2) are licensed 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 monitored. These discharge points are listed below:

- POINT 4 LAG Gogeldrie Main Drain at Gooragool Lagoon
- POINT 5 GMSRR Gogeldrie Main Southern Drain River Road
- POINT 6 YMS Yanco Main Southern Drain
- POINT 7 ROCUDG Cudgel Creek Roaches Escape
- POINT 15 MIRFLD Mirrool Creek Floodway Wyvern Station

11.1 System performance

Table 26 presents total diversions into the MIA and total water discharged from the MIA for 2018/19 compared to previous years. In 2018/19, 642 ML was discharged and included 150ML discharged to Mirrool Creek Floodway to facilitate necessary operational works. The large volume discharged in the 2016/17 season included 121,363 ML that was diverted to Mirrool Creek Floodway as a means of flood risk mitigation during a 1/150-year flood event.

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

Year	Diversions	Discharged
2018/19	586,752	642
2017/18	945 <i>,</i> 805	4,471
2016/17	780,083	122,092
2005/06	1,036,519	8,570

Table 26 Total water volumes (ML)

11.2 Water Quality Monitoring

Monthly summaries for each monitoring point are presented in Tables 27 - 31. Monitoring consisted of 11 sampling events, with 2 Action level detections and 1 Notification level detection. Metolachlor and Diuron were detected at Action levels, at Point 15 and Point 5 respectively. The number of Action level detections was lower compared to last reporting year where 5 Action levels were detected.

Diuron, Metolachlor and Chlorpyrifos were the three chemical types detected in 2018/19. Chemical detections were found at 3 of the 5 Licenced sites, Point 5 – GMSRR, Point 6 -YMS and Point 15 – MIRFLD.

Point 4 – LAG							
Month	Discharge Volumes (ML)	No. of sampling events	No. of detections	Chemical detection details			
Jul-18	16.8	0	0	-			
Aug-18	19.5	0	0	-			
Sep-18	11.9	0	0	-			
Oct-18	24.1	1	0	-			
Nov-18	5.9	1	0	-			
Dec-18	28.3	1	0	-			
Jan-19	4.6	0	0	-			
Feb-19	0	0	0	-			
Mar-19	0	0	0	-			
Apr-19	0	0	0	-			
May-19	7.5	1	0	-			
Jun-19	0	0	0	-			
Total	118.6	4	0	-			

Table 27 Monitoring results for Point 4 - LAG

Point 5 – GMSRR						
Month	Discharge Volumes (ML)	No. of sampling events	No. of detections	Chemical detection details		
Jul-18	104.6	1	0	-		
Aug-18	67.5	1	1	9/8/2018 Action level Diuron (9.8 µg/L)		
Sep-18	0	0	0	-		
Oct-18	0	0	0	-		
Nov-18	0	0	0	-		
Dec-18	0	0	0	-		
Jan-19	0	0	0	-		
Feb-19	0	0	0	-		
Mar-19	0	0	0	-		
Apr-19	0	0	0	-		
May-19	0	0	0	-		
Jun-19	0	0	0	-		
Total	172.1	2	1	-		

Table 28 Monitoring results for Point 5 - GMSRR

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-18	102	1	0	-		
Aug-18	-	0	0	-		
Sep-18	-	0	0	-		
Oct-18	0.3	1	1	19/10/2018 Notification level Chlorpyrifos (0.027 μ g/L)		
Nov-18	-	0	0	-		
Dec-18	-	0	0	-		
Jan-19	-	0	0	-		
Feb-19	-	0	0	-		
Mar-19	-	0	0	-		
Apr-19	-	0	0	-		
May-19	-	0	0	-		
Jun-19	-	0	0	-		
Total	102.3	2	1	-		

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-18	16.6	0	0	-		
Aug-18	66.1	1	0	-		
Sep-18	7.6	0	0	-		
Oct-18	6.9	1	0	-		
Nov-18	0	0	0	-		
Dec-18	0	0	0	-		
Jan-19	1.8	0	0	-		
Feb-19	0.2	0	0	-		
Mar-19	0	0	0	-		
Apr-19	0	0	0	-		
May-19	0	0	0	-		
Jun-19	0	0	0	-		
Total	99.2	2	0	-		

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-18	150	1	1	2/7/2018 Action level Metolachlor (0.12 µg/L)
Aug-18	0	0	0	-
Sep-18	0	0	0	-
Oct-18	0	0	0	-
Nov-18	0	0	0	-
Dec-18	0	0	0	-
Jan-19	0	0	0	-
Feb-19	0	0	0	-
Mar-19	0	0	0	-
Apr-19	0	0	0	-
May-19	0	0	0	-
Jun-19	0	0	0	-
Total	150	1	1	-