Dongara Titanium Minerals Project

Response to submissions

FINAL

November 2012

TRONOX

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This document has been prepared by Strategen Environmental Consultants Pty Ltd for Tronox Management Pty Ltd.

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1 Introduction

The Dongara Titanium Minerals Project Public Environmental Review (PER) was released for a public comment period of four weeks in May 2012. Comments (from government agencies, an non-government organisation and one member of the public) received primarily related to:

- The accuracy of the groundwater model predictions based on the parameters and assumptions used, and correspondingly, the likelihood of impacts from changes to groundwater levels to Groundwater Dependent Ecosystems (GDEs) and wetlands.
- Demonstration of rehabilitation performance at Tronox's Cooljarloo mine and the applicability of current practices to offset residual impacts and meet completion criteria set for the Dongara Project.

This document responds to the comments received in two parts:

Section 2: which details the outcomes of studies undertaken in response to comments on the assessment of groundwater drawdown. This section concludes by describing a modified groundwater management plan and an assessment of the resultant reduction in environmental impacts.

Section 3: provides a table listing Tronox's response to each comment received.

The document also includes a number of supporting appendices. These include the technical reports from the additional groundwater studies, an Environmental Offsets Plan for the project and a detailed appraisal of Tronox's rehabilitation performance from the Cooljarloo Minesite (appended to the Offsets Plan).

2 Reassessment of groundwater drawdown impacts

This section reassesses impacts arising from groundwater drawdown associated with mining within the superficial aquifer.

It steps through the outcomes of a number of studies undertaken on the groundwater drawdown prediction (PB, 2011 and 2011a) including:

- clarification of groundwater modelling (Section 2.1) via:
  - peer review of groundwater modelling (NTEC, 2012)
  - detailed analysis of the sensitivity of the model to model assumptions (conceptualisation) and inputs (the proposed mine plan) (PB 2012).
- evaluation of options to avoid or minimise impacts (Section 2.2.1) to identify the preferred option (Section 2.2.2) (Hydrosearch 2012).
- reassessment of groundwater drawdown related impacts after the application of the preferred mitigation options

The intent of these studies was to first clarify the uncertainty of the groundwater modelling which was identified to overestimate drawdown, and correspondingly potential impacts. Secondly, given the concerns raised regarding the magnitude of drawdown related impacts predicted, to identify how Tronox may best modify the Proposal to reduce impacts from drawdown on wetlands, and GDEs. The reassessment was undertaken using revised groundwater drawdown modelling predictions and additional drawdown mitigation measures introduced in response to comments made on the PER.

The outcome of this is a revision of the following impact assessments in the PER:

- Section 7.5 of the PER, which discusses the effects of groundwater drawdown on groundwater dependant ecosystems and wetlands
- Section 9.5 of the PER, which discusses impacts on vegetation and flora associated with both clearing and groundwater drawdown.

A summary of the outcomes of the studies, and the revised impact assessment, is provided in Section 2.9.

2.1 Clarification of groundwater model accuracy

2.1.1 Peer review of groundwater modelling

Tronox commissioned NTEC Environmental Technology (NTEC) in August 2012 to complete a Peer Review of Groundwater Modelling for the Dongara Titanium Minerals Project PER. This review was conducted in accordance with the Groundwater flow modelling guideline (Murray Darling Basin Commission, Nov 2000). The peer review considered both dry (PB 2011) and dredge mining (PB 2011a).

The review (NTEC 2012; contained in Appendix 1) concluded that the groundwater model was a sound representation of Dongara's regional conditions. It agreed that dry mining presented the largest drawdown risk. However, the review findings were limited in some areas as particular information regarding the model parameters and assumptions was insufficiently described or absent. The report recommended that the sensitivity analysis included in the original reports, be expanded to investigate the influence of certain parameters, model conditions and mining sequences on the model outputs (i.e. pit inflow and drawdown estimates).

2.1.2 Sensitivity Analysis

Tronox commissioned Parsons Brinckerhoff (PB) to revisit their previous modelling (PB 2011 and PB 2011a) to address the Peer Review findings and in light of Public Responses. This included the following phases:

1. Model refinement and clarification: refine the model to reflect the hydrogeological conceptualisation in Hydrosearch 2011 and clarify various model assumptions and parameters (such as the model layering rationale, i.e. the assumed depth of the zones within the two aquifers assigned in the model) including:
   * reducing assumed Yarragadee transmissivity to reflect pump testing results
   * amending general head boundary conditions based on measured water levels
   * calibrating the model to real water levels measurements from Yarragadee bores (previously used superficial bores).
   * predicting drawdown for Yarragadee abstraction in isolation of mine dewatering (i.e. with no mine dewatering).

2. Sensitivity to varying model parameters values: test the sensitivity of outputs to variation in key model parameters: hydraulic conductivity, hydraulic connection between the Superficial and Yarragadee Aquifers, rainfall infiltration, conductance of the general head model boundary conditions, rainfall infiltration and specific storage of the Yarragadee Aquifer.

3. Sensitivity to Mine Plan: test sensitivity of modelled outputs to changes in mine plan: alternating mining between high and lower risk pits, mining twice as fast and simulating the return of water in sand tailings to the void after mining).

Each phase included at least one, some numerous, runs of the model. Outputs from each run, in turn predicted pit inflows and groundwater drawdown, were reviewed against the base case, i.e. Dry Mining Scenario 1 as presented in the PER.

The results from each phase of the sensitivity analysis are summarised below. This highlights those findings that indicate a significant change from the base case in terms of drawdown within the superficial aquifer. A full description is provided in PB 2012 (Appendix 2).

2.1.2.1 Outcomes of the model refinement and clarification

The modification of the model conceptualisation and recalibration to measured heads in the Yarragadee Aquifer (referred to as the base case) did not result in significantly different outputs than the model results presented in the Dongara PER. Drawdown results in the Superficial and Yarragadee Aquifers of the base case model and the groundwater model presented in the PER are shown in Figure 1, Figure 2 and

Figure 3, respectively. This revised model better reflected the hydrogeological setting (as documented in Hydrosearch 2011) and as such was used for all subsequent analysis.

Tronox request PB to run Yarragadee abstraction for both dry mining (2.5 GL/yr from 4 bores) and dredge mining (5.4 GL/yr from six bores) in isolation of pit dewatering to determine its contribution to drawdown in the Superficial Aquifer. The results of the Yarragadee Aquifer only scenarios demonstrated the relatively minor contribution of abstracting 2.5 GL/yr from the Yarragadee Aquifer to drawdown in the Superficial Aquifer (Figure 4) and the larger extent as a result of abstracting 5.4 GL/yr from the Yarragadee Aquifer (Figure 5). The predicted drawdown of the Superficial Aquifer from abstracting 5.4 GL/yr from the Yarragadee Aquifer is similar to the base case, but the 5.4 GL/yr will be abstracted over a longer period of time, decreasing the rate of drawdown and reducing the severity and extent of impact to vegetation.

2.1.2.2 Outcomes of testing the sensitivity to varying model parameter values

The sensitivity analysis for most key parameters produced minor variations to the predicted maximum groundwater drawdown compared to the base case. Those scenarios displaying the largest variance were:

1. A decrease in the hydraulic conductivity (0.5 multiplier) in the Superficial Aquifer (Layer 1) increased the severity of drawdown by extending the 2 m contour to include Heracles, the 1 m to include Hebe and the 0.5 m approximately 3 km south of Hebe (see Figure 6).

2. An increase in the hydraulic conductivity (2 multiplier) in the Superficial Aquifer (Layer 1) resulted in a reduction of the area impacted by drawdown with the 0.25 m contour remaining within 2 km of Zeus and Heracles compared to the base case where the 0.25 m contour extends up to 4 km from Zeus (Figure 7).

This demonstrates that the model is most sensitive to the assumed hydraulic conductivity within the superficial aquifer. Halving the conductivity results in a moderate increase in the extent of drawdown, mostly to the east and south, in areas not considered to contain groundwater dependent ecosystems. The likelihood of conductivity being significantly different from that assumed in the base case is considered to be unlikely.

The extent of drawdown also increased slightly relative to baseline in the scenario where recharge was halved. The extension of the 2 m (and less) drawdown is confined to areas east of the Zeus orebody in areas where GDEs are not present (depth to groundwater exceeds 10 m). As such, there was no significant change in the predicted impacts associated with this scenario.

The eastern boundary was more sensitive to changes to the conductance of the general head boundary condition than the western boundary. However, the eastern boundary only varied within the stress periods by 5% and 9% in Layer 1 and Layer 2-3 respectively. The potential impact on groundwater drawdown is a slight increase or decrease in the extent of drawdown with the corresponding change in conductance of the general head boundary conditions.

2.1.2.3 Testing sensitivity of model outputs to changes in mine plan

The sensitivity analysis also tested a number of alternative mine plans in order to understand the influence of the mining approach on drawdown. This also assisted with the selection of mitigation options (Section 2.2). Tailings return, where items that were excluded from the base case, contributed to the inherent conservatism (over estimation of drawdown) of the base case impact prediction.

Of the scenarios considered, only doubling the rate of mining (with no corresponding change in reserve/pit design) resulted in a significant (reduction) in the extent of drawdown relative to base case. In this scenario, the area subject to groundwater drawdown decreased and the 0.5 m contour was less than 2 km from the west side of Zeus (Figure 8).

The rate of mining in the base case is based on a mineral throughput of 300 tonne per hour (tph). This is considered to be the lowest throughput rate feasible. In all probability the rate of ore processing, and thereby mining and backfill, will be closer to 500 tph. As such, drawdown would be expected to more likely reflect the 600 tph scenario, a lower drawdown extent, than the base case.

2.2 Evaluation of options to avoid or minimise impact

The PER and associated Environmental Management Plan set out an extensive programme for the management of groundwater drawdown. The key management measures contained in these plans are:

- backfilling as soon as possible to enable reinstatement of the aquifer and thereby through-flow across the mine void
- monitoring of groundwater levels to determine the compliance with triggers identified in the EMP and comparison of results with modelling to determine accuracy of groundwater drawdown contours
- investigating methods of water reuse and promotion of water use efficiency throughout site
- spreading the load of abstraction across bores, locating bores in eastern most extent of project.

The key outcome of the modelling sensitivity analysis (Section 2.1) was that the drawdown predictions for key areas of risk to GDEs (i.e. west of Zeus) show only moderate change with variations in model parameters and the mine plan. It also indicated that increasing the rate of mining will reduce the extent of drawdown by decreasing the time over which pits are dewatered, and the delay between initial excavation and reinstatement of the aquifer through backfill. However, although this provided the greatest reduction in drawdown of all examined scenarios, it still is not expected to significantly reduce the extent and magnitude of drawdown impacts in areas containing GDEs (i.e. west of the Zeus orebody).

As a result, this section examines additional mitigation strategies available for Tronox to further mitigate drawdown impacts.

2.2.1 Mitigation options selection

Potential options for avoiding or reducing drawdown were considered in terms of the trade-off between likely efficacy in reducing drawdown versus the cost (e.g. financial, impact on ore reserves, and environmental). The options considered, summarised and grouped by their rankings were:

- Low efficiency / high cost:
  - not, or reducing the extent of, mining in areas of risk: – removing minor portions of an orebody will have very significant financial costs and was considered unlikely to significantly reduce drawdown
  - mining in high risk areas for short periods (e.g. seasonally during low risk times such as winter): – this was not considered as high costs are associated with the increased number of plant/infrastructure relocations, increasing volume of overburden removal earlier in the project life, and a significant increase in the area open as multiple mining areas will need to be open concurrently
  - mining at a significantly higher rate: – this was modelled by PB (2012) to be of low efficiency and, on the assumption that the rate is not optimal, high relative cost as it requires capital to be sized to the throughput and it is exceedingly expensive to alter part way through the project.
- Moderate efficiency / moderate cost:
  - relocating mining in response to excessive drawdown/ecological impact: – while lower cost than seasonal mining, this is still carries significant financial cost due to additional plant/infrastructure to be relocated, potential delay/production stoppage, and is likely to significantly increase the area cleared at any time
  - mining half of Zeus then somewhere else of lower risk before returning to mine the rest of Zeus: – this is not a significant change form optimal mine plan and layout so only has a small incremental cost. However, PB (2012) modelled this scenario and there was no significant difference to maximum drawdown in base case scenario
  - maintenance of soil moisture by irrigation: – this was considered to be of moderate cost given the area involved (hundreds of hectares) and the difficulties in disruption (uncleared), moderate environmental risk due to complication such as increase dieback risk, and moderate (uncertain) efficacy – given that the mode of impact is lowering of the water table it is uncertain that surface application of water will be effective.
- Low cost / high efficiency:
  - watertable maintenance by infiltration / irrigation; – to curtain the pit perimeter with an injection/infiltration network to mitigate drawdown, clean water is available, some risk of mounding and complications in delivery due to perching, relatively low cost, requires moderately intensive management.

Of the options listed above, a reinjection system was considered the most feasible option. An investigation into the appropriate design, operating strategy and predicted outcomes of the reinjection system are outlined below in Section 2.2.2.

2.2.2 Reinjection System

This section describes the design, operation and of Tronox's proposed infiltration scheme. MWES and Hydrosearch were commissioned to investigate and design a reinjection system to mitigate the impacts of groundwater drawdown by maintaining groundwater levels. Several iterations of varying spacings, sizes and locations of infiltration locations, configuration of infiltration points, and quantities of water to be reinjected were considered. Each iteration was modelled utilising the same model conceptualisation as PB 2011, as amended in PB 2012 (Appendix 3).

The recommended conceptual design of the reinjection system includes a ~4.2 km long transect of 42 small infiltration trenches orientated north-south approximately 250 to 300 m west of the Zeus Pit (as shown in Figure 10). The trenches will be approximately 0.5 m deep, 1 m wide and 3 m long.

The system would be operational from the start of dewatering in the Zeus pit until mining at Zeus is completed. The volume of water required would be approximately 390 ML/yr based on Superficial Aquifer hydraulic conductivity values being commensurate with those used in the groundwater modelling (i.e. those used in the PER and PB 2011). Should the hydraulic conductivity be double (considered extreme case, 850 ML/yr would be required). This water would be sourced from the Yarragadee Aquifer under the groundwater licence (in application) as the water quality and quantity is more reliable than the Superficial Aquifer.

Approximately 22 piezometers would be installed along the line of trenches as well as shallow/deep paired monitoring bores down-flow from the recharge line to monitor the water levels. The water level

monitoring would guide the volume of water released to each trench and will commence on a weekly basis to track changes in the water levels during the commissioning phase of the reinjection system. As the groundwater levels stabilise, and monitoring dataset increases, monitoring frequency will be reduced appropriately.

The reinjection system is predicted to maintain groundwater drawdown to less than 0.5 m west of the line of recharge as shown in Figure 10. Based on the reduction in groundwater drawdown from the operation of the reinjection system, the GDE risk areas have been recalculated and are presented in Section 2.3.

The success of the reinjection system could be influence by the following factors:

1. The uncertainty of the hydraulic conductivity values – higher conductivity may increase the extent of drawdown and the volume of recharge required. Drawdown predicted if the hydraulic conductivity is twice that in the predicted impacts presented in the PER (PB, 2011) has been modelled by PB (2012) and is shown in
2. Figure 7: . As discussed previously, the volume of water required if the hydraulic conductivity is double, 850 ML/yr, can be sourced from the existing groundwater licence (in application).
3. Perching or mounding of the watertable may occur when the reinjection system is running and could adversely impact vegetation. Regular monitoring of the watertable and alterations of the volume of water reinjected depending on water level fluctuations will prevent any long term mounding. If the problem is identified as mounding, it will be reasonable quick to rectify. If a perched layer is present, close monitoring and experimenting with different volumes of recharge may be required to determine the optimum volume.
4. Recording and tracking the reinjection to ensure targets are met and no adverse impacts result will require a comprehensive monitoring system. This will be developed in consultation with Hydrosearch prior to the installation of the reinjection system.
5. Maintenance and modification of water flows will be required during the operational life of the system. A maintenance plan will be developed in consultation with mining personnel and Hydrosearch to ensure the plan is achievable and meets requirements.

2.3 Revised Assessment of likely impacts – GDEs and Wetlands

2.3.1 Drawdown

Section 2.2.2 outlined predicted success of a reinjection system installed west of Zeus to mitigate groundwater drawdown. The mitigated drawdown is predicted to have a significantly smaller extent compared to the drawdown presented in the PER (Strategen 2012), particularly in areas of groundwater dependant ecosystems. The 0.5 m revised drawdown contour does not extend west of the infiltration trenches as shown on Figure 1, for comparison the Figure 2 shows the drawdown presented in the PER. Groundwater drawdown is one of the likely indirect impacts to GDEs and Wetlands. The revised impacts on GDEs (Section 2.3.1.1) and Wetlands (Section 2.3.1.2) are compared to those presented in the PER below.

2.3.1.1 Groundwater-dependent ecosystems

Froend, Bowen and Associates (2011) developed potential risk categories for vegetation subject to groundwater drawdown. The risk rankings are outlined in Table 26 of the PER and form the GDE risk categories used in the PER and this assessment. The GDE risk areas have been recalculated based on the revised groundwater drawdown (Haselgrove 2012) using the model prepared by PB (2011) and are presented in the revised Figure 24 from the PER. All areas where the depth to groundwater is less than 10 m were assumed to be GDEs. The total area classified as GDEs, 4407 ha, completely encircles the area of wetlands, 1553 ha, mapped by Endemic (2011) (revised Figure 26 from the PER). This over estimates the area of actual GDEs as it ignores other factors that influence groundwater dependence such as soil profile. As such, the predictions of impact present are considered conservative (worst-case). This remains consistent with the approach used in the PER.

Section 7.5 of the PER presented an assessment of impacts to groundwater dependent ecosystems arising from the Proposal. Most notably 373 ha (8.5% of mapped extent) of GDEs were predicted to impacted (Large or Moderate change). The recharge via the reinjection system has reduced the areas subject to Large and Moderate change by 152 ha and 116 ha respectively, reducing the total area affected to 105 ha (Table 1 and Figure 10). Therefore, the majority of the area considered to be GDEs will not be affected.

Table 1: Impacts to GDEs

	Impact Area (PER)*		Revised Impact Area		Change
Degree of change	Area (ha)	%	Area (ha)	%	Area (ha)
Total area of potential GDEs	4369		4407**		38
No Change	3500	80.1	4019	91.2	519
Small - some evidence of change	496	11.4	282	6.4	-214
Moderate - measurable change	172	3.9	56	1.3	-116
Large - severe change	201	4.6	49	1.1	-152
Total predicted measurable change	373	8.5	105	2.4	-267

*Values from the PER (Strategen 2012) are shaded purple
** The total area of GDEs increased relative ot the PER (strategen) as in recalculating the area some inconsistencies have been corrected

The vegetation within the Large and Moderate change areas could experience the measurable changes outlined in Table 26 of the PER (Section 7.3.1), such as a reduction in the abundance of dominant species by 15% to over 50%. However, it is unlikely that all areas will be impacted to this level due to the conservativeness of the approach as all vegetation is considered to groundwater dependent within the area classified as GDEs (4407 ha). For example, Endemic 2011 and Blandford 2008 both identified evidence of discontinuous perching within these areas.

2.3.1.2 Wetlands

The wetlands within the Proposal Area, Zeus, Heracles and Hebe, were mapped by Endemic (2011). As shown in Table 2, the proposal is predicted to reduce the extent of Zeus wetland by approximately 236 ha (24%). The revised impact on the Zeus wetlands of 76 ha is a significant reduction in the extent of impact from the predicted area presented in the PER (revised Figure 26 from the PER). The comparison of the impact presented in the PER and the revised impact is presented in Table 2 . The area of Moderate change increased by a small amount,13 ha, due to a portion of a Large Change experiencing less drawdown. The revised total impact is predicted to be 76 ha, 31ha of direct disturbance and 35 ha of indirect disturbance. This is a significant reduction of 160 ha from the predicted total impact, 236 ha.

The two other wetlands, Heracles and Hebe, will not be affected by the Proposal as shown in Table 2 and Figure 26.

Table 2: Impacts to Wetlands

Wetland	Area (ha)	Direct Disturbance (ha) No change from PER	Groundwater Drawdown			Total impact Area* (ha)	Total impact Area* (%)	Total Revised Impact Area (ha)	Total Revised Impact Area (%)
			Indirect Impact Area (PER)* (ha)	Indirect Revised Impact Area (ha)	Change (ha)				
Zeus	1030	31	204	45	-159	236**	24	76	7.4
Heracles	32	0	0	0	0	0	0	0	0
Hebe	492	0	0	0	0	0	0	0	0

*Values from the PER shaded purple
** The total area of GDEs Values differ from the PER (Strategen) - calculation in the PER was incorrect

The potential impacts on wetlands as a result of the Proposal will be temporary. Following mining, pits will be backfilled and the watertable will recover with the vegetation remaining in situ. Those areas cleared for mining will be rehabilitated with vegetation communities commensurate with those present prior to mining.

The assessment considers impacts on wetlands, FCTs and GDEs to cover all classifications of vegetation. The association between wetland mapping and FCTs is presented in Figure 28. The impacts on FCTs is presented and discussed in Section 2.4.1.2.

2.4 Revised assessment of likely impacts - Vegetation Associations, FCTs and conservation significant species

2.4.1 Drawdown

Impacts on Vegetation Associations, FCTs, and conservation significant species as a result of groundwater drawdown were presented in Section 9.5 of the PER. The revised groundwater model, with recharge via a reinjection system, was used to revise drawdown contours and recalculate GDE risk areas. The impacts to Vegetation Associations, FCTs and conservation significant species have been reassessed based on revised GDE risk areas and are presented in the corresponding sections below.

2.4.1.1 Vegetation Associations

The PER presented predicted impacts to three vegetation associations, 378, 379 and 392. The remaining five vegetation associations were not subject to any direct or indirect impacts as a result of the project.

Table 3 provides a breakdown of the impacts on the three vegetation associations that was presented in the PER and that calculated based on the revised GDE risk areas. The extent of impact over vegetation associations 378 was reduced by approximately 200 ha to 98 ha. The impact on vegetation association 392 reduced significantly from 74 ha to 8 ha.

Impacts on Tathra do not differ from that presented in the PER due to the Disturbance Area remaining the same and only the GDE risk (indirect impact) changing.

Predicted impacts on the extent of vegetation associations have decreased with the inclusion of recharge in the groundwater model. However, even if the mitigation option is not installed, the extent of vegetation associations impacted by groundwater drawdown, 378 and 392, will not be reduced to less than 30%. The pre-impact extent of vegetation association 379 is below the 30% threshold. Direct impacts of 15 ha are proposed, representing 0.01 % of its current extent. No impacts as predicted on this associated from groundwater drawdown. Therefore, the three vegetation associations subject to direct or indirect impacts are not considered to be adversely affected as a result of the proposal.

Table 3: Impacts on the extent of Vegetation Associations from clearing and groundwater drawdown

Vegetation system	Vegetation association	Description	Current extent			Proposal impact			
			Total remaining extent Area (ha)	% pre-European extent remaining	Clearing area (ha)	GDE risk area - PER (ha)	GDE risk area - revised (ha)	Total - (PER) (ha)	Total - revised (ha)
Eridoon	378	Shrublands; scrub heath with scattered *Banksia* spp., *Eucalyptus todtiana* and *Xylomelum angustifolium* on deep sandy flats	60733	64.9	1385	299	98	1684	1483
	392	Shrublands; *Melaleuca thyoides* thicket	430	97.9	12	74	8	86	20
Tathra	379	Shrublands; scrub heath on the lateritic sandplains	130313	23.9	15	0	0	15	15

NB: only those associations affected by the proposal are shown. Values shaded purple are as presented in the PER (Strategen 2012)

2.4.1.2 Floristic Community Types

The impact assessment presented in the PER utilised Floristic Community Type mapping completed across the Dongara Study Area in 2009. The Dongara mapping was aligned with Iluka's FCT mapping to cover an area of approximately 35, 000 ha. Of the 20 FCTs identified, eight were predicted to be affected by groundwater drawdown and/or clearing in the PER (Section 9.5 of the PER). The largest impact proposed in the PER to a single FCT was a 41.4% reduction in the extent of FCT 10a, likely to be a moderate impact.

The impacts presented in the PER and the revised impacts are shown in Table 4, revised Figure 24 from the PER and revised Figure 28 from the PER. The most significant reduction in impact is for FCT10a, of which 41.4% was predicted to be affected without recharge. With recharge this reduces to a Low, 8.8%, level of impact. The predicted impact to all other FCTs was reduced or remained the same with less than 10% of the Total FCT area affected by groundwater drawdown and clearing with recharge implemented (Table 4).

With the implementation of the mitigation and management measures outlined in Section 2.2 and the reinjection system (Section 2.2.2), the likely predicted level of impact to all FCTs is Low. As a result, there will not be a significant decline in the extent of any FCT as a result of this proposal.

2.4.1.3 Conservation significant species

The PER predicted direct and indirect impacts to 12 conservation significant flora (Section 9.5 of the PER and Figure 15 in this document). Of the 12 species to be impacted, three were affected by groundwater drawdown. The remaining nine were solely affected by clearing. The predicted impact on these nine species has not changed during the reassessment of impacts ad the clearing footprint has not changed.

The recharge scheme reduces groundwater drawdown related impacts on the number of known locations of the conservation significant species, *Banksia elegans* and *Verticordia luteola* var. *luteola* to one (Table 5 and revised Figure 32 from the PER). No known locations of *Schoenus griffinianus* will be affected by drawdown.

The records of conservation significant species are concentrated in areas of exploration within and near the ore bodies. Therefore, the impacts presented in Table 5 are not considered representative of the likely impact. Impacts to conservation significant species were instead assessed based on habitat using the FCT mapping. Based on the results of the revised impacts presented in Table 4, all FCTs and conservation significant species habitats are likely to have a Low level of impact. As such, it is unlikely that any conservation significant species of vegetation community will be significantly impacted as a result of the proposal.

Table 4: Impacts to Floristic Community Types

FCT	Conservation significance ranking (Woodman 2011)	Total FCT area within Study Area (ha)	Direct Disturbance (ha)	Impact area - PER (ha)	Impact area - revised (ha)	Total – PER (ha)*	Total - PER (%)	Total - revised (ha)	Total - revised (%)	Likely Level of Impact
4	2	7776	138	191	72	329	4.2%	210	2.7%	Low – with a large area existing within the Study Area and less than 10% of this area to be affected by the Proposal, impacts to FCT 4 are unlikely to be significant.
5a	4	11787	1029	23	15	1052	8.9%	1044	8.9%	Low – exhibits the highest total impact area of all FCTs and has a high conservation significance ranking of 4 but less than 10% of the FCT will be impacted.
5b	2	7566	90	1	0	91	1.2%	90	1.2%	Low – with a large area existing within the Study Area and less than 10% of this area to be affected by the Proposal, impacts to FCT 5b are unlikely to be significant.
6c	4	1067	4	0	0	4	0.4%	4	0.4%	Low – area of impact to FCT equates to less than 10%.
10a	4	261	9	99	14	108	41.4%	23	8.8%	Low – area of impact to FCT equates to less than 10%.
10b	3	682	19	45	4	64	9.4%	23	3.3%	Low – area of impact to FCT equates to less than 10%.
16a	3	401	2	0	0	2	0.5%	2	0.5%	Low – area of impact to FCT equates to less than 10%.
23	4	111	1	9	0	10	9.0%	1	1.3%	Low – area of impact to FCT equates to less than 10%.
25a	4	133	0	5	0	5	3.8%	0	0.0%	Low – area of impact to FCT equates to less than 10%.
TOTAL		29784	1292	373	105	1665	5.6%	1398	4.7%	

Table 5: Impacts to Conservation Sig Species

Species	Conservation status (State and Federal)	No. Study Area locations	No. Disturbance Boundary locations	Drawdown impact (PER)	Revised Drawdown impact	Total Impact (PER)	Total Revised Impact	% impact (PER)	% Revised impact
Banksia elegans	P4	508	301	4	1	305	302	60	59.4%
Schoenus griffinianus	P3	11	-	1	0	1	0	9.1	0.0%
Verticordia luteola var. luteola	P3	5	2	3	1	5	3	100	60.0%

2.5 Potential for and nature of any cumulative impacts

There were no cumulative impacts identified in the PER and, as the drawdown extent is predicted to reduce with the proposed implementation of the recharge scheme, it is even less likely that any will result.

2.6 Summary of Proposed Management Measures and Performance Standards

The management measures outlined in Table 6 covers the installation and operation of the reinjection system to mitigate impacts associated with groundwater drawdown. These management measures will be in addition to those presented in the PER and to the GDE Management Plan (EMP Appendix 1 of the Dongara PER).

Table 6: Additional groundwater management and monitoring actions

Item	Action	Purpose	Timing	Responsibility
1.	Align the proposed reinjection system design with the final mine plan. Install 42 infiltration trenches (or number determined in above step) and supporting infrastructure (pipes, piezometers etc.) Recharge via infiltration trenches Monitoring the water levels and adjust volume of recharge appropriately	To recharge the groundwater during dewatering of Zeus pit and reduce impacts to GDEs and wetlands to within predicted areas.	12 months prior to mining Zeus 6 months prior to mining Zeus Period of mining in Zeus	Site Mine Planner/Consultant Site Environmental Manager

The total area of the Actual Footprint will not change with the implementation of this scheme. Less than 2 ha of disturbance will be required to install the recharge scheme and this disturbance will be located within the area of GDEs predicted to be impacted (Large and Moderate change).

2.7 Predicted environmental outcome against environmental objectives, policies, guidelines, standards and procedures

After application of the proposed management measures in Table 6 and those outlined in the GDE Management Plan (EMP Appendix 1 of the Dongara PER), groundwater drawdown 0.5m contour is not expected to extend beyond the transect of infiltration trenches positioned approximately 300m west of Zeus. As a result drawdown will effect 105ha of GDEs and 8.8% of FCT 10a compared to 373 ha and 41.4% predicted in the PER respectively. In addition, the Zeus wetland area impacted is predicted to reduce from 204 ha to 45ha.

2.8 Revised conditions of approval

In the PER a number of conditions of approval were proposed. One related to groundwater drawdown. As a result of the revised impact assessment outcomes, this is amended by:

Replacing

- No more than 373 ha of vegetation will experience measurable impact (a Moderate or Large change) from groundwater drawdown

With

- No more than 105 ha of vegetation will experience measurable impact (a Moderate or Large change) from groundwater drawdown

2.9 Summary of Outcomes from the Groundwater Studies

As a result of the sensitivity analysis completed (Section 2.1.2), Tronox is confident that the model is a correct representation of the regional setting and has accurately predicted groundwater drawdown and associated impacts. The sensitivity analysis results (Section 2.1.2.1) confirmed the veracity of the model and that changing the parameters, particularly hydraulic conductivity, does not increase the extent of predicted drawdown impacts. In the review of mitigation options, one system, the reinjection of water via infiltration ponds, was feasible, and when implemented, is predicted to reduce groundwater drawdown impacts by 70%.

The key outcome of the modelling sensitivity analysis (Section2.1.2.2 and 2.1.2.3) was that the drawdown predictions for key areas of risk to GDEs (i.e. west of Zeus) show only moderate change with variations in model parameters and the mine plan. It also indicated that increasing the rate of mining will reduce the extent of drawdown by decreasing the time over which pits are dewatered, and the delay between initial excavation and reinstatement of the aquifer through backfill. However, although this provided the greatest reduction in drawdown of all examined scenarios, it still is not expected to significantly reduce the extent and magnitude of drawdown impacts in areas containing GDEs (i.e. west of the Zeus orebody).

A number of mitigation options were considered with one scenario, a reinjection system, investigated further. The design and outcomes of implementing this system are outlined in Section 2.2.2. The groundwater model was rerun with the additional recharge from the system to generate revised groundwater contours. The GDE risk areas were then updated based on the revised contours. The reassessment substantially mitigated the risk of impact to GDEs, FCTs conservation significant species and vegetation associations.

The operation of a reinjection system has been added to the Dongara EMP to mitigate impacts associated with groundwater drawdown. Recharge via the reinjection system will commence at the time of mining the Zeus orebody to mitigate groundwater drawdown related impacts. The system is predicted to reduce groundwater drawdown to less than 0.5 m west of the transect of infiltration trenches. The reassessment has significantly reduced the predicted impact to:

- GDEs from 373 ha to 105 ha
- FCT 10a from 8.8% to 41.4%
- Zeus wetland from 204 ha to 45 ha
- conservation significant species and vegetation associations.

In summary, the key outcome of these studies is that Tronox has modified the proposed management of groundwater drawdown and significantly reduced the predicted associated impacts. The revised impact assessments are presented for groundwater dependant ecosystems and wetlands (Section 2.3.1.1 and 2.3.1.2), and vegetation and flora (Section 2.4.1.1, 2.4.1.2 and 2.4.1.3).

2.10 Figures for Groundwater Section

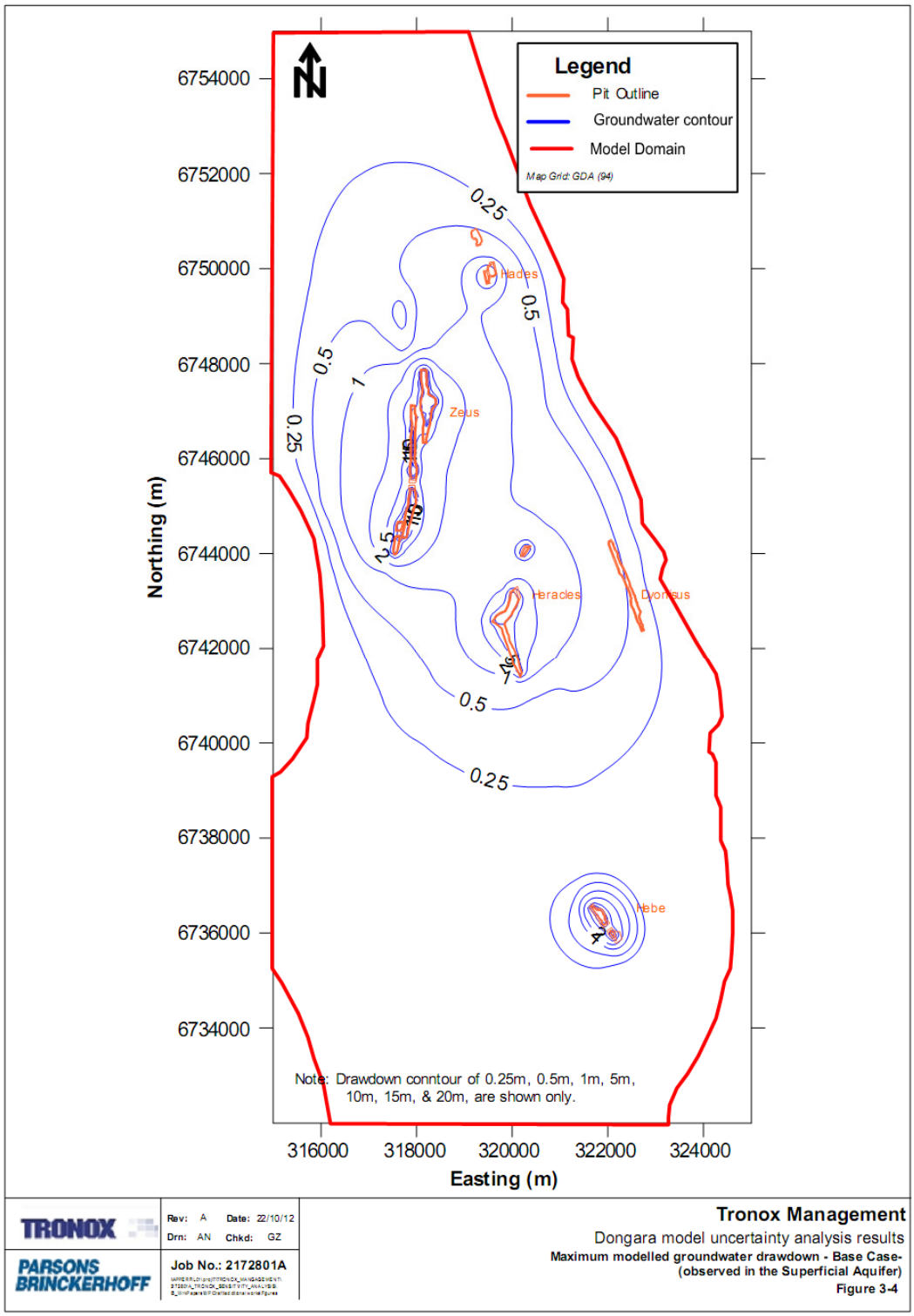

Figure 1: Groundwater drawdown results from the calibrated "Base Case" model (PB, 2012)

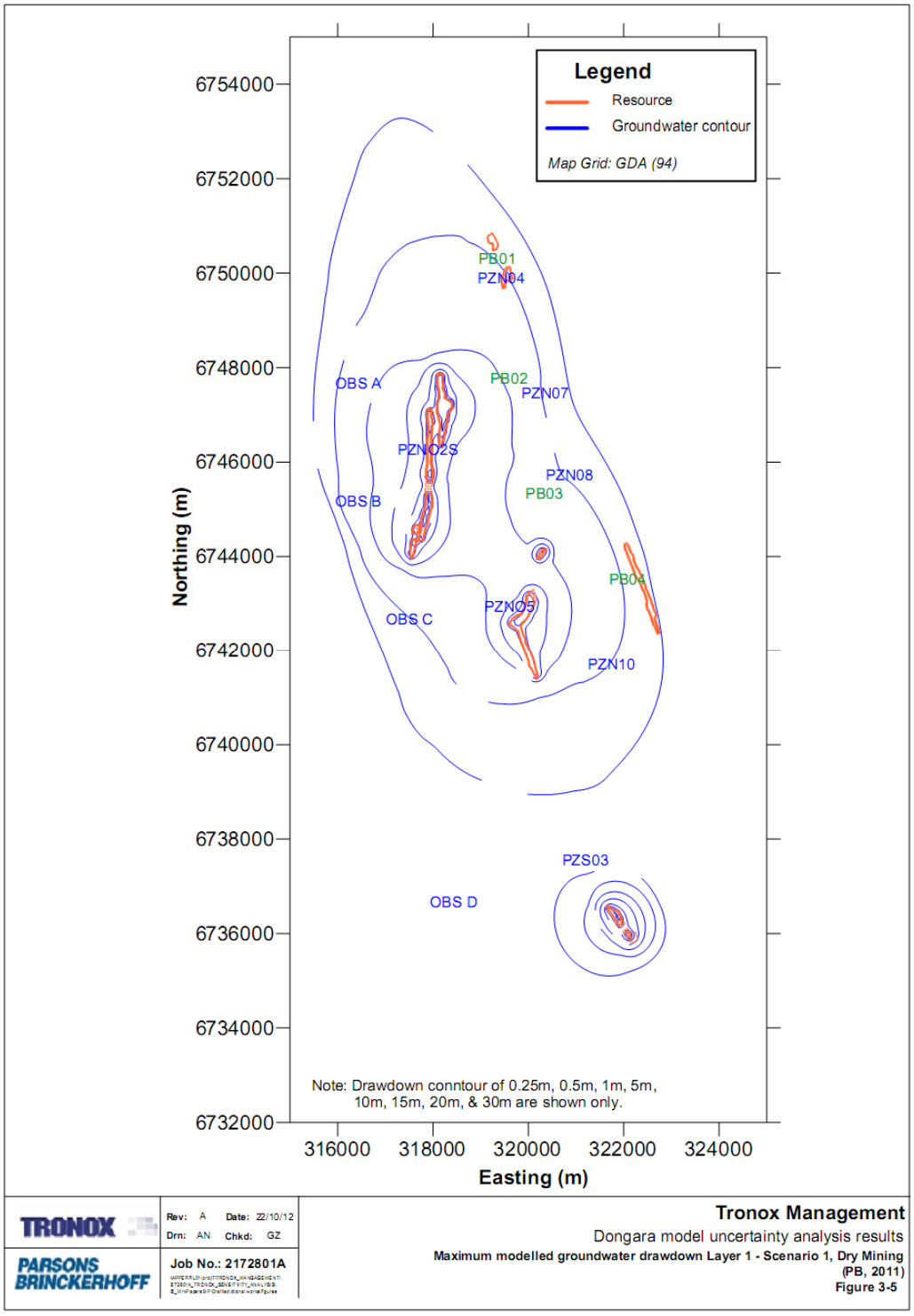

Figure 2: Groundwater drawdown presented in the PER (PB, 2011)

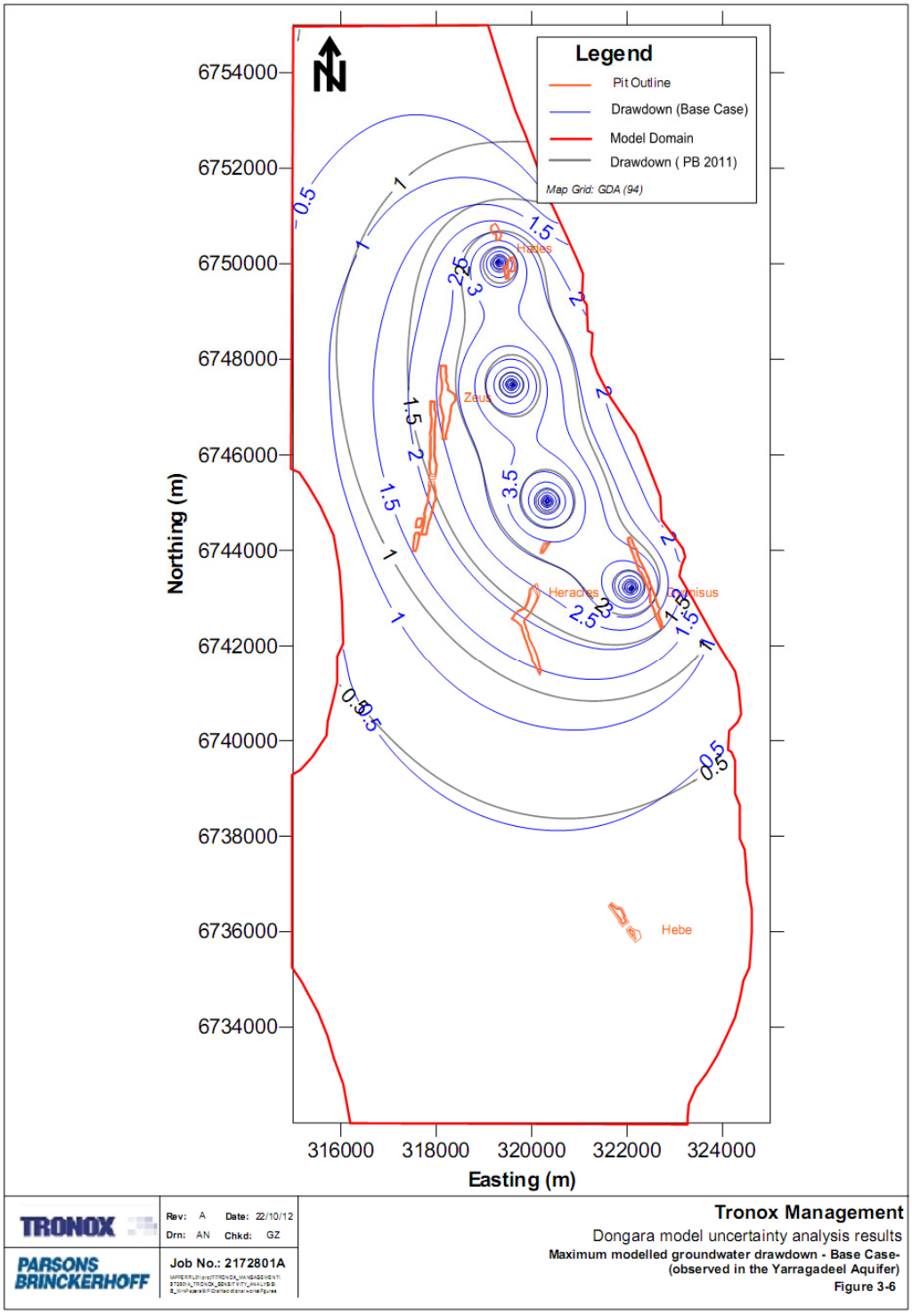

Figure 3: Drawdown observed in the Yarragadee Aquifer for the Base Case (PB, 2012) and the groundwater model presented in the PER (PB, 2011)

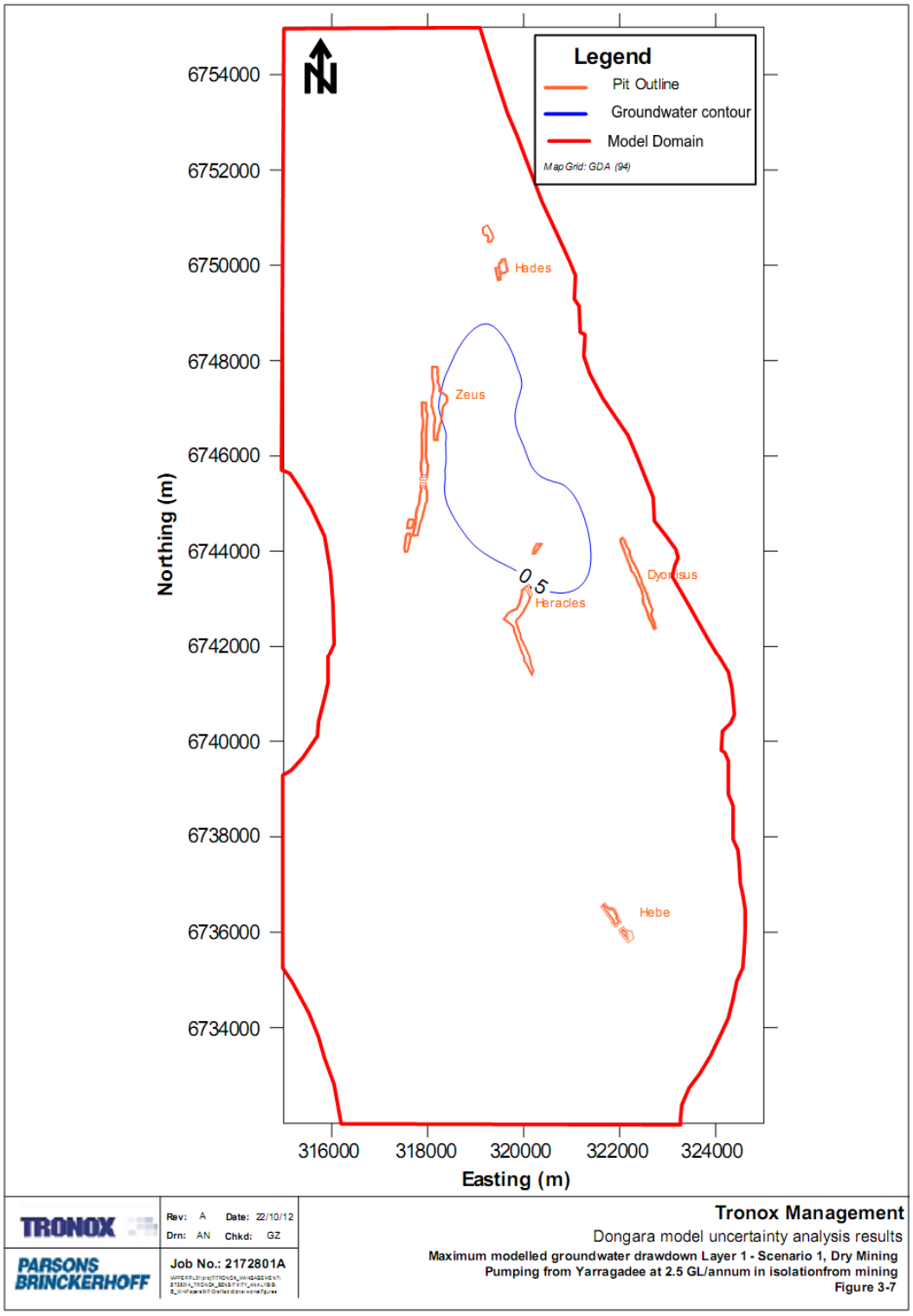

Figure 4: Modelled drawdown observed in the Superficial Aquifer from pumping 2.5 GL/annum in the Yarragadee Aquifer in isolation from mining.

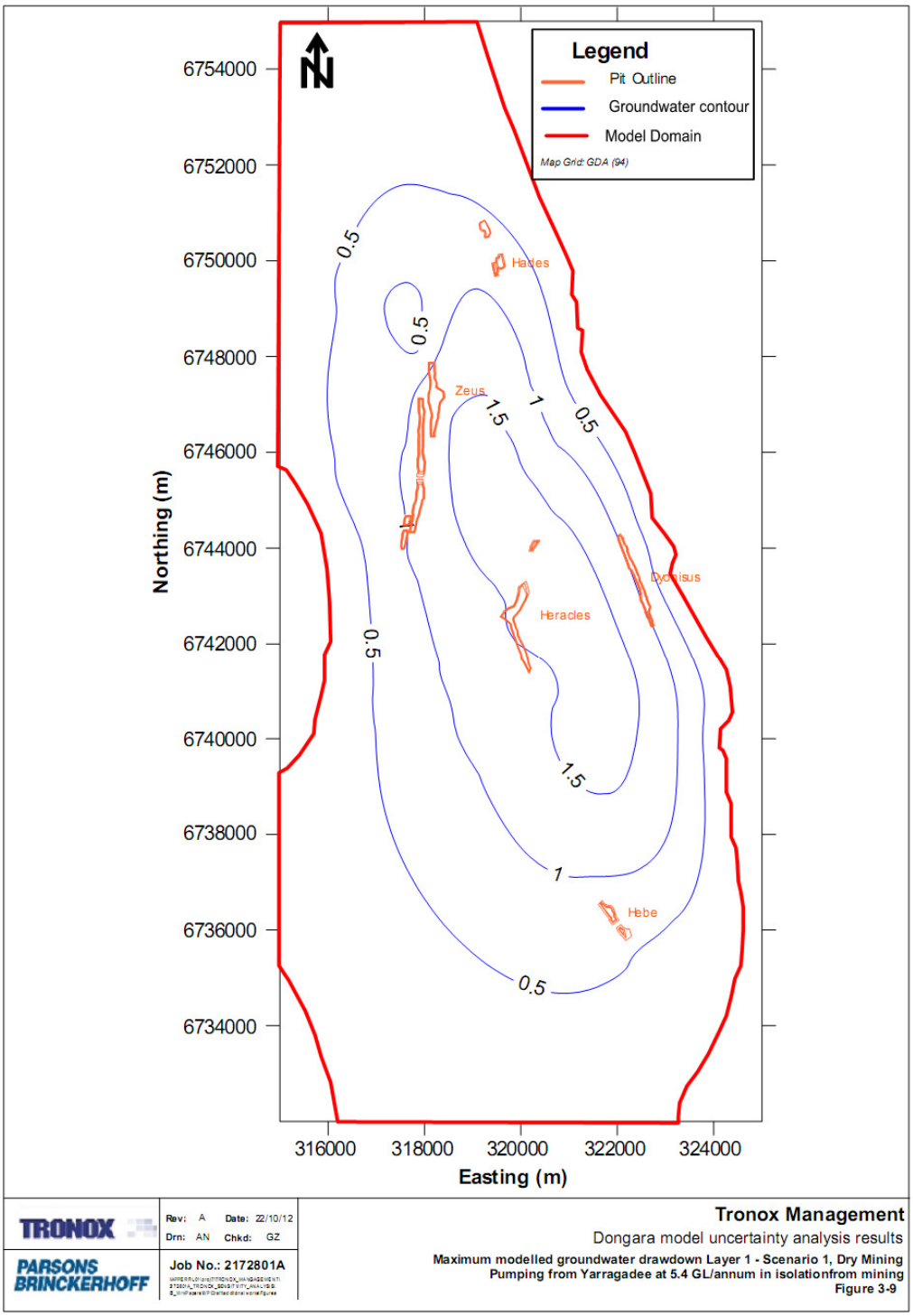

Figure 5: Modelled drawdown in the Superficial Aquifer of pumping at 5.4 GL/annum from the Yarragadee Aquifer in isolation from mining.

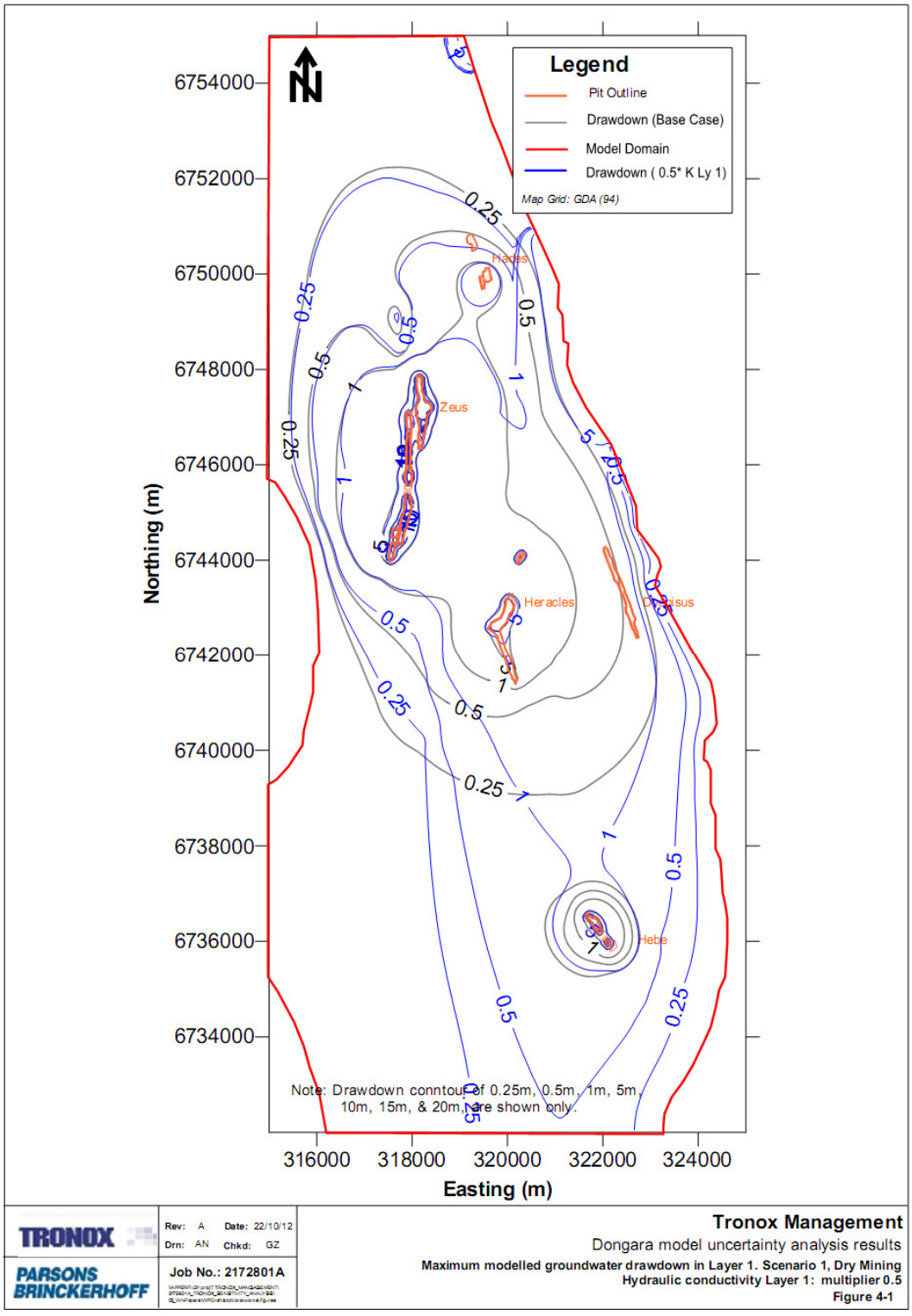

Figure 6: Predicted groundwater drawdown in the Superficial Aquifer with hydraulic conductivity multiplier 0.5 to base case

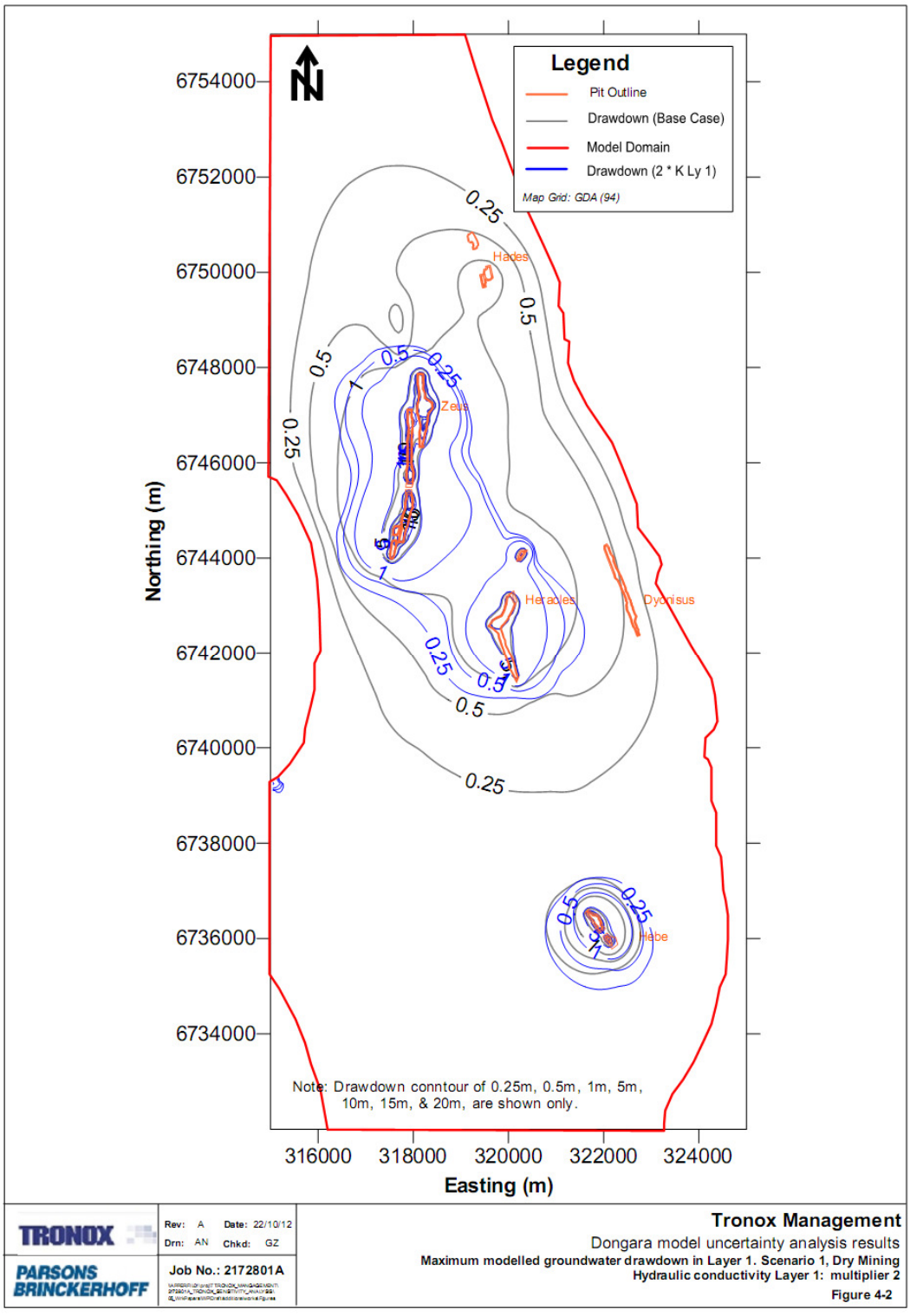

Figure 7: Predicted groundwater drawdown in the Superficial Aquifer with double the hydraulic conductivity to base case.

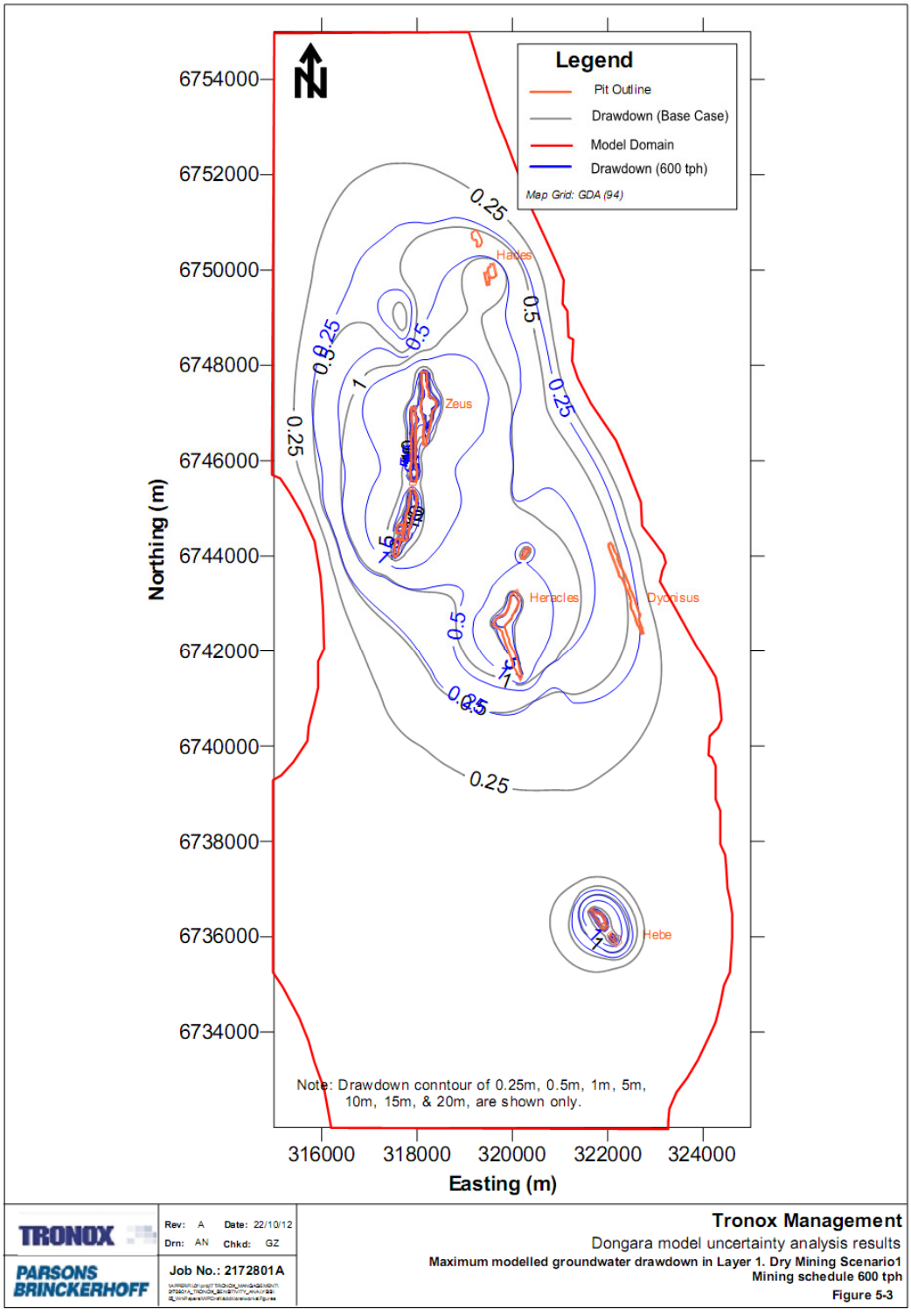

Figure 8: Drawdown in the Superficial Aquifer as a result of doubling the mining rate

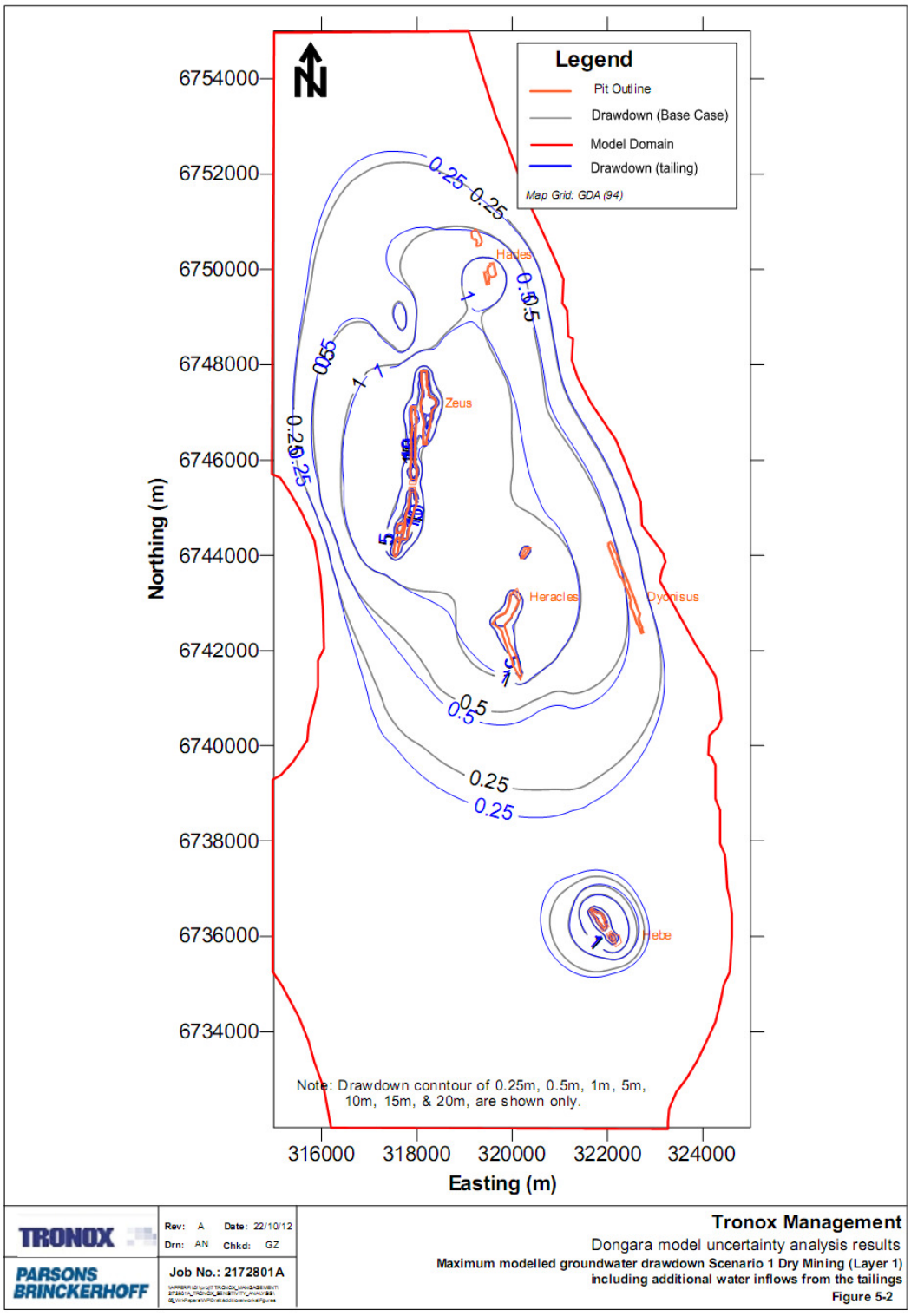

Figure 9: Groundwater drawdown in the Superficial Aquifer from the alternative mining sequence

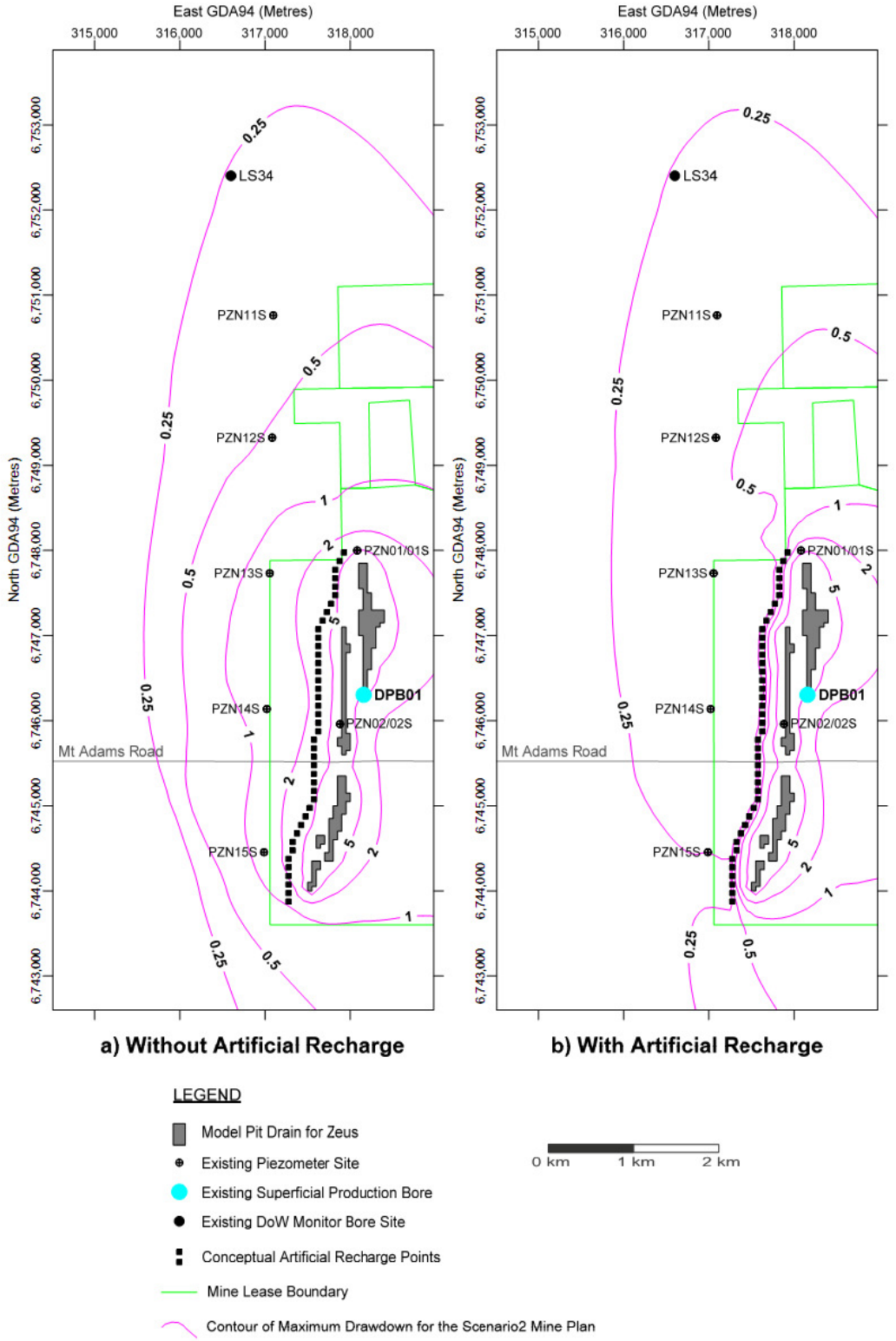

Figure 10: Proposed layout of reinjection system and maximum drawdown with artificial recharge

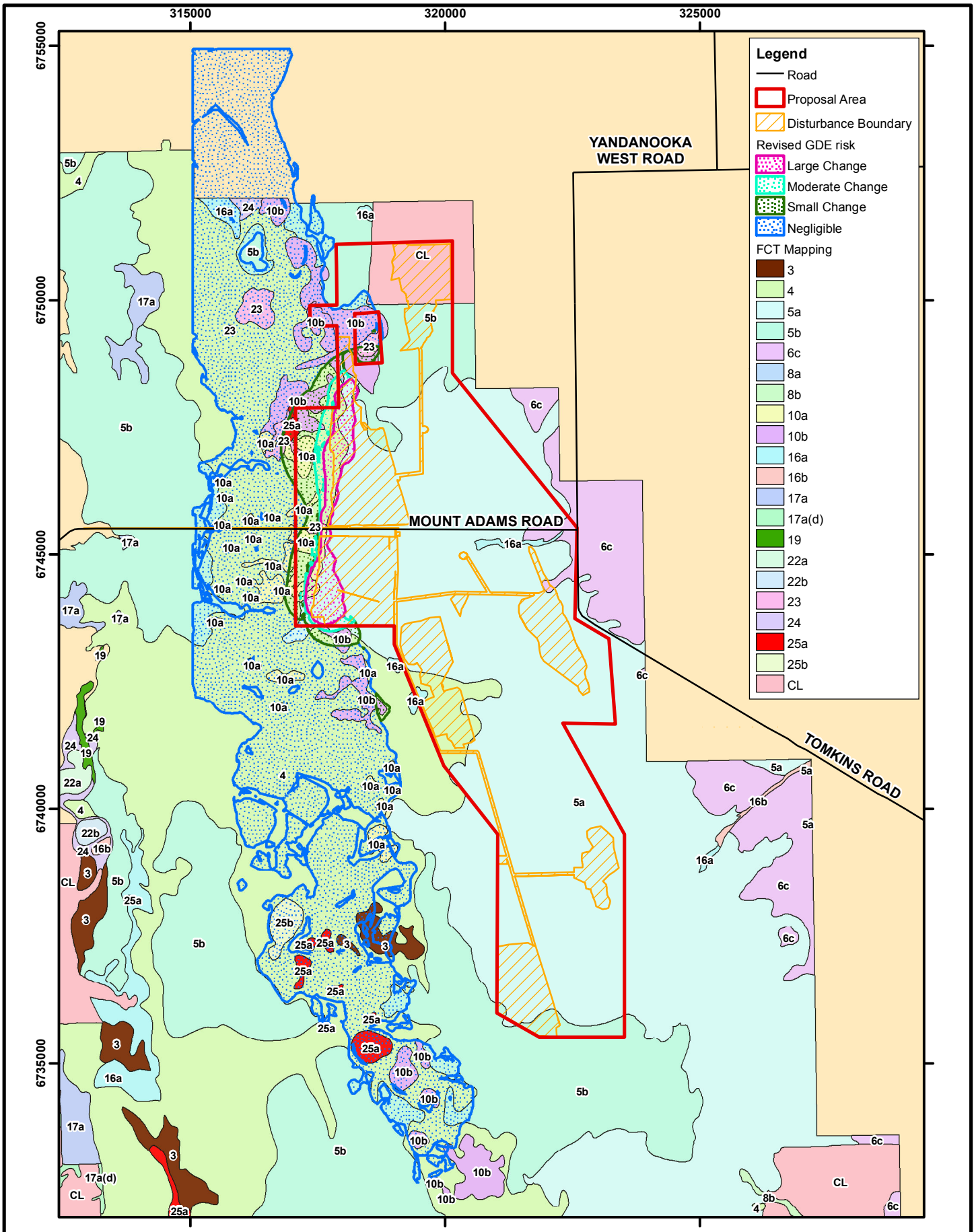

Figure 11: Relationship between GDEs and FCTs (Revised PER Figure 24)

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Scale
0 1 2 3 4 5 km

N

1:100,000
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 25/10/2012
Author: atomeo, awelker, jcrute

Source: Data sourced from Client. Roads sourced from Geoscience Australia, Dongara SH5005, 250k Topographical Mapsheet.
Note that positional errors may occur in some areas

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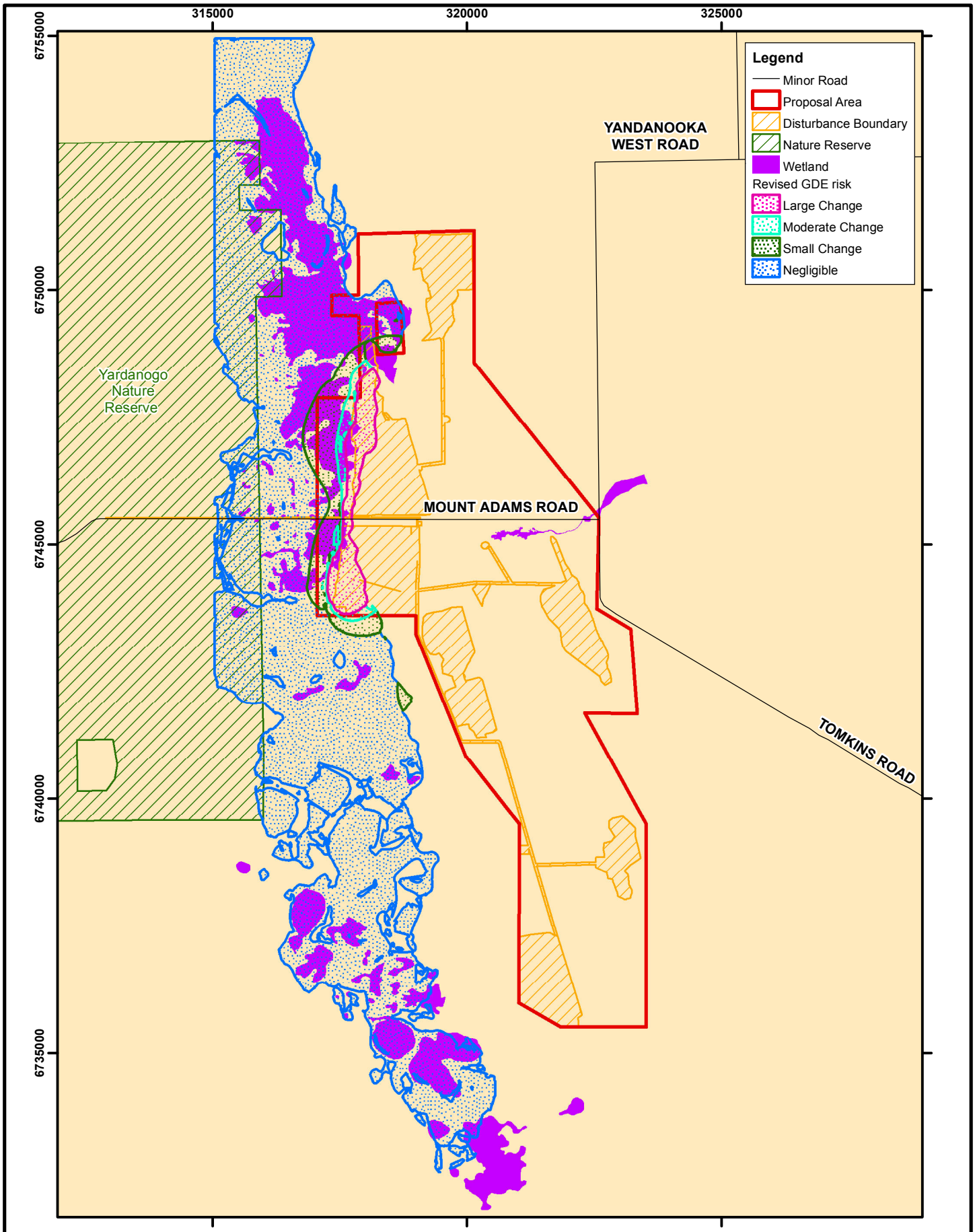

Figure 12: Relationship between GDEs, wetland and Nature Reserve (Revised PER Figure 26)

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Scale
0 1 2 3 4 5 km

N

1:100,000
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 25/10/2012
Author: atomeo, awelker

Source: Data sourced from Client. Roads and Reserves sourced from Geoscience Australia, Dongara SH5005, 250k Topographical Mapsheet.
Note that positional errors may occur in some areas

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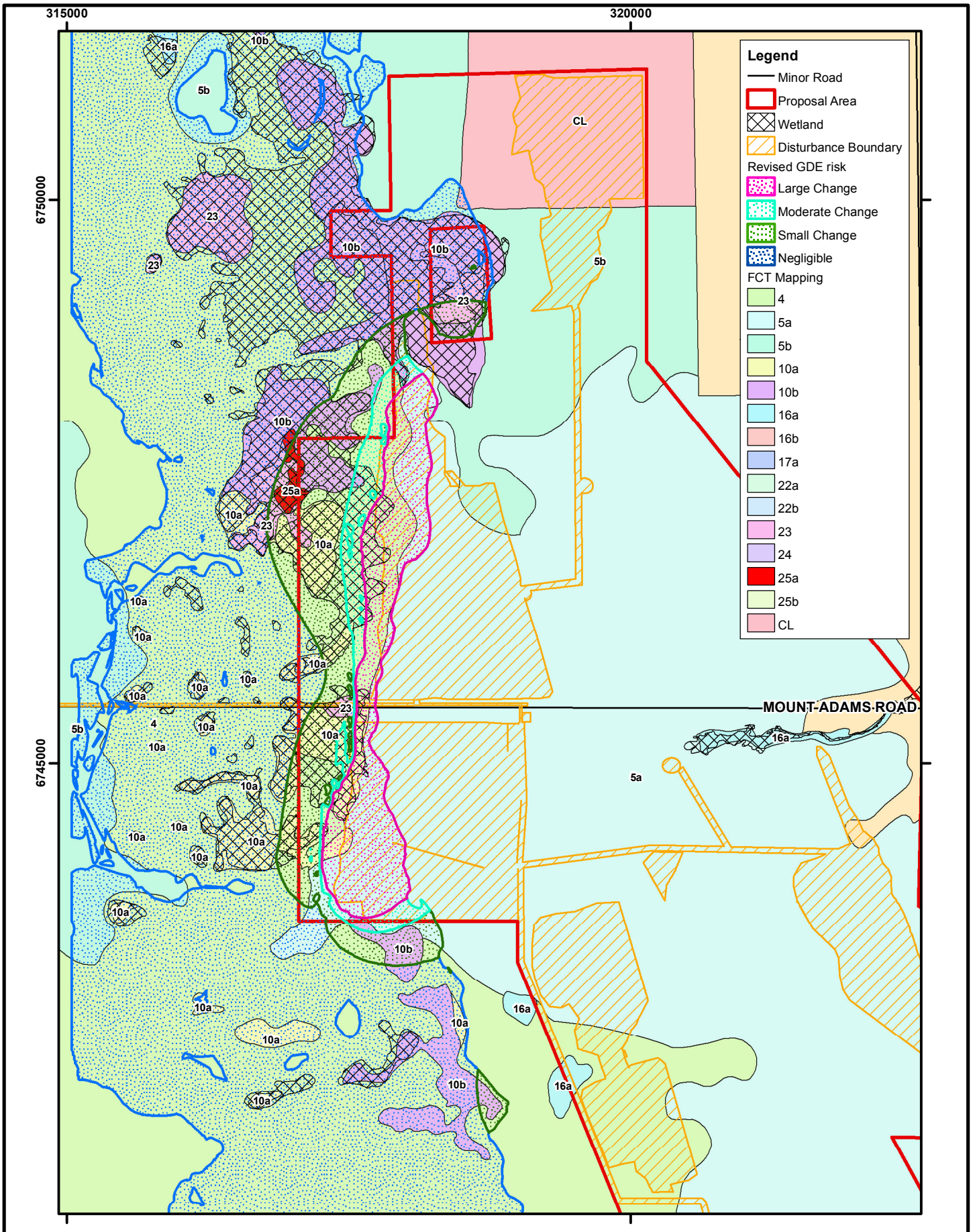

Figure 13: Revised predicted impacts to the Zeus wetland (Revised PER figure 28)

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Scale
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N

1:45,000
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 25/10/2012
Author: atomeo, awelker, jcrute

Source: Data sourced from Client. Roads sourced from Geoscience Australia, Dongara SH5005, 250k Topographical Mapsheet.
Note that positional errors may occur in some areas

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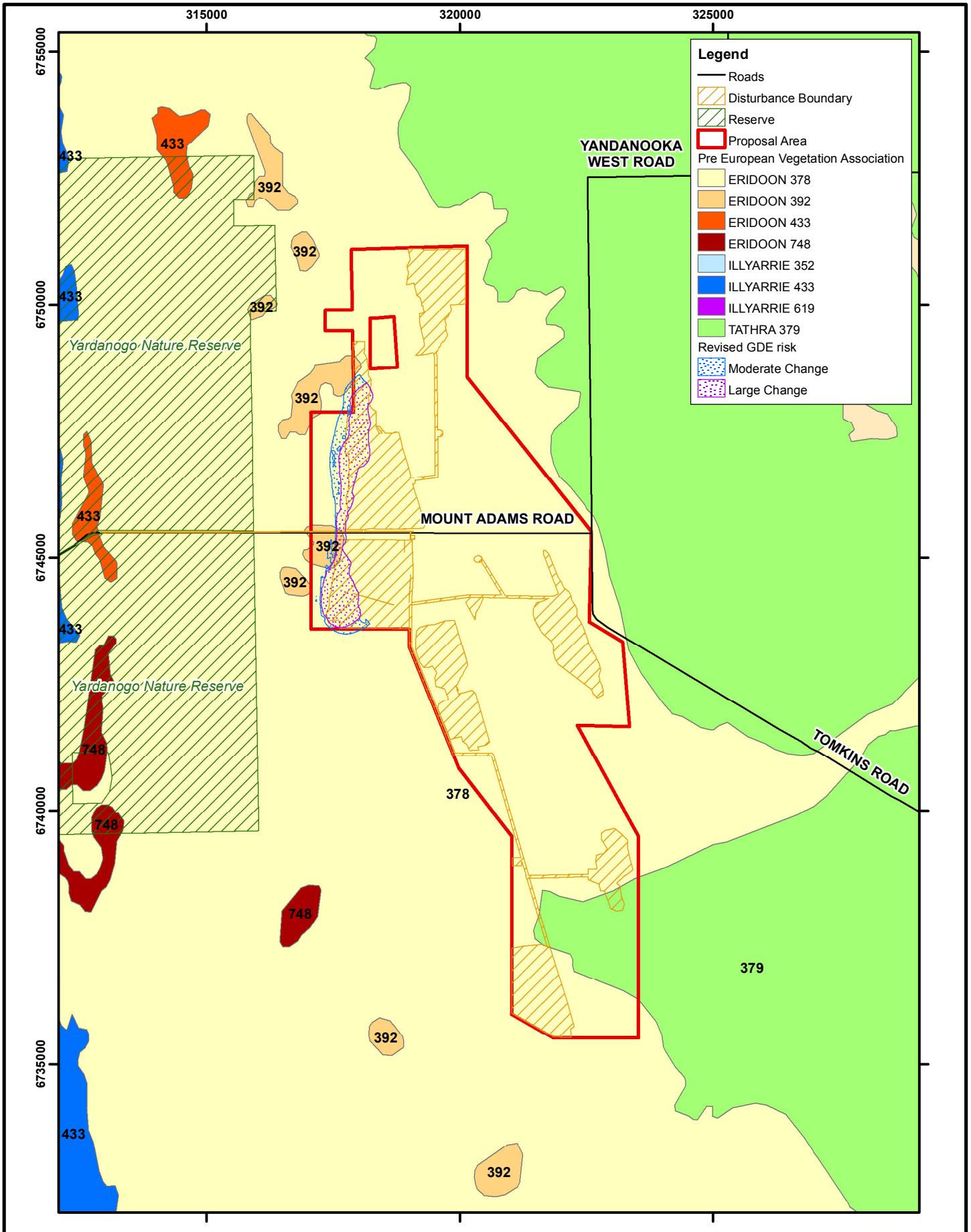

Figure 14: Revised impact on vegetation associations (Revised PER Figure 29)

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Scale
0 1 2 3 4 5 km

N

1:100,000
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 25/10/2012
Author: JCrute

Source: Vegetation association: Client 2011. Roads: Geoscience Australia, 2011. Reserves: SLIP, Landgate, 2011. Tenements: DoIR, 2011.

Note that positional errors may occur in some areas

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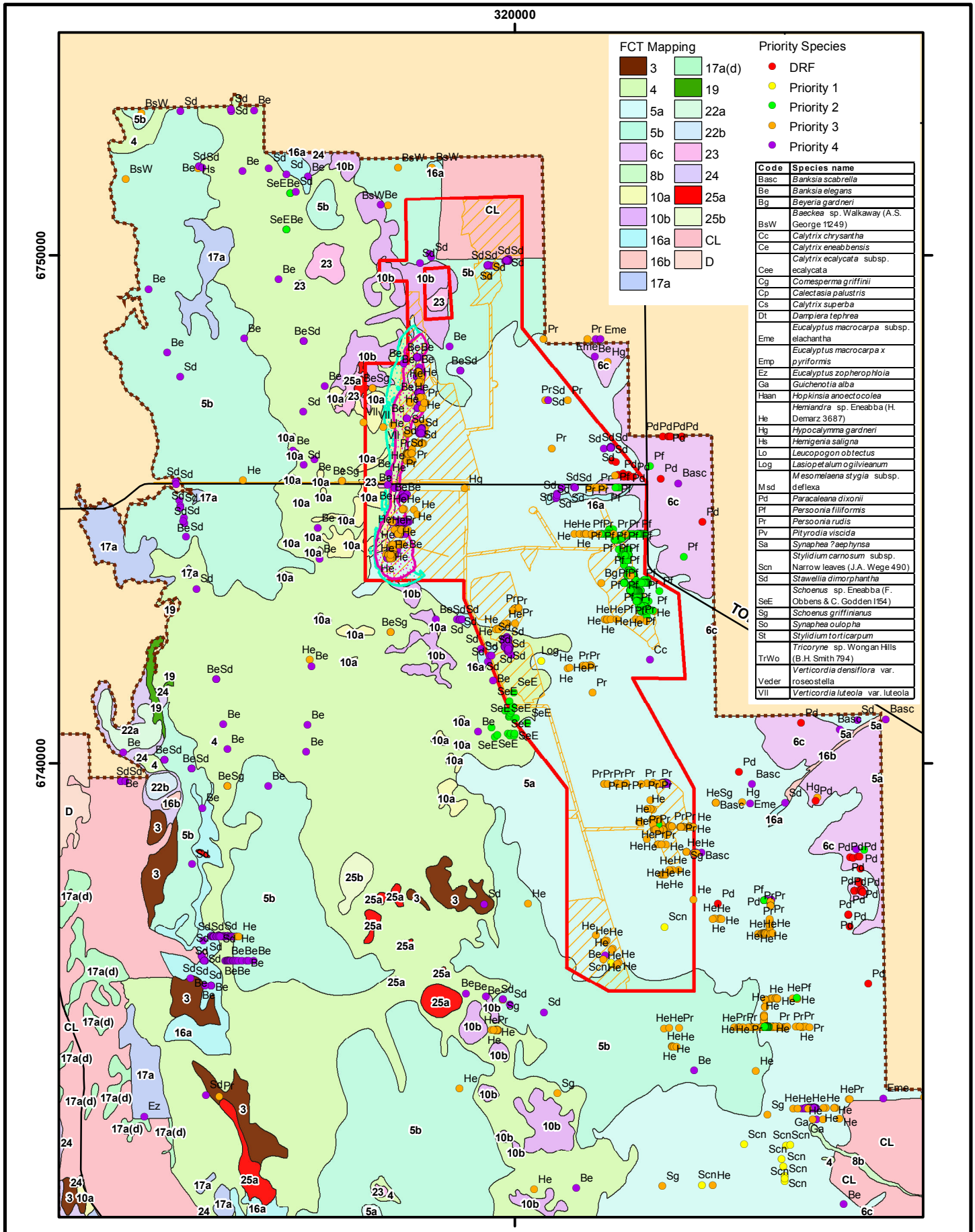

Figure 15: Revised impact on conservation significant flora - dewatering (Revised PER Figure 32)

Legend
- Proposal Area
- Disturbance Boundary
- Study Area

Revised GDE risk
- Large Change
- Moderate Change

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Scale
0 1 2 3 4 5 km

N

1:100,000 at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 25/10/2012
Author: jcrute

Source: Data sourced from Client.
Reserves and Roads sourced from Geoscience Australia, Dongara SH5005, 250k Topographical Mapsheet.

Note that positional errors may occur in some areas

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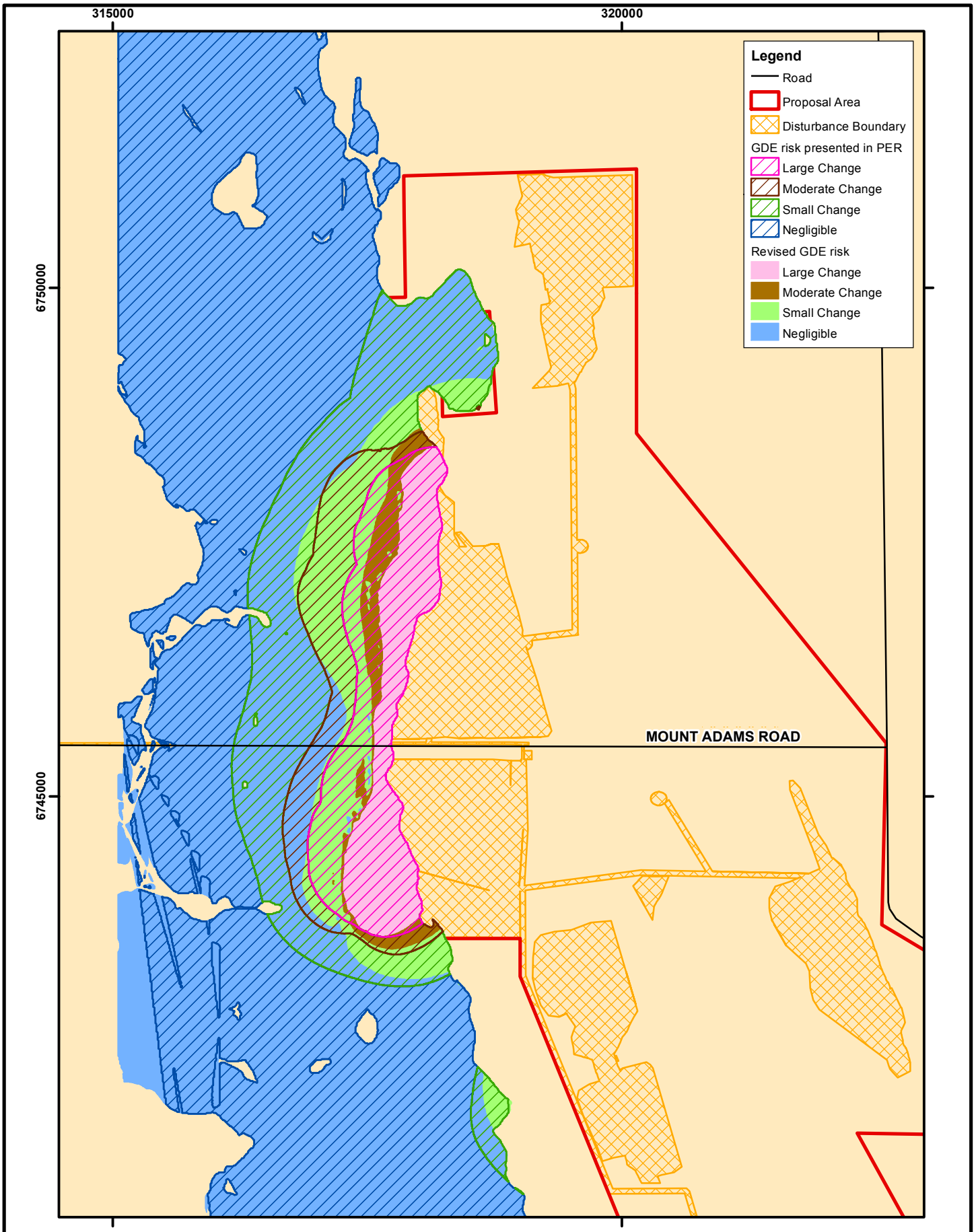

Figure16: Predicted GDE risk Contours Original (as presented in PER) and revised (includes recharge)

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Scale
0 0.5 1 1.5 2 2.5 km

N

1:50,000
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 29/10/2012
Author: atomeo, awelker, jcrute

Source: Data sourced from Client. Roads sourced from Geoscience Australia, Dongara SH5005, 250k Topographical Mapsheet.
Note that positional errors may occur in some areas

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3 Response to Submissions

Comments were received from the following:

- Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC)
- Department of Water (DoW)
- Department of Indigenous Affairs (DIA)
- Department of Mines and Petroleum (DMP)
- Department of Environment and Conservation (DEC)
- Wildflowers Society of Western Australia
- Radiological Council
- private submitter.

The response to submissions is provided in Table 7.

Table 7: Response to submissions

#	PER Section.	Reviewer comment/recommendation	Proponent response
DSEWPaC comments on PER – 07/06/12			
1.	PER 4.3.1	Socio-economic setting: Is it possible to provide an indication of the number of jobs which are expected to be created as a result of the project? Particularly if these jobs are in the local region? Socio-economic factors are taken into account as part of the Commonwealth assessment process.	Tronox estimates requiring a workforce of 60 to 80 employees and contractors (total) for the operational stages of the project (7 to 15 years). The number of employees for construction and closure will vary.
2.	PER 14.4.1	Paracaleana dixonii What is the minimum buffer distance between the individuals which will be avoided and the clearing footprint?	The proximity of the clearing footprint to the closest known Paracaleana dixonii individuals is approximately 600m refer to Figure 32 of the PER.
3.	App 1 EMP 3.3.3	Rehabilitation management plan: Management objective: "Rehabilitation suitable for fauna colonisation" Target: What does 'appropriate density to provide feeding resource for Carnaby's Black Cockatoo' mean? Also- are there any rehabilitation criteria relating to *S. dimorphantha*?	Rehabilitation suitable for fauna colonisation refers to the establishment of vegetation communities that include Banksia species. The target densities for species groups considered foraging resources for Carnaby's Cockatoo will be determined based on: • what is measured in comparable surrounding undisturbed communities • what is achievable indicated by rehabilitation monitoring results at Cooljarloo where the current completion criteria applied in relation to return of Banksia and other trees is: "tree densities are within the upper 75% of the range of values recorded for each corresponding baseline vegetation group" • the density of Carnaby's Black Cockatoo feeding species within each vegetation type prior to disturbance. The measure of performance will be compliance with the rehabilitation and closure completion criteria. Broad vegetation community types suitable for S. dimorphantha will be established in rehabilitation areas. Topsoil spread for the establishment of these communities types will matched with similar pre-existing community types. The criteria relating to topsoil and the establishment of community types will encourage the re-establishment of S. dimorphantha in rehabilitation.

#	PER Section.	Reviewer comment/recommendation	Proponent response
4.	Appx 2 MCP 10.3	Closure implementation schedule: The department requires more information regarding the staging of the clearing and the revegetation. What is the expected time lag in replacing Carnaby's Black Cockatoo foraging habitat (time between clearing and establishment of a viable food source for each of the 6 disturbance footprints)? How could the staging of the clearing be improved to reduce the maximum amount of vegetation impacted at any one time and mitigate impacts to Carnaby's by reducing the temporary loss of foraging habitat? DSEWPaC may expect a level of re-vegetation standard to be met in early stage(s) before later stage(s) are cleared.	Areas will only be cleared immediately prior to being required for mining. This ensures that vegetation isn't removed prematurely and the time between clearing and rehabilitation is minimised. Areas will be rehabilitated in the first growing season (Autumn) after the areas are closed (i.e. completion of landforming). Typically, mining areas are cleared three to six months ahead of mining to allow sufficient time for topsoil and overburden removal. Mining, backfill and rehabilitation are then generally completed in between 6 months and 3 years. Some areas experience longer time lag, for example when following backfill they are utilised for such activities as solar drying of clay tailings. In the case of non-mining areas (e.g. infrastructure corridors, processing plant sites and administration / support buildings) a significant portion of these will be cleared at project inception and will not be rehabilitated until mine closure. Others, such as those associated with particular orebodies, will be rehabilitated on completion of the orebody. As a result, there will be considerable variability in the timing of rehabilitation within orebodies and across the mine site. Opportunities considered to reduce timelag between clearing and rehabilitation include: • Not utilising on mine path solar drying – this would significantly reduce the delay to rehabilitation of pit areas associated with solar drying. However, it would require additional off mine path areas to be cleared, increasing the overall footprint. As such, it is considered unacceptable. • Tronox will implement an EMS that will encompass KPIs to plan, track and improve performance in areas such as: o The control of clearing activities, this will include an internal permitting system that, for each area proposed to be cleared will review if the timing, location or method of clearing can be improved such as to reduce impacts on environmental assets. This will include identification of high priority habitat for Carnaby's

#	PER Section.	Reviewer comment/recommendation	Proponent response
			Cockatoo (e.g. Floristic Community Type 5b) such that these can be avoided if possible, and attributed a higher priority for rehabilitation. o the area of rehabilitation completed each season, and the trend in total area open (thereby tracking the success in minimising total area disturbed and maximise rehabilitation) o the quality of rehabilitation as measured in monitoring and compared to completion criteria Tronox have demonstrated success in returning key foraging (Banksia) species in rehabilitation. Key Banksia tree species have been observed flowering within three to four years following site rehabilitation at the Cooljarloo Minesite. Programmes are also in place to further improve the return of these species within mine rehabilitation. Details of rehabilitation outcomes being achieved at Cooljarloo are described in Rehabilitation summary report (Appendix 2). Additional information on the procedures followed for rehabilitation is detailed in the Rehabilitation Management Plan and the Mine Closure Plan submitted within the PER.
5.	General- amount of clearing and offsets	As covered in the phone conference between DSEWPaC and Tiwest (6/6/12) The clearing of such a large area (1200 ha) of known Carnaby's Black Cockatoo would potentially pose a risk to the persistence and recovery of the species, particularly the flock of 350 birds that feed regularly on the site. In addition, the clearing of 67% of *S. dimorphantha* individuals in the local population could potentially result in a significant impact to the species in the area. Please provide any information you have on the previous success or expert views on the likely success of revegetating this species. DSEWPaC would encourage mitigating the impacts to Carnaby's Black Cockatoos as much as possible- particularly in regard to the staging of the project (as discussed above). In offsetting the residual impacts to Carnaby's Black Cockatoos, from DSEWPaC's perspective, Tiwest would effectively be offsetting the temporary loss of foraging resources, as well as the risk that revegetation	Carnaby's Black Cockatoos are likely to forage widely over the region during the non-breeding season (summer to early winter), and probably move progressively across the landscape in search of food. The observation of a large flock of birds seen regularly over a period of seven days in August 2012 is consistent with the birds foraging in one area for a few days then moving on as readily accessible seeds are exhausted. The flock was not seen on subsequent visits to site in October and November, the breeding season for the species, suggesting there is no breeding habitat nearby as discussed in Section 14.4.3 of the PER. The Proposal will temporarily affect 1200 ha or 3% within some 35,000 ha of native vegetation mapped for Tronox and Iluka. The majority of floristic community types support Carnaby's key foraging species, Banksia. Establishment of S dimorphantha post disturbance The establishment of vegetation communities that broadly represent those in the pre-disturbance environment will be targeted in rehabilitation. Topsoil from similar pre-existing community types will be spread for the establishment of the closest

#	PER Section.	Reviewer comment/recommendation	Proponent response
		does not adequately replace the foraging resource. The more information provided on maximising the chance of success of revegetation, the better (for example; history of Tiwest's successful revegetation, evidence of *S. dimorphantha* recolonising, information regarding the distribution of *S. dimorphantha* in the regional context [shapefile?], experts which will be consulted, detailed completion criteria and contingencies- particularly with regard to Carnaby's foraging species). Tiwest previously mentioned that they're seeking to acquire land as part of an offset package- offsetting impacts of the proposal to EPBC listed species. Please provide the following information: ▪ The size of the offset area ▪ The vegetation type and quality ▪ The current land tenure- and proposed land tenure (will it form part of the DEC conservation estate?) ▪ The distance from the project site ▪ The proximity of the site to any known Carnaby's Cockatoo breeding sites. ▪ If degraded, will the site require revegetation or management for weeds/ feral animals/ dieback?	targeted community types such as those supporting S. dimorphantha. Revegetation of the species and its supporting habitat is yet to be undertaken. However, S. dimorphantha has been observed to recolonise drill lines and access tracks post disturbance by exploration activities (Appendix 5). These studies demonstrate the ability for the species to regenerate post disturbance. S.dimorphantha occurs from just north of Dongara to Eneabba and includes at least 50,000 individuals as outlined in the application made to the DEC to downgrade the species (Appendix 5). As a result of this application, the species was downgraded from a DRF to a Priority 4. Tronox understands the species is listed as Vulnerable under the Australian Government EPBC Act and have considered the species in the attributes for acquisition/restoration of land for offsets (refer to Appendix 6 for details on offsets). Offsets for residual impacts A discussion of the basis for offsetting proposed for the project, and details of the offsets proposed, are provided in Appendix 6. The offsets proposed have been designed to maximise offsetting the impacts to Carnaby's Black Cockatoo feeding habitat, including rehabilitation of all disturbed areas. This considers impact mitigation measures proposed for areas disturbed during mining, such as mine rehabilitation, the outcomes expected from this and offers offsets commensurate with achieving a net environmental benefit from the project. Rehabilitation Success Progressive rehabilitation has been undertaken at Tronox's Cooljarloo mine site since 1989. A summary of rehabilitation work at the Cooljarloo site; the results, alignment with completion criteria and gaps in knowledge, has been prepared and is attached (Appendix 4). This summary provides the justification for considering rehabilitation at Dongara to be a lower risk activity than previously identified. Please also refer to response to Comment 4.
Department of Water – Cover Letter			
6.		The PER presents dredge or dry mining methods for resources situated below the watertable. If the proposal is approved by the OEPA, DoW recommends only dredge mining is approved as the mining method for	Tronox acknowledge that dredge mining may reduce impacts to wetland vegetation. However, due to the influence of market conditions, amongst other factors, on the mining method chosen at Dongara, dry mining will be retained as

#	PER Section.	Reviewer comment/recommendation	Proponent response
		resources below the watertable. Dredge mining will broaden the drawdown area, but reduce the area experiencing rapid drawdown, mitigating some impacts.	an option.
7.		DoW considers the pump testing (Parsons Brinckerhoff, October 2011) was not of a sufficient time to measure groundwater variations in the shallow semi connected aquifer system and did not include shallow observation bores to evaluate system connectivity. This has resulted in the inability to test or verify the connectivity of the Superficial aquifer with the underlying Yarragadee aquifer. If the proposal is approved, DoW will require a model revision be undertaken prior to the granting of a Section 5C groundwater licence. Further technical advice can be found in Appendix A.	Noted. Tronox have provided a detailed response to specific comments from DoW in Section 2.
8.		The current modelled groundwater drawdown predicts an impact on groundwater levels in the Superficial aquifer that would affect up to 373 ha of pristine-excellent condition vegetation and Conservation Category wetlands (Woodman 2009 and Endemic 2012). The PER interprets these impacts as not significant (Executive Summary pg vi & vii). The DoW considers these impacts to be significant and recommends the OEPA acknowledges possible loss of ecological value as a consequence of the mining activity. For further technical advice please refer to Appendix B.	Tronox considers that this comment misrepresents the findings of the impact assessment. The impacts associated with mine dewatering are presented in terms of the potential change in the extent of: • groundwater dependent ecosystems (GDEs) • wetlands • vegetation units (communities and associations). • Section 7.5.1 of the PER, states that the total area of GDEs predicted to be impacted (i.e. experience a measureable change) is 8.5% of the total local extent of GDEs, with the extent of large change (severe impact) limited to 4.6%. In other words, 3500 ha of the 4369 ha of GDEs mapped within the project area will not be impacted to any measureable extent. • Drawdown is not expected to impact the Heracles or Hebe wetlands and will impact 24% of the extent of the Zeus wetland. This equates to 16% of the total areas of wetlands mapped within the Project area. • At a vegetation community level, Table 34 of the PER shows that less than 10% of any vegetation unit will be impacted with the exception of FCT 10a of which approximately 41.4% will be impacted (by drawdown and clearing). • Based on these findings the impact assessment considered the Proposal will not significantly reduce the distribution of vegetation types or wetland communities. • Tronox have considered additional mitigation options for reducing impacts to GDEs in response to DoW and OEPA's comments on the area predicted to be

#	PER Section.	Reviewer comment/recommendation	Proponent response
			impacted by groundwater drawdown. The preferred mitigation option, detailed in Section 2.2.2, consists of 42 infiltration points through which water is reinjected along a north south line approximately 250 – 300 m from the western edge of Zeus. Revised modelling including the reinjection predicts drawdown of no more than 0.5 m west of the infiltration points. Consequently the total area of GDEs predicted to be impacted with the reinjection system (i.e. experience a measureable change) is 2.4% of the total local extent of GDEs, reduced from 8.5% without the reinjection system. The extent of large change (severe impact) is predicted to be limited to 1.1%, a reduction of 3.3% from predicted impacts with no recharge. In other words, 4301 ha of the 4407 ha of GDEs mapped within the project area will not be impacted to any measureable extent.
9.		If the proposal is approved, the DoW recommends the OEPA establish a Ministerial Condition specifying acceptable impacts to GDEs as this would strengthen the DoW's position in negotiating water licence entitlements and effective conditions for groundwater licences.	Comment directed at EPA. However, it is noted that DoW's suggestion would likely produce duplication in regulator processes. Tronox considers that the most effective management mechanism is the implementation of the reinjection system outlined in Section 2.2.2 in conjunction with the monitoring and contingency measures outlined in GDE Management Plan and as presented in Section 7.7 of the PER. The reinjection system reduces drawdown impacts on GDEs to 105 ha, a reduction of 268 ha. Tronox wouldn't anticipate needing to be conditioned under the groundwater licence on the impacts to GDEs.
Department of Water – Appendix A			
10.		Pump Testing Calculation of K was in error by using 17 m instead of 15 m of screen. The evaluator used Figure 14 (DMB03) instead of Figure 15 (DPB02). This error is not considered critical, with the correct K value of 10.7 m/day instead of 9.4 m/day. The minor increase in k would result in a subsequent minor decrease in the predicted drawdown.	Noted.
11.		Pump testing of DPB02 did not include shallow observation bores to evaluate system connectivity.	As mentioned in Section 6.2.1 of the hydrogeology report (Hydrosearch 2011), manual readings of water level were taken in the superficial observation bore LS32B. The results were omitted from the report but are presented here. Water Depth Readings in LS32B during the DPB02 Pump Test (Readings taken with an electric probe measuring to accuracy 0.01 feet)

<table>
<tr><th>#</th><th>PER Section.</th><th>Reviewer comment/recommendation</th><th>Proponent response</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Date</th><th>Time</th><th>Time Since Pump Started</th><th>Water Depth (feet)</th><th>Water Depth (metres)</th><th>Draw-down (metres)</th></tr>
<tr><td>13/03/200</td><td>07:17</td><td>-0.7</td><td>87.86</td><td>26.78</td><td>0</td></tr>
<tr><td>13/03/200</td><td>12:29</td><td>4.5</td><td>87.83</td><td>26.77</td><td>-0.009</td></tr>
<tr><td>14/03/200</td><td>09:24</td><td>25.4</td><td>87.84</td><td>26.77</td><td>-0.006</td></tr>
<tr><td>14/03/200</td><td>13:43</td><td>29.7</td><td>87.83</td><td>26.77</td><td>-0.009</td></tr>
<tr><td>15/03/200</td><td>07:48</td><td>47.8</td><td>87.86</td><td>26.78</td><td>0</td></tr>
</table>
The records above indicate that no drawdown was observed in LS32B, in fact the observed water level rose 0.009m, possibly due to the effect of recharge of the pump test water into the unconfined aquifer.

This is in contrast to the water level in the adjacent Yarragadee observation bore LS32A which drew down 3.9 metres. In general there would not be expected to be a clearly quantifiable response in the water level in the unconfined aquifer during a short-term pump test on the confined aquifer. However, vertical leakage to the pumped Yarragadee aquifer can be interpreted from flattening of the late-time drawdown curves in bores screened in the pumped aquifer (Figure 19 of the hydrogeology report).

Refer also to Response to item 12.
</td></tr>
<tr><td>12.</td><td></td><td>The constant rate pump test was conducted over 40 hours, which is deemed to be too short to measure groundwater variations in the shallow aquifer system in a semi connected system as proposed for the superficial and underlying Yarragadee Aquifers. If DoW had been contacted, Tiwest would have been advised to conduct the testing over 168 hours and that groundwater measurements include a shallow bore twinned with DOB03.</td><td>It is considered that the 40 hour duration of the Yarragadee pumping test was consistent with industry norms for a confined aquifer. Kruseman and de Ridder (1994), a widely-used manual for interpretation of pumping tests, suggest that: “in a confined aquifer, it is good practice to pump for 24 hours”. The DoW Operational Policy Number 5.12 “Hydrogeological reporting associated with a groundwater well licence” also does not specify duration of pumping but refers to the Australian Standard AS2368-1990 and the Minimum Construction Requirements. The Australian Standard AS2368-1990 for test pumping and the “Minimum Construction Requirements for Water Bores in Australia” (third edition, 2012) do not give guideline pumping durations for aquifer investigations, stating only that the appropriate duration “depends on nature of investigation”.

The normal approach, and that used in this study, is to observe leakage into a confined aquifer by the flattening of the late-time graph of drawdown in confined aquifer bores. The flattening of the drawdown curves at late time in the</td></tr>
</table>

#	PER Section.	Reviewer comment/recommendation	Proponent response
			Yarragadee pump test is consistent with the downward leakage. The DOW proposal for a 7 day pump test is considered unnecessary and problematic as there would likely be ambiguities in interpretation of the shallow monitoring data even with the best controlled test. One example is interference arising from the water discharged during pumping infiltrating into the unconfined aquifer. This would mask the expected small (some millimetres or at most a few centimetres) decline in water levels that might be observed in the unconfined aquifer after 7 days of pumping the Yarragadee aquifer. In terms of accounting for this uncertainty, the groundwater flow model was constructed with an upper Yarragadee (model layer with lower hydraulic conductivity) and middle Yarragadee (model layer with higher conductivity). These were assigned a hydraulic conductivity of 1 and 9.4 m/d respectively. This simulates a conservative degree of hydraulic connectivity between the layers and presents a worst case scenario in terms of predicting spatial impacts. This is aligned with the DoW view that the superficial and Yarragadee aquifer are being hydraulically connected.
13.		Modelling: The Kh/Kv value of 100 is incorrect and should be 1	The value reported for Kv of Layer 1 in Table 3-1 of the modelling report (PB 2011) was incorrectly stated. The model used 0.0017 to 0.032. The Ratio of Kh/Kv was correctly stated as 100. It is generally considered that the horizontal hydraulic conductivity is normally higher than the vertical hydraulic conductivity, even in a sand aquifer. Commonly a ratio of 10 is used for a sand aquifer but 100 is not extreme considering the high-slimes layers within the superficial aquifer in this area. The sensitivity analysis (PB, 2012) ran the model with the hydraulic conductivity of Layer 2 at double and half the value used in the PB (2011) model, horizontal conductivity remained constant. Decreasing and increasing the hydraulic conductivity, and consequently the Kh/Kv ratio, did not result in significant changes to drawdown compared to the base case. Therefore, the ratio used in the PB (2011) model of 100 was appropriate.
14.		Kh values of 1 m/day and 9.4 m/day for the Yarragadee Aquifer are too far too high assuming a highly connected system. Pump testing did not utilise any shallow observation bores to verify this connectivity.	Kh refers to horizontal hydraulic conductivity which is not related to the hydraulic connection between the superficial formations and the Yarragadee aquifer. The values of Kh used for the Yarragadee Aquifer in the Parsons Brinckerhoff Pty Ltd model (PB 2011) are consistent with the pump test and with the values of 1-3 m/day adopted in the DoW Prams model (Davidson & Yu, 2006).

#	PER Section.	Reviewer comment/recommendation	Proponent response
15.		A high kh value of 1 is indicative of a fully connected system.	Refer to response to Comment 14. As previously mentioned the value of 1 m/day is consistent with the DoW Prams model and the Kh value for the Yarragadee aquifer bears no relationship to the degree of connection to the superficial aquifer.
16.		Modelling was inappropriate to predicted drawdown associated with mine dewatering for the "dry" mineral mining process. The pump testing conducted to evaluate aquifer characteristics for the hydrogeological reporting was insufficient to estimate connectivity between the superficial and underlying Yarragadee Aquifer systems. This is the result of not have an appropriate monitoring bore in the superficial aquifer and not conducting a sufficiently long test (168 hours). The lack of appropriate pump test design has resulted in an inability to test or verify connectivity of the superficial aquifer with the underlying Yarragadee Aquifer. The groundwater modelling using a vertical hydraulic conductivity value of 1 m/day and 9.8 m/day is extremely high and in error. The high vertical hydraulic conductivity would result in an over estimation of drawdown impacts. The model did not evaluate mine dewatering impacts for the "dry" mining methodology. Mine dewatering is extrapolated to have the greatest impact upon groundwater within the unconfined superficial aquifer. The documents (Parsons Brinckerhoff October 2011) fail to provide an appropriate network of observation bores and associated drawdown over time such that the impact of mining can be appropriate assessed during the life of the project.	Refer to comments 10 though to 15. In summary: • Additional longer scale pump testing is not required, as the current approach is considered valid and in accordance with current industry practice • The vertical hydraulic conductivity of the superficial unit used in the model was 0.0017 to 0.032. Tronox reaffirm that the model conceptualisation was appropriate and, as is agreed by DOW, generally conservative in that is overestimated drawdown. A Peer review of the modelling report has since been completed (NTEC 2012). This found that the hydrogeological parameters used in the model were within reasonable ranges for the regional conditions. It also recommended additional testing of the model sensitivity to various parameters. This has since been completed (refer to Section 2.1.2). The results of this present the influence of dewatering in absence of Yarragadee abstraction plus an analysis of the model sensitivity to both changes in model conceptualisation as well as proposed mine plan. Tronox will continue to liaise with DOW regarding the detailed approach to operational control of groundwater management.
Department of Water – Appendix B			
17.		Through assessing the PER, OEPA should determine the acceptable environmental impacts associated with the whole project, *including* the water licence. DoW can then work to these limits when issuing the allowed volume and setting licence conditions and the operating strategy. To facilitate this, DoW uses this opportunity to comment on the PER to provide the following to OEPA:	Directed at EPA. However, Tronox considers that those impacts considered in Part IV assessment by the EPA to be environmentally acceptable should not then be considered again in detail within water licensing.

#	PER Section.	Reviewer comment/recommendation	Proponent response
		1. An outline of DoW's proposed approach to dealing with the water licence, specifically: a) A summary of the PER's predictions on environmental impact related to the proposed water licence. b) Notification that DoW would take these to be allowable impacts if the project is approved as described in the PER. c) A request to capture allowable impacts in the Ministerial Conditions. 2. Other water licence-related issues which may be relevant to OEPA's assessment of the PER.	
18.		Advice to OEPA with regards to GDE impacts of the water licence: 1 The PER predicts some substantial environmental impacts related to the water licence. If the proposal is approved by OEPA as described in the PER, DoW would consider those impacts 'acceptable' in assessing the water licence application and managing abstraction. If OEPA articulates the allowable impacts in Ministerial Conditions (e.g. "no more than xxx ha of the wetland shall be impacted by drawdown"), it will assist DoW to negotiate effective licence conditions and an operating strategy. A summary of these impacts follows: A total of 373 ha of GDE experiencing measurable loss of values due to drawdown (201 ha large change, 172 ha moderate change).	*Refer to response to Comment* 8 *on impact and* 9 *for management measures.*
19.		DoW also highlights the following issues for OEPA consideration in assessing the PER. • Based on DoW bore data, DoW agrees with the modelling approach to treat the Superficial and Yarragadee aquifers as being hydraulically connected. • Based on DoW data, DoW also agrees with the advice from Blandford (2007, 2008), who suggests that any impeding layers present in the study area are localised and would vary in the degree of obstruction to infiltration to the water table. This implies that perched layers are unlikely to have a broadscale effect in buffering drawdown impacts at wetlands. The GDE impact assessments (Froend 2011; Preston 2011) do not assume perching, and DoW supports this approach. Note that the conceptual model (Figure 4) in the wetland mapping report (Endemic 2012) implies perching at the Zeus wetland and is therefore	Noted. Endemic Report Noted - The Endemic report indicates there is perching at the Zeus wetland. Although perching is expected, to take a conservative approach to the impact assessment, the groundwater modelling did not include perching. As such, the GDE impact assessments do not assume perching. The Endemic report has not been used to determine impacts to wetlands, only location of wetlands.

#	PER Section.	Reviewer comment/recommendation	Proponent response
		inconsistent with other documents in the PER. • Figures 21 and 22 in the PER depict the difference in drawdown at the Superficial water table, between dry mining and dredge mining. Note that the 1 m drawdown contour covers a smaller area in dredge mining than in dry mining. However, the 0.25 m drawdown contour covers a larger area in dredge mining than in dry mining. Assuming these drawdown scenarios are calculated over the mine life (~12 years), the dredge option is still the most likely to minimise GDE impacts. This is because there will be a long time for the vegetation within the 0.25 m contour to adapt to the relatively small decline in groundwater (although the area affected is larger). Therefore, DoW supports a shift to dredge mining to mitigate GDE impacts.	*Refer to response to Comment* 6.
Department of Mines & Petroleum – Demelza Dravnieks			
20.		Acid Sulphate Soils (ASS). DMP previously provided comment on the draft PER indicating further information was required on the volume and management of ASS which would be disturbed or dewatered by the proposal (the previous advice is attached). No additional information has been provided in the final PER which means that the risk posed by oxidation of ASS cannot be adequately assessed. It is also noted that the assessment assumes that acid production would cease as soon as the watertable recovers, and this assumption must be justified (in some cases once oxygenation and acid production processes have started a change in conditions does not automatically halt the chemical processes). Detailed information on this issue will be required prior to the approval of a Mining Proposal under the *Mining Act 1978* and it is likely that the Mine Closure Plan (MCP) that has been provided will have to be revised at the Mining Proposal stage to include further information on the closure requirements relevant to ASS. Please note that if the MCP associated with this project is to be approved under the *Environmental Protection Act 1986*, further ASS information would be required as part of the PER assessment and the MCP would need to be revised prior to completion of the PER process. Please see below for further information on MCP requirements.	Further investigation of ASS at and around the Zeus deposit will be conducted prior to the submission of the Mine Closure Plan to the DMP.
21.		Closure Plan (MCP) in the appendices. The MCP has been prepared in accordance with the joint DMP/OEPA *"Guidelines for Preparing Mine Closure Plans - 2011"*. As stated previously in comments on the Draft PER, it is unclear as to whether or not the MCP referred to within the	The Mine Closure Plan will be revised and submitted to DMP to meet requirements under the Mining Act 1978 prior to the commencement of the project. The DMP has acknowledged the acceptability of the PER and associated MCP for EPA assessment. As the matters raised relate to revision of the MCP in order to meet

#	PER Section.	Reviewer comment/recommendation	Proponent response
		appendices of the PER will be approved as part of the Part IV process under the *Environmental Protection Act 1986*, or approved under the provisions of the *Mining Act 1978*. If the MCP is to be approved under the *Environmental Protection Act 1986* further information would be required for this to be an acceptable document by DMP. However, if the MCP is to be approved under the *Mining Act 1978*, the current closure information and closure criteria provided in Section 13 of the PER, as well as the 'draft' MCP are considered acceptable for inclusion in the PER. Key areas where further information will be required in the MCP at the Mining Proposal stage (if the MCP is to be approved under the *Mining Act 1978)* are outlined below: • Further detail on final land use, landform detail and diagrams (this information cannot be left to a decommission plans (as stated), as the final land use can heavily influence how an area is mined and rehabilitated). • Detailed site layout plans, which detail the rehabilitation domains and are referenced in the Closure Implementation section. • Volumes of ASS to be disturbed and dewatered, and locations of any long term containment cells for ASS or other problematic materials such as tailings. • The legal obligation register must include commitments outlined in the PER (and Mining Proposal if relevant/possible) • Stakeholder consultation needs to be focused on post mining land use and rehabilitation, not just on approvals. It is noted that the MCP indicates that consultation will be closure orientated towards the end of the project life and this is not sufficient. A communication plan/strategy should be detailed for consultation with the key stakeholders. It would be good for the stakeholder consultation to show actions that have been taken to address any issues raised by stakeholders. While it is acknowledged that Table 16 is just a summary of consultation, there needs to be reference to a consultation register which details all the consultation, date, issues discussed and resolutions (to be built on over the mine life).	requirements of a Mining Proposal under the Mining Act, these have not been addressed here.
22.		The Closure Risk Assessment should be revised in relation to the following points; • The closure risk assessment appears to consider the risk of	*Noted. Refer to response to Comment 20.*

#	PER Section.	Reviewer comment/recommendation	Proponent response
		ongoing ASS issues if ASS are oxidised during mining or dewatering to be low and only have onsite consequences. • DMP does not yet consider there to be sufficient information provided on the volume/management of ASS to be dewatered to justify this risk level. • It is noted that the closure risk assessment references successful rehabilitation being achieved at other Tiwest sites as a mitigation/assumption but has not provided details of this success (to justify this claim). • The consequence of rehabilitation failure in the risk assessment is considered to be major. In the definitions of consequence an event which results in the company not being released from liability following operations, or a cost exceeding $1Millon is categorised as catastrophic. Based on DMP experience, the cost of fixing failed rehabilitation of a mineral sands mine can well exceed $1Million and the liabilities associated with the site would not be relinquished until acceptable rehabilitation is achieved. It is therefore considered that failure of rehabilitation would most likely fit into the 'catastrophic' consequence category, which may result in further mitigation and controls being required. • Many of the potential risks appeared to be common across domain types, and are therefore repeated multiple times in the risk assessment. DMP have no concern with the risk assessment being simplified to reduce this duplication of information across domains where the risk and mitigation measures are the same, as it is likely to make the document easier to use/assess.	
23.		Comments on completion criteria; • It is noted that a 1 in 100 year event is referenced in some of the closure criteria. Where landforms are to be left at closure it is likely to be more appropriate to consider the maximum probable event level and ensure landforms are designed for that level to ensure they are stable over the long-term. • The performance indicator for the completion criteria of 'final land use' is indicated as 'post closure criteria'. This appears to be a self referencing criteria (circular argument) and needs to be revised and defined further. • Definitions for terms such as; 'unacceptable risk', 'unacceptable contamination', 'broadly represent', 'appropriate densities' are required so that completion criteria are measurable.	*Noted. Refer to response to Comment 21.*

#	PER Section.	Reviewer comment/recommendation	Proponent response
		• The performance indicator (monitoring) for each target (completion criteria) requires further definition to ensure the success of the site against each completion criteria can be clearly measured. • No detail on the methodology used to calculate the closure costs has been provided. The financial provisioning for closure section of the MCP is severely lacking in detail. • The Closure Implementation section references a Rehabilitation Management Plan (RMP) provided in the EMP. The RMP is indicated to contain further information on rehabilitation implementation and appears to duplicate some information in the MCP. It is not clear why this information cannot just be included in the MCP (which is a document required by legislation under the Mining Act 1978, where as the EMP is not). The MCP is a document that is intended to be continuously updated, and if relevant information is spread over a number of documents it will significantly increase the complexity of updating these documents, and may reduce their onsite useability. • It is not clear why the Indicative Project Schedule (table 19) does not include a timeframe for clearing or mining at Dionysus. • There is duplication of completion criteria within the document, with the criteria being restated in several different sections, which can lead to inconsistencies in the future when these criteria are revised. Completion criteria need to be specifically detailed in one section and then referenced in others where required (instead of re-stated). • Unplanned closure (this can sometimes be called called unexpected closure, as it should be planned) is different to temporary closure (generally called 'Care and Maintenance'), and therefore the management of these scenarios is different. The MCP does not address these scenarios sufficiently. • In Section 10 it should be noted that detailed waste dump designs will need to be developed prior to mining. • Further detail is required in section 11.2 in relation to the procedures for baseline and other monitoring, and this monitoring should be linked to completion criteria. • Where corrective actions are required after poor monitoring results, especially those related to erosion or rehabilitation failure, the corrective action needs to consider the landform design and waste/backfill properties as potential areas of failure (to prevent landform design mistakes re-occurring). Further work is required on the corrective actions and monitoring section to clearly link them to completion criteria.	

#	PER Section.	Reviewer comment/recommendation	Proponent response
		• The management of information section needs to include the records management all surveys, monitoring results and other environmental information for the project.	
24.		Proximity to tenement boundaries. It is noted that some mine landforms and infrastructure (ie Zeus and Hades pit, Hades, Hebe and Heracles Overburden Dumps, the Solar Drying Dam and the Water Dam) are located directly adjacent to the Mining Lease boundaries in Figure 5. A sufficient distance must be left between all mine disturbances and tenement boundaries to ensure that all mine impacts (including the zone of pit instability, tracks and areas to push down and re-contour overburden dumps) are located on appropriate tenure. Further detail on the location of all infrastructure in relation to tenement boundaries will be required as part of the Mining Proposal.	Mine planning will be conducted with consideration for the proximity to the tenement boundaries. The Mining Proposal will include the required information on infrastructure locations in relation to the tenement boundaries.
25.		It would be a good idea to include approvals under the *Mining Act 1978* within Section 2.2 of the PER (Proposal Timing).	Noted.
Department of Mines & Petroleum – Tyler Sudjovic			
26.		*Waste Characterisation:* The DMP provides the following comments in relation to the waste characterisation information provided within the PER: • *Zeus Deposit;* Further detailed analysis of areas potentially containing ASS in relation to the Zeus deposit (mine pit and associated groundwater drawdown areas) is required to adequately assess the risk posed by ASS. As is noted within the report prepared by Geoprocc (2010) the drawdown of groundwater (east of the Zeus Deposit) may expose soils with elevated peroxide oxidisable sulphur (POS) to air, potentially acidifying groundwater. Whilst the risk associated with groundwater drawdown has been highlighted within the PER and supporting documentation, limited information on how Tiwest Pty Ltd intend to manage this issue has been provided. The DMP does not consider Tiwest's commitment to *"record inflowing groundwater and treating with a neutralising agent as required"* provides sufficient detail as to how the issue will be managed. In addition to impacts resulting from groundwater drawdown, soils beneath the watertable within the Zeus pit shell were also identified with elevated levels POS. Given this material will be excavated and processed as part of the mining operations further information on the	Refer to the response to Comment 20. Tronox consider that there is sufficient information presented within the PER to broadly characterise the risk of significant impact arising from acid soils to be low. However, additional investigation is required to develop a detailed management response. The results of the investigation will dictate the management requirements of the project and will be specified in the Mining Proposal.

#	PER Section.	Reviewer comment/recommendation	Proponent response
		potential acidity and Acid Neutralising Capacity (ANC) of the tailings is required. The DMP acknowledges the commitment provided by Tiwest Pty Ltd to undertake additional investigations at the Zeus deposit and surrounding areas to further investigate the risk posed by ASS, and notes that such information will be required as part of assessment under the *Mining Act 1978*. • *Volumes of Material;* In addition to identifying the locations at which ASS may be encountered, estimates of the volumes of materials to be encountered are required to assess the risk posed by ASS and ensure the proposed management procedures (liming of tailings and treatment of groundwater) are appropriate.	
27.		*Closure;* The DMP considers the information relating to Mine Closure provided within the document to be sufficient for this stage of the project. It is however unclear as to whether or not the Mine Closure Plan referred to within the PER will be approved as part of the Part IV process under the *Environmental Protection Act 1986*, or approved under the provisions of the *Mining Act 1978*. Please be aware the DMP is unable to comment on the acceptability on the Mine Closure Plan as a copy has not been provided along with the PER document.	*Refer to response to Comment 21.*
Department of Environment & Conservation – Species & Communities Branch			
28.	Carnaby's Cockatoo Calptorhyn-chus latirostris	**Recommendation 1:** That if the proposal is approved, a condition requiring the development and implementation of a Carnaby's cockatoo monitoring and management plan be applied. The plan should be developed on the advice of DEC. **Recommendation 2:** That if the proposal is approved, a condition be applied that states the proponent will not impact on known or potential Carnaby's cockatoo nesting trees near the proposal area. **Discussion:** Carnaby's cockatoo is a threatened fauna species ranked as endangered. The proposal will have a significant residual impact on Carnaby's cockatoo foraging habitat that supports flocks of up to 350 individuals. While no habitat trees were identified in the proposal impact area, potential habitat trees have been identified nearby. The proposal's proposed Fauna Management Plan (part of the Environmental Management Plan) does not provide specific management actions for this threatened species. A specific Carnaby's cockatoo monitoring and management plan should be developed on the advice of	Noted. Tronox is currently considering how to incorporate monitoring of Carnaby's Black Cockatoos utilisation of rehabilitated areas. Noted. Searches of the Proposal area have identified no nesting habitat within the Proposal Area.

#	PER Section.	Reviewer comment/recommendation	Proponent response
		DEC, and implemented to manage the impact of this proposal on this species' foraging habitat, nesting habitat and water sources that are at risk.	
29.	Western Ground Parrot Pezoporus wallicus flaviventris	**Recommendation 3:** That further surveys for the western ground parrot occur prior to clearing to better determine the likely occurrence of the western ground parrot in the proposal area. **Recommendation 4:** That the proposal be assessed on the basis that it may impact on western ground parrot habitat. **Recommendation 5:** That if the proposal is approved, a condition requiring the development of a western ground parrot monitoring and management plan be applied. The plan should be developed on the advice of DEC. **Discussion:** The proposal area contains potential habitat of the western ground parrot and is located within the parrot's historical area of occupancy, although its presence in the proposal area is uncertain. The species was not confirmed (visually or aurally) in any of the surveys (2007/08), although a number of calls heard were considered potentially consistent with part of a western ground parrot call. All sub-populations of western ground parrot are important and "*The discovery of a northern population of the species would be highly significant*" (Metcalf and Bamford 2012, page 25). The western ground parrot is a threatened fauna species ranked as critically endangered. The species is only known from two areas on the south coast, and the most recent estimate is that there are less than 140 individuals remaining. The species is elusive, has low population densities and there are difficulties in determining through survey if the species is present or absent from an area. The main threatening processes identified for the species on the south coast are also present at Dongara (clearing, habitat fragmentation, changed hydrology, fire regimes, *Phytophthora* dieback, weeds and introduced predators). The *South Coast Threatened Birds Recovery Plan 2009-2018* (DEC) includes the western ground parrot and provides context on the species. Specific to development proposals, the recovery plan states that activities "*…should not be approved unless the proponent can demonstrate that they will have no significant impact on the taxon, its habitat or potential habitat, nor have the potential to spread or amplify*	Recommendation 3: Pre-mining, during mining and post mining surveys for the Western Ground Parrot are committed to in Table 18 of the PER. Recommendation 4: The potential for the proposal to impact on the Western Ground Parrot as a matter of National Environmental Significance is detailed in Section 14.4.5. Recommendation 5: Noted. The management measures set out within the PER and supporting EMP address the minimisation of risks arising from fire, weeds, pathogens (including Phytophthora dieback and changes in hydrology).

#	PER Section.	Reviewer comment/recommendation	Proponent response
		threatening processes such as Phytophthora cinnamomi and adverse hydrological changes" (page 10). The proposal's proposed Fauna Management Plan (part of the Environmental Management Plan) does not include monitoring detail for the western ground parrot. A specific western ground parrot monitoring and management plan should be developed on the advice of DEC.	
30.	Limiting the direct impact	**Recommendation 6:** That if the proposal is approved, the direct impact (clearing) of the proposal be limited to a maximum defined limit. **Discussion:** The project is located in the Mount Lesueur-Eneabba area, one of 15 national biodiversity hotspots. The area supports a large number of distinct, species-rich communities, particularly proteaceous scrub-heaths on sand that are rich in endemics and are susceptible to *Phytophthora* dieback. The area also contains a number of threatened flora and fauna species. Cumulative impacts on the Geraldton Sandplain from activities associated with petroleum and mining exploration and development proposals on conservation values can be significant. This development proposal will have a "*Longer-term impact on local biodiversity from permanent change in biodiversity of the area subject to clearing. This is expected as a result of rehabilitated communities differing in species composition and vegetation structure from the pre-mining state*" (PER, page 171). Given these known values, the direct impact of this proposal on conservation values should be minimised.	Noted. Tronox have stated 1315 ha (inclusive of 115ha of pasture, the remainder native vegetation) maximum clearing area in Table ES1 and Section 16.4 of the PER.
31.	Hydro-logical modelling	**Recommendation 7:** That the hydrological modelling used to predict impacts on the wetland from groundwater drawdown is peer reviewed to confirm the model's predictions. **Discussion:** The department was unable to review the hydrological modelling used to predict the impact(s) of the proposal on wetlands. The department can provide further specific advice on the impact assessment conclusions and the significance of the impact on the wetlands (including wetland functionality which at Zeus is likely to be compromised) following a peer review of the hydrological modelling.	Refer to response to Comment 16 for the results of the peer review and sensitivity analysis.

#	PER Section.	Reviewer comment/recommendation	Proponent response
32.	Limiting the indirect impact	**Recommendation 8:** That if the proposal is approved, the measurable indirect impact of the proposal is limited to a maximum defined limit. **Recommendation 9:** That if the proposal is approved, a condition be applied requiring the Zeus ore body to be dredge mined rather than dry mined. **Recommendation 10:** That if the proposal is approved, a condition be applied requiring the development of a groundwater drawdown monitoring and management plan that is developed on the advice of DEC. **Discussion:** The greatest predicted indirect impact of the proposal on conservation values relates to the impact of groundwater drawdown for dry mining, in particular for mining the Zeus pit which is located closest to the Zeus wetlands. However, the proponent has not committed to dry mining or dredge mining, rather stating that mining will include both methods. For the following reasons, DEC recommends dredge mining at the Zeus deposit. The proposal is predicted to have a significant impact on the Zeus wetland (24.1 %), Eridoon_392 (Shrublands; *Melaleuca thyoides* thickets) vegetation association (19.5 %) and the 10a floristic community type (FCT) (41.4 %) from direct (clearing) and indirect (groundwater drawdown) impacts. Minimising the impact from groundwater drawdown (via dredge mining the Zeus deposit) through dredge mining would, in part, mitigate some of this impact. For context: • The Zeus wetland is considered to be equivalent to a 'Conservation Category Wetland'. • The wetlands are not well represented in the nearby nature reserve. • The Eridoon_392 (Shrublands; *Melaleuca thyoides* thickets) vegetation association is poorly represented in	Recommendation 8: Noted. Refer to Section 16.4 of the PER. Also note that Sections 2.3 and 2.4 of this document sets out an amended assessment of groundwater drawdown impacts. This is the result of additional sensitivity analysis and additional management measures being proposed (infiltration). Recommendation 9: Dredge vs. dry mining: refer to response on Comment 6. Recommendation 10: A groundwater drawdown monitoring and management plan is outlined in Section 3.1 of the EMP. Tronox designed the management and monitoring outlined in the EMP to meet the management objectives and targets. Tronox will update this plan to include the reinjection system outlined in Section 2.2.2. The additional mitigation measure proposed significantly reduces the predicted impact on wetlands, groundwater dependant ecosystems and vegetation. In the event that the objectives and targets are not met, Tronox will implement the contingencies outlined in Table 5 of the EMP.

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		the conservation reserve system, with only 3.3% of the current extent of this association in IUCN category I-IV reserves. • The 10a FCT is identified as groundwater dependent and largely associated with wetland habitats. The largest occurrences of the 10a FCT mapped for the proposal at Zeus will be impacted. The groundwater drawdown monitoring and management plan should also provide advice on the closure outcome for the wetlands (i.e. will they be reinstated if the impact of the proposal is not temporary as indicated on page vii of the PER).	
33.	Flora	**Recommendation 11:** That the intensity and methodology of flora surveys (including targeted surveys for species of conservation significance) in the impact footprint is clarified. **Discussion:** Discussion on the survey methodology and intensity of survey in the project's footprint was not provided. For DEC to be able to provide advice on the adequacy of the surveys to accurately predict the impact on flora and vegetation, this methodology should be supplied. In particular, the impact of the proposal on *Beyeria gardneri* (removal of a population, the next nearest record of this Priority 3 species is 25 km away), *Verticordia luteola* var. *luteola* (removal of a population, the next nearest record of this Priority 3 species is 20 km away), *Mesomelaena stygia* subsp. *deflexa* (removal of the majority of the most northerly population of this species) and *Persoonia filiformis* (removal of the majority of the largest population of this Priority 2 species) is considered significant at the project level. In the proponent's clarification as recommended above, DEC is also seeking information on whether the surveys specifically targeted these species outside the impact footprint. Depending on the response of the proponent to this recommendation, additional mitigation measures may be required.	Details of the flora survey method (WEC 2007) were provided to and commented on by DEC prior to undertaking the studies. A description of the method was provided in WEC 2009 that was appended to the PER. Surveys for relevant conservation significant species undertaken outside the footprint were opportunistic. This means that some searching in appropriate habitat was undertaken. As shown on Table 36 of the PER, for all flora species of conservation significance the Proposal is expected to remove less than 10% of the predicted habitat and therefore the Proposal is considered unlikely to significantly affect the conservation status of any species.
34.	Sandplain duck orchid	**Recommendation 12:** That the results of the November 2011 targeted Paracaleana dixonii survey are provided to DEC and the EPA to inform the impact assessment. **Discussion:** *Paracaleana dixonii* is Declared Rare Flora (ranked	The targeted Paracaleana dixonii survey mentioned in the PER refers to surveys targeting areas of proposed exploration drilling and monitoring recovery post drilling. The results of such surveys are provided to DEC as part of the assessment/approval and reporting processes for exploration activities.

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	Paraca-leana dixonii	vulnerable) with known habitat in the proposal area. The PER states that a targeted *P. dixonii* survey was scheduled to be conducted in November 2011, however the results of this survey were not provided. The results of the survey should be provided to DEC and the EPA to enable an informed impact assessment of the proposal on this orchid species.	Table 35 of the PER, states that none of the 40 populations recorded in the Study Area will be impacted by the Proposal.
35.	Rehab-ilitation and closure	**Recommendation 13:** That the proponent gives reasons for the rehabilitation target of $\geq$ 60 % species richness (when compared to reference sites in the same vegetation group) in rehabilitation. **Recommendation 14:** That if the proposal is approved, the proponent be required to optimise direct return of topsoil and soil profile reconstruction in rehabilitation to improve the likelihood that the rehabilitation can sustain a diversity and structure of native vegetation more similar to the pre-mining condition. **Recommendation 15:** That if the proposal is approved, the rehabilitation target a diversity of native species that are important as foraging habitat for Carnaby's cockatoo and habitat for the western ground parrot, in addition to conservation significant flora and vegetation. **Recommendation 16:** That if the proposal is approved, the closure outcome for Declared and environmental weeds, as a result of the implementation of the proposal be: • no new weed species established in the project area; and, • the cover and density of weeds being comparable to adjacent non-impacted sites. **Discussion:** Rehabilitation efforts and habitat restoration will be important for minimising the impact of the proposal on conservation significant flora, vegetation and fauna. The project fauna assessment states '*Habitat restoration post-mining will also be important for impact minimisation*' (Metcalf and Bamford, 2012, page ii). The success of the rehabilitation will require: • direct return of topsoil; • soil profile reconstruction that avoids barriers to root growth; • return of high diversity of native species;	Recommendation 13: EPA Guidance Statement 6 states that "In a biodiversity conservation sense, the rehabilitation of native vegetation is usually not expected to fully replace or improve upon original values of ecosystems." This implies that while rehabilitation should strive to replace like for like, there are limitations on what is achievable and that this should be taken into account when determining appropriate management requirements for, and acceptable environmental outcomes from, a proposal. Tronox have extensive experience of rehabilitation in a similar setting, namely the Cooljarloo Minesite. This provides essential insight into what can be expected from rehabilitation at other operations in a similar setting, Dongara included. An assessment of performance achieved at Cooljarloo is included in this response (refer to Appendix 4). It is this, and consideration of the key difference between the two sites (e.g. lower rainfall and different species composition) that influenced the target. Tronox recognise that the rehabilitation of all areas disturbed will not entirely mitigate all impacts of the project. Therefore, offsets are presented for all significant residual impacts of the project. Additional details on offsets are provided in the Offsets Plan Appendix 6). Recommendation 14 Tronox recognise the import of topsoil and subsoil management in rehabilitation and have advanced systems to ensure that their management is such that outcomes are "optimised". Current procedures applied at Cooljarloo require all rehabilitation completed to receive some (at least 10% by volume) fresh topsoil. Fresh topsoil is topsoil that has not been stockpiled over a winter period and as such, retains the seed, soil biota and organic matter that is lost during stockpiling over longer periods. Tronox distinguish direct return as a mechanism for applying fresh topsoil that involves no stockpiling. At times the fresh topsoil applied is via direct return techniques (i.e. not stockpiled). This sometimes requires pre-stripping of areas (stripping topsoil within the proposed footprint, ahead of when they may be required by mining activities). Topsoil management for the Dongara minesite

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		• targeted return of species that provide habitat for threatened fauna (Carnaby's cockatoo and western ground parrot, not just Carnaby's cockatoo as indicated in the PER on page 132); • targeted return of flora species of conservation significance; and • weed and *Phytophthora* dieback management. The proponent is using its experience at Cooljarloo as evidence of successful rehabilitation in the sandplains, however there are issues with Cooljarloo's current rehabilitation predictions, management and outcomes that are currently the topic of discussion between the OEPA, Department of Agriculture and Food, Department of Mines and Petroleum and DEC. Cooljarloo is not considered an appropriate benchmark for rehabilitation outcomes.	will at least comply with this standard. Soil profile reconstruction standards target the return of materials appropriate for establishing a safe and stable landform; and supporting target vegetation communities. There are a number of factors to be managed to achieve this. Tronox have identified, and set criteria for those considered fundamental to rehabilitation outcomes as appropriate for this stage of project development. These focus on moisture infiltration and retention, material stability and root penetration. Recommendation 15 & 16 Noted. Discussion The PER (Section 13), EMP (Section 3.3) and MCP discuss the management of the matters raised by DEC in some detail and provides Tronox's plan to address any gaps in knowledge.
36.	Cumulative impacts	**Recommendation 17:** That the proponent clarifies if the impact assessment included impacts from: • disposal of mine dewater; • mulching native vegetation for rehabilitation; and • sourcing gravel and basic raw materials for the project area(s). **Discussion:** It is unclear if the impacts from disposal of mine dewater, sourcing mulch for rehabilitation (PER, page 133) or basic raw materials have been included in the impact assessment for the proposal. These impacts should be included in the EPA's assessment.	Disposal of mine dewater There is no plan to discharge water to the environment as a result of pit dewatering. All water generated in pit dewatering will be consumed in ore processing activities. In the event of an extreme weather system (e.g. cyclone), all water storage options will be exhausted prior to discharging water to the surrounding environment. Mulching native vegetation for rehabilitation Mulch harvesting outside the mine path (i.e. in addition to the 1315 ha clearing area) is not included in the impact assessment. Only areas within the mine footprint will be harvested prior to clearing for mining and mechanical clearing will not extend beyond the 1315 ha. Should additional clearing be required, this will be referred to DEC and/or DMP for assessment in accordance with the appropriate legislation. Sourcing gravel and raw materials for the project area(s) Materials required for construction are planned to be sourced from within the mine footprint or external (e.g. off lease) sources. Management of the introduction of

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			weeds and dieback will be controlled by verifying that material is weed and dieback free (e.g. treatment of material) as per Section 9.2 of the PER.
37.	Phytoph -thora dieback	**Recommendation 18:** That the proposal be recognised as presenting a very high risk for the introduction and spread of Phytophthora dieback throughout the mine footprint and into adjacent vegetation. **Recommendation 19:** That if the proposal was to be approved, the following requirements be considered in relation to Phytophthora dieback management prior to ground disturbing activities: • that a baseline Phytophthora dieback survey occurs over the entire project area; and, • that material imported into the site be verified as being Phytophthora dieback and weed free. **Discussion:** The status of *Phytophthora* dieback in the project area is not known as the dieback survey provided with the PER by Glenvan Consulting (2012) was for a targeted exploration program and did not cover all of the proposal area. A large proportion of the vegetation in the proposal area is susceptible to *Phytophthora* dieback. Any additional impacts to the vegetation from the spread of *Phytophthora* dieback could be significant to flora, vegetation and fauna of conservation significance.	Recommendation 18: Noted. Tronox have clearly recognised the consequence of Phytophthora dieback introduction to the area. Section 9.5.2 of the PER presents an impact assessment for flora and vegetation from the risk of introducing and spreading dieback. Implementation of the Weed and Phytophthora cinnamomi Management measures within the EMP has been prepared to minimise the risk of infestations through monitoring and management. It should be noted that this follows the same or better approach to that applied at other sites, irrespective of the lower likelihood of the disease establishing at the site. Recommendation 19: Noted – both activities will be included in the revised EMP
38.	Yardano go Nature Reserve	**Recommendation 21:** That if the proposal is approved, a condition be applied which states that the proposal will not have a direct or indirect impact on the Yardanogo Nature Reserve. **Discussion:** Yardanogo Nature Reserve is located approximately 1.5 kms from the Zeus deposit. The reserve is divided by Mt Adams road, which will be used as a mine service corridor. Tiwest have made a series of recommended outcome based conditions (Section 16.4, page 170), including one related to indirect impacts on Yardanogo Nature Reserve. Tiwest recommend '*critical controls and triggers to be applied relating to the cessation of dewatering until appropriate remedial action is undertaken if measurable impact (**a Moderate or Large change)*** <<emphasis added>> *is recorded in the Yardanogo Nature Reserve*'.	Noted – no measurable impacts on Yardanogo Nature Reserve from groundwater drawdown are expected as a result of the Proposal. The likelihood of any measurable impact to the Nature Reserve is considered remote. The condition mentioned is the final measure in a series of contingencies measures that have been developed although not expected to be required.

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		A statement regarding moderate or large changes to Yardanogo Nature Reserve is of concern when impacts on the reserve are not identified (although this is not clear) or assessed in the PER.	
39.	Banksia hookeriana industry	**Recommendation 22:** That the potential impact of the proposal on the Banksia hookeriana wildflower picking industry is considered in the assessment. **Recommendation 23:** That if the proposal is approved, a condition be applied requiring the proponent to develop a management strategy to address the impacts on the B. hookeriana picking in the proposal area in consultation with DEC. Discussion: B. hookeriana is restricted geographically to an area of about 33x74 km in the northern sandplains centred on Eneabba. This species is commercially harvested by wildflower pickers and a special endorsement is required from DEC under the Wildlife Conservation Act 1950 to pick from Crown land. The proposed area encompasses some of the traditional harvesting areas for licensed wildflower pickers. The PER does not describe the impact of the proposal on this industry or how the impact could be managed.	FCT 5b is a thicket dominated by Banksia hookeriana and/or Banksia attenuata, with emergent Banksia prionotes on yellow sand on upper slopes and dune crests. It is the prime habitat for Banksia hookeriana in the project area. FCT5b is located in the western section of the Proposal Area on upperslopes and ridges with a deep yellow sand profile. The structure of this community is strongly influenced by fire. Trees of Banksia hookeriana up to 3 m in height were observed in areas that had not been periodically burnt during controlled burns. The project will be clear up to 91 ha of FCT 5b, 1.2% of the total area mapped, equating to a low level of impact (Table 34). To reduce likely impacts on the Banksia hookeriana wildflower picking industry, Tronox will consult with wildflower pickets to maintain access (providing they meet certain minimum safety requirements) to stands of the species in 5b within non-active mining areas. The species appears to germinate well from seed and topsoil/mulch. Therefore, Tronox expect Banksia hookeriana to return in rehabilitation. Tronox do not believe that a separate management strategy is required for an impact of 90ha, 1.2% of Banksia hookeriana habitat. Impacts to the species will be mitigated through the Rehabilitation Management Plan.
40.	Fauna trans-locations	**Recommendation 24:** That DEC is consulted prior to fauna translocations being attempted. **Discussion:** As part of the management actions linked with fauna, the proponent has proposed fauna translocations. Translocations require licensing under the Wildlife Conservation Act. In addition, for threatened fauna, a translocation proposal approved by the DEC Director of Nature Conservation is required.	Tronox will reword the planned management activities to something similar to "should fauna relocations be undertaken, they will only do so with the appropriate permitting and licences".
41.	Offsets	**Recommendation 25:** That if the proposal is approved, an appropriate offsets package be developed on the advice of DEC, to mitigate the impacts on: • Carnaby's cockatoo Calptorhynchus latirostris (threatened,	A final Offsets plan has been developed and submitted concurrently with this document (Appendix 6). The Offsets Plan addresses the matters raised by DEC and was derived in consultation with DEC and DSEWPaC.

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		ranked endangered); • sandplain duck orchid Paracaleana dixonii (DRF, ranked vulnerable); and, • restricted, endemic and conservation significant flora and vegetation values. **Discussion:** The residual impact of the proposal is significant and should be offset consistent with the State Government's offset policy and EPA policy and position statements. There has been limited consultation between the proponent and DEC regarding an offsets package for this proposal. The framework provided in the PER is lacking adequate detail for DEC to adequately comment on residual impacts and related offset requirements. DEC understands that the offset package is yet to be finalised.	
Department of Environment & Conservation – Environmental Services Group			
42.	General	**Recommendation 1:** That the proponent develops a contingency plan to ensure that potential water quality changes associated with groundwater drawdown do not affect environmental receptors near the Dongara mineral sand deposits. **Discussion:** The proponent has indicated that acid sulfate soil materials have a patchy distribution near the proposed Dongara mineral sand deposits, and that the acid neutralising capacity of soil materials typically exceeds the potential acid generating capacity of these materials. This is likely to limit the release of metals into groundwater if these materials are exposed to oxygen by mine dewatering. However there is a risk that other groundwater quality parameters (principally sulfate and arsenic) could be adversely affected by mine dewatering. It is recommended that the proponent undertakes sufficient groundwater monitoring to enable changes in water quality to be detected. It is also recommended that a contingency plan is prepared to ensure that management measures are available in the event that monitoring suggests that environmental receptors (especially nearby wetlands) could be affected by groundwater contamination caused by dewatering.	The Surface and Groundwater Management Plan outlines management actions to enable management objectives to be met and a monitoring program to measure the success of the management actions. Contingencies in the event monitoring indicates the management actions are not being achieved are outlined in Section 3.1.6 of the EMP. Additional ASS studies will be completed prior to mining (refer to response to Comment 20). The results of these studies will guide revision of Section 3.1 of the EMP (if required).

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		Author: Contaminated Sites Branch	
43.	General	**Recommendation 2:** That the proponent develops a more detailed dust management plan which provides objective monitoring techniques, trigger levels for dust management controls, designated responsibilities for management actions, management targets and criteria, and review procedures to evaluate the management plan and techniques. **Discussion:** The environmental management plan provided does not provide a rigorous methodology for managing dust emissions or assessing the effectiveness of dust management techniques. **Author:** Air Quality Management Branch	Impacts of dust from mining activities were not determined to be a high risk. The implementation of the proposed management and monitoring programmes will ensure this is the case. The management plan in Section 3.6 of the EMP (Table 21 and 22) utilises practices similar to those applied at Cooljarloo mine site. These have proven effective at ensuring that dust is low. If monitoring results indicate the management practices are not effective, Tronox will execute the contingency actions outlined in Table 23.
Wildflower Society of Western Australia			
44.		At the outset we don't believe the EPA should approve the project because of the impact of clearing 1200 ha of bushland and the further impact on an additional 373 ha of Groundwater Dependent Ecosystems (GDE). Based on more than 'thirty years of operation the industry has not shown that a high standard of biodiversity can be returned after mining.	Tronox have been rehabilitating at the Cooljarloo mine site since 1990. The successes Tronox has achieved since this time are described in the attached Review of Rehabilitation (Appendix 2). This states that the rehabilitation practices applied by Tronox follow or exceed relevant standards and guidelines. Tronox are confident that areas disturbed during mining are being rehabilitated with vegetation communities that are similar to the surrounds. Further to this, Tronox are actively seeking to improve rehabilitation outcomes and are implementing a programme to achieve this.
45.	3.2	Form and timing of consultation undertaken We have outlined in the introduction of this submission the interest of the Society in the region. To the best of our knowledge Tiwest has made no effort to consult with the Society on this project apart from providing a copy of the Scoping Document. In our view this does not indicate a willingness to take part in effective consultation. We have also tried to make presentations to the Mineral Sands Rehabilitation Coordinating Committee (MSARCCC) but this has been thwarted by the Department of Mines and Petroleum.	Noted The Wildflower Society has been invited to and has participated in various forums held by Tronox. These focus on matter relating to vegetation and rehabilitation specifically, including workshops on development of completion criteria for the Cooljarloo Minesite with members of the MSARCC Group. Tronox will continue to involve the Society in this manner.
46.	4.2.1	Biological Environment 4.2.1 Biogeography	Directed at EPA.

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		The majority of the vegetation within the project area is considered to be in pristine or excellent condition (P40). This is an invaluable resource within the vastly decreased naturally vegetated area of the bioregion. Clearing for agriculture is not allowed as set out in the EPA Position Statement No.2 (December 2000) and based on the current standards being achieved for revegetation clearing for mining should not be allowed. Mining particularly mineral sand mining cannot be regarded as a temporary land use.	Minerals sands mining, such as that proposed for the Dongara Project, is a temporary landuse. All areas disturbed during mining are rehabilitated to a high standard and the land returned in a state appropriate for the target end-use. In the case of the Dongara Project, the landscape will be reformed such that it is similar to pre-disturbance leaving no residual voids or pits. Areas of Crown Land will be rehabilitated to vegetation communities similar to those in the surrounding, undisturbed areas and areas of farmland, to pasture in consultation with the relevant landholder. Mine rehabilitation does not restore the land to its pre-disturbance state. However, it does return land with inherent ecological value (in the case of areas of native vegetation) that goes a long way towards replacing the values removed during mineral extraction. The difference between the value of mine rehabilitation and the pre-mining environment, while expected to diminish over time, is recognised by Tronox through offsets . As a result this proposal expects to deliver a net gain for the environment.
47.	5.3/2	Consistency with environmental principles Principle 2. Intergenerational Equity We believe the proponent in their consideration given in the Proposal has addressed this principle in a trivial matter. They say "in planning to achieve safe and stable landforms will enable the proposal to maintain the benefits for future generations". Effective operation of this principle implies much more than this, including achieving self-sustaining biodiverse ecosystems.	Restoring self-sustaining ecosystems is a commitment made prior to mining and will be achieved during rehabilitation. The key measures for ensuring a self-sustaining ecosystem is developed is outlined in Section 13.5.2 in the PER
48.	5.3/3	Principle 3. Conservation of Biological Diversity and Ecological Integrity If this principle was complied with clearing of the project should not be allowed as biological diversity and ecological integrity are best preserved in situ. At the very least the Zeus deposit should be excluded from the project. It is adjacent to the Yardanogo Nature Reserve and contains the equivalent of Conservation Category wetlands and has adjacent ground-dependent ecosystems. There is a precedent set by the EPA back in 2002 when the EPA said mining at Windarling should not be allowed because of an unacceptable impact on the environment. Windarling was part of an overall project which included Mt Jackson. Mining was to be	Biological diversity will be returned in the rehabilitation and will be measured by Table 41 in Section 13 of the PER. Methods to be applied to return self-sustaining diverse ecosystems are outlined in Section 13.5.2 of the PER. Proposed completion criteria listed in Tables 23, 25, 27 and 29 (Closure Plan) illustrate the outcomes aimed for in Tronox's rehabilitation. The Koolyanobbing Iron Ore Expansion proposal for mining at Windarling (EPA Report 1082) is not considered an appropriate comparison to the Dongara Titanium Minerals Project. Tronox have acknowledged the environmental sensitivity of the setting of the Dongara project. However, the Dongara project assessment has not raised issues of a magnitude similar to those presented in

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		allowed at the later site only. At the very least we call upon the EPA to reject mining of the Zeus deposit.	EPA Report 1082. Most notably, the Dongara project does not risk a change in conservation status of Threatened flora or vegetation communities. Tronox has given some thought to the options for reducing impacts associated with mining the Zeus orebody in particular. The Zeus contains a significant portion of the contained minerals, and thereby project value. Excluding Zeus from the mine plan would thereby have a significant impact on the project viability. As described in Section 2.6, Tronox has proposed additional mitigation measures that will significantly reduce the area of indirect impact to vegetation, GDE and wetlands associated with groundwater drawdown.
49.	7	Groundwater-dependent ecosystems (including wetlands) The PER describes the areas of wetland within the project area to be affected and the subtlety of the transition from wetland to dryland vegetation (P77). We don't believe this will be able to be recreated in revegetation because of way soil material characteristics are altered by the mining process. This has been a major reason for the revegetation failures at other projects.	The project involves direct clearing of 31 ha of 1030 ha (Table 30 of the PER) of wetland areas/communities. Tronox have described investigations (some already complete and other planned) within the Mine Closure Plan that collate information required to have a clear understanding of soils and the relationship of these to moisture availability and vegetation requirements is fundamental to rehabilitation success. Tronox do not propose to recreate pre-disturbance communities. Rather rehabilitate disturbed areas to communities that are composed of local endemic flora and of similar composition and structure. Residual significant impacts will be offset (refer to Appendix 6).
50.	9.5	Assessment of likely direct and indirect impacts Impacts to vegetation types (p95-102) We are very concerned at the impact on the Eridoon vegetation association 392 (p 97) and the FCT 10a (p 99). Table 35 shows that more than seven species of priority flora will have between 50% and 100% of their local populations destroyed by the project. This level of impact is not acceptable particularly as re-establishment of self-sustaining populations is not assured.	Impacts to 392 Impacts to Eridoon vegetation association 392 will not reduce the pre-european extent below the 30% threshold level. As shown on Table 33, 78.4% of the pre-European extent will remain after the implementation of the Proposal. A total of 86 ha of Eridoon 392 has the potential to be impacted by the proposal compared to a predicted impact to 20 ha with the reinjection system implemented. Of this area, approximately 12ha will be directly impacted through clearing, with the remainder, 8ha, at risk of impact by groundwater drawdown. The impacts to Eridoon 392 associated with groundwater drawdown consist of the vegetation suffering varying degrees of drought stress. As the vegetation remains in situ, it has high chance of recovery. Impacts on Community 10a Impact on FCT 10a will be limited to 108 ha which is 41.4% of the extent with the Study Area if there is not recharge. Of this, 9.3 ha will be directly affected by

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			clearing and 99 ha at risk of impact by groundwater drawdown (Table 34 of PER). The additional groundwater drawdown mitigation measures proposed by Tronox (Section 2.6)) reduced this to 23 ha and thereby the total proportion of FCT 10a affected to 8.8%. Impacts to priority species As shown on Table 36, less than 10% of the potential habitat for all flora species of conservation significance will be affected. Although Table 35 shows that for some species there is a high percentage of local populations to be removed this is the result of more intense surveying within and immediately adjacent to the disturbance area during exploration. The surrounding landscape has not been as intensively surveyed resulting in a misrepresentation of the percentage of populations to be removed. The assessment of impacts on a regional level and by the proportion of habitat removed provides greater certainty that species are distributed over a much wider area and illustrates that the impacts on a regional level are low.
51.	13.3.2	Closure Planning 13.3.2 Closure objectives The overarching objectives are according to the PER are: Establish safe and stable landforms supporting a sustainable native ecosystem similar to that which occurs in adjacent areas, and which; • Can be achieved using mining industry current practice • Returns vegetation groups appropriate to the post mining land capabilities and are broadly representative of unmined reference sites. We believe that these bullet points 2 and 3 on page 130 are incompatible and are typical of the platitudes which occur in many PER documents. We call on the proponent to show where this has been achieved bearing in mind they have been operating in excess of thirty years. The EPA should not be approving this project unless this issue can be resolved to their satisfaction and also shown to the community, such as Wildflower Society members. Neither in the PER document or the supporting documents on the attached CD is there an independent assessment of the current standard of revegetation being achieved. The EPA should be asking for such information to be submitted as supplementary report and it be made	Tronox, as the Cooljarloo Joint Venture and then Tiwest, commenced operations in 1989, twenty three years prior to this report. Appendix 4 provides information relating to rehabilitation practices, processes and outcomes relevant to the Cooljarloo Minesite. This clearly states that Tronox is both achieving good success in accomplishing rehabilitation outcomes, and is actively seeking to improve these by identifying and addressing deficiencies in performance outcomes. The Wildflower Society has previously provided detailed information regarding rehabilitation performance at the Cooljarloo as part of consultation undertaken on rehabilitation completion criteria for the site. Regarding an audit of rehabilitation in the Mineral Sands Industry, Tronox are not aware of one but agree that such a report should be made available to relevant stakeholders.

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		publicly available particularly to those who have made a PER submission. This should happen before the final consideration of the project by the EPA. These matters have been raised on other projects initiated by this proponent and the Society has been told the EPA will see the standard of revegetation will be capable of being managed appropriately. To date we have seen no evidence of this. It is our understanding an audit by the OEPA of rehabilitation in the Mineral Sands Industry is currently taking place. We believe this was commenced more than twelve months ago and would think it should be completed or nearly so by now. This audit should be published and made publically available long before the Minister for Environment makes a decision on this project the implementation of which would destroy up to 1500 ha of very high conservation bushland.	
52.	13.4.1	Closure criteria We are concerned that the closure criteria in Table 41 are very minimalist and below what should be expected of best practice mining industry standards. Biodiversity: *species richness greater than or equal to 60% of mean recorded in reference sites for the same vegetation group* is totally inadequate. We raised this in a Rehabilitation Forum with Tiwest on March 12th 2009. Alcoa are achieving 100% and in mines in the eastern states (in a non-biodiversity hotspot) 75% is the proposed target. Weeds: Whilst we agree no declared weeds should be in the rehabilitated areas the words *total combined projected foliar cover of other weeds* is *not significantly greater than measured in the reference plots* is not acceptable. This is once again typical of the "weasel words" which appear in PER documents. The proponent should be agreeing there will be no increase and because they would be totally reforming the landscape and vegetation, they should at the same time be eliminating weeds.	*Refer to response to Comment 35.*
53.	13.5.1	Landform stability It is most important that material characterisation takes place prior to any mining so that landform reconstruction can be optimal to support proper drainage and vegetation establishment and survival through to a self-sustaining ecosystem. This does not seem to come through in the PER document and appears a major deficiency in the document.	The importance of material characterisation of topsoil, soil profile reconstruction materials (upper soil profile) and landform reconstruction materials is recognised in Section 13.5.1 of the PER and committed to Table 9, Section 3.3.4 of the EMP. Details are also set out within the Mine Closure Plan.

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54.		Research We are surprised the PER document does not refer to any proposed research or investigation into better establishing a self-sustaining ecosystem of various plant communities. It does mention experience has been obtained at Cooljarloo but we would have thought significant work was needed to improve on the shrubland type revegetation currently being achieved.	The Mine Closure Plan provides information regarding Tronox's planned investigations. This includes investigation into propagation and establishment of plant communities and conservation significant flora.
Radiological Council			
55.		As a mineral sands mine, it is noted that the commitments do not reflect the legislative requirement for registration and licensing under the Radiation Safety Act 1975. Although the Mines Safety and Inspection Regulations 1995 takes precedence over the Radiation Safety (General) Regulations 1983, the Radiation Safety Act 1975 takes precedence for all matters incidental to the keeping and use of radioactive substances, irradiating apparatus and certain electronic products. Under the Act, the Radiological Council may place conditions, restrictions and limitations on the registration in order to ensure the health and safety of the public and the environment is protected. In general, the Radiological Council requires compliance with the Mines Safety and Inspection Regulations 1995. However, further conditions may be placed on the registration under the Radiation Safety Act. Once mining operations cease, the site will remain registered under the Radiation Safety Act 1975 until the Radiological Council approves the release of the site and terminates the registration.	Noted. The appropriate registrations will be sought for the storage, handling and use of radioactive sources at the site.
56.		Any amendments to the existing Tiwest Joint Venture Northern Operations Radiation Management Plan (Section 15.4.4) will also require the approval of the Radiological Council.	Noted.
57.		Pre-mining gamma radiation surveys must be undertaken prior to mining. The document does not make it clear as to whether this has been conducted.	Surveys have not yet been conducted but will be completed prior to mining activities commencing. Section 3.8 of the EMP will be amended accordingly.

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Department of Indigenous Affairs			
58.		It is understood that the Department has previously provided advice on the draft Proposal through correspondence from myself dated 20 February 2012 (Your Ref.: A447314). Having reviewed the Document I can advise that my previous advice remains relevant and that no further advice can be provided at this time for reasons made clear in my previous correspondence. As mentioned previously, the proponent's attention should be drawn to the Cultural Heritage Due Diligence Guidelines, a guiding document for decision making for works associated with this Proposal. A copy of the guidelines are attached and can be found at: http://www.dia.wa.gov.aulDocuments/HeritageCulture/Heritage%20management/AHA Due Diligence Guidelines.pdf	Noted
Member of the Public: Ms Carol Jenkins			
59.	General	Tiwest needs to clarify what, where and how large the disturbance and clearance areas are, respectively.	Up to 1200ha of native vegetation will be cleared. Up to 115ha of farmland will be disturbed. The PER refer to two “named areas”: • Actual Footprint: (1315 ha) the total area of clearing and disturbance, made up of made up of 1200 ha of native vegetation and 115 ha of farmland. • Disturbance Boundary: (1410 ha) this is the area within which the clearing (up to the Actual Footprint) will be undertaken. It is larger than the area to be cleared to allow for minor movement of mining activities during final planning prior to clearing occurring. While the impact assessment presented in the PER assumed that the full 1410ha would be cleared, Tronox plan to restrict clearing to the Actual Footprint. In other words the total area to be cleared will not exceed the Actual Footprint and will remain within the Disturbance Boundary. The Actual Footprint (block colours) and the Disturbance Boundary (red hashed

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			area) are shown in Figure 5, page 16 of the PER. The area of vegetation predicted to be affected by groundwater drawdown was 37 3ha within the PER but, due to the introduction of additional mitigation measures (See Section X), has been reduced to 105 ha. This is associated with the area that is predicted to display measureable change as a result of drawdown arising during the mining into the water table, mainly at the Zeus orebody. As such, the Impact Area for the project (incorporating clearing and groundwater drawdown) equates to 1420 ha (i.e. 1315 ha plus 105 ha).
60.	General	The nature of Dieback and the proximity of the Project to the Yardanogo Nature Reserve should require more specific risk management measures and commitments to be provided in the PER to ensure that all reasonable steps are taken to reduce the spread.	The risk of spreading dieback within and to areas adjacent to the Dongara project site is identified in Section 9.2 of the PER and assessed in Section 9.5.2. Key management actions are outlines in Section 9.7 with detailed management outlined in the Weed and Phytophthora cinnamomi section of the Environmental Management Plan (Section 3.4)
61.	Table **ES1** and Table 1	No mention in the **PER** of how many traffic movements currently occur along the proposed route, and therefore the PER cannot adequately assess the level the impact associated with Project traffic on members of the public and the environment. The potential impact of other project related traffic has not been assessed (delivery of consumables, removal of waste, personnel movements).	Table ES1 states a maximum of 10 return trips per day to the Chandala processing site will be undertaken for this proposal. These trucks will use Mt Adams Rd and Brand Hwy which will be upgraded to support the increase in traffic. An upgrade to Mt Adams Rd, the main access road to the site, and the construction of turning lanes at the intersection of Brand Hwy and Mt Adams Rd, are being discussed with the Shire of Irwin. These upgrades are likely to be contained within the existing road reserve and will be completed separately from this proposal. Tronox employees and consultants will utilise Mt Adams Rd. This will counteract the increase in traffic and potential impacts on locals.
62.	Executive Summary	The classification of this reduction as a moderate impact is inconsistent with Figure 30, which describes a large proportion of vegetation community 10a at having "Large Change", further defined in Table 26 as representing significant impacts to species composition, distribution, community structure and vegetation health. The **PER** also needs to demonstrate that the remaining 59% will be viable over a long-term.	The assessment of the impacts to community FCT 10a as moderate was on the basis that of the 108 ha would be affected, 9 ha through direct clearing and 99 ha through groundwater drawdown. Impacts arising from drawdown were split between moderate and large change. Given this and the high likelihood of post impact recovery, the impacts were considered moderate. In recognition of the significance of these, and other, potential impacts associated with groundwater drawdown, Tronox has amended the proposal to further mitigate groundwater drawdown. The amended impact assessment is included in Sections 2.3 and 2.4 and relies of implementation of infiltration to reduce the extent of drawdown. This reduces the extent of drawdown impact to community FCT 10a to

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			14 ha. The total area impacted by the project is expected to be 23 ha (8.8%). The ongoing viability of the remaining extent of FCT 10a will not be impacted by this project.
63.	Executive Summary	The EPA WA Environmental Offsets Policy states that offsets will only be considered for the offsetting of residual impacts after avoidance and mitigation measures have been implemented. Due to the lack of information provided regarding the investigation of alternatives to the proposed Project, it is impossible to state with certainty that avoidance and mitigation have been adequately investigated and hence whether offsetting impacts is the only recourse. This is particularly true of the three potentially significant stygofauna species that have only been recorded within the Project area.	The majority of mining projects have only very limited options in terms of the alternatives as the location of the ore body is fixed. The only alternatives that can effectively be considered relate to the location of infrastructure. Options for the placement of infrastructure and associated dumps and dams were considered to minimise impacts on the environment. For example, the original location for overburden dumps was on the west side of the Zeus orebody. Due to the high value of the vegetation west of the Zeus orebody, the dumps were moved to the east side. Initially only dry mining was considered for the Dongara project. Consideration of dredge mining as a complementary method or alternative method has (and will) provide opportunities for a reduction in groundwater drawdown, extraction of a greater volume of minerals and alternative configurations of mining the pits. Mitigation measures are described for all potential impacts and are summarised in Section 16.3 of the PER. . The main mitigation measure Tronox will take is the rehabilitation of the disturbance area to self-sustaining vegetation that is representative of the pre-existing environment. The Cooljarloo rehabilitation practices and procedures which have resulted in proven outcomes as specified in the Rehabilitation summary report (Appendix 4) will be adapted and applied to the Dongara project As stated in Section 11.3 of the PER, none of the subterranean fauna species are considered restricted to the project area. In addition, the habitat is not considered to be unique, the lowering of the water will not be a permanent impact and the aquifers are connected. Section 2.2 of this response to comments provides additional commentary on options for mitigating groundwater drawdown. Refer also to the Offsets Plan (Appendix 6) for further detail on the avoidance, mitigation and offsets provided.
64.	Project Alternatives & Table 25	The EPA Guidelines for Preparing a Public Environmental Review 2010 states that Proponents will use best practicable measures and genuine evaluation of options or alternatives in siting, planning and designing their proposals to avoid, and where this is not possible, to minimise impacts on the environment. Sections 6-15 have a small section outlining alternatives;	*Refer to response to Comment 63.*

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		however in most cases no analysis of alternatives is presents, and in the others, only trivial details are provided. The PER does not present sufficient detail to allow an assessment about whether the Project meets the EPA Statement of Expectations.	

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65.	Table 4	This wording needs to be clarified to provide some indication of what the depth of the final pits will be so that some assessment of the potential for the formation of pit lakes can be made. Also, no information is provided to suggest that 1m above the average pre-disturbance maximum groundwater level is sufficient to mitigate the potential impacts.	Section 13.4.2 of the PER states that "…final mine voids are not required." and "…all mine voids will be backfilled to or above maximum seasonable groundwater levels or pre-disturbance contours". As such, the formation of pits lakes is not a risk. There are areas of the pre-disturbance environment where the groundwater levels approach within 1 m of the ground surface (or even higher). Tronox have thereby allowed for such landform to be constructed in rehabilitation.
66.	Section 2.1.3	There may be a considerable increase in clearance footprint associated with the installation of transmission lines to the external power network, and the impacts of this have not been assessed. This needs to either be included in subsequent documentation or the PER approval condition must exclude this as an option and demand on-site generation. It is not clear whether the traffic numbers in Table 1 reflect the transport of power-generation diesel.	The approval being sought by Tronox is specific to both the extent (footprint of 1315 ha) and location (Disturbance Boundary) of vegetation clearing. It precludes clearing outside these bounds and inherently offsite power generation. As such, an approval condition specifically excluding offsite power generation is not necessary. The planned power supply is expected to be onsite, preferably a natural gas fired power station. The traffic numbers in Table 1 refer exclusively to transport of mineral concentrate.
67.	Section 4.2.3	Only 9 of the 20 communities have been provided a ranking. What is the justification for not providing a ranking for all communities?	Only those FCTs impacted by the proposal have been assigned a conservation ranking. As the area surveyed for vegetation mapping extended well beyond the Project Boundary there are a number of vegetation communities (FCTs) that were not impacted and thereby ranked..
68.	Section 4.2.6 .	Seventeen of the 18 species identified have unknown conservation status and distribution, with Figure 19 suggesting that three of these have only ever been recorded within the Project area. The Precautionary Principal is outlined in Table 24 however the submission of the PER indicates that Tiwest have not applied this. The EPA should request Tiwest provide further information in order to demonstrate that the 17 species concerned, and in particular the three species that have only been recorded within the Project area, will not be significantly impacted by the Project.	The two harpacticoid copepods are from a stygofaunal group that are considered to be widespread. The syncarid, Hexabathynella sp., is considered to be the same as another Hexabathynella recorded outside of the disturbance area within the Study area.
69.	Table 37	The table indicates that several conservation significant species will have high to very high (up to 100%) reduction in abundance within the Project area, but the PER does not present adequate information to allow an assessment of the significance of this, providing only information about the number of populations within the region, but failing to provide any context about the size/nature of these populations. For example, from the data provided, it is possible that a species that is 100% impacted within the Project area may represent a high proportion of the total individuals in the	Impacts to conservation significant flora was based on impacts to FCTs considered to be habitat for the species (refer to Table 36, PER). The % of habitat affected is below 10% for all species. A large percentage of the known locations of species will be taken as a result of the project due to a concentration of locations on the drill lines - Refer to the response to Comment 50 for additional detail.

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		region if the other nominated regional populations are only small relative to the population within the Project area. The information provided in the PER is wholly insufficient to allow this to be determined and therefore the conclusion that the impacts are low cannot be verified.	
70.	Section 9.6	The data presented in Section 9.6 (and throughout the PER) indicates that there may be significant impacts to these conservation significant species as a result of the combined Aviva and Tiwest projects. It is unclear how the EPA proposes to manage these potential impacts, nor what Tiwest has suggested/implemented to avoid potential impacts.	Three species are likely to be impacted by both Aviva and Tronox project. Tronox's impact on all three species is likely to be low as shown in Table 37, Summary of impacts to conservation significant flora from clearing and groundwater drawdown.
71.	Section 12.3.1	"Proposes the use of a neutralising agent (line) for the management of potential acidification of the groundwater" - Whilst this may work (and there are significant concerns with how this would be achieved whilst not adversely effecting stygofauna with rapid changes in water quality), it's not clear how acidification would be managed post-closure.	Management of ASS disturbed or exposed during mining and groundwater drawdown is described in the EMP. ASS material will be buried below the water table and groundwater levels will recover post mining, therefore, acidification issues are not expected post-closure. Refer also to response to comment 20.
72.	Section 15	"Other Factors" - These sections make broad statements about impacts that are not backed up by referenced reports or studies. Some items, such as radiation and greenhouse gas, generate significant public and community interest/concern that warrants far greater attention than provided in the PER. For example, what is the likely annual exposure of the workforce or members of the public to radiation and what is the total greenhouse gas emission from the operation? It is unreasonable for the public to accept Tiwest's word that radiation exposures are considered low and that they have done everything they can to reduce their carbon footprint, this should be demonstrated. This information should not be buried in EMPs, it should be presented within the PER.	Radiation and greenhouse gas emissions were not considered significant factors by EPA or Tronox. As stated in Section 15.4 of the PER radiation impacts are managed through the requirements of the Radiological Council, refer to Comments 55 to 57. As stated in Section 15.3.1 of the PER, there are already a range of policies and regulations that cover greenhouse gases and provide controls and incentives on greenhouse gas emissions.

4 References

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