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**TORO ENERGY
LAKE MAITLAND
PEER REVIEW – SUBTERRANEAN FAUNA**



A Resource Development
Group Company

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EXECUTIVE SUMMARY

The Lake Maitland subterranean fauna assessment reports (Troglofauna and Stygofauna, produced by Outback Ecology, are well structured and well written reports. The scope of works and methodology used are appropriate for the assessment of subterranean fauna and meet the requirements of current guidelines (EAG 12). The results are presented in relevant detail and information given is appropriate for each group of subterranean fauna. The conclusions presented in the report are appropriate and include a detailed risk assessment of the potential impacts that the development of the project could have on the subterranean fauna communities found at Lake Maitland.

The report presents sufficient information for EIA process initiation. Recommendations for the development of monitoring programs for subterranean fauna should be considered.

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1 INTRODUCTION

Toro Energy Limited (Toro) acquired the Lake Maitland uranium deposit from Mega Uranium in August 2013 and plans to seek environmental approval for the mining of this deposit as well as the Millipede deposit. Toro plans to process ore from Centipede and Lake Way along with ore from Millipede and Lake Maitland at one central processing plant located adjacent to the Centipede deposit. Toro intends to refer the Millipede and Lake Maitland deposits to the Environmental Protection Authority (EPA) for assessment, which will require detailed surveys and studies across all proposed disturbance areas.

Mega Uranium undertook and completed environmental assessments and surveys across the Lake Maitland project sufficient to allow the proposal to be assessed under an Environmental Review and Management Programme (ERMP) (equivalent to the current PER level) in 2009. Initial discussions between the OEPA and Toro indicate that the existing environmental assessments and surveys for Lake Maitland would be acceptable for submission in a PER following peer review for correctness of content and adequacy. Toro have sought the advice and recommendations of *ecologia* Environment and appropriate sub-consultants who will undertake a peer review of the following reports:

- Regional and local flora
- Terrestrial fauna
- Short Range Endemic invertebrates (SREs)
- Stygofauna
- Troglifauna
- Aquatic Ecology
- Sediments and erosion
- Soils and waste rock characterization and geochemical assessment
- Human health and ecological risk assessment (human and non human biota) and
- Air quality impact assessment and monitoring

This peer review report pertains to the Subterranean fauna (Stygofauna and Troglifauna) report(s) which were undertaken by Outback Ecology Services in 2012.

1.1 LEGISLATION AND POLICY BACKGROUND OF PEER REVIEW

1.1.1 Compliance

This peer review will satisfy the requirements of all necessary statutory legislation, guidance and policy, including but not limited to:

Subterranean fauna:

- EPA Environmental Assessment Guideline No. 12, Consideration of subterranean fauna in environmental impact assessment in Western Australia (EPA 2013) ; and
- EPA Guidance Statement No. 54a, Sampling methods and survey considerations for subterranean fauna in Western Australia.

Environmental Assessment Guideline 12 supersedes EPA Guidance statement 54: Consideration of subterranean fauna in groundwater and caves during environmental impact assessment in Western Australia (EPA 2003)

1.1.2 Approach

A review was undertaken of all environmental reports pertaining to the acquired Lake Maitland Project for breadth of scope, technical methodology, correctness of content and adequacy. The main findings of the peer review were to determine:

- a) Correctness of findings and conclusions of all reports;
- b) Adequacy of scope, methodology and results of all reports;
- c) Compliance of all reports with statutory legislation and policy; and
- d) Recommendations to address knowledge gaps (if applicable).

2 REVIEW RESULTS

2.1 CORRECTNESS OF FINDINGS AND CONCLUSIONS

Troglofauna

The major findings the troglofauna assessment (Outback Ecology 2012a) were based on appropriate methodologies and relevant analyses of available results. As such, the findings are considered to be correct. The conclusions and advice based on these findings are correct and appropriate. A summary of the major findings from the report (Outback Ecology 2012a) is given below.

- The Barwidgee calcrete system (associated with Lake Maitland) hosts a troglofauna assemblage of similar diversity, composition and abundance to the Lake Way associated Calcrete systems that also occurs along the Carey Palaeochannel (110 km to the north west).
- Nine troglofauna species were only collected from within calcrete habitats associated with the Barwidgee calcrete system or from fine grained sediments fringing the northern Lake Maitland playa.
- No species were recorded from the proposed borefield area.
- One species was restricted in distribution to within the mining operations resource area;
 - Scolopendridae sp. OES1 – known from a single specimen collected from calcrete habitat.
- Four species were restricted in distribution to the mining operations 0.5 m groundwater drawdown contour area:
 - *Haloniscus* sp. OES12 – collected from within the resource area, as well as from outside within the modelled 0.5 to 1 m drawdown contours;
 - *Haloniscus* sp. OES14 – recorded from more than 950 m from outside the resource area but within the 0.5 to 1 m drawdown contours;
 - Pauropoda sp. – recorded from more than 2.3 km from outside the resource area but within the 0.5 to 1 m drawdown contours; and
 - *Tyrannochthonius* sp. OES5 – single specimen collected from more than 100 m from outside the resource area but within the 1.5 to 2 m drawdown contours.

The removal of habitat by mining excavation will have a direct impact on the long-term persistence of Scolopendridae sp. OES1 if this species does only occur in the resource area. However, the distribution ranges and habitat preferences of species known from a single specimen cannot be reliably assessed with the seemingly restricted distribution being a likely artefact of that species occurring at a low population density and possessing an irregular distribution in response to varying environmental factors. The wider distribution of other members of the troglofauna assemblage throughout the calcrete habitats and associated lake playa environments, and the much greater expanse of adjacent calcrete habitat outside of the resource area indicate that the distribution of Scolopendridae sp. OES1 is likely to be of a range that extends beyond the resource area. When taking these factors into consideration, as well as the short operational life of the LMUP (12 years), the proposed mining of the resource area is not considered likely to pose a long term conservation risk to Scolopendridae sp. OES1.

The modeled drawdowns associated with the proposed mining of the resource area are also not considered likely to pose a long term conservation risk to the four species of troglofauna found within the 0.5 m groundwater drawdown contour for the main reasons:

- the depth of the modeled groundwater drawdowns are not considered to be of a large enough magnitude to lower the relative humidity to such a degree, if at all, to

render the subterranean environments within the 0.5 to 2 m drawdown contours uninhabitable;

- the wider distribution of other members of the troglifauna assemblage throughout the calcrete habitats and associated lake playa environments; and
- the existence of adjacent calcrete habitat remaining outside the lateral extent of the 0.5 m groundwater drawdown contour.

Stygofauna

The major findings the stygofauna assessment (Outback Ecology 2012b) were based on appropriate methodologies and relevant analyses of available results. As such, the findings are considered to be correct. The conclusions and advice based on these findings are correct and appropriate. A summary of the major findings is given below.

- The diversity of the Barwidgee calcrete stygofauna PEC is comparable to the Lake Way associated calcrete PEC's, Lake Violet, Hinkler Well and Uramurdah, that also occur in the Carey Palaeochannel, 110 km to the north west of the LMUP (110 km to the north west).
- Twenty eight species of stygofauna were recorded. Twenty seven species were collected and one species, *Limbodessus usitatus*, was not collected but is known from published records to occur in the Barwidgee calcrete outside the LMUP impact zones.
- Twenty three species were recorded from the Barwidgee calcrete system and northern Lake Maitland playa system;
 - 10 species were recorded from inside the mining operations resource area;
 - eight species were recorded from inside the mining operations modelled 0.5 m groundwater drawdown (without mitigation) contour; and
 - 19 species were recorded outside the mining operations modelled 0.5 m groundwater drawdown contour;
- six species were recorded from the upper tributary catchment area to the north of Lake Maitland associated with the proposed borefield;
 - three species were recorded from inside the proposed Borefield groundwater 0.5 m modelled groundwater drawdown contour; and
 - four species were recorded from outside the proposed Borefield groundwater 0.5 m drawdown contour;
- three of the 28 stygofauna species recorded were of conservation concern because their distributions were not demonstrated to occur outside of the Mining operations impact areas. These were:
 - Chiltoniidae sp. SAM4 and Schizopera sp. TK1 – not recorded outside the mining operations resource area;
 - *Haloniscus* sp. OES1 – not recorded outside the mining operations modelled 0.5 m groundwater drawdown contour.

The proposed mining of the resource area is not considered likely to pose a long term conservation risk to Chiltoniidae sp. SAM4 or *Schizopera* sp. TK1 when taking into consideration the:

- Limited area of calcrete habitat removal associated with mining excavation, relative to the much greater expanse of adjacent calcrete habitat remaining;
- Broader distribution patterns and habitat preferences of other Chiltoniid and Schizopera species;

- Broader distributions habitat preferences of other members of the stygofauna assemblage that were collected sympatrically; and
- Expected operational life of the LMUP (12 years).

The modelled groundwater drawdowns associated with the proposed mining of the resource area is not considered likely to pose a long term conservation risk to the stygal isopod, *Haloniscus* sp. OES1, when taking into consideration the:

- The depth of the modeled groundwater drawdowns within the 0.5 to 1 m drawdown contours are not considered to be of a large enough magnitude to lower the SWL to such an extent to render the inhabited subterranean environments present uninhabitable;
- Large lateral and vertical extent of adjacent calcrete habitat remaining outside of the Mining operations impact areas;
- Broader distribution patterns of other members of the stygofauna assemblage that were collected sympatrically;
- Broader distributions habitat preferences of other sympatric members of the stygofauna assemblage; and
- Expected operational life of the LMUP (12 years).

2.2 ADEQUACY OF SURVEY

2.2.1 Scope of Works

The overarching objective of the subterranean fauna assessments were to assess the troglofauna values of the LMUP, document the diversity and abundance of the Barwidgee stygofauna assemblage PEC within the LMUP and to investigate if the removal of potential habitat through excavation and groundwater drawdown will place any stygofauna within the LMUP at risk. Specific objectives of the assessment were to:

- Evaluate the habitats within the proposed mining areas and borefield that support subterranean fauna;
- Identify any potential risks to obligate subterranean fauna from the proposed mining activities; and
- Consider the conservation significance of any subterranean fauna species occurring within the LMUP.

The scope of the subterranean fauna assessments encompassed a literature review, database searches and a Level 2 troglofauna and stygofauna survey of the LMUP. All aspects of the scope were completed. Under EAG 12 the subterranean assessment can be considered a “comprehensive Level 2” assessment.

2.2.2 Sampling/Survey adequacy

Current guidelines (EAG12) do not prescribe specific methodologies or sampling intensity for subterranean fauna surveys, however it is indicated that the survey needs to be sufficient to ensure that the subterranean fauna is adequately understood in the context of the project footprint and surrounding areas. Both the troglofauna and stygofauna assessments have collected sufficient data to allow the subterranean fauna of the region to be considered in context with the project footprint, thus meeting the requirements outlined in EAG 12.

Troglofauna

The troglofauna survey covered a relatively broad geographical spread of samples from within representative geologies of the proposed impact areas as well as from within representative areas outside of the potential LMUP impacts. Mega developed the majority of the bores sampled specifically for troglofauna sampling. A total of 76 litter traps were deployed and nine net hauls were conducted within the impact areas and an additional deployment of 16 litter traps and six net hauls completed outside of impact areas (Impact areas were defined as areas within the 0.5m water drawdown contour). Litter trap sampling was conducted between November 2010 and November 2011, with additional net haul scraping completed in conjunction with the stygofauna assessments (2007 – 2011).

Stygofauna

The stygofauna survey covered a relatively broad geographical spread of samples from within representative geologies of the proposed impact areas as well as from within representative areas outside of the potential LMUP impacts. Bores sampled were situated within a range of surface geologies, ranging from clayey colluvial sands around the shoreline of the lake playa through to calcrete geologies associated with the Barwidgee calcrete.

A total of 165 net haul samples from 87 holes were collected over ten rounds of sampling between 2007 and 2011. One hundred and eleven samples were from the impact areas, and 54 from non-impact areas.

Within the impact zones:

- 54 samples were from the mining operations resource area;
- 36 from within the associated modelled 0.5 m groundwater drawdown contour; and
- 21 from within the modelled 0.5 m drawdown contour in the proposed borefield.

Stygofauna survey methodology, consisting of three hauls of both 150um and 50um nets and associated hygiene, storage and transport of samples were used for each bore sampled. The methodology used meets current standard sampling methodology.

The spread (both geographically and geologically) and number of sampling locations and the division between the impact and non-impact areas (biased towards the impact area) allowed for an adequate assessment of the impact area with a determination of the distribution of collected taxa in the surrounding region for both stygofauna and troglifauna.

2.2.3 Results

The results section is detailed, well presented and well discussed with respect to broader context, citing relevant literature. Survey adequacy is calculated using relevant statistical analyses and the identification of each taxa has been completed to the highest level available. Each taxa recorded is discussed in terms of its potential distribution (All taxa are mapped displaying the currently known distribution of each taxa based on the results of the surveys) within each impact area and the surrounding region and which has allowed a fairly extensive risk assessment is completed on the potential impacts of the project on the subterranean fauna. Taxa of conservation concern have been identified and an assessment of long term conservation risk made.

A summary of the main results of the assessment are presented below:

Troglofauna:

Nine species from five orders were collected:

- Chilpoda: Scolopendridae sp. OES1 (1 specimen);
- Hemiptera: Meenoplidae sp. OES1 (3 specimens);
- Isopoda: *Haloniscus* sp. OES12 (41 specimens);
Haloniscus sp. OES14 (22 specimens); and
Trichorhina sp. OES6 (95 specimens);
- Pauropoda sp. (2 specimens); and
- Pseudoscorpionida: *Tyrannochthonius* sp. OES4 (4 specimens);
Tyrannochthonius sp. OES5 (1 specimen); and
Tyrannochthonius sp. OES6 (1 specimen).

All troglifauna collected were from within calcrete habitats associated with the Barwidgee calcrete system or from fine grained sediments fringing the northern Lake Maitland playa.

No troglomorphic species were found to occur in the upper tributary catchment area to the north of Lake Maitland associated with the proposed borefield, which is characterised by weathered basement geologies of the Yandal greenstone belt.

Both impacts pose varying degrees of risk to the conservation of five of the nine troglomorphic species collected that were restricted in distribution to within the:

- Resource area – Scolopendridae sp. OES1;
- 1.5 m groundwater drawdown contour zone – *Haloniscus* sp. OES12; and

- 0.5 m groundwater drawdown contour zone – *Haloniscus* sp. OES14, Pauropoda sp., and *Tyrannochthonius* sp. OES5.

The proposed mining of the resource area is not considered likely to pose a long term conservation risk to Scolopendridae sp. OES1 when taking into consideration the:

- Wider distribution of other members of the troglofauna assemblage throughout the calcrete habitats and associated lake playa environments;
- Limited area of calcrete habitat removal associated with mining excavation, relative to the much greater expanse of adjacent calcrete habitat remaining; and
- Short operational life of the LMUP (12 years).

The modeled drawdowns associated with the proposed mining of the resource area are not considered likely to pose a long term conservation risk to the species of troglofauna found within the 0.5 m groundwater drawdown contour for the following considerations:

- The depth of the modeled groundwater drawdowns are not considered to be of a large enough magnitude to lower the relative humidity to such a degree to render the subterranean environments within the 0.5 to 2 m drawdown contours uninhabitable by members of the troglofauna assemblage recorded;
- The proposed lowering of the groundwater will expose additional calcrete habitats that could be colonised;
- The wider distribution of other members of the troglofauna assemblage throughout the calcrete habitats and associated lake playa environments;
- The existence of adjacent calcrete habitat remaining outside the lateral extent of the 0.5 m groundwater drawdown contour; and
- The short operational life of the LMUP (12 years).

The remaining four troglofauna species, Meenoplidae sp. OES1, *Trichorhina* sp. OES6, *Tyrannochthonius* sp. OES4 and *Tyrannochthonius* sp. OES6, are not of conservation concern because their distributions were demonstrated to extend beyond, or to not occur within, the LMUP impact zones.

Stygofauna

27 species from seven higher level taxonomic groups were collected:

- Amphipoda: *Chiltoniidae* sp. OES1; and
Chiltoniidae sp. SAM4;
- Bathynellacea: *Atopobathynella* sp. OES6; and
Bathynellidae sp. OES1
- Coleoptera: *Limbodessus barwidgeensis*;
- Copepoda: *Halicyclops eberhardi*;
Halicyclops sp. TK1;
Halicyclops sp. TK2;
Halicyclops sp. TK3;
Mesocyclops brooksi;
Microcyclops varicans;
Ameiropsyllus sp. TK1;
Nitokra lacustris pacifica;
Nitokra sp. TK3;

Australocamptus similis;
Kinnecaris sp. TK3;
Schizopera sp. TK1;
Schizopera sp. TK5;
Schizopera sp. TK6; and
Schizopera sp. TK8;

- Isopoda: *Haloniscus* sp. OES1;
- Oligochaeta: Enchytraeidae sp. OES1;
Enchytraeidae sp. OES2;
Naididae sp. OES1; and
Naididae sp. OES2;
- Ostracoda: *Candonopsis dani*;
Candonopsis sp. IK2

An additional species, *Limbodessus usitatus* (Coleoptera: Dytiscidae), that was not collected in this study has been recorded from the Barwidgee calcrete previously from outside the LMUP impact zones (Watts and Humphreys 2006) bringing the total number of species recorded to 28.

Stygofauna diversity and abundance was greatest from within the calcrete habitats of the Carey palaeovalley associated with the Barwidgee calcrete system and northern Lake Maitland playa with all seven higher level taxonomic groups present, represented by 23 species.

Stygofauna diversity and abundance was much lower in the upper tributary catchment area to the north of Lake Maitland associated with the proposed borefield, which is characterised by weathered basement geologies of the Yandal greenstone belt. Only two higher level groups, Copepoda and Oligochaeta were present, represented by six species.

Three of the 28 stygofauna species recorded were of conservation concern because their distributions were not demonstrated to occur outside of the Mining operations impact areas. These were:

- Chiltoniidae sp. SAM4 and *Schizopera* sp. TK1 – not recorded outside the mining operations resource area;
- *Haloniscus* sp. OES1 – not recorded outside the mining operations modelled 0.5 m groundwater drawdown contour.

The proposed mining of the resource area is not considered likely to pose a long term conservation risk to Chiltoniidae sp. SAM4 or *Schizopera* sp. TK1 when taking into consideration the:

- Limited area of calcrete habitat removal associated with mining excavation, relative to the much greater expanse of adjacent calcrete habitat remaining;
- Broader distribution patterns and habitat preferences of other Chiltoniid and *Schizopera* species;
- Broader distributions habitat preferences of other members of the stygofauna assemblage that were collected sympatrically; and
- Expected operational life of the LMUP (12 years).

The modelled groundwater drawdowns associated with the proposed mining of the resource area is not considered likely to pose a long term conservation risk to the stygal isopod, *Haloniscus* sp. OES1, when taking into consideration the:

- The depth of the modeled groundwater drawdowns within the 0.5 to 1 m drawdown contours are not considered to be of a large enough magnitude to lower the SWL to such an extent to render the inhabited subterranean environments present uninhabitable;

- Large lateral and vertical extent of adjacent calcrete habitat remaining outside of the Mining operations impact areas;
- Broader distribution patterns of other members of the stygofauna assemblage that were collected sympatrically;
- Broader distributions habitat preferences of other sympatric members of the stygofauna assemblage; and
- Expected operational life of the LMUP (12 years).

2.3 CURRENCY OF RESULTS

The results of this assessment are still current and meet current guidelines for the assessment of subterranean fauna. Future subterranean assessments completed in the surrounding region should be noted and the results compared with the current assessment as taxa recorded in the impact areas may have distributions that extend further out in the surrounding region which could be confirmed by future assessments.

2.4 COMPLIANCE

The assessment aligns with statutory legislation.

2.5 RECOMMENDATIONS AND GAP ASSESSMENT

The assessment can be considered adequate and complete. Recommendations for monitoring of subterranean fauna are correct and should be considered.

3 CONCLUSIONS AND RECOMMENDATIONS

- The report is well structured and well written.
- The scope of works and methodology used are appropriate for the assessment of subterranean fauna.
- The results are presented in relevant detail and information given is appropriate for each group of subterranean fauna (troglafauna and stygofauna).
- The conclusions presented in the report are appropriate and backed with currently available data and regional information.
- The report presents sufficient information for EIA process initiation. The risk assessment of potential impacts from LMUP are suitable based on the level of data available.
- Recommendations for the development of monitoring programs should be considered.

The report presents a good basis for EIA process to be initiated. No further work is required.

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4 REFERENCES

- Environmental Protection Authority, 2003. Guidance for the Assessment of Environmental Factors, Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia.
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