Seasonal Watering Proposal for the Wimmera Mallee Pipeline Wetlands Wimmera CMA Region 2017-18

Report prepared for: **Victorian Environmental Water Holder**
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Wimmera CMA

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GWMWater
VEWH

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1. Executive summary

The 2017-18 water year is likely to see a year of consolidation of improved conditions for wetlands supplied by the Wimmera Mallee Pipeline following a wet year in 2016-17. Good rainfall in winter/spring 2016 led to a number of wetlands filling from flood flows and/or local runoff. It also meant that limited environmental watering was required for these wetlands to retain or enhance their values. Furthermore it provided the first year of full allocation of the entitlement for pipeline wetlands for several years to share amongst wetlands in the Wimmera, Mallee and North Central CMA areas into the future.

Given a number of these wetlands were inundated in 2016 and they have an episodic hydrology, watering under most circumstances will be targeted at filling/topping up the dams associated with the wetlands rather than inundating the broader wetland area. This means these wetlands retain their value as a watering point for local fauna, especially birds.

In several cases this is possible due to infrastructure works such as pipelines and small channels which can efficiently direct water to specific wetland areas and avoid third-party impacts. This will be able to be trialled in earnest with increased water availability.

There is a solid foundation of ecological understanding of the wetlands values however knowledge of environmental water delivery to these wetlands is still in its early phases. Therefore monitoring will be undertaken to ensure environmental water is being used efficiently and effectively to maintain the value of these wetlands. Their episodic hydrology means a regime of wetting and drying over a number of years will achieve the maximum environmental outcomes. An Environmental Water Management Plan has been developed for these wetlands which assists long-term planning for environmental water use.

Estimation of volumes required to achieve these objectives are included in Table 1 which provides the watering scenarios based on varying climatic conditions – given the fact that numerous wetlands were inundated last year there is no need to repeat that this year but the high allocations mean that regardless of climate, watering actions at wetlands that missed out on inundation in spring 2016 can take place in 2017.

Table 1: Priority watering actions under a range of planning scenarios for Wimmera Mallee Pipeline wetlands in the Wimmera CMA region.

Wimmera Mallee Pipeline Wetlands – Wimmera CMA	DROUGHT	DRY	AVERAGE	WET
Total maximum environmental water required (ML)	**Fill/top up all dams plus provide wetland inundation for Crow Swamp, Carapugna, Tarkedia and Challambra – total of 137 ML**			

Information to ascertain changes due to environmental water actions will be gathered from a variety of sources (landholder observations, photo points and sound recordings).

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2. Introduction

This seasonal watering proposal outlines the Wimmera CMA's proposed priorities for use of environmental water from the Wimmera and Glenelg Rivers Environmental Entitlement (the 'Water Holdings'), in the Wimmera CMA region for off-stream wetlands connected to the Wimmera Mallee Pipeline for the water year 2017-18. This seasonal watering proposal is submitted to the Victorian Environmental Water Holder (VEWH) in accordance with section 192A of the *Water Act 1989*. This seasonal watering proposal is endorsed by the Wimmera CMA Board for use by the VEWH as part of the development of the VEWH *Seasonal Watering Plan 2017-18*.

This proposal flags intentions for monitoring and communication to demonstrate the outcomes the watering has achieved as well as analysing and mitigating the risks associated with environmental watering activities. It is also valuable in terms of communicating priorities to storage operators to manage infrastructure to undertake releases as well as the community to flag priorities and highlight the assumptions, transparency and rigor that goes into decisions around the use of regulated environmental water.

3. Engagement

It is prescribed in the Environmental Entitlement for the Wimmera and Glenelg Rivers that the best available science is needed to determine environmental water use in order to achieve the best regional ecological outcomes. There is currently limited but sufficient ecological information on which to base decision making but not a long record of monitoring data. Therefore community information and input assists greatly in this regard. There is also useful feedback from stakeholders (i.e. other CMAs, VEWH), private landholders and Crown land managers (i.e. Parks Victoria) with respect to implementation of environmental watering actions.

Landholders and land managers with wetlands on their estate were consulted during the development of the Seasonal Watering Proposal as well as GWMWater in their role as storage manager, responsible for supplying the water to these wetlands (Table 2). A highlight of this was an event in March 2017 which, combined with North Central CMA involved a field trip to view several wetlands near Watchem. This was targeted at people who have wetlands supplied by the pipeline on or next to their properties.

Table 2. Consultation undertaken in the development of the Seasonal Watering Proposal

Organisation/ individual consulted	Consultation mechanism	Purpose of consultation	Issues raised (and how it was addressed)
Landholders with wetlands on their property	Phone calls	Discuss outcomes of current year's watering and plans for next year	Indicated ongoing support for watering actions
Field and Game (Stuart McFarlane, Dale Russell)	E-mail, Phone call	Seek feedback re. outcomes for game reserves	Nil – appreciated being consulted
Parks Victoria (Evan McDowell)	E-mail	Illustrate outcomes of current year's watering and plans for next year as well as determining process for PV endorsement	Nil – provided sign off contact
GWMWater (Kym Wilson)	E-mail	Illustrate plans for next year in terms of determining feasibility of delivery and determining process for GWMWater endorsement	Nil

4. Environmental Objectives and Flow Recommendations

The Wimmera Mallee Pipeline Project (WMPP) was implemented to modernise water delivery infrastructure throughout the Wimmera Mallee Region. Upon its completion in 2010, the project has converted approximately 17,500 km of highly inefficient earthen water channels to 8,800 km of reticulated pipeline. The project has resulted in a number of significant water savings which have been re-directed to deliver a range of environmental, economic and social benefits.

The *Wimmera and Glenelg Rivers Environmental Entitlement 2010* provided the legal means by which the majority of the water savings could be returned to the region's flow stressed rivers as well as isolated wetlands within the Wimmera Mallee Pipeline footprint. The 1000 ML entitlement supports priority wetlands that were historically associated with water storage under the former open channel water supply system. These wetlands, typically containing dams, are no longer part of the water delivery system, being replaced with tanks and pipes. The entitlement recognises the significance water within these wetlands provides within a region characterised by a semi-arid climate and limited surface water. Wetlands eligible to receive water from this entitlement are scattered across the Wimmera, North Central and Mallee CMA regions.

The following 13 wetlands were identified for supply within the Wimmera CMA region:

- Carapugna
- Challambra Swamp
- Harcoan's Swamp
- Mutton Swamp
- Pinedale
- Sawpit Swamp
- Wal Wal Swamp
- Crow Swamp
- Krong Swamp
- Tarkedia
- Opie's Dam
- Schultz/ Koschitzke
- Fielding's Dam

They are all located in the north-east of the Wimmera CMA region (Figure 1).

The long-term objective for these wetlands are for them to act as a refuge for native fauna, especially wetland species during summer/autumn particularly during droughts as well as enhanced wetland vegetation abundance and diversity.

The absence of definitive information on the values and watering requirements of these wetlands led to the undertaking of studies by Australian Ecosystems in 2012 and Rakali Consulting in 2013, on behalf of Wimmera CMA. The studies benchmarked their condition through Index of Wetland Condition and flora surveys, mapping Ecological Vegetation Classes (EVCs) and recording observed fauna at each wetland. Following this the approximate areas and the recommended watering regime as classified in the *Water the Salinity Regime and Depth Preferences for Victorian Wetland EVCs* (DSE, 2012) were used as a guide to provide approximate volumes for each EVC area in each wetland (Table 3).

Ideally, dams should contain water perennially for local fauna but filling them in winter/spring and then having them dry out (but not empty) over summer/autumn will lead to fluctuation of water levels and encourage the growth of a diverse range of wetland vegetation. This in turn leads to benefits for fauna such as provision of habitat for tadpoles.

The watering of wetlands that are State Game Reserves (Sawpit Swamp, Mutton Swamp, Wal Wal Swamp and Crow Swamp) will provide social benefits in terms of increased duck hunting opportunities. There will be other social benefits around bird watching and the aesthetics of surface water in a typically dry, semi-arid environment. Local community members, including landholders with wetlands on their property have been able to benefit from yabbying in dams that would otherwise be dry.

Figure 1: Off-stream wetlands proposed to be supplied in the Wimmera CMA region

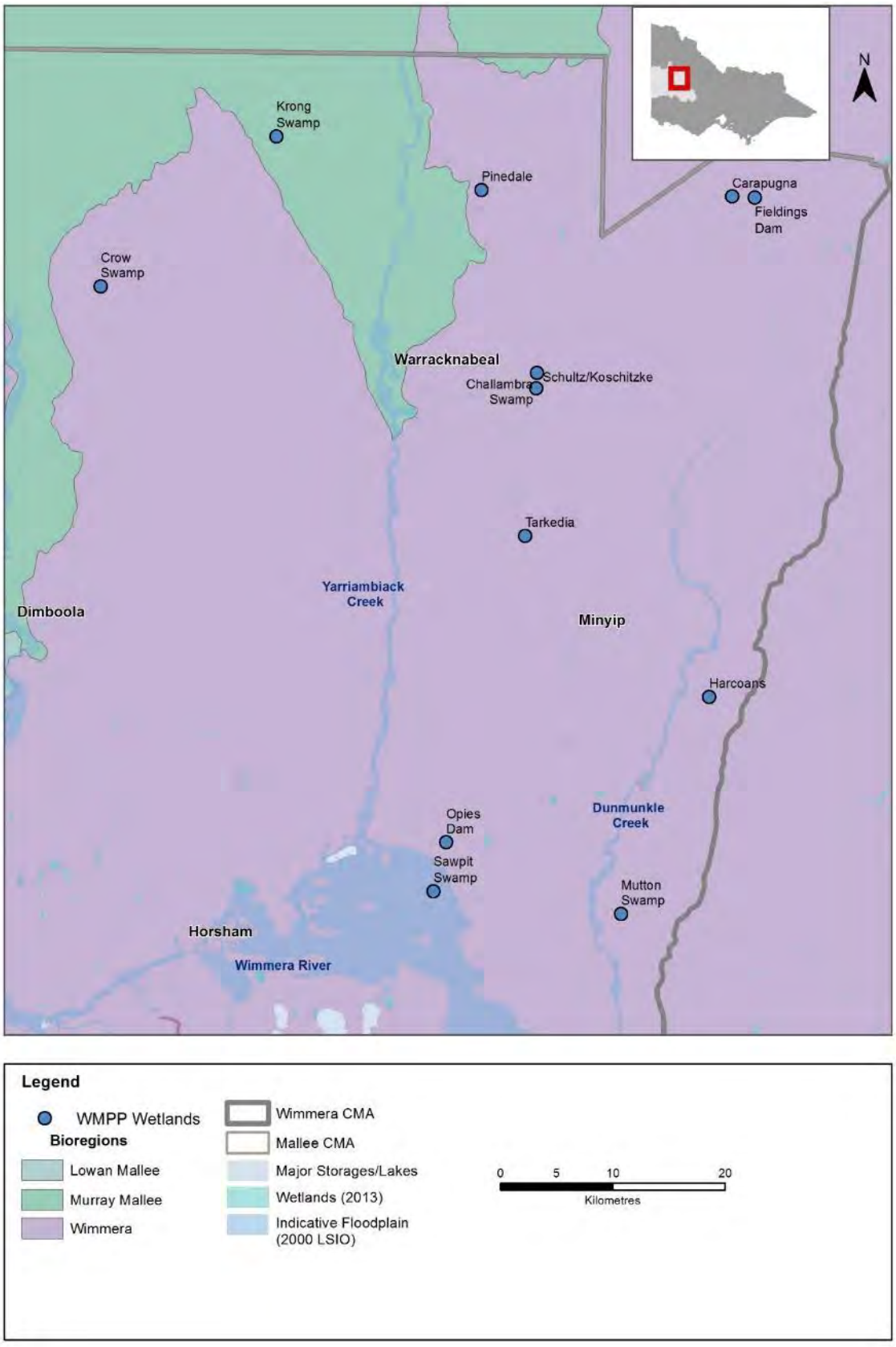
N
Krong Swamp
Pinedale
Carapugna
Fieldings Dam
Crow Swamp
Warracknabeal
Schultz/Koschitzke
Challambra Swamp
Tarkedia
Yarriambiack Creek
Dimboola
Minyip
Harcoans
Dunmunkle Creek
Opies Dam
Sawpit Swamp
Mutton Swamp
Horsham
Wimmera River
Legend
WMPP Wetlands
Bioregions
Lowan Mallee
Murray Mallee
Wimmera
Wimmera CMA
Mallee CMA
Major Storages/Lakes
Wetlands (2013)
Indicative Floodplain (2000 LSIO)
0 5 10 20
Kilometres

Table 3. Wetland categories of nominated wetlands and inundation preference information from Australian Ecosystems (2013) and Rakali Consulting (2014).

Wetland name	Wetland category	Wetland EVCs	Optimum inundation frequency	Inundation duration	Inundation depth	Approximate Volume Required per EVC (ML)
Carapugna	Freshwater Meadow	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	50.4
		Northern Wimmera Riverine Chenopod Wetland	Sporadic and uncommon	Not recommended to be artificially inundated		
Challambra Swamp	Freshwater Meadow	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	32
		Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 2 m	46.4
Crow Swamp	Shallow Freshwater Marsh	Intermittent Swampy Woodland	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	14
		Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 200 cm	37.5
		Northern Wimmera Riverine Chenopod Wetland	< 3 years in 10	1 month to > 1 year	Up to 30 cm	2.4
Harcoan's Swamp	Freshwater Meadow	Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 200 cm	40
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	2.1
Krong Swamp	Freshwater Meadow	Lignum Swampy Woodland	Once every 2 – 5 years	Up to 4 months	Up to 30 cm	4
		Lignum Shrubland	Only if dry for > 2 years	< 6 months	50 cm on average	11
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	18.6
Mutton Swamp	Freshwater Meadow	Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 200 cm	39
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	40
Pinedale	Shallow Freshwater Marsh	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	12.9
		Northern Wimmera Riverine Chenopod Wetland	Sporadic and uncommon	Not recommended to be artificially inundated		8.9
Sawpit Swamp	Shallow Freshwater Marsh	Intermittent Swampy Woodland	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	17.4
		Floodway Pond Herbland	3-7 years in 10 Only if dry for > 6 months	< 12 months	30 cm to 2 m	18
		Floodway Pond Herbland- Riverine Swamp Complex	Only if dry for > 2 years	< 4 months	50 cm on average	65.5
Wal Wal Swamp	Shallow Freshwater	Red Gum Swamp-Cane Grass Wetland Complex	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	24

Wetland name	Wetland category	Wetland EVCs	Optimum inundation frequency	Inundation duration	Inundation depth	Approximate Volume Required per EVC (ML)
	Marsh	Cane Grass Wetland-Aquatic Herbland Complex	8-10 years in 10	1 – 8 months	30 cm to 1 m	16.5
		Riverine Swampy Woodland	Sporadic and uncommon	Not recommended to be artificially inundated		2.2
Opie's Dam	NA – Dam	NA	Permanent	Maintenance of surface water for Growling Grass Frog population		4
Tarkedia	Shallow Freshwater Marsh	Lignum Swampy Woodland	Once every 2 – 5 years	Up to 4 months	Up to 30 cm	13.5
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	13.5
Fielding's Dam	Freshwater Meadow	Herb-rich Gilgai Wetland	3-7 years in 10	Up to 3 months	Up to 20 cm	10
Schultz/ Koschitzke	Freshwater Meadow	Plains Grassy Wetland/ Spike-sedge Wetland	3-7 years in 10	1 month to > 1 year	Up to 1 m	50
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	24

Community members at a combined Wimmera and North Central CMA wetland pipeline information day, March 2017

5. Seasonal Review

There is limited information about these wetlands in terms of their history of inundation prior to the delivery of environmental water, the ecological values they support and how these values may have responded to changes in water availability. The ongoing drought conditions that persisted from 1997 to 2009 would have meant that these wetlands would have been largely dry and the channel system would have only provided water infrequently to the dams in/adjacent to these wetlands. It is highly likely that most of these dams were dry from at least 2004-05 to 2010-11. Some (e.g. Crow Swamp) did not even contain water in 2010-11 despite record rainfall.

The period from September 2010 to January 2011 was exceptionally wet and therefore the runoff generated led to significant inundation events. Conditions following the January 2011 floods have been dry and the wetlands dried out such that water was only present in locations where environmental water has been delivered. Sawpit Swamp was the first wetland connected to the Wimmera Mallee Pipeline and benefited from a couple of watering events prior to 2014-15. Following the completion of wetland assessments and infrastructure works from mid-2014 through to early 2015, watering efforts escalated in early 2015. Including, filling dams at: Fielding's Dam, Tarkedia, Harcoan's, Krong Swamp, Carapugna. Filling dams and providing shallow wetland inundation at: Mutton Swamp, Crow Swamp, Pinedale. Filling dam and providing deep inundation at: Wal Wal Swamp. Examples of outcomes at these wetlands are shown in Section 8.

In 2015-16 watering took place in November and December to provide low level inundation at Sawpit Swamp, top up Fielding's Dam as well as fill Krong Swamp and Carapugna. During the off-peak pipeline delivery period in April-June 2016 there were top ups for dams at Mutton Swamp, Crow Swamp, Wal Wal Swamp, Tarkedia, Carapugna and Pinedale. Wet conditions in spring 2016 let to Wal Wal Swamp, Harcoan's, Krong Swamp, Mutton Swamp, Carapugna, Schultz/Koschitzke and Sawpit Swamp receiving good levels of natural runoff to achieve desired wetland water outcomes. The inundation history of these wetlands from 2004/05 is outlined in Table 4.

Local fauna, especially wetland bird and frog populations have benefitted from wetlands and/or dams receiving water and positive vegetation outcomes have been observed which is leading to a gradual increase in the environmental values of these wetlands. Localised heavy rainfall is enough to maintain many of the values (e.g. threatened aquatic plants species have been observed in wetlands that are yet to be supplied from the pipeline). However in dry years this will not happen and so water supplied by the pipeline plays a more important role. Similarly in very wet years water supplied by the pipeline may keep wetlands topped up to meet recommended durations of inundation.

There were limited shared benefits provided by environmental water in 2016-17 – there were modest duck hunting opportunities given water was only confined to the dam area for Mutton, Wal Wal and Crow Swamps. Yabbying and bird watching were the other main shared benefits that took place in 2016-17.

Figure 2. Black Swan at Schultz-Koschitzke's – October 2016

Table 4. Historical watering regime of wetlands from 2004/05 up to March 2016

Key	WET	WET-DRY	DRY												
Wetland Name	Water regime														Ecological outcomes/observations 2016/17
	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17		
Carapunga	D O	D	D	D	D	D	U		D	D	E D	E D	U P		Wet conditions saw a good response for flora and fanua
Challambra Swamp	D O	D					U		D	D	E D	E D	P		Water in dam leads to benefits for local fauna.
Harcoan's Swamp	D O						U				E D		U P		Very positive response by waterbirds to set spring 2016. Dam does not hold water well.
Mutton Swamp							U	D	D		E D	E D	U P		Water in dam leads to benefits for local fauna. Low level inundation leads to improved wetland vegetation and waterbird outcomes.
Pinedale	D O						U				E	E	D P		Water in dam leads to benefits for local fauna. Wetland flora (black box) still showing benefits of previous watering.
Sawpit Swamp							U			E	E	E	U P		Very positive flora response to flooding. Dam does not hold water well.
Wal Wal Swamp							U				E	E	U P		Very positive flora and fauna response to flooding.
Krong Swamp	D O						U				E D	E	U P		Very positive flora and fauna response to flooding. Dam does not hold water well.
Crow Swamp											E D	E D	D P		Water in dam leads to benefits for local fauna. Low level inundation leads to improved wetland vegetation and waterbird outcomes.
Opie's Dam (Dam only)	D O						U D	D	D				D P		Some runoff led to water in dam
Tarkedia							U				E D	E D	D P		Water in dam leads to benefits for local fauna.
Fielding's Dam	D O	D					U	D	D		E D	E D	E		Water in dam leads to benefits for local fauna.
Schultz/Koschitzke	D O						U					E	U P		Very positive flora and fauna response to flooding.

Key- O: Received consumptive water U: Received unregulated water E: Received environmental water D: Dam contains water only (i.e. wetland dry) P: Planned delivery for April-June 2017

6. Scenario Planning and Prioritisation

Increased information around the watering of these wetlands has been developed during the drafting of Environmental Water Management Plans (EWMPs) for the region in terms of establishing a recommendations around the frequency and duration of wetland inundation events. Given the highly episodic nature of the wetlands' hydrology, they would not naturally be inundated every year. In fact during droughts, it might be over a decade between significant inundation events. Therefore, providing water to these wetlands can be done on a rotational basis, watering several every year. However given low allocations this can be further curtailed to focus on providing water to the dams to benefit local fauna. Table 5 lists the priority watering actions for the Wimmera Mallee Pipeline wetlands in 2017-18 in the Wimmera region. Table 6 outlines where these priority watering actions fit within the context of different climate scenarios. Table 7 lists these watering objectives in more detail under the various climate scenarios. The recent wet conditions means that for a number of wetlands, there is no need to undertake watering actions beyond topping up/refilling dams. Watering activities will continue to support shared benefits around duck hunting at Mutton, Wal Wal, Sawpit and Crow Swamps. Elsewhere the benefits pertain more to yabbying, birdwatching and the aesthetics of seeing surface water in a largely dry landscape.

6.1. Priority Watering Actions

Table 5. Priority watering actions 2017-18

Priority	Wetland watering action	Rationale
Very high	Fill/ top up dams at all wetland sites.	Provide refuges for local fauna especially wetland birds in a semi-arid region under dry conditions for dams that retain water well. For dams that do not retain water well – provides opportunity to enable recruitment of local flora and fauna.
High	Water adjacent wetland areas at, Tarkedia, Crow, Challambra Carapugna	Enhance high value wetland flora including threatened species.
Medium	NA – all priority watering actions achieved	
Low	NA – all priority watering actions achieved	

6.2. Scenario Planning

Table 6. Scenario Planning

Scenario outcomes	Drought	Dry	Average	Wet
Expected climatic conditions and water availability	Carryover approx. 1680 ML Allocations 0ML	Carryover approx. 1680 ML Allocations 60 ML	Carryover approx. 1680 ML Allocations 250 ML	Carryover approx. 1680 ML Allocations 250 ML
Expected inflows	Nil	Nil	Shallow inundation (< 0.2 m)	Moderate inundation (<0.5 m)
Environmental objectives	Refuges for fauna and enhancing flora at priority wetlands			
Priority watering actions	Fill/ top up dams at all wetland sites. Water adjacent wetland areas at, Tarkedia, Crow, Challambra, Carapugna			
Estimated environmental water requirement	63 ML all dams, 14 ML Carapugna, 45 ML Challambra, 4 ML Tarkedia, 11ML Crow Swamp (137 ML – total)			
High priority carryover requirements	NA – allocations sufficient			
Additional water demand and use (if available)	Nil			

Following wet conditions 2016 there are very good allocations coming into 2017-18 which should enable all priority watering actions to be achieved. The estimated environmental water requirement volumes are sufficient to fill/top up all dams as well as a volume to inundate wetlands at Tarkedia, Crow Swamp, Challambra Swamp and Carapugna. The volume for these four wetlands is the maximum modelled volume that can delivered (Table 8) plus 10% given pipeline demands are likely to be less than those assumed in the modelled delivery rates.

Table 7. Priority watering actions proposed for wetlands supplied by the Wimmera Mallee Pipeline in the Wimmera CMA area and priority for watering in 2017-18

Wetland	Priority watering actions	Estimated max. volume required (ML)		Priority (Dam)	Priority (Wetland)
		Dam	Wetland		
Carapugna	Refill dam and priority wetland EVC	8	22	Very High	High
Challambra Swamp	Refill dam and priority wetland EVC	5	45	Very High	High
Crow Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC	3	22	Very High	High
Harcoan's Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC	5	35	Very High	NA
Krong Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC	3	12	Very High	NA
Mutton Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC	5	45	Very High	NA
Pinedale	Refill dam only (watering adjacent wetland vegetation is not desirable this year due to risks of overwatering)	4	NA	Very High	NA
Sawpit Swamp	Refill dam and priority wetland EVC	10	40	Very High	NA
Wal Wal Swamp	Refill dam and priority wetland EVC	5	15	Very High	NA
Opie's Dam	Refill dam	4	NA	Very High	NA
Tarkedia	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC	4	9.5	Very High	High
Fielding's Dam	Refill dam	2	NA	Very High	NA
Schultz/Koschitzke	Refill dam and priority wetland EVC	5	45	Very High	NA
Total	*For wetland watering actions listed above*	*63*	*290.5*		

7. Delivery Constraints

The information provided by Australian Ecosystems (2013) and Rakali Consulting (2014) provides a solid foundation for undertaking watering actions through the mapping of EVCs and development of watering recommendations based on DSE (2012). For each wetland there needs to be consideration of the modelled pipeline capacity to deliver water compared to the volumes required to meet the recommended water level and duration (see Table 8).

There are some wetlands where hydraulic modelling indicates that the amount that can be delivered on an annual basis is close to or above that required to inundate the lowermost EVC within the wetlands (highlighted in green). Whilst in others the hydraulic capacity to supply the wetland is much lower than the volume required to supply sufficient water to fill the wetland to the recommended level within a year (highlighted in yellow).

Table 8. Comparison between modelled maximum annual demand delivered from the pipeline outlet (from GWMWater 2012, 2013), compared to the initial target wetland EVC volume(from Australian Ecosystems, 2013) and (Rakali, 2014). Dam volumes within the wetland area would be much smaller (several megalitres).

Wetland	Modelled Maximum Demand (ML)	Wetland target EVC Approximate Capacity
Carapugna	20	50.4
Challambra Swamp	45	46.4
Crow Swamp	12	37.5
Harcoans	30	40
Krong Swamp	15	11
Mutton	50	39
Pinedale	25	12.9
Sawpit Swamp	50	83.5
Wal Wal Swamp	15	16.5
Opie's Dam	2	2
Tarkedia	8	13.5
Schultz/Koschitzke	20	50
Fielding's Dam	4	10

Some other key factors are worth noting:

- Given the long period of delivery (a number of months) there is likely to be seepage and evaporation losses within the wetlands whilst deliveries are occurring. They will increase during the warmer months although deliveries are typically during cooler months.
- The period for delivery is typically 'off-peak' which are months where demand on the Wimmera Mallee Pipeline for supplying towns and farms is lowest (May-September). This maximises the delivery rate of water to wetlands. It may not be possible to deliver water to these wetlands in peak periods due to other demands.
- Some wetlands have had infrastructure constructed in February 2015 to enable much better environmental outcomes to be achieved from the application of environmental water. The details of which are included in RPS (2014) and an example is included in Figure 3. This will enable targeted watering of wetlands or watering of both the dam and the wetland.
- The estimates of the volumes required to be supplied to these wetlands are very coarse (i.e. calculated from area of EVC multiplied by the recommended depth) and so does not take into account variations in topography within the wetlands themselves. Given they are depressions within the landscape it is likely that they are underestimates. However given the fact that the estimated volume is calculated to achieve the maximum height recommended within these wetland EVCs, shortfalls will still achieve a similar outcome (i.e. a wetland requiring inundation level of 0.3 m to 1m will still benefit if the inundation is 0.7 m compared to 1m). Adaptive management based on observed outcomes through environmental water delivery will be crucial to

ensuring that watering outcomes are obtained into the future (i.e. volumes required to inundate the wetland to a certain level and how long the water persists).

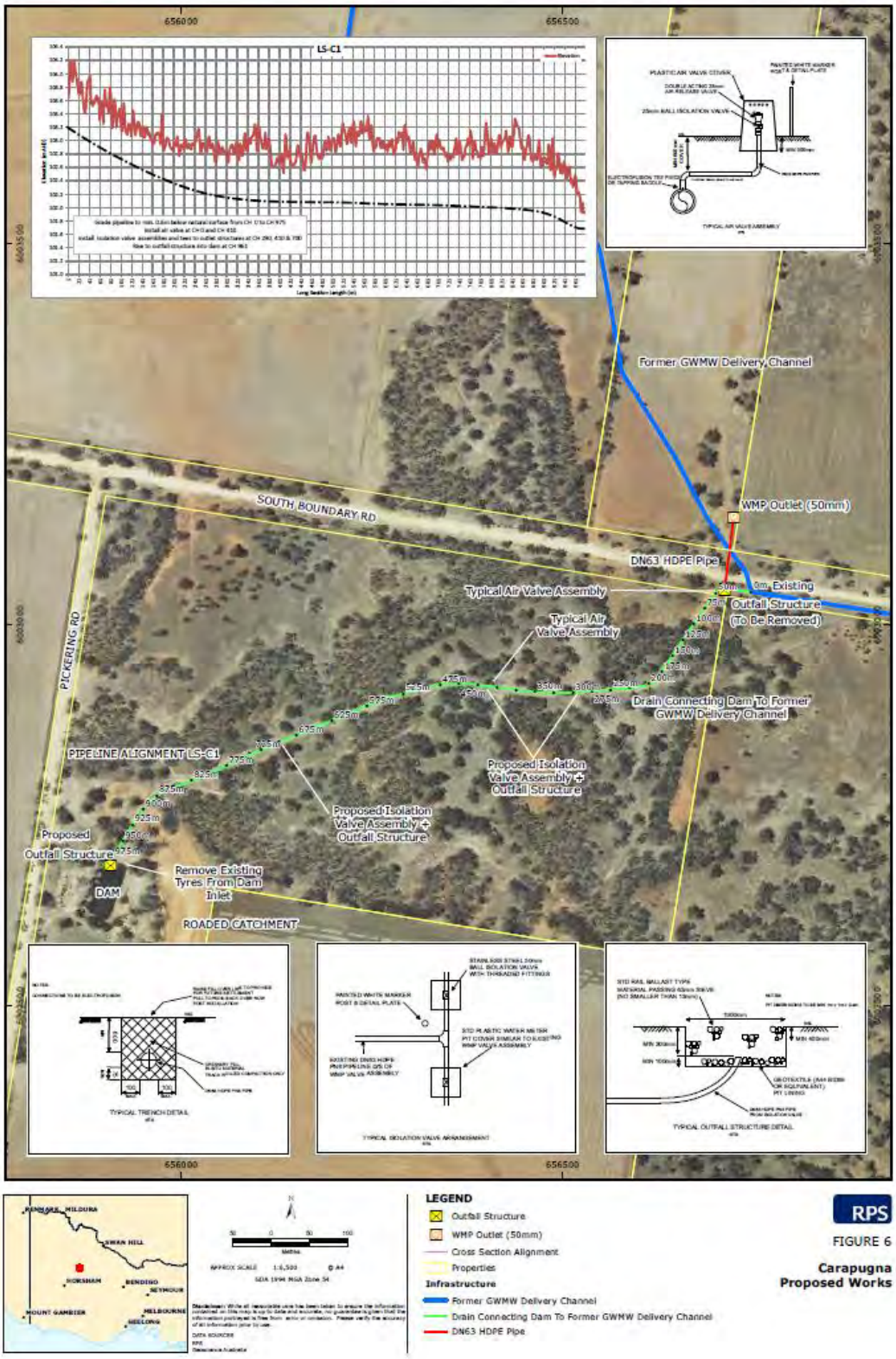

Figure 3. Example diagram of works undertaken at Carapugna in February 2015 to enhance wetland hydrology.

8. Increasing Knowledge

The work undertaken by Australian Ecosystems in 2012 and Rakali Consulting in 2013 has provided an invaluable initial benchmarking exercise and fills some key gaps in terms of understanding the watering requirements and values to be enhanced. DELWP (2015, draft) also provides useful information on the watering needs of wetland vegetation, waterbirds and wetland dependent fauna, namely frogs and turtles. However there is still not much data available for these locations given their isolated nature and lack of previous watering activities so adaptive management through effective monitoring is a critical process going forward.

Wimmera CMA and Birchip Landcare Group have deployed equipment including frog monitoring equipment and motion sensor cameras at several wetlands in the Wimmera CMA region receiving environmental water to determine the types of fauna that benefit from the water (Figures 4-7). Ideally additional monitoring (e.g. vegetation, WETMAP) could be applied to determine other outcomes including wetland vegetation condition and diversity. Carapugna is the only wetland supplied by the Wimmera Mallee Pipeline to be on the initial list of wetlands included in the initial WETMAP monitoring program.

Monitoring of environmental water releases is a critical component of adaptive management and enables meaningful reporting of environmental outcomes generated by these activities and justification for the significant amounts of public investment made in environmental water recovery and management. So far limited resources have been made available for monitoring these wetlands prior to and after the application of environmental water, therefore fairly rudimentary monitoring activities are proposed in Table 9. Wimmera CMA will work with relevant landholders with respect to monitoring and including local knowledge into decision making processes. Should funding be available, a more comprehensive assessment of vegetation would be beneficial in order to quantify changes that have resulted from watering activities. Monitoring undertaken can not only facilitate reporting on outcomes of environmental watering activities but fill knowledge gaps regarding the effectiveness of these activities going forward.

Table 9. Proposed monitoring for Wimmera Mallee Pipeline Wetlands

Wetland	Objective	Hypotheses	Indicator(s)	Frequency
All	Area/depth inundated	Need to establish a relationship between volumes delivered and habitat provided	Depth (bathymetry data) and volume (meters) including using pressure sensors	Periodic
	Water quality	Water will be of sufficient quality to sustain aquatic and wetland ecosystems	Salinity, pH and dissolved oxygen	Periodic
	Wetland condition (vegetation etc.)	Watering will lead to an increase in wetland condition and any declines in condition (e.g. too frequent inundation) will be captured	IWC Scores, established transects and photopoints	Subject to funding
	Frogs	Watering will trigger a response in the frog population	Frog audio surveys	Periodic
	Wetland birds and other fauna	Watering will attract wetland birds and other fauna in a dry region to use habitat	Motion sensor camera	Periodic

Figure 4. Nesting White Necked Herons at Mutton Swamp – November 2016.

Figure 5. Unregulated overland flows filled Harcoan's and it provided great conditions for waterbirds – with prolific duck breeding when the water levels were high.

Figure 6. Unregulated overland flows filled Harcoan's and it provided great conditions for waterbirds – as the wetland dried out a large number of Straw-necked Ibis and White-faced Herons.

Figure 7. Flood flows from the Wimmera River filled Sawpit Swamp which benefitted waterbirds, largely ducks and herons although there were a number of terrestrial birds that were observed

9. Risk assessment and management

Risk assessment and management is a critical aspect of long-term environmental water planning, Table 10 illustrates the various risks (likelihood and consequence) associated with planned environmental flow components. The risk assessment was developed in conjunction with VEWH and GWMWater.

Table 10. Risk assessment and where appropriate mitigation measures for environmental watering

Legend:

1. Risk category abbreviations are: Env. – environment/sustainability; BC – business cost; Safety – People/safety/wellbeing; Rep – Political/reputation; Legal – legal consequence; Service – service delivery
2. L refers to the Likelihood of a risk occurring. Abbreviations for consequence ratings are: AC – almost certain; L – likely; P – possible; U – unlikely; R - rare
3. C refers to the Consequence if the risk occurs. Abbreviations for consequence ratings are: N – negligible; Min – minor; Mod – moderate; Maj – major; Ext - extreme

No.	Risk category [1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action
1	Env	Insufficient water available for proposed watering actions to meet environmental objectives.	P	Maj	Extreme	Adaptively prioritise and revise watering actions to optimise outcomes from water available considering seasonal conditions. Prioritise sites and/or watering actions Maximise use of consumptive water en-route for environmental benefit. Consider reserving contingency volume for current year and balancing against carryover needs for future years. Communicate with community and stakeholders around planned watering actions and any revisions required. Undertake complementary actions (e.g. carp removal, fencing).	CMA VEWH GWMWater VEWH CMA CMA
2	Env	Environmental water deliveries may generate or mobilise poor quality water (e.g. blackwater, BGA), with adverse water quality and environmental outcomes ; or Areas not targeted for environmental watering	P	Mod	High	Ongoing monitoring to inform water deliveries, including arranging improved access to data. Adapt flow management based on antecedent conditions and local knowledge.	CMA VEWH

No.	Risk category [1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action
		actions experience poor quality water (e.g. blackwater, BGA), with adverse water quality and environmental outcomes				Maximise use of consumptive water *en route* for environmental benefit. Establish environmental reserve to manage management needs. Communicate around current conditions and revised objectives. Undertake complementary actions, including provision of information to the community	GWMWater VEWH CMA CMA
3	Env	Environmental deliveries create improved conditions for non-native species (e.g. carp, invasive weeds) leading to adverse environmental impacts. (*Note: This risk addresses the incremental impact of environmental water deliveries on pest plant and animal populations, noting that even in the absence of environmental delivery actions these pests are likely to spread in waterways with adverse environmental impacts)*	P	Min	Medium	Adaptively manage flow to incorporate new knowledge from monitoring and research. Monitor invasive species extent and control existing populations (e.g. opportunistic removal of carp in dry conditions). Install physical barrier to prevent translocation (e.g. carp barriers). Develop management agreements with landholders that include pest plant and animal control measures.	CMA CMA CMA CMA
4	Rep	Inability to demonstrate that environmental water objectives have been achieved, which may lead to a loss of public/political support for activities.	L	Mod	High	Seek additional funding for and undertake targeted local monitoring (leveraging existing data sets where possible). Invest in monitoring and research to address knowledge gaps and influence existing monitoring programs. Share new knowledge to promote adaptive management. Communicate monitoring results to local communities.	CMA VEWH VEWH CMA
5	Legal	Environmental releases cause unauthorised inundation of private land, resulting in impacts	P	Mod	Medium	Ongoing communication with GWMWater and land managers in planning and delivery	CMA

No.	Risk category [1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action
		on landowner activities and assets.				phases. Consider weather forecasts when planning releases and reschedule deliveries if forecasts indicate potential for flooding. Test and monitor delivery rate and respond to potential incidents. Maintain and inspect infrastructure, including upgrading infrastructure where required before delivery occurs. Identify likely areas of impact by understanding historical impacts and previous experience, and modify flow planning, or undertake works to reduce risk of inundation.	GWMWater GWMWater GWMWater CMA
6	BC	Insufficient staff resources available to deliver all planned environmental watering actions, leading to cancellation or interruption of deliveries.	P	Mod	Medium	Ongoing communication with the GWMWater to understand constraints and develop a schedule of delivery to manage staff resources. Implement remote monitoring to minimise staff time in the field, within available funding. Continue to actively prioritise actions to match available resources and ensure key actions are delivered.	CMA GWMWater CMA
7	BC	Volume delivered or released exceeds volume approved and/or ordered for use in the event or year.	R	Mod	Medium	Communicate seasonal watering statements to all partners. Monitor delivery rate, provide delivery data to CMA/VEWH and respond to potential incidents. Monitor water use against volume approved for use in seasonal watering statement and adapt water orders if required.	VEWH GWMWater CMA VEWH

No.	Risk category [1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action
						Monitor water use against volume approved and undertake regular communications with CMA and GWMWater as part of portfolio management activities. Prioritise sites and/or watering actions if insufficient water is available.	VEWH
8	Safety	Where delivery structures are unsafe and have limitations on their operation, planned environmental deliveries may not be feasible leading to a failure to achieve environmental outcomes.	R	E	High	Upgrade or modify infrastructure to improve safety. Modify method of operation to avoid unsafe work practices and update safety procedures to reflect this (note: safe work procedures may need to be communicated to community/volunteer resources as well as agency staff where they undertake structure operations).	Asset owner Asset owner
9	Env	Flow rate at environmental flow compliance point not able to be demonstrated, which may lead to failure to achieve target flows and environmental benefits not being achieved.	L	Mod	High	Install/upgrade stream gauge monitoring, in collaboration with GWMWater, to improve ability to demonstrate target flow rate achieved.	VEWH
10	Env	Target flow rate at environmental flow compliance point not achieved due to environmental conditions, (for example high losses at very dry sites, hot weather causing excessive evaporation, antecedent conditions and inflow rates) and environmental benefits not being achieved.	L	Mod	High	Monitor flow rate and adjust delivery volume within approved volume.	CMA
11	Env	Target flow rate at environmental flow release or measurement point not delivered as ordered, leading to sub-optimal environmental outcomes.	U	Mod	Med	Monitor flow rate and adjust delivery to meet ordered flow rates. Ongoing communication with the CMA to manage infrastructure or maintenance constraints.	GWMWater GWMWater
12	Safety	Environmental releases create rapid or unexpected changes in flow conditions, resulting in injury to river user	R	E	High	Communicate flow deliveries to communities and key stakeholders and avoid large flows or rapid changes in flow	CMA

No.	Risk category [1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action
						rate during periods of high river use. (e.g. using community SMS updates services). Erect signage where appropriate.	CMA
13	Rep	Community groups not supportive of environmental watering delivery.			Medium	Engage with the local community through a variety of avenues (e.g. workshops, forums, individually to communicate benefits of environmental watering. Develop Statewide communication products and engage with peak bodies Each organisation will share their intended environmental water related communications plans with all partners	CMA VEWH CMA/VEWH
14	Env	Inadequate monitoring of wetland water levels leads to over delivery to wetlands with local flooding and environmental impacts.	L	Min	Medium	Inspection of wetlands immediately prior to commencement of deliveries to confirm levels and water needs, with regular monitoring of levels during events. Enlisting the assistance of local interest groups and landholders to provide feedback on wetland levels during delivery events.	CMA CMA

10. Approval and Endorsement

APPROVAL

I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the Wimmera Mallee Pipeline Wetlands – Wimmera CMA Region 2017-18.

SIGNED FOR AND ON BEHALF OF Wimmera Catchment Management Authority

Signature of authorised representative

Name of authorised representative
David Brennan, Chief Executive Officer

Date:

PUBLIC LAND MANAGER ENDORSEMENT

I, the authorised representative of the agency shown below, acknowledge that the priority watering actions being proposed in section 6 of the proposal are consistent with land management priorities for Wimmera Mallee Pipeline Wetlands for Parks Victoria Land Managed in the Wimmera CMA region.

SIGNED FOR AND ON BEHALF OF Public Land Manager (Parks Victoria)

Signature of authorised representative

Name of authorised representative
Gavan Mathieson, District Manager, South West District

Date:

11. References

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12. Appendices

12.1. Acronyms

CMA: Catchment Management Authority
DELWP: Department of Land, Water and Planning
DSE: Department of Sustainability and Environment
EVC: Ecological Vegetation Class
IWC: Index of Wetland Condition
VEWH: Victorian Environmental Water Holder

12.1. Guidance Material – Risk Assessment

Tables sourced from *Seasonal Watering Proposals Guidelines 2015-16* (VEWH, 2014)

Table 11. Risk likelihood

Rating		Description
Rare	1	Event may occur only in exceptional circumstances
Unlikely	2	The event could occur at some time
Possible	3	The event might occur
Likely	4	The event will probably occur in most circumstances
Almost certain	5	The event is expected to occur in most circumstances

Table 12. Risk Consequence

Rating		Environment *Impact on the surrounding environment, including habitats and species, as well as the broader landscape*	Business Costs *Cost to the state*	People *Workers, local communities and other stakeholders*		Political/ Reputational *How media, public and stakeholder perception of State is influenced*	Legal *Legal consequence*	Service Delivery *Effect on the business*
				Safety and Well-being	People and Culture			
RISK								
Negligible Harm	1	No material effect on the environment, contained locally within a single site/ area. Environment affected for days	Cost impact of up to 2.5% of allocated operational budgets (including capital budget); OR a cost impact of up to $2.5m	On-site first aid treatment only	Staff disgruntlement	Minimal adverse local attention (1 day only)	Non-compliance with legislation, identified internally and resulting in internal acknowledgement and process review.	Insignificant impact to the Organisation's capability in providing its services - no inconvenience to customers/ stakeholders
Minor Harm	2	Limited effect on the environment, restricted to a single township or locality. Environment affected for weeks.	Cost impact between 5%-10% of allocated operational budgets (including capital budget); OR a cost impact of up to $5m	Minor injuries/illness requiring medical attention	Complaints, passively upset, and uncooperative	Adverse localised public attention on a single issue over a short period. (up to 1 week)	Non-compliance with legislation or breach of duty of care, identified externally and either (1) resolved without prosecution of or civil action, or (2) resulting in prosecution or civil action involving low level of resourcing required to defend, exposure to low level remedies or damages, and low level risk of negative precedent	Minimal short term temporary impact to the Organisation's capability in providing its services - customers/ stakeholders slightly inconvenienced
Moderate Harm	3	Moderate effect on the environment, impacting on a municipality or multiple localities. Environment affected for months.	Cost impact >10% of allocated operational budgets (including capital budget); OR a cost impact of up to $10m	Significant injury/illness requiring in-patient hospitalisation	Low morale, disengagement, increased absenteeism and workplace conflict	Adverse localised negative public attention on a single issue over a sustained period (up to 2 months)	Non-compliance with legislation or breach of duty of care resulting in prosecution of, or civil action, with one of high level of resourcing required to defend; exposure to high level remedies or damages or high level risk of negative precedent.	Significant impact to the Organisation's capability in providing its services - customers/ stakeholders inconvenienced
Major Harm	4	Major effect on the environment, impacting on a region or multiple municipalities. Environment affected for 1-3 years.	Cost impact between $10m-$50m	Extensive and/or permanent injury/ illness	Major morale issues, high absenteeism and resignations of key staff	Serious adverse public attention on more than one issue over a prolonged period (up to 2 years)	Non-compliance with legislation or breach of duty of care resulting in prosecution of or civil action (with *all of* high level of resourcing required to defend, exposure to high level remedies or damages, and high level risk of negative precedent); or public enquiry	Continuing difficulties in the Organisation's capability in servicing customers/stakeholders over a protracted period - delays caused beyond target)
Extreme Harm	**5**	**Very serious effect on the environment, impacting on the state or multiple regions. Environment affected for >3 years**	**Cost impact of over $50m**	**Death or permanent disability/ illness**	**Organisation wide morale issues, mass resignations and absenteeism**	**Very serious public outcry over a prolonged period (greater than 2 years), or leading to a formal inquiry, serious investigation of other major political event**	**Non compliance with legislation or breach of duty of care resulting in prosecution of or civil action (leading to imprisonment of an officer and/or uninsured compensation payments).**	**Long term detrimental effect on the Organisation's capability in providing services to customers/ stakeholders**

Table 13. Risk Rating

Likelihood	Consequence				
	Negligible	Minor	Moderate	Major	Extreme
Almost certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	Extreme	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Low	Low	Low	Medium	High