

# COMPLIANCE LDWQOS

BRISBANE | PERTH | SINGAPORE | PAPUA NEW GUINEA

PREPARED FOR NT DITT



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**STREET**  
27 / 43 Lang Parade  
Auchenflower 4066  
QUEENSLAND



**REGISTERED**  
c/- de Blonk Smith and  
Young Accountants  
GPO 119, Brisbane 4001  
QUEENSLAND



**POSTAL**  
PO Box 2151  
Toowong 4066  
QUEENSLAND



**CONTACT**  
+61 (0)7 3721 0100 P  
info@hydrobiology.com

ABN 26 096 574 659

[www.hydrobiology.com](http://www.hydrobiology.com)

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Ross Smith

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## contents

1. BACKGROUND AND OBJECTIVES	6
2. METHODS	8
3. LDWQOS FOR COMPLIANCE	9
4. CONCLUSION	15
5. REFERENCES	16

## tables

Table 3-1 Summary of compliance LDWQOs and assessment rules ...	11
Table 3-2 Comparison of surface water quality measured in the Finniss River upstream (U/S) and downstream (D/S) from Mt Burton (Zone 5) between 2013 and 2019. ....	12
Table 3-3 Summary of proposed surface water seasonal compliance LDWQOs for Zone 6 and 7. ....	13

# 1. BACKGROUND AND OBJECTIVES

The Northern Territory Environment Protection Authority (NTEPA) would like to set compliance water quality objectives for the Finniss River, downstream from the former Rum Jungle mine to adopt during rehabilitation of the site. The various impact assessments and data reviews that Hydrobiology performed to date for the Department of Industry, Tourism and Trade (DITT) have indicated that each river zone, both in the East Branch and the Finniss River, had individual exceedances of the standard ANZG (2018) guideline values. More recently, Hydrobiology (2020) demonstrated that many individual measurements of concentration exceeded even the locally derived water quality objectives (LDWQOs) for a number of parameters, notably for the main Finniss River downstream of the East Branch in Zones 6 and 7, but also including for some tributaries not influenced by the Rum Jungle mine site.

The LDWQOs have been developed over a number of years. A majority of them were derived incrementally by Hydrobiology (2013, 2015, 2016), starting with the use of national default Guideline Values (DGVs) in 2013 with LDWQOs subsequently developed and refined for the East Branch zones for some parameters in 2015 and 2016. Uranium and selenium were added by Hydrobiology (2019).

In Hydrobiology (2016), LDWQOs were derived for all parameters for which there were available water quality measurement data for time periods relevant to the biological sampling in 2014 and 2015, and for which there was a gradient of taxonomic richness declining with increasing parameter concentration (or reducing value for pH). The Weibull function fits for parameter concentrations (Cu, Zn, Ni, Co, Mn, EC, SO<sub>4</sub>, Mg) were presented versus percent of average reference site number of taxa

and selected LDWQOs based on a decision tree rule. Mn and EC defaulted to the standard national guideline values (or default approach for EC) as a result of poor model fit and absence of clear threshold response data.

The proposed LDWQOs represent targets of very substantial improvement in the current condition of the river. A recent assessment of the historical data collected from all zones between 2010 and 2020 (Hydrobiology, 2020) suggests that some of the LDWQOs adopted in Hydrobiology (2016), in particular those that defaulted to standard guideline values from ANZG (2018), were not met even in zones where the biological monitoring indicated no significant effect on the receptors investigated (Zones 1, 5, 6 and 7). These LDWQOs would not be suitable as compliance objectives.

This report aims to provide the NT EPA with a solution to define suitable compliance LDWQOs for the zones in the Finniss River downstream of the East Branch, for which no impacts from elevated toxicant concentrations were previously observed (Zones 6 and 7).

# 2.

# METHODS

The proposed compliance LDWQOs presented in this report were largely based on the existing LDWQOs. However, some values were further refined following the process below.

The existing LDWQOs, designed to provide protection of 95% of species in the ecosystem, were set to the national default water quality guideline values (DGVs) for many toxicants in Hydrobiology (2016) where there was no clear evidence available for different sensitivity of the Finniss River biota, compared with the national dataset, from the 2014 and 2015 sampling. However, in Zones 5, 6 and 7, for which no impacts to biodiversity were observed in the 2014 and 2015 sampling, several of these DGVs were subsequently found to be regularly exceeded (Hydrobiology, 2020).

In this report, the 80<sup>th</sup> and 95<sup>th</sup> percentile of seasonal measurements from 2010 to 2020 were calculated for Zones 5, 6 and 7. The Finniss River being perennial in these zones, sites were accessed frequently providing a representative dataset with sufficient seasonal coverage.

The calculated percentiles (80<sup>th</sup> for EC and 95<sup>th</sup> for toxicants) were compared with the existing LDWQOs, including those based on DGVs, and exceedances of the LDWQOs were identified. For those parameters with calculated percentiles exceeding the LDWQOs, an alternative strategy for a compliance value was developed to reflect the ecosystem status observed in Hydrobiology (2016) and is further detailed in the results section.

# 3.

## LDWQOS FOR COMPLIANCE

Table 3-3 presents a summary of the new proposed compliance LDWQOs for Zones 6 and 7, and Table 3-2 presents the percentiles for parameter measurements in Zone 5 that the proposed compliance LDWQOs are based on. Further explanation regarding their derivation is provided in the paragraphs below:

### ZONE 5

In recent years (2018-2019), the water quality within Zone 5 substantially worsened in the section of the Finnis River upstream from Mt Burton. Copper concentrations above 100 µg/L were measured upstream of Mt Burton (FRUSMB) both in the dry and wet seasons of 2018 and 2019 compared with concentrations below 6 µg/L downstream of Mount Burton (FRDSMB and FRUSEB) (Table 3-2). It should be noted that these sites are all upstream of the Rum Jungle mine site, and the source of this change in water quality has not been investigated.

Magnesium and cobalt were also found at elevated concentrations upstream compared with downstream, both exceeding their respective LDWQOs at the upstream site (Table 3-2). Other toxicants, including arsenic, cadmium, iron, nickel, lead and zinc were also found in higher concentrations upstream. Based on these observations, the dataset for Zone 5 was split and only data for sites in the Finnis River downstream from Mt Burton (FRDSMB and FRUSEB) were used for the derivation of compliance LDWQOs on the basis that these sites reflected the water quality that was

delivered to the junction with the East Branch. That is, the water quality of this reach of Zone 5 represents the best water quality that can be achieved downstream of the East Branch without requiring dilution of the upstream waters.

## ZONE 6 AND 7

Compliance LDWQOs developed based on the water quality of the last reach of Zone 5 were applied for Zone 6 and 7. Any future changes in water quality occurring in Zone 5 can be expected to constrain concurrent water quality in Zones 6 and 7 because flow from the main Finniss River is the greatest contributor to flow in both downstream zones.

Given the observations of recently worsened water quality upstream from Mt Burton, we recommend that the proposed LDWQOs should be calculated based on the previous 4 years of data collected in Zone 5 (sites FRDSMB and FRUSEB combined). This is consistent with the recommendations of ANZG (2018) for monitoring of toxicants (<sup>1,2</sup>).

At the time of writing, the compliance LDWQOs were set based on the calculated 80<sup>th</sup> and 95<sup>th</sup> percentiles (for EC and toxicants, respectively) of lower Zone 5 from the dataset available (including data from 2013 to 2019). Some of these proposed LDWQOs were exceeded in one or both of the downstream zones based on the dataset analysed. However, they represented reasonable post-construction objectives:

- In Zone 6, the water quality measured exceeded these compliance LDWQOs for EC and copper in the wet season and cobalt, magnesium and uranium at both seasons.
- In Zone 7, the water quality measured exceeded the compliance levels for aluminium, copper and iron in the wet season only.

## USING THE COMPLIANCE LDWQOS

Table 3-1 summarises compliance LDWQOs and corresponding assessment rules.

By default, the ANZG (2018) guidelines recommend that the median quality values of surface water should be lower than the 80<sup>th</sup> percentile of concentration values of a suitable reference site (<sup>2</sup>). This rule was adopted for EC.

In the case of toxicants, a more conservative approach is adopted by selecting the 95<sup>th</sup> percentile of surface water concentrations for comparison instead of the median, i.e. action will be triggered if the 95<sup>th</sup> percentile of the test distribution exceeds the compliance LDWQO. This is consistent with the discussion of referential assessment for toxicants of ANZG (2018, <sup>1</sup>)

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1 <https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/local-conditions#default-guideline-values-and-background-concentrations>

2 <https://www.waterquality.gov.au/anz-guidelines/monitoring/data-analysis/derivation-assessment>

Table 3-1 Summary of compliance LDWQOs and assessment rules

Parameter		Compliance LDWQOs for Zone 6 and 7	Value to compare to LDWQO
<b>EC</b>		80 <sup>th</sup> percentile of the latest 4 years of data for Zone 5 (sites FRDSMB and FRUSEB combined)	median
<b>Toxicants</b>	<b>SO<sub>4</sub>, Al, As, Cd, Co, Fe, Mn, Ni, Pb, Zn, U</b>	Existing LDWQOs, see Table 3-3	95 <sup>th</sup> percentile
	<b>Cu, Mg</b>	80 <sup>th</sup> percentile of the latest 4 years of data for Zone 5 (sites FRDSMB and FRUSEB combined)	95 <sup>th</sup> percentile

Table 3-2 Comparison of surface water quality measured in the Finniss River upstream (U/S) and downstream (D/S) from Mt Burton (Zone 5) between 2013 and 2019.

Zone	Season*	EC	SO <sub>4</sub>	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
		µS/cm	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>ANZG (2018)</b>		-	-	55	13	0.2	1.4	1.4	-	-	1900	11	3.4	8	0.5
<b>LDWQO</b>		190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	2.7
<b>5 U/S Mt Burton</b>	Wet (80/95 <sup>th</sup> percentile**)	<b>361</b>	-	81.4	<b>2.7</b>	<b>0.03</b>	<b>167</b>	<b>9.4</b>	<b>300</b>	<b>46.5</b>	61.3	<b>10.4</b>	<b>0.41</b>	<b>6.4</b>	2.1
	Dry (80/95 <sup>th</sup> percentile**)	417	-	91.3	<b>2.7</b>	<b>0.04</b>	<b>239</b>	<b>14.6</b>	<b>289</b>	<b>46.0</b>	<b>75.8</b>	<b>15.1</b>	<b>0.62</b>	<b>5.6</b>	2.1
<b>5 D/S Mt Burton</b>	Wet (80/95 <sup>th</sup> percentile**)	350	-	<b>106</b>	1.9	0.02	5.1	0.27	268	40.4	<b>68.0</b>	0.60	0.18	3.3	<b>2.3</b>
	Dry (80/95 <sup>th</sup> percentile**)	<b>435</b>	-	<b>91.4</b>	1.6	0.02	5.9	0.33	286	39.2	50.6	0.73	0.17	5.2	<b>2.6</b>

Notes: metal concentrations correspond to dissolved concentrations, not total; the LDWQOs presented correspond to previously locally derived water quality objectives as per Hydrobiology (2013, 2016, 2019); the data presented correspond to the 80<sup>th</sup> percentile of data for EC and the 95<sup>th</sup> percentile of measured data for all other parameters; \*Wet season includes November to March, dry season includes April to October (if applicable); - denotes missing data; orange cells indicate exceedances compared with LDWQOs; bold values indicate the higher concentration between U/S and D/S.

Table 3-3 Summary of proposed surface water seasonal compliance LDWQOs for Zone 6 and 7.

Zone	Season*	EC	SO4	Al	As	Cd	Cu	Co	Fe	Mg	Mn	Ni	Pb	Zn	U
		µS/cm	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
6	ANZG (2018)	-	-	55	13	0.2	1.4	1.4	-	-	1900	11	3.4	8	0.5
	LDWQO	190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	2.9
	Wet (80/95 <sup>th</sup> percentile**)	<b>424</b>	21.6	89.7	2.2	0.09	<b>9.7</b>	<b>6.2</b>	236	<b>44.1</b>	110	8.3	0.50	23.4	<b>5.3</b>
	Dry (80/95 <sup>th</sup> percentile**)	<b>419</b>	23.4	37.4	1.8	0.02	<b>5.2</b>	<b>4.4</b>	136	<b>40.5</b>	136	7.3	0.14	6.5	<b>4.3</b>
	Wet season Compliance LDWQOs	<b>350**</b>	594	117	13	0.54	<b>5.1**</b>	2.8	300	<b>40.4**</b>	140	20	3.4	26.1	2.7
	Dry season Compliance LDWQOs	<b>435**</b>	594	117	13	0.54	<b>5.9**</b>	2.8	300	<b>39.2**</b>	140	20	3.4	26.1	2.7
7	ANZG (2018)	-	-	55	13	0.2	1.4	1.4	-	-	1900	11	3.4	8	0.5
	LDWQO	190.7	594	117	-	0.54	3.4	2.8	300	33.2	140	20	-	26.1	2.7
	Wet (80/95 <sup>th</sup> percentile**)	93.9	11.4	<b>121</b>	0.73	0.02	<b>8.3</b>	1.6	<b>317</b>	9.9	39.6	2.9	0.34	8.3	0.59
	Dry (80/95 <sup>th</sup> percentile**)	82.3	7.3	51.6	0.49	0.02	<b>3.8</b>	0.82	243	6.29	24.6	1.8	0.12	4.1	0.33
	Wet season Compliance LDWQOs	<b>350**</b>	594	117	13	0.54	<b>5.1**</b>	2.8	300	<b>40.4**</b>	140	20	3.4	26.1	2.7
	Dry season Compliance LDWQOs	<b>435**</b>	594	117	13	0.54	<b>5.9**</b>	2.8	300	<b>39.2**</b>	140	20	3.4	26.1	2.7

Notes: metal concentrations correspond to dissolved concentrations, not total; the LDWQOs presented correspond to previously locally derived water quality objectives as per Hydrobiology (2013, 2016, 2019); the data presented correspond to the 80<sup>th</sup> percentile of data for EC and the 95<sup>th</sup> percentile of data for all other parameters; the 95<sup>th</sup> percentiles data for Zone 1 correspond to modelled datasets to address missing values due to patchy sampling as per Hydrobiology (2020), all other data presented for the perennial sites (Zone 5 to 7) had sufficient data coverage, the values presented for these sites correspond to 80<sup>th</sup> and 95<sup>th</sup> percentiles

of measured data; \*Wet season includes November to March, dry season includes April to October (if applicable); - denotes missing data; orange cells indicate exceedances compared with LDWQOs; \*\* these compliance LDWQOs are based on 80<sup>th</sup>/95<sup>th</sup> percentiles of data from Zone 5 (downstream from Mt Burton), these should be recalculated based on the most recent 4 years of data for any future assessment.

# 4. CONCLUSION

This report provides compliance LDWQOs for Zone 6 and 7 of the Finniss River. It is not expected that Zones 6 and 7 will be compliant during the construction phase, but these GVs represent achievable post-construction objectives.

LDWQOs for Zones 8 and 9 were not addressed as part of this report. Zone 8 remains classified as a high conservation value system.

# 5. REFERENCES

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.* Available at: [www.waterquality.gov.au/anz-guidelines](http://www.waterquality.gov.au/anz-guidelines) (Accessed: 23 July 2021).

Hydrobiology (2013) 'Environmental Values Downstream of the Former Rum Jungle Mine site – Phase 2', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy.*

Hydrobiology (2015) 'Rum Jungle Impact Assessment Preliminary Report', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy.*

Hydrobiology (2016) 'Rum Jungle Impact Assessment', *Hydrobiology Pty Ltd prepared for the Northern Territory Department of Mines and Energy*, p. 98.

Hydrobiology (2019) 'Rum Jungle - Refinement of LDWQTVs', *Hydrobiology Pty Ltd prepared for Northern Territory Department of Primary Industry and Resources.*

Hydrobiology (2020) 'Rum Jungle Surface Water Quality Data Summaries', *prepared for NTDITT.*



STREET

27 / 43 Lang Parade  
Auchenflower 4066  
QUEENSLAND



POSTAL

PO Box 2151  
Toowong 4066  
QUEENSLAND



CONTACT

+61 (0)7 3721 0100 P  
info@hydrobiology.com

ABN 26 096 574 659

[www.hydrobiology.com](http://www.hydrobiology.com)