Government of Western Australia
Department of Parks and Wildlife

Toolibin Lake Natural Diversity Recovery Catchment

Project Summary

updated 2013

Facts about ***TOOLIBIN LAKE***...

Situated within the larger catchment of the Upper Blackwood River. Over 90% of the catchment has been cleared of deep-rooted native vegetation in the last hundred years.

Toolibin catchment is 48 977 hectares with the lake floor at 300 hectares.

Average rainfall around 400mm.

The lake is an ephemeral or seasonal wetland filling on average every 3 years (1960's – 1990's), this cycle of wetting and drying has formed a wooded wetland with large stands of paperbarks and sheoaks across the floor of the lake.

The trees provide excellent breeding and feeding habitat for migratory waterbirds when the lake is full.

Toolibin is largest wetland remaining in the region with this type of vegetation association and has been listed as a threatened ecological community (TEC) under *EPBC 1999 Act*.

Toolibin was recognised as a Wetland of International Significance under the Ramsar Convention.

The main threat to Toolibin Lake is altered hydrology which includes: Saline surface water flows; rising saline groundwater; increased water logging; and reduced rainfall.

Photo by Audrey Bird

The Ramsar Convention on Wetlands

What is the Ramsar Convention?

The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The Convention's mission is *"the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout*

Threatened Ecological Community (TEC)

Toolibin Lake is listed as a TEC under the Commonwealth's *Environmental Protections and Biodiversity Conservation (EPBC) Act 1999*.

The listing is recorded as *"Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor - Toolibin Lake"*.

The current threatened status is *Critically Endangered*.

There are 3 wetlands in this area including Toolibin Lake, Walbyring Lake and Dulbining Lake that are listed as TEC's as well as two unnamed lakes that are of similar type, all vary in condition.

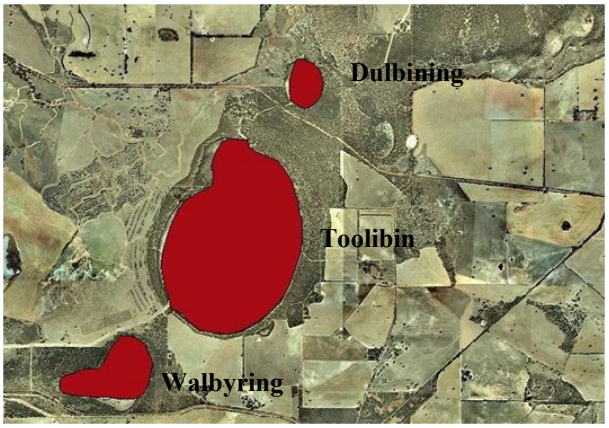
The TEC fits criteria 2 (a), (d) and (e) of Section 6 of the EPBC Act for the following reasons (Endangered Species Scientific Subcommittee, 2000):

The community has been reduced in area and number of occurrences by at least 90%;

Toolibin Lake is the only remaining large occurrence of the once widespread community, and is threatened by altered hydrology due to clearing of the catchment, with the final salinisation inevitable if the water table rises above the lake floor; and

The community is subject to other threats including weed invasion and grazing.

In the process of being nominated as TEC is Eucalyptus woodlands of the Western Australian Wheatbelt.



TEC Toolibin Lake

Eucalypt woodland of the WA Wheatbelt

TEC Dulbining 3

Bird Life

Toolibin Lake and the threatened ecological community it supports provide excellent breeding and feeding habitat for migratory waterbirds when the lake is full.

42 species have been recorded at the lake with 24 species of waterbirds recorded as breeding.

Significant deterioration in the health of the veg across the lake was first noted in the early 1970's.

The recovery plan addresses altered hydrology and management actions are to maintain Toolibin Lake as suitable for the continued use of the lake as a feeding and breeding habitat for waterbirds.

EPBC Threatened Species
(resident waterbird)

Australiasian Bittern

EPBC Vulnerable Species
(terrestrial resident)

Mallefowl

EPBC Migratory Species
(waterbird)

Common Green-shank
Glossy Ibis
Great Egret
Oriental Plover
Rainbow Bee-eater

Wildlife Conservation Act
P4 species
(terrestrial resident)

Western Rosella (inland species)
White-browed Babbler

Wheatbelt Threatened
(resident waterbird)

Freckled Duck

MAJOR RECOVERY ACTIONS SINCE 1994

Separator Gate \ Diversion Structure

The diversion structure allows management to close the gates which diverts low volume, highly-saline water from flowing into Toolibin Lake.

The gates and structure divert up to 6m^3\second onto to Taarblin Lake.

Larger flows have occurred, such as the one in 1983 in which 35m^3\second of water was recorded. The diversion Gates are not designed to divert these usually fresh flows and flood the Lake floor.

The 6.5 kilometre diversion structure was constructed in 1995 and successfully used for the first time in 1996.

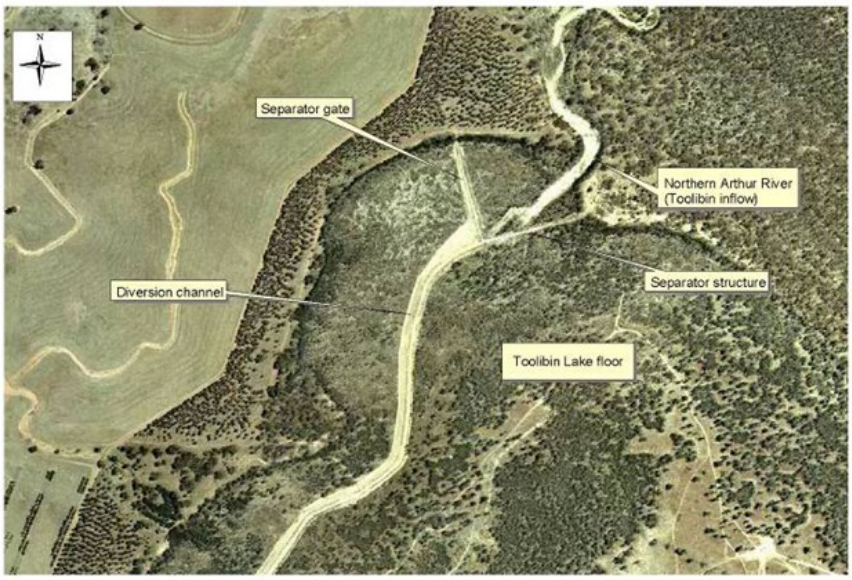
Over 6000 tonnes of salt diverted away from the floor of the lake

The gates and structure was upgraded in 2010. The old timber gates and posts were replaced with aluminium.

Improvement and extension of the weir was also undertaken. The cost of the upgrade was $165 000.

Old wooden gates

New aluminium gates



MAJOR RECOVERY ACTIONS SINCE 1994

Dulbining waterway

The waterway improves the conveyance of water through Dulbining Nature Reserve by controlling highly-saline surface water-logging, inundation and lower the salt storage above Toolibin Lake by reducing ponding and salinisation.

Managing surface water at Dulbining Nature Reserve will improve the quality and quantity of surface water that reaches Toolibin Lake. In a drying climate this will provide greater capacity to manage surface water flows into the lake to ensure that this unique ecosystem is protected.

Construction began on 12 November 2007 when the waterway was cleared of vegetation and topsoil before progressive removal of the subsoil upstream.

The waterway is about 6 kilometers in length extending from North Toolibin Rd down to Dulbining Lake near Wickepin-Harrismith Rd. The width varies from 3 metres for minor channels to 20 metres where the waterway terminates at Dulbining Lake.

All sections of the waterway were completed to design specification in May 2009. Approximate cost $800,000.

Vegetation & soil were removed for construction of the waterway

Dulbining waterway

The channels at the top of the picture is the waterway which terminates at Dulbining Lake.

MAJOR RECOVERY ACTIONS SINCE 1994

Upgrade outlet control

The channels and sump allow highly-saline water to be removed from the Toolibin Lake floor after a fill event.

As water evaporates from Lake dissolved salts are retained in ponds and when the Lake eventually dries the salt crystallizes and builds up on the surface and accumulates.

Without intervention the only way water can be removed is through evaporation and seepage. This will expose significant areas of the lake floor vegetation to greater salinity and lead to further degradation.

The construction of channels will allow the removal of water from low lying areas of the lake to a sump. If the salinity levels exceed limits of acceptable change the water will be pumped from the sump into the diversion structure and eventually out to Taarblin Lake.

Work occurred in May 2010 with the construction of two channels and the sump. Other minor channels will be completed as required. Approximate Cost $60,000.

Construction of the sump

The sump and pump

Taarblin Lake is approx 900ha in size (over twice the size of Toolibin).

It is a nature reserve & was a freshwater lake until the 1950s and is still an important area for waterbirds.

It fills and overflows infrequently, the last time was in 1983.

The Lake only discharges downstream with very large flows, and has little impact on the downstream Blackwood catchment.

It is a disposal point for diverted saline, surface water flows and pumped groundwater from Toolibin.

Without management intervention Taarblin Lake is the future of Toolibin Lake.

MAJOR RECOVERY ACTIONS SINCE 1994
Groundwater Management

Groundwater Pumping System

The system addresses the threat of saline groundwater rising through the soil profile and bringing salts to the root zone of plants and mass degradation.

Part of an integrated solution with works in the catchment used to tackle the overall cause, which is decreased water usage across the catchment.

Pumping is an expensive option probably only viable for high value assets such as recovery catchments.

air displacement pumps

- 8 air displacement pumps installed in 1996
- Pumping commenced March 1997
- 1 extra pump installed in 2000
- Combined currently pumping approx 230KL of groundwater per day
- Pumps are set at a depth of 35 m
- Operation of pumps
- Submersed tank fills with water
- Compressed air flows into the tank pressurising the tank
- Pressure forces water up the delivery pipe to pumping station
- Pump exhausts
- New cycle commences
- Cost $300 000

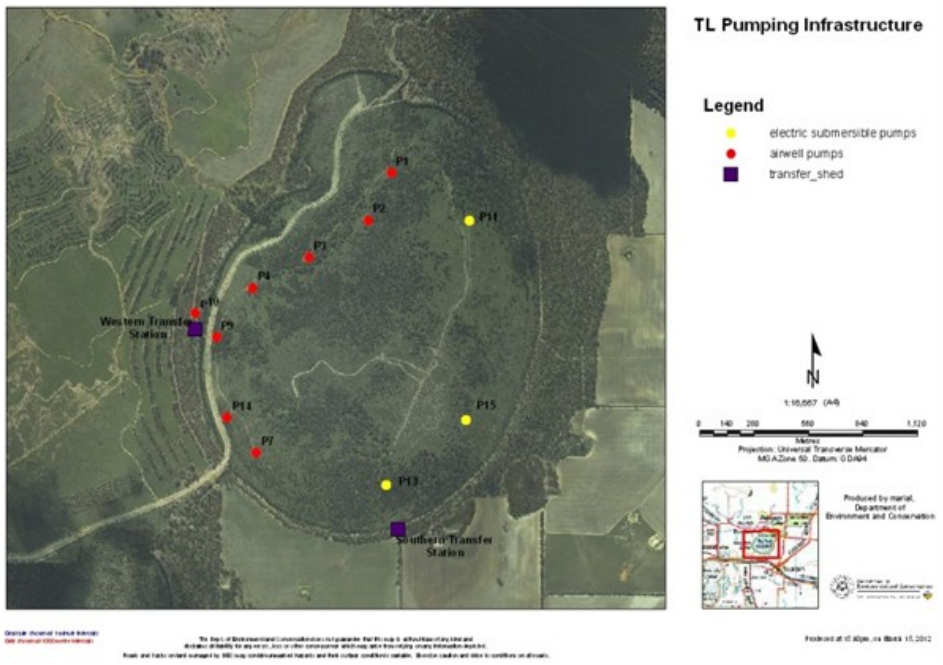
electric submersible pumps

- Commissioned July 2001
- 3 submersible pumps capable of pumping greater flows from the air displacement pumps
- combined are pumping 500KL of groundwater per day
- Pumps 11 is situated in a paleochannel (ancient stream bed). It is a higher yielding aquifer than the pallid zone/saprolite grit aquifer. Approx 250 KL per day is pumped, same as the entire air displacement bore field
- Cost $300 000

dosers & telemetry

- Biofouling causes blockages in the lines and reduces pumping capacity
- Dosers dispensing sanitizer were installed at all pumps to reduce the effect of iron bacteria
- Cost $70 000

- A new telemetry system was installed to capture volumes from each pump and totals
- The information is transmitted to Narrogin office
- Faults and breakdowns in the system can be responded to quickly reducing the downtime
- Cost $135 000



Regeneration

Management intervention as well as change in the Lake's hydro-period has contributed to regeneration of native species.

The current dry cycle has allowed these seedlings to establish across the lake floor.

Regeneration has been successful in certain areas of the lake floor, particularly around pumps where there is significant groundwater drawdown .

Regeneration around pump 9 (2011)

Mass germination occurred after a heavy summer rainfall event in 1998 around pump 9. Monitoring plots were established to monitor the success of regeneration.

Chadwick's Block

Chadwick's was former agricultural land with areas of the block prone to groundwater seepage. A revegetation plan was prepared for the site with the goal of *contributing to the hydrological stability of the Toolibin catchment for protection of the nature conservation values of the nearby nature reserve system, in particular Lake Toolibin.*

Over the years the 135 hectares of cleared land has been prepared for revegetation. The area was ripped, mounded and access tracks were graded for planting of over 120,000 seedlings.

As well as its hydrological influence the area has biodiversity values, seed production areas and various research plots and trials including sites for farm forestry initiatives.

The major goal for hydrological stability has been well met with water table dropping to over three meters below the surface and water logging on the site alleviated.

Ash Bed Regeneration Trial

This trial involved the burning of woody debris in open areas between the trees to encourage seeding from the *Eucalyptus salmonophloia* and *E. wandoo*.

The trial hopes to demonstrate a technique that could be used by landholders in the catchment as well as within parts of the reserve.

Debris has been dumped into 9 windrows of approx 1m high, 2m x 10m and burnt as soon as possible after the opening rains. The debris needed to be dry enough to reach a temperature of approx. 350ºC.

Seed was scattered over some of the plots and it was hoped that seed would be shed from the overhead canopy.

Unfortunately last years rainfall was not conducive to a germination trial so we will be monitoring again this year.

Revegetation

Revegetation and remnant fencing within the catchment contributes to managing altered hydrology and biodiversity.

Revegetation with endemic species and oil mallees has occurred extensively throughout the catchment. High-water uptake species such as oil mallees contributes to the quality of surface water flowing and entering Toolibin Lake, and managing groundwater levels.

Planting with local species can provide additional habitat for native fauna and flora species in a highly fragmented landscape.

Cost-Sharing Revegetation & Fencing

Revegetation and fencing has occurred as a cost-sharing project with catchment landholders on private property.

Cost-sharing fencing provides private landholders the materials to fence remnant vegetation within the catchment.

Cost-sharing revegetation has occurred extensively throughout the catchment on private property and conservation estate.

The Department has experienced staff to assist landholders on species selection and propagation, site preparation and planting.

The Department has revegetation equipment for hire including potti putkis, rippers and mounders.

RESEARCH & INVESTIGATIONS

Toolibin Lake NDRC is absolutely about combining research with operations.

Much research has been undertaken in the catchment in areas of hydrology, eco-physiology and the recovery planning process by other agencies, honours and PHd students.

The Department and Future Farm Industries Co-operative Research Centre and the University of Western Australia have formed a partnership to investigate plant and hydrological processes at Toolibin Lake.

The water requirements and tolerances of the two dominant trees on the lake bed – sheoak and paperbark are being studied to help understand the connection between growth and water use by the trees and hydrology.

A rectangular bund was constructed on the lake bed. The bund contained more than 100 trees, with some trees fitted with sensors to measure tree girth, sap flow, and measure water and soil parameters. Over two weeks, 100 000 litres of fresh water was applied to the bund and a water depth of more than 30 centimetres was maintained for seven days.

The trial confirmed the different rooting depths of the trees and demonstrated that they can rapidly increase water use following flooding, particularly the sheoak. The discovery of different root zone niches used by the two species (sheoak roots are shallower than the paperbark's) helps to explain the sequence of tree deaths that has occurred and the ecological requirements that management must consider.

It also showed that surface and groundwater rapidly connect, which is provoking additional research to better guide groundwater management. *(Higbid & Drake, 2012)*

In 2012 DEC carried out an extensive borehole geophysics program to understand how quickly water and dissolved salts move in different aquifers in the Toolibin Catchment.

The bores were originally surveyed in the mid 1990s by DAFWA, so following up on this survey fifteen years later proved interesting to see where the changes in groundwater salinity occurred.

Applying the borehole nuclear magnetic resonance technique provided a unique opportunity to take a technology developed for the oil industry and apply it in environmental management to map aquifers and their ability to transmit water beneath Toolibin Lake.

Preliminary results have shown the borehole geophysics investigation at Toolibin Lake has effectively mapped the distribution of the aquifers that transmit more water and solutes.

This information has been well received at conference presentations in Perth and internationally and, importantly has provided the Department with new investigation targets for managing groundwater beneath the lake. Specifically, the work highlights those bores from which pumping is less effective and could be decommissioned and moved to other areas where pumping will be more effective.

All of this information will go into the new recovery plan highlighting the importance of taking an adaptive approach to management. *(J Rutherford, Senior Hydrologist)*

Some of the research and investigations at TOOLIBIN LAKE..

Hyperspectral imagery
RECOVERY PLANNING AND LANDHOLDER PERCEPTION
Surface and groundwater interactions
NATURAL REGENERATION TECHNIQUES
Hydrological simulation model to inform conservation management
Solar Saltfield at Toolibin Lake
Temporal and Spatial Effects of a Long Term Large Scale Alley Farming Experiment on Water Table Dynamics:
Biodiversity risk factors using expert groups - Treating linguistic uncertainty and documenting epistemic uncertainty

COMMUNICATIONS

The Toolibin Lake Recovery Team is comprised of a broad range of stakeholders and was established in 1993 to oversee recovery actions. Regular team meetings are held.

A Technical Advisory Group (TAG) was established later to work with the Recovery Team on scientific and technical aspects of the recovery process.

The Department communicates the project to its stakeholders through:

- Hosting field days, educational excursions and cultural days;
- Producing media releases, quarterly newsletter and articles for publication;
- Publication of scientific papers and reports by technical specialists and scientists working in the catchment; and
- Participation at agricultural shows, conferences and workshops.

Interpretive panels and walk trail have been constructed at Toolibin to enhance the visitor experience and demonstrate actions implemented to manage altered hydrology.

For more information on the project checkout our website http://www.dec.wa.gov.au/management-and-protection/land/salinity/recovery-catchments/toolibin-lake

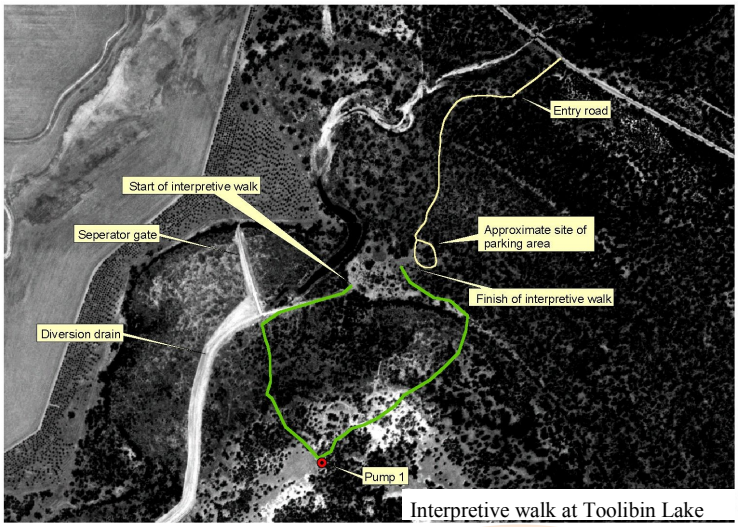
The catchment is located within the area of the Aboriginal language group Wilman.

An Aboriginal heritage site is situated on the western boundary of Toolibin Lake (Lake Torrbarn) and is listed on the Department of Indigenous Affairs unregistered artifact site is recorded as a camp.

www.dia.gov.au

Excursion by students from the University of Notre Dame

Field day with stakeholders



Interpretive walk at Toolibin Lake

Woolorama 2011

Interpretive shelter

Ramsar Convention on Wetlands Certifies

Toolibin Lake

Designated a Wetland of International Importance

1990

Natural Diversity Recovery Catchment Program Designates

Toolibin Lake

As the first natural diversity recovery catchment

1996

Institute of Engineers Australia Awarded

Toolibin Lake Recovery Team & Technical Advisory Group

Inaugural National Salinity Prize

2002

The Department manages the following reserves as part of the natural diversity recovery catchment:

Toolibin Nature Reserve
Dingerlin Nature Reserve
Walbyring Nature Reserve
Dulbining Nature Reserve
Chadwick's Revegetation Block
Miller's Revegetation Block

Toolibin Nature Reserve

This 1500 hectare area of conservation estate in a highly-fragmented landscape is managed for other threats to biodiversity, including weeds, pest animals, fire and recreation.

This 48 000 hectare catchment also includes other reserves vested for the purpose of water and public utilities.

Other nature reserves within the catchment not directly affected by altered hydrology but valued for their biodiversity include:

Birdwhistle Nature Reserve
Brooks Nature Reserve
Yarling Nature Reserve

Brooks Nature Reserve

Reserve Management

Weeds

Weeds are controlled on the reserves as part of fire management to reduce the fuel burden. The recreations site and tracks throughout the reserve are chemically sprayed each year.

Pest Animals

Pests animals which threaten the biodiversity values of conservation estate include rabbits, foxes and kangaroos. Baiting of rabbits occurs around revegetation sites in preparation for planting of seedlings and consecutive years thereafter as well as annual baiting in our major reserve system. Foxes are baited when the lake fills and breeding and feeding waterbirds inhabit the area. Kangaroos are a significant threat to regenerating seedlings in particular *Casuarina obesa*, one of the species associated with the TEC. Periodic spotlighting occurs yearly and culling operations to reduce numbers on the Lake floor are the current control actions.

Hygiene Management

The spread of weeds and diseases such as Phytophthora are a great threat to biodiversity. Hygiene management through the reserve system involves eliminating the spread of soil and plant propagules through conservation reserves and private property. This involves ensuring vehicles and all equipment are clean on entry into reserves, soil and gravel is tested before being brought in for any works, and restricting movement to dry soil condition days.

Recreation

Toolibin Lake was a popular passive recreation site for the community for many years. Even in these dry times up to 700 vehicles are recorded at the site each year. DEC has installed interpretation panels at the recreations site, constructed an interpretive walk and provided BBQ, toilets and picnic facilities.

Recovery action	A	Output
Appointing the Recovery Team	1	Recovery Team and Technical Advisory Group established
Groundwater pumping Stage 1	1	8 active groundwater pumps
Groundwater pumping Stage 2	1	3 active groundwater pumps
Groundwater pumping under Dulbining Nature Reserve	U	No action taken
Feasibility investigation of surface water control	1	Gutteridge Haskins & Davey Pty Ltd (1992) Jim Davies & Associates (1994) Cattlin et al. (2004)
Design surface water control scheme	1	Jim Davies & Associates (1995) BG & E Consulting Engineers (2005)
Implementation of surface water control scheme	1	Construction of catchment drains Construction of diversion drain Separator gate constructed and upgraded Construction of Dulbining waterway
Lake outlet control feasibility study	1	JDA Consultant Hydrologists (1999)
Lake outlet control works	1	Outflow structure constructed Sump installed and conveyance channels constructed
Protection of lake vegetation from grazing	2	Areas of revegetation and regeneration fenced Kangaroo monitoring and control Rabbit baiting
Construction and planting of gilgai mounds	U	No action taken
Fire management	2	Monitoring of plots within the 2006 fire scar area as part of regular vegetation surveys
Land management planning	2	One third of catchment landholders have implemented farm plans
Revegetation of deep sands and salt affected land	2	278.2 hectares of revegetation 14 kilometres of remnant vegetation fenced
EM survey of potential salt affected land	1	George (1998) Street & Pracillio (2000) Geoforce (2004) EM38 readings at vegetation monitoring plots as part of regular vegetation surveys ASST (2012)
Alley style revegetation of Toolibin Flats	2	1,884 hectares of alley style revegetation
Break of slope revegetation	U	Limited interest from landholders
Control of waterlogging	2	Construction of catchment drains
Soil structure improvement on Toolibin Flats	2	Minimum tillage and soil treatments widely adopted
Development of a decision support system	2	Implementation of an Access database for Toolibin data and reports Froend & Storey (1996a, 1996b) Dogramaci et al. (2003) Jones et al. (2009)
Groundwater monitoring	1	Data stored by DEC, DAFWA and DoW DEC undergoing implementation of Hydstra
Surface water monitoring	1	Data stored by DEC, DAFWA and DoW DEC undergoing implementation of Hydstra
Vegetation monitoring	1	Regular vegetation surveys undertaken (Appendix 1) Shackleford (2012)
Invertebrate monitoring	2	Limited surveys undertaken Halse et al. (2000)
Waterbird monitoring	2	Limited surveys undertaken Halse et al. (2000)
Additional actions		
Commercial use of saline groundwater	U	Actis Environmental Services (1999) Partridge (2003) Maunsell Australia Pty Ltd (2003)
Communication and interpretation	1	Department of Conservation and Land Management (1999) Community workshops and media articles DEC website Educational tours

Summary table of recovery actions from Toolibin Lake Recovery Plan 1994

Assessment of the progress against the recovery actions since implementation of the recovery plan are summarised and presented in the table.

Assessment has been classified as:
1 = Implemented
2 = Some progress towards implementation

Work in progress

The Department is in the process of revising a new recovery plan for Toolibin Lake for the next 20 years.

The process began by:

1. Establishing and prioritizing human values:
   - Knowledge & education values
   - Philosophical/spiritual/intrinsic values
   - Productive values

2. Develop an aspirational goal

3. Identify biological assets

4. Identify key processes that threaten the asset

5. Determine feasibility of managing the key processes

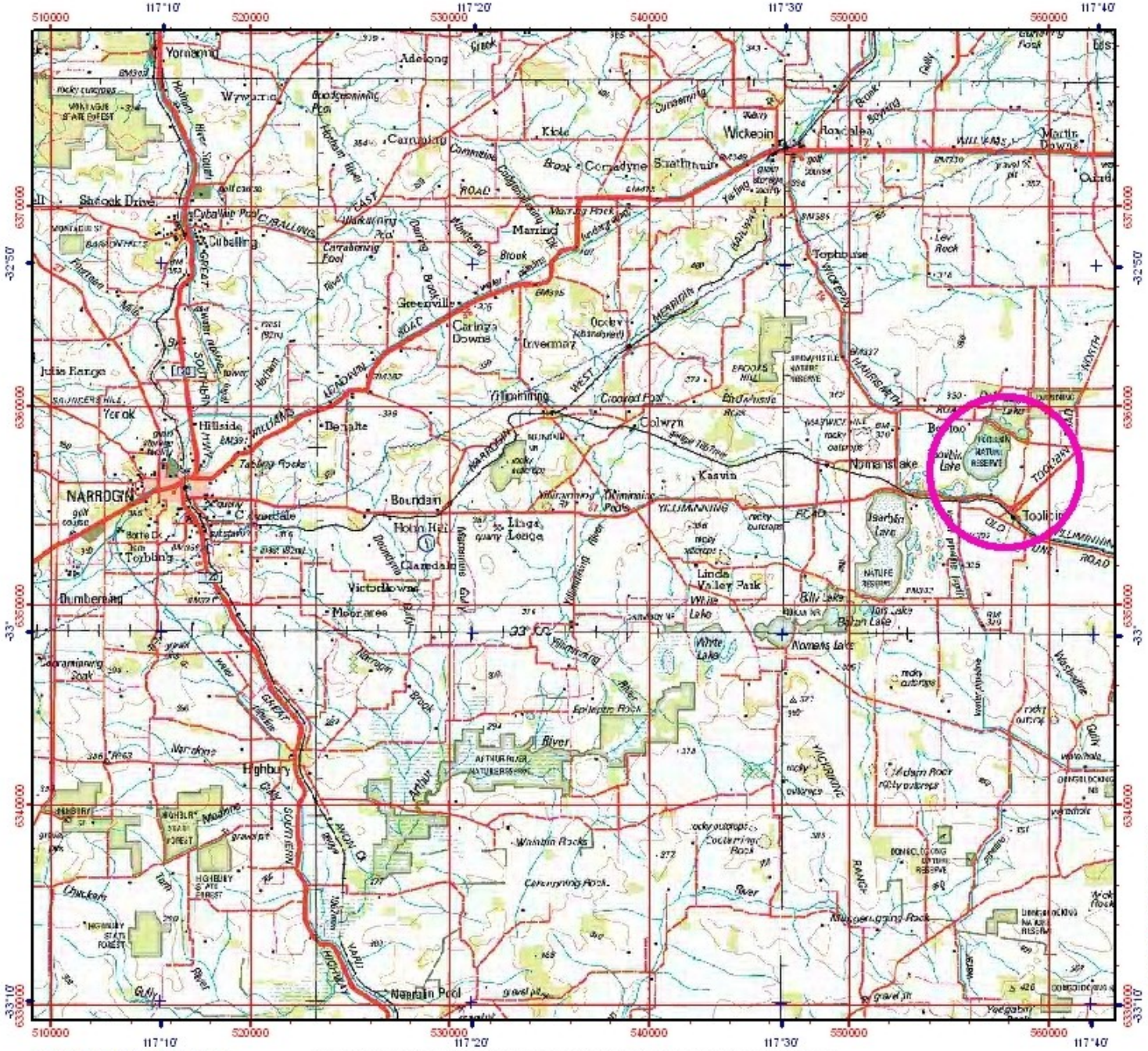
6. Implement set of priority actions

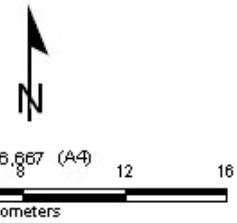
7. Outcomes

Stay tuned…..

Toolibin Lake

LOCALITY MAP





Projection: Universal Transverse Mercator
MGA Zone 50. Datum: GDA94

Graticule shown at 10 minutes intervals
Grid shown at 10000 metre intervals

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Under the Direction of
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Director General, Department of
Environment and Conservation

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