Appendix C:
Mt Dromedary GDE Indicators
(NRA 2018a)
Mt Dromedary Groundwater Dependent Ecosystem Indicators

Introduction

Novonix Ltd (NVX)\(^1\) is applying to the Queensland Department of Environment and Science (DES)\(^2\) for an environmental authority (EA) for a graphite mining project in north-west Queensland (hereafter the ‘Mt Dromedary Project’). As part of the EA application, NVX is required to consider potential impacts on Groundwater Dependent Ecosystems (GDEs) from the proposed mining activity. Rob Lait & Associates (RLA) has been commissioned by NVX to prepare an Underground Water Impact Report (UWIR) for the project. Potential impacts on GDEs will be assessed as part of the UWIR.

This NRA Environmental Consultants (NRA) Technical Note provides information on indicators of GDEs within the project area. Information presented here is for the exclusive use of NVX and RLA to inform the potential impact assessment of the project on GDEs. The impact assessment will be determined by RLA as part of the UWIR.

The findings herein have been formulated in the context of published guidelines, field observations and available information at the time of writing. However, it is recognised that the assessment of GDEs across north-central Queensland relies on data that may prove to be incorrect or incomplete. The paucity of reliable groundwater data across remote Queensland is particularly challenging, and the groundwater drawdown studies that have informed this document are yet to be completed (RLA in prep).

Data has been obtained from desk based searches of Government databases and/or third parties, and NRA has used this information in good faith. NRA’s opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. NRA’s opinions relate solely and exclusively to

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\(^1\) Previously Graphitecorp Ltd.

\(^2\) Previously the Queensland Department of Environment and Heritage Protection (EHP).
environmental management matters, and are based on the technical and practical experience of environmental practitioners. They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts. Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as at the date of this document.

Definition of GDEs

GDEs are ecosystems that require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements to maintain their communities of plants and animals, ecosystem processes and ecosystem services (Richardson et al. 2011a-b, as defined in EHP 2016).

The three types of GDEs are identified in Eamus et al. (2015) and Richardson et al. (2011a) and are referred to in Commonwealth and Queensland government mapping as follows. These terms are used in this report.

- Aquifer and cave ecosystems where stygofauna reside; ie subterranean GDE (Type 1).
- Ecosystems reliant on the surface expression of groundwater; ie aquatic GDE (Type 2).
- Ecosystems reliant on the sub-surface presence of groundwater within the rooting depth of the ecosystem; ie terrestrial GDE (Type 3).

Project background

The proposed Mt Dromedary mining leases (MLA 100121 and MLA 100126) is approximately 125 km north-northwest of Cloncurry on the Burke Developmental Road (Figure 1). NVX proposes to develop an open cut mine at Mt Dromedary. The pit is expected to extend to approximately 90 m below ground surface, and cover approximately 25 ha. During the mining operations, water in the open pit (ie ‘associated water’) will be removed and reused on-site. The predicted extent and potential impacts of interfering with associated water will be assessed by RLA in the UWIR (in preparation).

Approach

To determine potential GDEs at the Mt Dromedary Project, a review of desk-based search results and field survey data was undertaken. Communications with Tim Ryan (A/Science Leader, Ecosystem Survey and Mapping, Queensland Department of Environment and Science, 23 January 2018) clarified the approach used to determine GDEs.

The following databases were reviewed to identify potential GDEs at the Mt Dromedary Project.

- Groundwater Dependent Ecosystem Atlas (BoM 2018).
- Queensland Spring Database (DSITI 2017a).
- Regional Ecosystem (RE) mapping (version 8.0) (DNRM 2017).
- Flora Wetland Indicator Species (WIS) List (EHP 2013).

Field work conducted by NRA in 2016 and 2017 identified and described the baseline environmental attributes within the proposed mining leases, including surface water conditions and flora species along watercourses. Although the baseline survey did not target
GDE indicators, data collected during the field surveys has been used here to inform locations of GDE indicators and potential GDEs.

**Guidelines and key references**

The assessment reported herein considered guidance from the following documents.

- *Guideline: Application requirements for activities with impacts to water* (EHP 2017b).
- *EIS information guideline – Groundwater dependent ecosystems* (EHP 2016).
- *Groundwater-dependent ecosystems: recent insights from satellite and field-based studies* (Eamus et al. 2015).
- *Ecohydrology: Vegetation function, water and resource management* (Eamus et al. 2006).

**Results**

The likely presence of GDEs within the mining leases was determined by reviewing the database search results, which found the following.

- Potential aquatic and terrestrial GDEs are mapped near Mt Dromedary, but not within the proposed mining leases (*Figures 2 and 3* respectively) (BoM 2018).
- No potential subterranean GDEs were mapped for the project area (BoM 2018).
- Queensland GDE mapping did not show GDEs within or near the mining leases (DSITI 2017b).
- No springs are mapped for the mining leases or surrounding area (DSITI 2017a).
- No wetlands occur within the mining leases; the closest mapped wetland is approximately 4 km south-west of the proposed open pit (EHP 2017a).

Four watercourses occur within the Mt Dromedary Project area (*Figures 1 and 4*). The northern (Kateys Creek) and eastern (unnamed) watercourses are within the Flinders River catchment, and flow east to Dismal Creek (*Figure 1*). The central and southern-most (unnamed) watercourses are within the Leichhardt River catchment, and flow west onto the Leichhardt River floodplain adjacent to Leichhardt River (*Figure 1*). All of the watercourses are intermittent, and permanent pools are not known to occur on the mining leases or near to the mining leases (based on review of aerial photography, observations during the February 2016 baseline surface water survey (NRA 2016a), and surface water monitoring by NVX personnel in 2017). Photographs in *Plates 1 to 3* show nil or very small pools of water in the eastern and central watercourses less than 24 hours after a large storm event flushed the systems (*pers. obs.* Shannon Wetherall, Senior Environmental Scientist, NRA, February 2016). These photographs are reflective of the surface water conditions along the watercourses on the mining leases. Based on the government mapping and field observations, it is considered that aquatic GDEs are not within the proposed mining leases or near to the project area.

DNRM (2017) RE mapping for the project area includes wetland REs (*ie* riverine wetland (*ie* RE 1.3.7), palustrine wetland REs (*eg* RE 1.3.6), floodplain – other than floodplain wetland REs (*eg* RE 2.3.3)) and non-wetland REs (*eg* RE 1.11.3). The baseline flora survey (NRA 2016b) verified the REs on the mining leases where the proposed activities will be
undertaken. The field survey did not include the REs in the western-most portion of MLA 100121 (ie REs associated with floodplain – other than floodplain wetlands, and palustrine wetland areas) because this portion of the mining lease was incorporated into the project after the baseline survey was undertaken. This is not considered to be a limitation to this report because the predicted groundwater drawdown associated with development of the open pit (RLA in prep) does not extend to these areas.

The baseline flora survey (NRA 2016b) identified that most of the REs were consistent with the DNRM (2017) mapping. The exception to this is the riverine wetland RE 1.3.7, which was less extensive than shown on the DNRM (2017) mapping. RE 1.3.7b. This RE is dominated by mature River Red Gum (*Eucalyptus camaldulensis*) and occurred on the northern and eastern watercourses (shown on Figure 4). Plate 1 shows this RE on the eastern watercourse. The areas of RE 1.3.7b are considered to be terrestrial GDEs because this RE is a ‘riverine wetland or fringing riverine wetland’ (Queensland Herbarium 2016) and it is likely that *E. camaldulensis* sources sub-surface groundwater. Based on the predicted drawdown contours for the project (RLA in prep), it is expected that the interference with groundwater associated with developing the open pit will not affect the terrestrial GDEs in RE 1.3.7b. This will be confirmed by RLA in the UWIR.

The REs along the central watercourse, which occur within the predicted groundwater drawdown area (RLA in prep), are mapped (DNRM 2017, NRA 2016b) as non-wetland REs (ie RE 1.11.3x1b/1.11.2a, RE 1.11.3b, RE 1.11.2a/1.11.3x1b/1.5.4, RE 1.5.4). During the baseline field survey (NRA 2016a, b), Wetland Indicator Species (WIS), Black Tea-tree (*Melaleuca bracteata*) and a sedge (*Fimbristylis* sp.), were recorded on the banks of the watercourse (approximate extent shown on Figure 4) (observations from NRA 2016a). EHP (2013) notes that ‘the presence of a WIS at a site does not, in itself, confirm the site to be a wetland, but is one line of evidence towards determining the wetland status of a site’. The WIS plants on the central watercourse occur as a narrow strip of vegetation (<5 m wide) and do not extend beyond the stream bank (Plates 2 and 3). Adjacent to the central watercourse, mature *Corymbia terminalis* and *Eucalyptus leucophylla* occur; these comprise the dominant tree species in this area and are not WIS.

Bore log and monthly water level data from a groundwater monitoring bore near the central watercourse suggest that the water table in this area may be as shallow as approximately 4.5 m below the ground surface at peak groundwater levels (nominally March) (pers. comm. Angela Bush, Senior Consultant – Hydrogeologist, Australasian Groundwater and Environmental Consultants Pty Ltd, 24 January 2018). It is assumed that roots of vegetation adjacent to the central watercourse may intercept groundwater at some time; therefore, it is likely that this vegetation is a terrestrial GDE indicator. Along the central watercourse, *M. bracteata* grows more densely than the surrounding vegetation and contributes to ecosystem services by assisting with stream-bank stability (erosion control) and by contributing to species richness (and therefore biodiversity) and habitat connectivity.

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3 Studies reported in Anderson et al. (2016) note that *E. camaldulensis* in riparian areas and on the floodplain, where groundwater is relatively close to the surface, use groundwater for some of their water requirements.

4 Monitoring bore GWMB01 (at 417910E, 7830390N (GDA94, zone 54k)) is approximately 20 m from the central watercourse, and water levels were measured monthly in 2017 by NVX.

5 It is possible to undertake studies to verify the reliance of a plant on groundwater versus surface water; for example, by measuring isotopes in the xylem water. This further investigative work has not been undertaken for Mt Dromedary, and is not planned to be undertaken. Rather, for the purpose of potential impact assessment, it is assumed that vegetation along the central watercourse intermittently intercepts groundwater.
Plate 1: River Red Gum (*Eucalyptus camaldulensis*) in RE 1.3.7b on MLA 100126

Plate 2: WIS *M. bracteata* on the banks of the central watercourse, adjacent to the proposed open pit

Plate 3: WIS *M. bracteata* on the banks of the central watercourse, approximately 500 m south-west of the proposed open pit
Figure 1: Project location and watercourses

Project: Mt Dromedary
Groundwater Dependent
Ecosystem Indicators

- Mining lease application boundary
- Roads
- Drainage

NRA Ref: 490007.03
Date: January 2018

Source:

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Figure 2: Mapped potential aquatic GDEs
Project: Mt Dromedary Groundwater Dependent Ecosystem Indicators

- Mining lease application boundary
- Major drainage

Aquatic GDE (GDE Atlas, BoM 2018)
- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction
Figure 3: Mapped potential terrestrial GDEs

Project: Mt Dromedary
Groundwater Dependent Ecosystem Indicators

- Mining lease application boundary
- Terrestrial GDE (GDE Atlas, BoM 2018)
  - High potential for groundwater interaction
  - Moderate potential for groundwater interaction
  - Low potential for groundwater interaction

NRA Ref: 496007.03
Date: January 2018

Source:
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NRA
Figure 4: GDE indicators observed in the project area

Project: Mt Dromedary Groundwater Dependent Ecosystem Indicators

- Mining lease application boundary
- Proposed open cut pit
- Roads
- Drainage
- NRA field observed RE 1.3.7b
- Approximate location of WIS along the drainage feature

Source:
NRA 2018, Novonix Ltd @ State of Queensland (Department of Natural Resources and Mines) 2014 @ State of Queensland (Department of Natural Resources and Mines) 2017. Updated data available at http://data.qld.gov.au/catalogue/

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Date: January 2018
References


NRA 2016a, Mt Dromedary 2016 Wet Season Surface Water Survey, prepared by NRA Environmental Consultants for Graphitecorp Ltd, 8 April 2016.

Queensland Herbarium 2016, *Regional Ecosystem Description Database (REDD), version 10.0*, Queensland Department of Science, Information Technology and Innovation, Brisbane.

