image resources

Boonanarring Mineral Sands Mine
Public Environmental Review Assessment No. 1947

Image Resources' (the proponent's) responses to the Office of the Environmental Protection Authority's summary of public submissions.

Table of Contents

1. The proposal - General comments

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
1	Public Submitter No. 2	The PER states that the mine will require temporary overburden placement areas and topsoil stockpile areas. This is consistent with discussions between the submitter and proponent that a 50 to 100 metre area on the western boundary of the submitter's property would be used as a temporary overburden placement area and topsoil placement area. However there is no information on how long these areas would be used for, stock and fencing management, dust and noise abatement measures for these areas and, if the owner of the property is not agreeable to having these areas on their property, where the overburden and topsoil would be stockpiled.	The proposal layout shown in the PER is indicative in nature. Individual proposal elements such as temporary overburden placement areas and topsoil stockpile areas can be placed elsewhere within the proposal envelope if required. Approvals for land surface access rights within the proposal development envelope and Mining Lease are currently being negotiated with the various landowners. Matters such as stock and fencing management for land adjoining the proposal development envelope/Mining Lease will be negotiated with the landowners as relevant during the development of the surface access agreements. A range of dust management and mitigation measures are proposed, which will include the key measure of using biodegradable stabilising agents on stockpiles to minimise wind and rain erosion. Noise will be managed by minimising the amount of 'double handling' required in establishing these stockpiles, and conducting these types of 'out of pit' operations during daylight hours only. Potential noise issues associated with the stockpiles will be temporary in nature, limited to their establishment and subsequent removal. Progressive rehabilitation will be undertaken, and disturbed areas within the proposal development envelope will be kept to a minimum. A Mine Rehabilitation and Closure Plan will be developed for the proposal. It will take into account the outcomes of stakeholder consultation with regard to rehabilitation and closure objectives. This plan will be assessed and approved by the Department of Mines and Petroleum (DMP) under the *Mining Act 1978*. The DMP will also be monitoring its implementation by Image Resources (the proponent), and compliance with identified rehabilitation and closure objectives.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
2	Public Submitter No. 2, No. 3	Landowners were informed during consultation between May and October 2013 (as noted in the PER) "that a dry separation plant is not proposed to be located on site at this stage." However, the PER does provide for the construction and operation of a mobile dry plant. There is lack of information of how amenity would be impacted from construction and operation of a mobile dry plant and how it will be managed or mitigated. The submitter requests the proponent to detail more information in relation to this. The submitter is opposed to this facility as this will add significant air pollution, increase noise and light emissions, and will impact on business and health. Given this area is zoned agricultural land, the submitter contends a dry mill plant should not be built in this location as this is an industrial process and not a mining process. The submitter recommends that a different location be arranged for the dry mill operation. Please clarify the dry plant facility proposed and potential impacts.	As noted by the submitters, a dry mill was not originally included in the proposal, a position that corresponds with the early feedback given by the proponent during consultation on the proposal, as recorded in Table 2.1 of the PER. However, the potential for inclusion of a dry mill was clearly flagged as an option in the referral of the proposal to the EPA (October 2012) which was available for public comment, and was confirmed as being part of the proposal in the PER released for public review (January 2013 - See Section 1.3, page 1-7), which overtly acknowledged this evolution of the proposal design over time. Dry milling is an integral part of mineral sands mining and processing, and therefore is in keeping with the nature of the proposal. The Dry Mill is proposed to be located to the immediate east of the wet plant, and just south of Wannamal Road West as indicated in Figure 1.3 of the PER. It is not intended to be mobile in terms of movement within the proposal development envelope during mining; however, it will be relocated from site after mining is completed. Figure 1 (Attachment A) shows the dimensions of the Dry Mill. The potential impacts associated with the 'land footprint' of the dry mill within the proposal development envelope have been addressed by its inclusion in the PER. There will be no dust emissions from the operation of the Dry Mill, and noise-generating equipment will be enclosed within the building structure. The detail of noise management associated with the operation of the dry mill will be addressed in the Works Approvals and Licence Applications under Part V of the *Environmental Protection Act 1986.* Lighting for plant operation purposes will also be contained within the enclosed Dry Mill structure. External lighting will be minimised to only that required for safety purposes, and will be managed through measures such as use of LED where practicable, and use of shrouded directional lighting and sensor-activated lighting

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
3	Public Submitter No. 5	The submitter is concerned that the PER is misleading and refers to their property as a failed Pawlownia Plantation. The submitter contends a commercial business is operating on their land, with licence and approvals from the Gingin shire.	The property does contain a failed Pawlonia Plantation within the proposal development envelope and the proposed disturbance area within this envelope. The submitter's composting facility is located on the property outside of the proposal development envelope. The proponent is of the view that operations of this facility would not be adversely impacted by the proposal (refer to responses to Items 1 and 41 for further detail).
4	Public Submitter No. 5	The submitter is concerned that the electricity overhead wires running from the Eastern boundary of their property to their work station runs through the proposed mining location. Please clarify.	The proponent has already accepted responsibility for maintaining power supply to the composting facility, as communicated in a number of discussions over time with this submitter. This commitment is re-iterated.

2. Flora and Vegetation

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
5	Public Submitter No. 2	The submitter is concerned about the proposed clearing of 21 hectares of native vegetation within the road verges of Wannamal West Road and Aurisch Road and within the access track to Bartlett's Well Nature Reserve. These areas provide habitat for fauna, help in dust and noise abatement, and help reduce erosion and salinity in the area. Clearing of this vegetation should be prohibited.	The PER based its impact assessment on a conservative 'worst case' scenario of requirement of clearing all remnant vegetation within the proposal development envelope, including the road reserves contained within the boundaries of the proposal development envelope (as stated on Page 6-3 of the PER). Even if this were to be the case, it was determined that this loss of vegetation would not result in any change to conservation status of any ecological community, or any material change in ecological function in the local area, and therefore is not significant in either a local or regional context. However, in keeping with its commitment to minimising potential environmental impacts associated with the proposal to the greatest extent practicable, The proponent is proposing to retain the majority of the vegetation within the proposal development envelope on the verges of Wannamal Road West and Aurisch Road and within the Bartlett's Well access track (as stated on Page 6-9 of the PER). This will be achieved by limiting disturbance to only that required to provide safe access across these roads as they intersect the mining tenement, and in the case of Aurisch Road also includes the area of mining. As such, the disturbance of vegetation within the road corridors associated with the proposal is more likely to be in the order of approximately 3 ha.
6	Wildflower Society of WA	Monitoring of vegetation and hydrology is mentioned in the PER. Whilst this may or may not be done in practice, there is no confidence that if adverse impacts are observed there will be any action to counter this. Once the mine is given a license to operate the submitter has observed it is almost impossible to get its operations restricted in the face of such matters as vegetation death or vegetation community collapse. It is always blamed on exceptional circumstances or a one in an 'x' number of year drought and that it would have happened anyway.	The proponent believes that the studies undertaken to inform the PER, particularly Supporting Studies 4.1 and 4.1a (groundwater) demonstrate that the proposal can be managed so that potential impacts are avoided or minimised such that there will be no unacceptable impacts to the environment. There is negligible (if any) predicted impact to the vegetation to the east of the proposal development envelope, and in particular to the nature reserves, given the positioning of these on the Mirrabooka Aquifer and the existing depth to groundwater of the Superficial Aquifer where it does underlie this vegetation (i.e. approximately 50 metres below ground, refer

6 cont.		A fifty metre buffer from the Boonanarring Nature Reserve is completely inadequate. Commitments given for mineral sands mines south of Perth where vegetation was going to be protected by both buffers and reinjection of water both failed. Examples include the Tutunup titanium minerals mine and the Iluka mine. It is believed that the same situation applies here. It is apparent that drought or climate change is already impacting both Boonanarring Nature Reserve and Bartlett's Well Nature Reserve, and changing the hydrology adjacent to the reserves could hasten the death of vegetation. The precautionary principle should be applied and further work done, the buffer increased, or the project not proceed in order to protect the conservation estate. This is also applicable to the wetlands to the west of the proposal and there are concerns that any impact will be blamed on climate change. The EPA should insist on continuous monitoring and publically available reports on the wetland monitoring. Appropriate trigger points to shut down operations should be set.	PER Figure 5.9). Please refer to the response provided to the comment below (Item 7) for further detail regarding prediction of potential impacts to the nature reserves and their management, including a rationale for the proposed buffer, and proposed ongoing monitoring. All groundwater drawdown scenarios predict a low risk of impact to any wetlands to the west, including the sensitivity analyses conducted and reported in full in Supporting Study 4.1a. The only wetland potentially impacted to the west of the project site is Collard Wetland if it assumed that this wetland is fully reliant on the Superficial Aquifer (Refer to the Cross Section Figure for Pit C, included in Appendix B of this response to submissions). If monitoring does show potential groundwater drawdown impacts on this wetland, a groundwater re-infiltration system will be implemented. The preliminary design and effectiveness of this proposed groundwater re-infiltration system is as reported in Supporting Study 4.1a and PER Section 6.2.2.1.3. Field tests to confirm the effectiveness of the re-infiltration method will be conducted at the commencement of mining, which will be well before any potential impacts would be observed at Collard Wetland. These matters are further detailed in the Water Operating Strategy prepared for the proposal, to be assessed and approved by the Department of Water under the RIWI Act 1916.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
7	Department of Parks and Wildlife (DPaW)	The proposal is located directly adjacent to two nature reserves in the Swan Region. The PER states that the "*proposal will not reduce the environmental values of the nearby nature reserves*". The PER also indicates that direct and indirect impacts of the proposal on the nature reserves can be avoided by incorporating a 50 metre buffer between the operating pits and the nearby nature reserves (see page 6-9). However, the document does not provide a scientifically based justification for the application of the 50 metre buffer distance. Both reserves are important components of the State's conservation reserve system and include representative vegetation and conservation category wetlands in a highly cleared landscape. The Boonanarring Nature Reserve protects vegetation types not present in any other conservation reserves (occurring within the transition zone of vegetation associations of the Swan Coastal Plain, Darling Scarp and Dandaragan Plateau)[1]. Given the close proximity of the proposed mine, the proponent's stated intention that the proposal will not impact on the reserves and the uncertainty around the effectiveness of the 50 metre buffer, a condition should apply to the project that ensures the outcome of no impacts on the Boonanarring and Bartlett's Well nature reserves. Compliance with this outcome should be demonstrated through an appropriate nature reserves monitoring and response plan. This plan should focus on hydrology and vegetation elements (including	There will be no direct impacts to the two nature reserves from the proposal as The proponent has excluded the areas of these reserves from the proposal development envelope it is seeking approval to operate within. The key potential indirect impact to the nature reserves was considered to be associated with groundwater drawdown in the Superficial and Yarragadee Aquifers as a result of dewatering and obtaining of production water required to facilitate mining, and the consequential effects this may have on the biota of the nature reserves. Detailed and rigorous H3 level investigations were undertaken to establish baseline groundwater conditions and predict potential impacts, these investigations are detailed in PER Sections 5.3.2, 6.2.2.1 and Supporting Studies 4.1 and 4.1a. These included: • collection of quarterly groundwater monitoring data from existing bores; • installation of an additional 42 peizometers at 26 sites, 4 test bores and 7 monitoring bores and conducting investigations and monitoring; • research of public domain references; • interpretation of local and sub-regional hydrogeology based on the proposal area data and supporting data derived from the public domain references; • development and calibration of model to predict potential drawdown; • sensitivity simulations to add to the transparency and rigor in the predictive modelling of the project footprint on the groundwater modelling; and • independent technical review of all of the above work. These investigations established that there is negligible risk to the nature reserves as result of the proposal due to the fact that they are largely situated on the Mirrabooka Aquifer, rather than the Superficial Aquifer. Interactions between the Mirrabooka and Superficial Aquifers were

7 cont.		targeting any conservation significant wetlands, potential groundwater dependent vegetation and taxa at potential risk from the implementation of the proposal). Objectives, outcomes and actions for monitoring and management set out in the plan should conform with the SMART (Specific Measurable Achievable Relevant Time-bound) principle with monitoring design utilising the BACI (Before After Control Impact) approach. The results of monitoring programs should be used to inform management response actions, including the implementation of the proposed managed aquifer recharge program. For this example, piezometers or other appropriate monitoring devices should be used to measure groundwater depth and quality in conjunction with vegetation monitoring, and 'trigger' levels established for management response. This is due to the likelihood of -vegetation taking a 'delayed' time to show visible impacts from the time of drawdown to noticeable phreatophytic vegetation condition changes. It would also be appropriate for a similar monitoring program to be implemented for conservation significant wetlands and remnant vegetation off reserve, which have the potential to be impacted (see recommendation 7 and page 6-29). [1] Further reading on the reserve can be found at Burbidge, A.H., Boscacci, L.J., Alford, J .J. and Keighery, G.J. (1996) *A biological survey of Boonanarring Nature Reserve* **CALMScience** 2:153-187 which recommended the Boonanarring Nature Reserve be reclassified as class A.	interpreted using available data and informed the groundwater model (Supporting Study 4.1), the interpretations show: • the interface between the Mirrabooka and superficial aquifers is defined by the western limits of the Kardinya Shale beds; • the interface has been interpreted in the range 100 to 600 m east of the proposed Project footprints; • to the east of the interface, the water table in the Mirrabooka Aquifer is perched above beds of Kardinya Shale; • at the interface, groundwater from the Mirrabooka Aquifer spills over the western limits of the Kardinya Shale beds; and • to the west of the interface, groundwater discharge from the Mirrabooka Aquifer recharges the superficial aquifer. Under the described circumstances, the proposed pits would not intersect the Kardinya Shale or the Mirrabooka Aquifer. There would be no Project-related drawdown of the water table of the Mirrabooka Aquifer. The interpretations and predictions indicate a low-risk that the Project would influence the Mirrabooka Aquifer and its interactions with the superficial aquifer. These findings, as relevant to the Bartlett's Well and Boonanarring Nature Reserves and the Collard Wetland, are illustrated in cross sections figures included as Attachment B to this response document. Monitoring bores would enable the observation of any Project-related changes to the existing baseline. In addition, a range of management measures are proposed (refer Section 6.2.3 of the PER) to further reduce the potential risk of impacts on the nature reserves associated with groundwater drawdown on the mine site. The other potential indirect impact on the nature reserves relates to dust. A range of management measures is proposed in the PER to reduce the potential for these impacts (See PER Section 6.1.3), with further detail provided in the Outline Dust Management Plan prepared for the proposal (refer Attachment C) One of the management measures proposed is the implementation of a

7 cont.			50 m buffer between mining operations and the boundaries of the nature reserves. The proposed 50 m buffer is not intended as the primary management measure for the proposal. It is an additional management measure to provide further confidence that there will be no adverse indirect environmental impacts on the adjacent nature reserves by eliminating mining activity immediately adjacent to the reserves, and therefore, minimising potential impacts arising from mining activities taking place immediately adjacent to these reserves. The proponent has been monitoring groundwater levels and groundwater quality at 8 sites around the proposal development area on a quarterly basis since March 2012, with monitoring of 42 piezometers added to this in January 2013, and a further 6 groundwater monitoring sites added in June 2013, totalling 14 bores and 42 piezometers being monitored on a quarterly basis to date (See Figure 8-1 of Supporting Study 4.1a – Addendum to H3). It is proposed to further enhance this programme by the addition of other groundwater monitoring sites, and vegetation monitoring sites, coupled with trigger levels for implementation of specific management responses. The additional groundwater monitoring bores will be positioned along gradient and across gradient of the groundwater regime, as outlined in Figure 8-2 of Supporting Study 4.1a. The objective of this enhanced monitoring system is to add to the baseline knowledge and to enable the characterisation of change linked to the activity within the proposal development envelope. These monitoring, contingency re-infiltration systems and early warning monitoring systems, placed in the context of management principles and strategies for groundwater and surface water management will be aligned with recognised standards for environmental management (ISO 14001:2004) and will be based on SMART principles and the BACI approach. The detail of this monitoring and management will be further developed in a staged manner as part of the Water Operating Strategy being prepared for the project. The Water Operating Strategy will be assessed and approved by the Department of Water under the RIWI Act 1916.

3. Hydrological Processes

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
8	Public Submitter No. 1, No. 2, No. 5	Submitters are concerned that dewatering at the mine would diminish the bore water supply. Submitters contend that the predicted drawdown of 2 metres at the bore on the Leederville Mound located adjacent to their properties is alarming. This is a major concern, as new farming activities have already put the water supply under stress. It is expected that the proponent will exceed the anticipated lowering of the water table by a much greater degree than predicted. Submitters do not want the viability of their bores to be adversely impacted by extraction of large volumes of water as a result of the proposal. The PER states that "arrangements will be entered into to supply supplementary water to other users within the area predicted to be influenced by groundwater drawdown, if monitoring indicates that their supply is being affected by the proposal". The submitter is concerned that should the water supply be shown to be impacted, verification of the impact and negotiations for remedial actions would be required. The preference is that: • water quality and quantity monitoring equipment on existing bores and other water source points on their property be installed as soon as possible;	The predicted drawdown referred to as associated with the proposal is within the Superficial Aquifer, not the Leederville Aquifer. As such, any existing landowner bores drawing from the Leederville Aquifer would not be impacted by drawdown associated with the proposal. There are some bores that are in the direct path of mining, which will need to be replaced post mining, the arrangements for which will be included in surface access and compensation agreements being negotiated between the relevant landowners and The proponent. The only bores that are predicted to be impacted by drawdown of the Superficial Aquifer are: a bore on Blue Lake Farm (PB1), with the predicted change not considered to be significant or a likely impediment to existing supplies; and, a bore on the Drew Property (Drew 02) (Refer Supporting Study 4.1 and PER Section 6.2.2.1.2). The proponent has provided a written guarantee of replacement of water supply to one landowner with bores outside of the predicted area of potential impacts, and is prepared to provide similar landowners as required if evidence shows that unexpected impacts to their existing water supplies are experienced due to mining. The proponent already has an extensive groundwater monitoring system in place, and plans to augment this system with additional monitoring bores or piezometers located in specific areas to add further information (this would include, for example, additional monitoring points as shown in Figure 8-2 of Supporting Study 4.1a). Some additional monitoring points may or may not coincide with the submitters' bores as monitoring locations will be chosen based on technical data and will be designed to facilitate implementation of management measures necessary to minimising potential impacts. The monitoring information gathered will assist in differentiating between impacts observed as a consequence of mining activities and impacts observed due to other factors such as existing other users of this aquifer. All information generated from monitoring will be provided to the Department of Water, to individual landowners included in the monitoring programme, and to other regulators as relevant to demonstrate compliance with conditions of approval.

8 cont.		• all information generated from monitoring should be provided; • additional deeper bores that penetrate into the Leederville or Yarragadee aquifer should be installed on their property in anticipation of a reduction in water quality or quantity.	There is no predicted reduction in water quality or quantity as a result of mining, other than a temporary reduction in quantity for bores PB1 and Drew 02, which are within the Superficial Aquifer. As such, installation of additional bores into the Leederville and Yarragadee Aquifer on behalf of landowners is not proposed. It should also be noted that any such bores could not be installed or operated without appropriate licences being sought from and granted by the Department of Water.
9	Gingin Water Group Inc.	The submitter makes the following comments in relation to the proposal: • Technical review of the hydrogeological investigation indicates a professional and experienced approach to hydrogeological aspects. • First principle review of the modelling indicated an acceptable accuracy as it related to predicted inflows, zone of influence and cone of dewatering. • Hydrogeological parameters (mainly hydraulic conductivity) assigned to the different lithologies are within the known range for these formations, although lower than expected. • The conceptual hydrogeological understanding of the interaction between unconfined and confined aquifers appears to be correct and a conservative approach was reportedly used by URS in its modelling. • Regional impacts results as predicted by the numerical model appear to be accurate but the localised impacts near the mine might be less accurate. This limitation is reportedly to be addressed	As noted by the submitter, The proponent has engaged appropriate technical specialists and used third party independent technical review to facilitate a thorough and robust investigation of the existing hydrogeology and hydrology of the proposal area, and prediction of potential impacts. The submitter's comments acknowledging the validity of the technical work conducted are appreciated. ***Response re: Unknown compounding effects on the surrounding users/farms or the environment due to over-allocation of the aquifers*.** The proposed development footprint is located in an agricultural setting where the natural baseline has been altered. The proposed mining schedule has a comparatively short operational life-span and the drawdown footprint is mitigated by backfilling of each pit and replication of the pre-development landscapes. These aspects indicate that the proposed development footprint would have a temporary effect. In order to characterise this temporary footprint available data on groundwater abstraction sources and groundwater level trends was considered; data gathered covered the proposed development footprint as well as a significant radius of areas peripheral to this. A census of local water bores and groundwater use was included in the study. This delivered anecdotal information on observed changes experienced by landowners. In addition, a network of monitoring bores and piezometers has been established, both within the proposed development footprint and its periphery. Most recently installed were monitoring bores within the Collard Wetland; The monitoring points are regularly sampled, providing representative data that characterise the existing altered baseline. The characteristics of the altered baseline were integrated in the groundwater flow model, which represented reasonable worst-case perspectives, including:

9 cont.		by a higher density of monitoring holes to be constructed by the proponent. • The abstraction of groundwater is reportedly in an area where most of the reserve allocation for groundwater is already oversubscribed. This includes the Superficial, Leederville-Parmelia and Yarragadee aquifers. This would make any impact or loss of groundwater due to this project extremely high and might have unknown compounding effects on the surrounding users/farmers or the environment. • The low accuracy of the modelling results when compared to observed levels (calibration of model) do raise some concern, especially where it relates to the Superficial aquifer (45 to 82 percent correlation). The following recommendations are made by the submitter: • The mine should try not to use any of the inflow waters into the open pits from the Superficial aquifer on the mine or during processing. All of this water needs to be returned to the Superficial aquifer through artificial recharge or as direct release into the environment. This should be the fundamental approach of the mine as the sensitivity of the environment and local population mainly relates to impacts on the Superficial aquifer. • The assumption that there is no connection between the Mirrabooka- and Superficial aquifers as it relates to	• Boundary conditions that conformed to observed transient declines in groundwater levels. • Simulated rainfall recharge based on the historical low annual rainfalls recorded in the period 2008 to 2013. • Recharge rates derived from lower-bound (compared to PRAMS) percentages of measured annual rainfall; and • Simulation of known abstraction sources at full licence allocations. These parameters provided a conservatively lower-bound model water balance, enabling reasonable worst-case predictions. Through these mechanisms, there have been demonstrated intentions to understand and characterise changes linked to the proposed development footprint. Further, the objective of the existing and proposed groundwater monitoring is to provide reasonable transient snapshots of the altered baseline, with the aim that changes linked to climate, existing and future uses by landowners and or other causes can be differentiated from influences by the Project. ***Response re: Low accuracy of modeling results when compared to observed levels.*** The accuracy of the groundwater flow model is considered reasonable in context of the proposed development footprint, given the available data, and the potential risk of impact linked to the footprint. The groundwater model is based on accepted regional parameters (PRAMS) with local refinements, e.g. the simulated property zones were based on sub-regional stratigraphic domains as derived from PRAMS but with local refinements informed by preliminary interpretations of the mineral resource drilling and logs from the groundwater exploration bores. Further, the local abstraction records were semi-quantitative and as such, the current model reflects this by not prescribing actual abstraction volumes and or actual periods of pumping. By association, there is expectation that the local influences from these abstractions would only be broadly represented by the groundwater flow model.

9 cont.		potential impacts on wetlands should not be taken as fact. Some leakage/interaction between these aquifers should be assumed. • The difficulty in successful artificial recharge should not be underestimated and a loss of at least 30 to 50 percent should be assumed in the water and environmental balance for the mine as it relates to the Superficial aquifer. Over time monitoring might indicate a more accurate recharge success rate or water loss percentage. • Groundwater monitoring data should be made freely available to the public, the Gingin Water Group and/or local landowners.	Given the inputs to the model are based on regional, local and preliminary data inputs (topographical, recharge, aquifer hydraulics stratigraphic and land-use) and influences on water table elevations, the model outputs reflect the broad nature of these parameters and replication of observed water table elevations. Further refinement of the stratigraphy within proposed development footprint and additional property zones would be required to improve the model representation of observed water table elevations; This will be presented in support of the Water Operating Strategy. At the time of model development there was no available data that could inform the distribution and hydraulics of additional property zones. An enhanced geological model may enable future model refinements in this regard. ***Response re: Leakage/interaction between the Mirrabooka and Superficial aquifers as it relates to potential impacts on wetlands should be assumed.*** Interactions between the Mirrabooka and Superficial Aquifer have been interpreted based on the available data, including records from local monitoring bores within both the Mirrabooka Aquifer and adjoining Superficial Aquifer. These interpretations are incorporated within the conceptual and groundwater flow models. The predicted footprints for the Project incorporate these interactions. The interpretations show: • The interface between the Mirrabooka and superficial aquifers is defined by the western limits of the Kardinya Shale beds. • The interface has been interpreted in the range 100 to 600 m east of the proposed Project footprints. • To the east of the interface, the water table in the Mirrabooka Aquifer is perched above beds of Kardinya Shale. • At the interface, groundwater from the Mirrabooka Aquifer spills over the western limits of the Kardinya Shale beds; and • To the west of the interface, groundwater discharge from the Mirrabooka Aquifer recharges the Superficial Aquifer. Under the described circumstances, the proposed pits would not intersect the Kardinya Shale or the Mirrabooka Aquifer. There would be no Project-related

9 cont.			drawdown of the water table of the Mirrabooka Aquifer. (Refer cross section figures illustrating this point, as included in Attachment B to this response to submissions). ***Response re: Loss of at least 30-50 % should be assumed in the water and environmental balance of the mine as it relates to the superficial aquifer.*** The proponent recognises that some water losses largely through evaporation would be unavoidable. The magnitude of losses would be dependent on the strategies developed to infiltrate the Superficial Aquifer groundwater. The proponent is aligned to groundwater management strategies that would enable no significant change to environmentally sensitive receptors. It may be preferable during the implementation of these strategies that the majority of groundwater abstracted from the superficial aquifer for pit dewatering is re-infiltrated in the vicinity of the abstraction sources. The conceptualisation and design of infiltration systems that would support a project water balance that provides no significant change to environmentally sensitive receptors is at a planning stage (Refer PER Section 1.3 and Figure 1.9). For the majority of the groundwater abstracted for pit dewatering, The proponent will minimise water balance deficits to the greatest extent practicable; it may be pragmatic to preferentially return it almost immediately to the mined voids that are being backfilled. At this planning stage, all infiltration designs and concepts are being considered which aim to provide the best opportunities to efficiently infiltrate the groundwater in settings compatible to the abstractions sources and close to pre-mining water table settings. The proponent will be guided by DoW's requirements in relation to this matter and will continue to inform relevant stakeholders throughout the process. The issues raised by the submitter will be addressed in detail through the assessment by DoW of The proponent's 5C RIWI Act licence application for dewatering.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
10	Wildflower Society of WA	There is a less than full knowledge of the hydrology of the area and there is a high chance of the wetlands to the west of the proposal being adversely impacted. The mine pits and dewatering will most likely adversely impact the vegetation to the east and the Boonanarring Nature Reserve and Bartlett's Well Nature Reserve due to excavation and changed seepage and in groundwater movement.	The key potential indirect impact to the nature reserves was considered to be associated with groundwater drawdown in the Superficial and Yarragadee Aquifers required to facilitate mining, and the consequential effects this may have on the biota of the nature reserves. Detailed and rigorous H3 level investigations were undertaken to establish baseline conditions and predict potential impacts, these investigations are detailed in PER Sections 5.3.2, 6.2.2.1 and Supporting Studies 4.1 and 4.1a. These included: • collection of quarterly groundwater monitoring data from existing bores; • installation of an additional 42 peizometers at 26 sites, 4 test bores and 7 monitoring bores and conducting investigations and monitoring; • research of public domain references; • interpretation of local and sub-regional hydrogeology based on the proposal area data and supporting data derived from the public domain references; • development and calibration of model to predict potential drawdown; • sensitivity simulations to add to the transparency and rigor in the predictive modelling of the project footprint on the groundwater modelling; and • independent technical review of all of the above work. These investigations established that there is negligible risk to the reserves as result of the proposal due to the fact that they are largely situated on the Mirrabooka Aquifer, rather than the Superficial Aquifer. The Mirrabooka Aquifer is not predicted to be impacted by any drawdown of the Superficial Aquifer as a result of the proposal. (refer also to response to Item 9) In addition, a range of management measures are proposed (refer Section 6.2.3 of the PER) to further reduce the risk of potential impacts on the nature reserves associated with groundwater drawdown on the mine site. There are no predicted impacts to the wetlands to the west of the proposal, other than potential impacts to the Collard Wetland. DoW has also acknowledged in its submission that the proposal presents low risk of impact to the wetlands to the west of the proposal. Based on modeling, the Superficial Aquifer in the vicinity of Collard Wetland could be drawn down by 0.2 m commencing 2 years after mining

10 cont.			and associated dewatering has started. The H3 assessment included in the PER has assumed a 'reasonably worst case' scenario that the Collard Wetland would be affected by drawdown of the Superficial Aquifer and has modeled various mitigation scenarios involving re-infiltration, which show that the drawdown of the aquifer in the area of the Collard Wetland can be eliminated (Figure 6-17 of the PER). However, an alternative concept was presented by investigations conducted as part of Supporting Study 3.3. These investigations concluded it is most likely that the Collard Wetland is a discharge area for the Bassendean Sands directly east of the wetland and that a clay layer beneath the wetland, and underneath the Bassendean sands is sufficient to retard vertical infiltration from the Superficial Aquifer, therefore effectively separating the local Collard Wetland from the regional Superficial Aquifer (i.e. should not be affected by dewatering associated with mining). Regardless, The proponent is of the view that potential impacts to this wetland can be managed through either re-charge of the Superficial Aquifer as proposed in the PER, and/or re-charge of the localized Bassendean Sands to the east of the wetland and to the west of the mine site.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
11	Public Submitter No. 2, No. 5	Submitters are concerned with the possible drawdown on the Geomorphic Wetlands, as this is pristine natural vegetation. It is noted in the PER that "if monitoring shows that, contrary to current expectations, the Collard Wetland or other wetlands on the Beermullah Plain are being adversely affected by the groundwater drawdown associated with the proposal, a system of reinfiltrating groundwater will be implemented as a risk mitigation scheme. The initial investigations undertaken in Supporting Study 4.1 identified that infiltration of 100 kL/day water along a 1.5 km long drain would be successful in reducing the potential drawdown footprint within the Superficial Aquifer in the area of Collard Wetland to less than 0.1 m in amplitude." Rather than proceed on the basis that the groundwater drawdown may adversely affect the Collard Wetland or other wetlands on the Beermullah Plain, the EPA should assume that there will be an adverse impact and require the proponent to design and operate re-infiltration measures at the outset of mine operations.	Refer response immediately above (Item 10). The proponent would be prepared to implement the re-infiltration measures at the commencement of mining, but would need to ensure that this would not cause groundwater mounding and its associated potential impacts.
12	Public Submitter No. 3	The submitter is concerned that their groundwater sources are not included in the Hydrological Assessment H3 report other than in Table 9-2 Monitoring Programme. It is noted that the report has identified Existing Groundwater Users as being users which have allocations. Although the submitter does not have an allocation, they are dependent on the water sources for their livelihood and use 32,000 litres per day. The submitter contends that this should be included in the H3 Report. The submitter is also concerned that the Barrett-Lennard	The investigations and conclusions reported in the H3 report and its addendum (Supporting Studies 4.1 and 4.1a) were based on a regional, local and semi-quantitative data set (as outlined in previous responses – Items 9 and 10). Independent technical reviews were undertaken of the work conducted at various stages of the H3 investigation and reporting processes. These studies have not predicted impact to the submitter's water supply as a result of the proposal The H3 report is being used as the technical basis for preparing a Water Operating Strategy for the project which will detail monitoring,

12 cont.		natural spring is not included in the monitoring programme and contends that it should be included and stated in the H3 report. The proponent should install continuous data monitoring piezometers at the submitter's water sources immediately so that detailed seasonal understanding can be determined prior to commencement of mining. The natural spring on Beermullah is required for domestic and stock water, and also supports a wetland ecosystem that has recognised significance (demonstrated by grants from WWF and DEC) and is an area that has been fenced off to protect the ecosystem from damage by stock. The catchment feeding the spring is likely to be channelled via the valley as depicted by the black dotted line in figure 6-14 of the H3 report. If the proponent severs an underground stream that feeds the natural spring, supplementary water would be required immediately and must be supplied by the proponent. The submitter recommends that the proponent undertake additional research to understand the risk that mining poses to their water supply, such as field surveys using isotopes for the path from John Thurtell's valley down to their spring, to arrange for an emergency water supply, and have data analysed by a minimum of two independent hydrologists to review possible causes. Should the spring stop flowing permanently, the proponent should pay for all studies to rectify this in a timely manner. Monitoring data may require time to analyse but supplementary water will be required immediately. All monitoring data should be available to all water users that may be impacted by the mine.	management and mitigation measures. The H3 report results are also being used to inform enhancements to the existing groundwater and surface water monitoring plan. The enhanced monitoring plan will assist in differentiating between mine impacts related to the mine and impacts related to other matters such as climate change and other users. The model, presented in the H3 Report and H3 Addendum (Supporting Studies 4.1 and 4.1a), has incorporated lithological permeability based on PRAMS as well as project specific data. Additionally, data has been gathered from local landowners regarding concepts of preferred flow pathways. All available data will be incorporated into the enhanced monitoring scheme in order to manage before and after flows. All information generated from monitoring will be provided to the Department of Water to demonstrate compliance with the approved water operating strategy and 5C licence conditions of approval, to individual landowners included in the monitoring programme, and to other regulators as relevant to demonstrate compliance with conditions of approval that they may issue. Results of monitoring undertaken to date have been, and will continue to be provided to individual landowners included in the monitoring programme as they have become available. Some of these landowners have expressed concerns about results pertaining to bores and surface water sites on their properties being made publicly available. The proponent has already provided a written commitment to the submitter to replace water supplies if it is shown that mining has impacted these supplies (as attached to the submitter's letter to the EPA).

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
13	Public Submitter No. 3	Section 7 of the H3 report indicates the drawdown impacts on three environmentally sensitive areas. Further, the PER notes on page 6-24 the proposed reinfiltration of groundwater should monitoring show adverse impacts to the wetlands. This was raised at a community meeting and the proponent indicated the mitigation measures would include returning all possible water collected from dewatering to recharge to the west of the mining pit. The proponent indicated there will be mitigation across a plain and if 'underground streams' were identified in mining, then point recharge would occur. The submitter recommends that information gathered from data loggers be available in a relevant time frame and explained to those impacted by the mining operations. These mitigation measures regarding recharge should be documented in the PER and the H3 report.	The proponent will minimise any temporary water balance deficits to the greatest extent practicable, and commits to implementing groundwater re-infiltration measures if monitoring shows groundwater drawdown is propagating from the mine to the Collard Wetland to the west of these pits. Any disturbance of the ground, whether it be agricultural or mining, is unlikely to retain the original soil profile. The model, presented in the H3 Report and H3 Addendum, has incorporated lithological permeabilities based on PRAMS as well as project specific data. Additionally, data has been gathered from local landowners regarding concepts of preferred flow pathways. All available data will be incorporated into the enhanced monitoring scheme and contingency re-infiltration schemes in order to manage before and after flows All information generated from monitoring will be provided to the Department of Water to demonstrate compliance with the approved water operating strategy and 5C license conditions of approval, to individual landowners included in the monitoring programme, and to other regulators as relevant to demonstrate compliance with conditions of approval that they may issue. Results of monitoring undertaken to date have been, and will continue to be provided to individual landowners included in the monitoring programme as they have become available. Some of these landowners have expressed concerns about results pertaining to bores and surface water sites on their properties being made publicly available.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
14	Public Submitter No. 4	There is local complexity in the superficial aquifer system which occurs at a scale that cannot be reasonably understood by the investigations conducted by Image Resources. The level of reliance of wetlands on the aquifer system that is being dewatered is not well understood. Accepting that/all wetland features in the near vicinity of the minesite are probably in hydraulic connection with, and therefore sensitive to, the dewatering operations is the conservative position that should be adopted.	The proponent has fulfilled the requirements of a H3 hydrogeological assessment based on the criteria set out in Operational policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (Department of Water, November 2009). The H3 level of assessment reflects the highest level of reasonable and practical investigations intended to provide an understanding of the proposed development footprint activities and transient effects. It was recognised that the local stratigraphy hosts a number of complexities. These do not solely relate to the Superficial Aquifer. These complexities have been investigated in preparation of the H3 hydrogeological assessment, including: • sourcing data available in the public domain; • using PRAMS to provide a reasonable starting template for the local stratigraphy; • completion of a local groundwater exploration programme of seasonable scope and scale. The findings from the groundwater exploration provide information in regard to the Superficial, Mirrabooka and Leederville aquifers and water table settings in Collard Wetland; • use of preliminary interpretations of close-spaced mineral resource drilling to define the bottom elevation of the Superficial Aquifer; • development of a representative groundwater flow model that was informed by the available information; and • sensitivity assessments of the groundwater flow model enabling presentation of reasonable worst-case scenarios in respect of potential drawdown footprints on environmentally sensitive areas. The H3 assessment and groundwater flow model provide an understanding of the local wetland functions, including their reliance on the Superficial Aquifer. It is proposed to undertake further reasonable and practical tasks in seeking additional information during the pre-production and production activities. These tasks will be documented in the Water Operating Strategy and would include (but are not limited to):

14 cont.			• assessment of options to infiltrate groundwater abstracted from the superficial aquifer; • construction of additional monitoring facilities, with a particular focus on the definition of the transient drawdown footprints within the Superficial Aquifer; and • use of the geology model to support characterisation of the Yoganup Formation and to refine the interpretations of the local stratigraphy and groundwater flow paths to designated wetland and environmentally sensitive areas. The investigations undertaken to date have conservatively assumed that the Collard Wetland to the west of the proposal development envelope could be sensitive to the lowering of the Superficial Aquifer as a result of mining, and management and mitigations measures have been designed accordingly (refer PER Section.6.2.2.1.3)
15	Public Submitter No. 4	There is one east-west cross-section provided in the hydrogeological assessment for a north-south pit area that is around 10 km long. At a minimum there should have been one east-west cross-section for each of the four pit areas. The east-west cross-section provided includes bore BNPB01. URS provide two versions of the cross-section: *Figure 7.3* in the main report and *Figure 3.2* in the addendum, which show completely different conceptual geology. In summary, bore BNPB01 is variably: • implied to screen Bassendean Sand • (*Table 6.3 of H3 hydrogeological assessment; Page 1 of Appendix F)* • intersect unsaturated Bassendean Sand, Guildford Clay, Ascot Formation then Guildford Clay again (this would appear erroneous), with the potentiometric head in the upper Guildford Clay unit (*Figure 7-3 in the H3 hydrogeological assessment);* or	Both figures reflect local stratigraphic interpretations at a conceptual level. The differences that occur relate to the distribution of sand beds in the Guildford Clay. In this regard Figure 7-3 (Supporting Study 4.1 - H3 Report) illustrates a thin continuous basal sand bed together with shallow discrete and isolated sand faces. Figure 3-2 (Supporting Study 4.1a - H3 Addendum) shows a continuous sand bed that tends to combine the basal and isolated sand faces. From a practical perspective, the data informing the cross-sections are from two groundwater exploration bores that are about 600 m apart. This aspect influences the likely accuracy of the interpretations.

15 cont.		• intersect Bassendean Sand, Guildford Clay then Guildford Clay (sand beds) with the water table in the Bassendean Sand and the screen in the Guildford Clay (sand beds) unit *(Figure 3-2 in the Addendum to H3 Hydrogeological Assessment).*	
16	Public Submitter No. 4	In *Table 6-4* of the *H3 hydrogeological assessment,* URS provides the range of hydraulic conductivity for Bassendean Sand based on: • project pneumatic tests in BNP14S, BNP021D and BNP021S (1.8-3.7 m/day), • project pumping test of BNPB01 (18- 60 m/day) • the Perth Regional Aquifers Model used by the Department of Water which URS reports as 10 m/day citing the reference (PRAMS, 2008). The reference that URS is quoting states *"over the entire area of the Bassendean Sand, the horizontal hydraulic conductivities for the Bassendean Sand range between 10 and 50 m/day, with an average of 15 m/day"* (page 36, Department of Water report HG20, 2008). URS has used a value of 2.75 m/day for the Bassendean Sand (which is the average of the pneumatic test results for BNP14S, BNP021D and BNP021S) across the entire model domain and the sensitivity of the numerical model to this parameter is not discussed in *Section 7.3.2.*	The assessment of aquifer hydraulics was based on the analytical methods that provided the best fit across the board to the lithological data for the aquifer test intervals. There was also recognition that: • despite reasonable intentions, the planned aquifer tests in BNPB02 and BNPB03 could not be conducted because of low water table elevations, limited water column height in each bore and low groundwater yields; and • aquifer tests could be conducted in BNPB01 that were not originally planned, but recognising that BNPB01 was located approximately 900 m west of the strandlines forming the Yoganup Formation. The assessment also considered the lithological logs for the groundwater exploration bores and aligned these to: • the lithological logs from adjacent groundwater exploration bores and resource drilling; and • geophysical logs, gamma and resistivity. This approach was based on the understanding that the lithology logged from the air-core and mud-rotary drilling might be subjective due to mixing, sorting and dilution of the samples in the transit from the hole. There are other variables, including the differentiation of clay, sandy clay and clayey sand lithologies within small intervals.

<table>
<tr><th>Item</th><th>Submitter</th><th>OEPA Summary of submission and/or issue</th><th>Proponent's response to comment</th></tr>
<tr><td>16 cont.</td><td>Public Submitter No. 4</td><td>It is not explained why the results of the pneumatic tests were chosen as these tests sample a much smaller portion of the aquifer than pumping tests. It is a known scale of measurement effect that hydraulic conductivity from small-scale field measurements are lower than regional values.

URS completed a sensitivity analysis of the transmissivity of the superficial aquifer as part of the addendum works. In the sensitivity analysis URS used 0.2 m/day and 3.56 m/day for the hydraulic conductivity of the Bassendean Sand. Figure 3-2 refers to model layer zones, which implies that different hydraulic parameters are used in the layer zones, but there is no reference to this. In the addendum, the hydraulic conductivity of the Guildford Clay (Sand Beds) is not mentioned although on Figure 3-2 it is shown to adjoin the Yoganup Formation west of Pit C.</td><td>The table below indicates a reasonable alignment in the slug-test analyses when aligned to the described screen interval lithologies.
<table>
<tr><th>Dominant Lithology</th><th>Lateral Hydraulic Conductivity (m/day)</th><th>Range and Average (m/day)</th></tr>
<tr><td>Clay</td><td>0.3</td><td rowspan="4">Range 0.01 to 1.0
Average 0.36</td></tr>
<tr><td>Clay</td><td>0.16</td></tr>
<tr><td>Clay</td><td>0.01</td></tr>
<tr><td>Clay</td><td>1</td></tr>
<tr><td>Sandy Clay</td><td>0.3</td><td rowspan="3">Range 0.02 to 0.3
Average 0.12</td></tr>
<tr><td>Sandy Clay</td><td>0.02</td></tr>
<tr><td>Sandy Clay</td><td>0.03</td></tr>
<tr><td>Clayey Sand</td><td>1.4</td><td rowspan="5">Range 0.4 to 4.7
Average 1.85</td></tr>
<tr><td>Clayey Sand</td><td>4.7</td></tr>
<tr><td>Clayey Sand – Sandy Clay</td><td>2.3</td></tr>
<tr><td>Clayey Sand</td><td>0.4</td></tr>
<tr><td>Clayey Sand</td><td>0.45</td></tr>
<tr><td>Sand - Clayey Sand</td><td>1.9</td><td rowspan="3">Range 1.8 to 2.0
Average 1.9</td></tr>
<tr><td>Sand - Clayey Sand</td><td>2</td></tr>
<tr><td>Sand - Clayey Sand</td><td>1.8</td></tr>
<tr><td>Sand</td><td>1</td><td rowspan="4">Range 1.0 to 3.7
Average 2.2</td></tr>
<tr><td>Sand</td><td>1</td></tr>
<tr><td>Sand</td><td>3.7</td></tr>
<tr><td>Sand</td><td>3</td></tr>
<tr><td>Coarse Sand and Gravel</td><td>18</td><td rowspan="2">Range 18 to 56
Average 37</td></tr>
<tr><td>Coarse Sand and Gravel</td><td>56</td></tr>
<tr><td>Sandstone</td><td>6.5 – 6.7</td><td>Range 3.8 to 6.7
Average 5.4</td></tr>
</table>
</td></tr>
</table>

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
17	Public Submitter No. 4	The aquifer testing procedures used to determine hydraulic conductivity of the superficial aquifer did not meet relevant Australian Standard and were well below normal industry practice. <u>PUMPING TEST</u> Appendix C of H3 Hydrogeological Assessment. Results in the H3 hydrogeological assessment clearly indicate that there was no attempt to measure the flow rate for the three-day, "constant" rate pumping test of BNPB01. This is in direct contravention of the Australia Standard for Pumping Tests in Waterwells (AS2168-1990). The purpose of the pumping test is to maintain a constant flow rate and measure the rate of groundwater level decline. The flow rate used in the analysis was 4 L/s based on visual observation of the rate of water discharging from the bore. There is a discussion of decreasing flow rate and of a drop in flow rate after 44 hours when the discharge was directed to a tank (where was the discharge going prior?). It is never acceptable to estimate a flow rate for a pumping test. However this methodology was defended in a public meeting held on 21 January 2014 in Gingin. In addition to the poor quality of the pumping test, it is clear that the pumping test had little potential to stress the aquifer in order to assess its hydraulic properties. The small drawdown developed in the test that was completed should have led to a decision to abandon the test and to install a larger capacity pump with metered headworks so that the pumping test could be repeated at a greater pumping rate to induce more drawdown to evaluate the hydraulic properties of a larger portion of the aquifer	Production bore BNPB01 is located approximately 900 m west of proposed Pit C in a stratigraphic setting not representative of the pits setting. Its original purpose was in providing water supply during the groundwater exploration drilling programme. Initially, there was no intention to conduct aquifer tests in BNPB01. Subsequently, the circumstances encountered in BNPB02 and BNPB03 that prevented the conduct of aquifer tests, resulted in attempts to gain broadly indicative data on the superficial aquifer downstream of the pits. In this regard it was decided to use the equipment already installed in BNPB01 to conduct an aquifer test. It was recognised that the aquifer tests in BNPB01 did not conform to standard procedures; it was identified that pumping rates were not measured but only visually estimated and there were difficulties in maintaining constant pumping rate. Nevertheless, the pumping of BNPB01 provided indications of comparatively high yield and transmissivity from sand beds in the superficial aquifer, which was the intention of the test. The construction of the monitoring bores (piezometers) was dictated by the use of a mineral exploration drilling rig. The monitoring bores were constructed at the maximum diameter allowable by this rig and the purpose of these piezometers was to gather data on water table levels as well as grain size analyses and hydraulic conductivity. It was indicated that the tests for hydraulic conductivity were low rigor, but also in the context that any slug tests would provide indicative data given the point source and limited screen commonly associated with these tests. Overall, the hydraulic conductivity values were reasonably consistent when aligned with the dominant screen interval lithology and were also considered reasonable when compared to information in the available literature and experience (for example at the Gingin Mine and other mineral sands projects within the Perth Basin).

17 cont.		system. PNEUMATIC TESTS Image Resources indicate that the pneumatic tests were accepted as low rigour tests, but were completed as the small diameter (25 mm) monitoring bores could not be tested with any other method. The investigation bores were clearly not designed to provide reliable data to inform the regional numerical model. It is industry standard practice to install at minimum 50 mm diameter monitoring bores to enable more rigorous tests to be conducted, or larger bores if a higher level of rigour is required. As an aside, geophysical logging of the superficial aquifer bores would have been highly beneficial given the complexity of the system.	
18	Public Submitter No. 4	No pumping test conducted in the Yoganup Formation. There is a private user bore Drew02 equipped with a solar pump which is located in the middle of Pit C which has piezometers BN011D (210 m distant) and BNP012D (Yoganup at 520 m distant) nearby. By installing a flowmeter on Drew02 as well as loggers in all three bores and analysing the pumping cycles in the hydrographs for each bore over period of time would provide the basis for a more robust estimate of hydraulic conductivity for the Yoganup Formation. It might be difficult to find a logger to fit a 25 mm diameter piezometer.	The proponent's groundwater investigations have made reasonable attempts to characterise the hydraulics of the Yoganup Formation. Two test production bores (BNPB02 and BNPB03) were drilled and constructed with intentions to conduct pumping tests. Locations and design depths of BNPB02 and BNPB03 were informed by preliminary mineral resource drilling data, with preference to identify confining beds of but not to penetrate the underlying Leederville Aquifer. Both production bores were constructed in January 2013. Airlifting after construction was difficult; these difficulties were linked to limited submergence and low yield. At the time of completion, standing water levels were recorded as 'dry' and less than 1 m for BNPB02 and BNPB03, respectively. These aspects were described in Appendix C of the H3 report (Supporting Study 4.1). It was concluded at the time that neither BNPB02 nor BNPB03 could be successfully used to conduct test pumping.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
19	Public Submitter No. 4	The artificial augmentation system that is proposed for Collard's wetland has been implemented by URS or predecessors (and indeed the same technical personnel that are advising Image Resources) at Tutunup mine near Busselton. An operational failure led to loss of vegetation within a threatened ecological community due to the inability of the mining company to manage the rate and magnitude of its drawdown impacts. This precedent should be clearly recognised and discussed so that the level of certainty associated with the artificial augmentation systems is understood by the community and the regulator. Assuming that the artificial augmentation system is workable, it will be important to match the monitoring programme and initial response triggers to the time required to design, procure, permit, install and commission the augmentation system. Does the artificial augmentation system need to be constructed and installed prior to mining to preclude the risk of drawdown impacts affecting the wetland?	The proponent proposes to implement a hierarchy of measures in relation to management of potential impacts of groundwater drawdown associated with the proposal. The first of these measures is to minimise the water balance deficits in the mine pits to the greatest extent practicable. The Collard Wetland artificial recharge concepts presented in the H3 Hydrogeological assessment are viewed as reasonable. It is recognised, however, they require additional work (including site investigations) to ensure final designs would be effective and robust. Any artificial recharge schemes will have unique characteristics that are suited to the setting in which they function. These unique characteristics may include (but are not limited to): • local objectives, including allowable range of water table fluctuations; • trigger values; • physical aspects of the wetlands and surrounds; • access and proximity constraints; • depths to the water table; • hydraulic and storage characteristics of the local aquifer; • contingency measures; and • stakeholder inputs. Artificial recharge designs that incorporate focused infiltration in settings of highest risk and/or in perimeter areas of the wetlands are recognised to provide the most effective risk mitigation to changes related to drawdown. All monitoring and reporting timeframes as well as proposed recharge mitigation schemes will be included in the Water Operating Strategy, which will require approval by the Department of Water prior to any water abstraction licence being granted.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
20	Public Submitter No. 4	The submitter recommends that Image Resources commit to installing dataloggers for baseline monitoring of groundwater levels and that these dataloggers should be installed immediately. At the public meeting, Image Resources appeared unwilling to commit to baseline monitoring and sampling until a project funding partner was identified and a commitment to commence the mine was made. It is possible that if this approach is maintained, the mine will start with insufficient baseline data available from which to make fair determinations of changes in groundwater levels or quality. In the addendum to the H3 hydrogeological assessment, URS propose four trigger value sites for the superficial aquifer and recommend that they are equipped with automated devices for the daily measurement of water table elevations *(page 25)*. URS propose a trigger value of change in the range of 0.1 to 0.3 m from the baseline water table fluctuations.	It is planned to install dataloggers at various monitoring sites as identified as necessary to add to existing knowledge (for example, refer to response to Item 31). Contrary to the submitter's assertion, baseline monitoring and sampling has been undertaken for the proposal. This monitoring and sampling has been undertaken on a quarterly basis of 8 bores since May 2012, with the addition of monitoring of 42 piezometers in January 2013, and the further addition of another 6 groundwater sites in June 2013 (refer PER Section 5.3.2 and Figure 5.5). Reports of the results of the quarterly sampling have been made available to landowners as they have become available. The most recent monitoring was undertaken in January, 2014 and will continue on a quarterly basis through to the project development and operating phases. The original monitoring network has been expanded over time to add monitoring sites at the request of other landowners in the region of the project, and will continue to be expanded to further enhance the existing baseline information. This may include the installation of further dataloggers within existing or new monitoring sites.
21	Public Submitter No. 5	The mining trench is indicated to go through the submitter's operating bore and will damage existing irrigation on their farm.	The proponent has been negotiating a surface access agreement with this landowner. The details of replacement of water sources and the affected bore will be addressed through this agreement.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
22	DPaW	The proposal may have an impact on wetlands and vegetation from changes to local hydrology (regime and connectivity, particularly down gradient of the groundwater flow to the west of the proposal). Changes to local hydrology if these occur, are most likely to be the cause of impacts of the proposal on conservation assets, namely conservation significant wetlands. The PER predicts a drawdown of the superficial aquifer between 0.2 and 1.0 metre based on hydrological modelling. Studies on hydrogeological conditions and processes should be independently peer-reviewed by a suitably qualified professional to validate the predicted drawdown impacts and subsequent impact of the native vegetation and wetlands within the zone of influence of the proposed mine.	The studies on hydrogeological conditions and processes and represented in PER Supporting Studies 4.1 and 4.1a, and which form the technical basis for the relevant discussions and impact predictions in the PER were independently peer reviewed by Kevin Haselgrove (HydroSearch Pty Ltd). The reviews were undertaken progressively during the investigation and reporting phases of the H3 investigations, as per the current Australian groundwater modelling guidelines (SKM, NCGRT, 2012). The studies do not predict any impact on conservation significant wetlands, other than potentially Collard Wetland. Based on modeling, the superficial aquifer in the vicinity of Collard Wetland could be drawn down by 0.2 m commencing 2 years after mining and associated dewatering has started (Refer cross section figure for Pit C in Attachment B to this response to submissions). The H3 assessment included in the PER has assumed a 'reasonable worst case' scenario that the Collard Wetland would be affected by drawdown of the Superficial Aquifer and has modeled various mitigation scenarios involving re-infiltration, which show that the drawdown of the aquifer in the area of the Collard Wetland can be mitigated (Figure 6-17 of the PER). However, an alternative scenario was presented by investigations conducted as part of Supporting Study 3.3. These concluded that it is most likely that the Collard Wetland is a discharge area for the Bassendean Sands directly east of the wetland and that a clay layer beneath the wetland, and underneath the Bassendean Sands is sufficient to retard vertical infiltration from the Superficial Aquifer (i.e. should not be affected by dewatering associated with mining). Regardless, The proponent is of the view that potential impacts to this wetland can be managed through either re-charge of the Superficial Aquifer as proposed in the PER, and/or re-charge of the local Bassendean Sands to the east of the wetland and to the west of the mine site. It is predicted, based on existing groundwater levels and potential drawdown of these levels, that approximately 14 ha of vegetation to the immediate west of the proposal development envelope may be affected if no management is implemented. The proponent is of the view that groundwater re-infiltration within these vegetation areas would be

22 cont.			sufficient to ameliorate significant impacts in relation to the proposal if proposed vegetation and groundwater monitoring down gradient of the mine indicates that it is required. The proposal may provide the opportunity to mitigate the high rates of Banksia species deaths already observed in this block of vegetation, particularly in its north-eastern part.
23	DPaW	A mining access road is proposed to traverse a seasonal drainage line associated with the ephemeral spring located within Bartlett's Well Nature Reserve. Any impedance of surface water flow associated with this ephemeral creek may have a detrimental impact on the upslope spring located in the nature reserve. It is recommended that the track which traverses this drainage line is engineered to minimise the potential impact on the existing drainage regime. Also, during the operations, runoff is proposed to be diverted temporarily around the mine pit and infrastructure, with the assumption that this would have no material change to down gradient surface hydrology. Insufficient information was provided to determine if the surface water drainage or dewatering re-infiltration scheme associated with the mine will detrimentally impact on the Bartlett's Well Nature Reserve. Therefore, the proponent should ensure that no drainage water is discharged into nature reserves and that the surface water drainage associated with the nature reserves is not altered by the implementation of the proposal. The proposal should be designed and managed so that it does not alter the surface water drainage associated with the nature reserves.	The track that crosses the drainage line associated with the Bartlett's Well Nature Reserve, and indeed any infrastructure constructed for the proposal within the proposal development envelope that could alter surface drainage, will be designed so that it will minimise the potential impact to the existing drainage regime. A preliminary surface water drainage design was included in Appendix B of Supporting Study 4.2 showing how the surface water drainage upstream or downstream of the mine will be maintained. No drainage water will be discharged into the nature reserves. It should be noted that the nature reserves are 'upstream' of the mine site and therefore not at any risk of accidental discharge.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
24	DPaW	The information presented on wetlands in the PER does not provide adequate detail on the risks to wetland values in the potential impact zone for DPaW to be able to provide advice on the potential impacts. The significant wetlands downstream of the hydrological flow to the west of the proposal are at most risk of significant impact from changes to the hydrological regime of the area from implementation of the proposal. For example, the 360 Environmental *Wetland Hydrological and Ecological Values* (October 2013) report (PER Appendix 3 Supporting Studies 3.1) provides a summary and interpretation of existing wetland information, but does not include new survey information on wetland extent, class, hydrological connectivity or values. Further information should be provided on wetlands potentially impacted by groundwater changes due to mining operations to facilitate evaluation of the nature and significance of impacts.	The risk to wetland values is associated with temporary groundwater drawdown within the Superficial Aquifer associated with the proposal. These risks were investigated by Supporting Study 4.1 and 4.1 which predicted no impacts to the wetlands to the west of the proposal development envelope, other than potentially Collard Wetland. This prediction is discussed in PER Section 6.2.2.1.3 and the associated Supporting Study 3.2 (360 Environmental). This supporting study was prepared by 360 Environmental subsequent to Supporting Study 3.1 (360 Environmental), and takes into account predicted groundwater drawdown levels identified in Supporting Study 4.1. Given that the wetlands identified to the west of the proposal development envelope, other than Collard Wetland, are well outside the predicted zone of impact, no new field surveys of these wetlands were considered necessary for this proposal. The values of the Collard Wetland and its associated vegetation were further assessed by site investigations and are as reported in Supporting Study 3.3 (Endemic Pty Ltd), and summarised in PER Section 5.3.3. Potential impacts to the Collard Wetland are addressed in PER Section 6.2.2.1.3. Refer also to responses to items 9 and 10.
25	DPaW	It is proposed that *"re-infiltration of groundwater if required, to minimise potential impacts on areas within the influence of potential groundwater drawdown*" may occur, but the triggers to implement a re-infiltration scheme are not identified in the PER (see page 6-30). As there are uncertainties surrounding the potential impacts of groundwater extraction from the superficial aquifer on the surrounding nature reserves, native vegetation remnants and wetlands, monitoring programs should be linked to trigger levels for the re-infiltration of groundwater. Trigger levels for re-infiltration should be established.	Trigger levels will be established through the Water Operating Strategy being developed for the proposal, as part of the 5C licence application, and will form part of a management regime which will be adapted in response to observed monitoring results.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
26	DPaW	Survey information used in the PER to identify wetland dependant and groundwater dependent vegetation is limited in its scope, and as a result limited in the way it can be used to identify vegetation at risk from impact by changes to hydrology from the implementation of the proposal. The Level 2 Flora and Vegetation survey had the stated purpose to map vegetation in the two nature reserves and assess which areas of vegetation were sensitive to changes in groundwater levels. However, without detailed descriptions of the methodology (e.g. the report does not explain when the survey was conducted) it is not possible to determine how reliable the results are or form conclusions on the predicted impacts of the proposal on wetlands and groundwater dependent vegetation. The Level 2 Flora and Vegetation survey also only included two wetland sites, both east of the proposal area, containing small wetlands mapped within the *Geomorphic Wetlands Swan Coastal Plain* dataset. Why the important wetlands west of the proposal area were not included in the survey is unclear, but may be related to the level of perceived risk that these wetlands will be affected.	Detailed descriptions of the methodology of the Level 2 Flora and Vegetation Survey are included in Supporting Study 1.1. The proponent maintains that the results of these surveys, conducted in accordance with EPA Guidance Statement 51 are reliable, and can be used together with the results of the independently technically reviewed hydrogeological studies (Supporting Studies 4.1 and 4.1a), to predict potential impacts on groundwater dependent vegetation in the vicinity of, or within, the proposal development envelope. Level 2 Flora and Vegetation Surveys of the wetlands to the west of the proposal area were not conducted because the results of hydrogeological studies undertaken for the proposal show that there will be no impact on these as a result of implementation of the proposal, other than potentially the Collard Wetland. The vegetation of this wetland was surveyed and is as reported in Supporting Study 3.3. Re-infiltration measures have been investigated and modelled which show that the impact on this latter wetland can be eliminated (refer Supporting Study 4.1a and PER Figure 6.17).

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
27	Department of Water (DoW)	The DoW will need to over-allocate resources of the Superficial and Yarragadee aquifers to provide water licences should the proposal be approved. Strong management mechanisms would be required, including ensuring no measurable drawdown at Environmental Protection Policy (EPP) lakes attributable to mining as modelled in the PER.	The proponent, though its extensive consultation with DoW for this proposal, is aware of the need for DoW to over-allocate the resources of the Superficial and Yarragadee Aquifers to provide water licences for the proposal under the RIWI Act. The proponent believes that the work undertaken through the H3 assessment, as reported in Supporting Studies 4.1 and 4.1a has provided a strong body of evidence to support the predictions of: - negligible (if any) risk to EPP wetlands west of the mine; - low risk to the Collard Wetland; - low risk to the two patches of remnant Banksia woodland to the west of the mine.
28	DoW	Modelled drawdown from Superficial aquifer dewatering poses low risk of impact on three key groups of assets: • EPP wetlands west of the mine; • The Collard Wetland (a Conservation Category Wetland); and • Two patches of remnant Banksia woodland west of mine, one of which encompasses a Priority Ecological Community buffer.	Agreed. Refer response to Item 27 above.
29	DoW	The PER describes the proposal as water resource neutral for the Superficial aquifer, upon which the wetlands rely, due to import of Yarragadee water in sand tailings. This may be true for the proposal as a whole but not for Pits C and D which are adjacent to the most sensitive groundwater dependent ecosystems. The water balance deficits for Pits C and D would need to be minimised.	The proponent will minimise water balance deficits in Pits C and D to the greatest extent practicable, and commits to implementing groundwater re-infiltration measures if monitoring shows groundwater drawdown is propagating from the mine to the Collard Wetland to the west of these pits. These measures will be outlined in further detailed in the Water Operating Strategy submitted to the DoW for assessment and approval.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
30	DoW	Volumes dewatered are likely to be much higher over an 8 year mine life, hence DoW approval would be limited to a period of 5 years, with consideration to extend approval beyond this timeframe subject to compliance with monitoring and reporting conditions, and demonstration that potential impacts have been appropriately and effectively managed. The length of mining (and therefore total volume dewatered) should be limited to 5 years, with extension of approval beyond the initial 5 years being subject to the proponent meeting approval conditions.	The proponent is of the view that the environmental risks associated with the proposal are low, and therefore the proposed limitation of time is not warranted. Enhanced monitoring, additional data collection, and increased resolution of modelling over time as well as compliance reporting on at least an annual basis will be sufficient to demonstrate ongoing compliance with approval conditions and effective management of potential environmental risks.

31	DoW	PER information on Collard Wetland hydrology is not yet sufficient to discount drawdown impacts or design a reliable artificial recharge system. Further work will need to be done in this regard, such as deeper monitoring bores to establish the relationship between the Collard wetland and the superficial aquifer. This work will inform water management arrangements, including the suitability of artificial recharge. The proponent would need to ensure that there is no significant effect on the Collard wetland, defined as no vegetation deaths caused by drawdown. Baseline water levels for bores relevant to the Collard wetland and the EPP lakes should be monitored for a minimum of one year prior to dewatering, which may require commencing mining in Pit A or B rather than Pit C. Annual end of summer rapid assessment vegetation health monitoring (e.g. canopy/foliage health, photographs, analysed in conjunction with groundwater data) at the Collard wetland and in Banksia woodland areas within the predicted drawdown zone would be required. If observed impacts correlate with groundwater decline, investigations should be undertaken to determine whether dewatering is the cause.	The results of the predictive modeling reported in Supporting Study 4.1 – H3 Report show that the Superficial Aquifer is not predicted to be drawn down in relation to any EPP lake, and that in the vicinity of Collard Wetland it is predicted to be drawn down by 0.2 m commencing 2 years after mining and associated dewatering has started (Refer cross section figure for Pit C in Attachment B to this response to submissions). Investigations conducted as part of Supporting Study 3.3 have concluded that it is most likely that the Collard Wetland is a discharge area for the Bassendean Sands directly east of the wetland and that a clay layer beneath the wetland, and underneath the Bassendean Sands is sufficient to retard vertical infiltration from the Superficial Aquifer. That is, the Collard Wetland should not be affected by dewatering of the Superficial Aquifer associated with mining, or will only be affected in a limited manner if there is some degree of 'leakage' between the wetland and the Superficial Aquifer. The H3 Report,, has assumed a 'reasonable worst case' scenario that the Collard Wetland would be affected by drawdown of the Superficial Aquifer and has modeled various mitigation scenarios involving re-infiltration, which show that the drawdown of the aquifer in the area of the Collard Wetland can be mitigated (Figure 6-17 of the PER). As such, the proponent is confident that there is already sufficient knowledge to provide assurance that any potential impacts on the Collard Wetland can be managed so that the environmental values of this wetland are not compromised by the proposal. It should also be noted that the proponent has deliberately chosen to commence mining at Pit C rather than Pit A or B, in keeping with discussions with the OEPA, so that it can maximize the amount of time available to gather data and confirm predictive modeling in relation to the two nature reserves, which are considered to be the highest value environmental assets in the vicinity of the proposal. The proponent is of the view that it would be most effective to continue its multi-staged approach to building on current knowledge and refining proposed groundwater management through the preparation of a Water Operating Strategy to be submitted to and assessed by DoW under the Section 5C RIWI Act licensing process. The initial Water Operating

31 cont.			Strategy is being prepared based on existing data. This initial Water Operating Strategy identifies additional data to be gathered and includes a defined timeline within which The proponent will implement measures to gather this data. This includes (but is not limited to) measures such as: 1. Installation of a total of 6 data loggers within three existing piezometers in Collard Wetland and three existing piezometers to the east of the wetland (see figure 3 of SS 3.3 for locations). This facilitates the gathering of baseline information on the natural fluctuations and water balance of the wetland. These measurements, together with the installation of nested piezometers (refer item 3 below), will inform the re-charge strategy, particularly if a two-pronged approach of re-charging the Bassendean Sands as well as recharging the Superficial Aquifer is required to mimic the wetland's current recharge mechanism. Dataloggers will also be installed at 7 other sites (as recommended in Supporting Study 4.1a) to obtain further data to utilize in designing monitoring and management measures. 2. Installation of 3 sets of nested piezometers to the immediate east of the wetland to establish whether there is a relationship between Collard Wetland and the Superficial Aquifer. This would be done immediately pre-commencement of mining on site. 3. Conduct of field trials of the re-infiltration mitigation scheme proposed in the H3 report/PER at the commencement of mining if the nested piezometers establish a connection between the Collard Wetland and the Superficial Aquifer. The results of these field trials would be used to refine the modeled design of the re-infiltration scheme. 4. Installation of additional monitoring bores between the mine pits and the wetland at the commencement of mining. The monitoring of these bores would provide early warning indicators of changes in water table levels, which would trigger implementation of management and mitigation measures in a timely manner to prevent or minimise downstream impacts. 5. Implementation of vegetation health monitoring at the commencement

31 cont.			of mining, with results to be linked to ground water monitoring observations and proposal activities as relevant. 6. An update and calibration of the existing water balance and groundwater model using the enhanced data collection and refined geological model outputs. The initial Water Operating Strategy will be updated in accordance with the data gathered by the above measures, and re-submitted to DoW within a defined timeframe after submission and approval of the initial Water Operating Strategy. This updated Water Operating Strategy will provide further detail on the management strategy and mitigation plans (including trigger values), contingency plans based on the additional data gathered. This process of building on existing data and maximizing the effectiveness of on-site management by those who will be directly involved in the management is in keeping with The proponent's philosophy of continuous, scientifically rigorous, practicable and effective investigation and management of the project. The proponent agrees with the DoW's expressed view that the project presents low risk to the Collard Wetland and remnant vegetation, and therefore, is of the view that the proposed multi-staged approach to investigation and management design is environmentally responsible.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
32	DoW	The proponent would need to ensure that there is no significant effect on the Banksia woodland remnants west of the mine, defined as no vegetation deaths caused by drawdown. Draining land resulting in vegetation death may trigger native vegetation clearing provisions under Part V of the *Environmental Protection Act 1986*.	The proponent commits to implementing any management measures required to ensure that there is no significant effect on the Banksia woodland remnants west of the mine. It is predicted, based on existing groundwater levels and potential drawdown of these levels, that approximately 14 ha of this vegetation may be affected if no management is implemented. The proponent is of the view that groundwater re-infiltration within these vegetation areas would be sufficient to ameliorate significant impacts in relation to the proposal if proposed vegetation and groundwater monitoring down gradient of the mine indicates that it is required. The proposal may provide the opportunity to mitigate the high rates of Banksia species deaths already observed in this block of vegetation, particularly in its north-eastern part.

4. Inland Waters Environmental Quality

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
33	Department of Mines and Petroleum (DMP), Department of Environment Regulation (DER)	The DER has previously reviewed the draft PER and has had additional discussions with the proponent about how acid sulphate soils will be managed during mining. During these discussions, the proponent made a commitment to undertake detailed acid sulphate soil investigations and to develop plans for managing these materials before each mining operation commenced. Given the relatively low rate of pumping required to dewater mine pits in the area, the DER is satisfied that acid sulphate soil disturbance will be manageable and with information provided, that water table drawdown is unlikely to cause adverse impacts on wetlands in the vicinity of the proposed mining corridor. The DER recommends that the proponent make a formal commitment to undertake detailed acid sulphate soil investigations and to develop plans for managing these materials before each mining operation commences. The DMP would like the opportunity to comment on these management plans.	A commitment to undertake detailed investigations of ASS has been provided in the PER (Sections 5.3.4 and 6.2.3), and in more detail in Supporting Study 5.1. The proponent re-affirms this commitment. An outline of the ASS management plan will also be provided in the Mining Proposal to be submitted to the DMP for assessment and approval.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
34	Public Submitter No. 2 and No. 3	The submitter contends that the development of acid sulphate soils often occurs in the long term and that this may occur well after the proposed mine has been constructed, operated and closed down. This was raised at the community meeting and the proponent indicated that in the event that acid sulphate soils was identified, the acid sulphate sand would be mixed with lime to mitigate any impacts and the mixture returned to backfill. This mitigation measure must be documented and validated by the EPA. If this measure is not recognised or financially viable, alternative mitigation measures are required. The EPA should require the proponent to detail what they will do to address this issue in the long term, well after mine closure. A long term monitoring plan for acid sulphate soils should be in place, so that if acid sulphate soils occurs decades on, these impacts can be mitigated as soon as possible and not as the expensive of the land holder.	As outlined in PER Section 5.3.4 and 6.2.3 and in Supporting Study 5.1, the proponent will undertake progressive and detailed investigations into potential acid sulphate soils on site, and will develop tailored and specific management measures to address these issues. This issue will also be addressed in the Mine Closure Plan required to be prepared and approved under the *Mining Act 1978.* Sampling for acid sulphate soils (ASS) will be carried out in conjunction with grade control drilling at a minimum of six months ahead of any disturbance. It is intended that the pre-mining assessment programme be conducted to delineate the lateral and vertical extent of any ASS horizons and associated volumes of ASS so that appropriate management can be implemented. The samples will undergo a field based assessment and a laboratory analysis. The analytical results will be then be used to develop a spatial model of ASS in the project area, detailing the location and volumes of ASS present, and the amount of neutralising material required to counteract any potential or existing acidity. Any actual or potential or potential ASS identified during the pre-disturbance investigations will be stockpiled separately to other non-ASS overburden during mining so that appropriate neutralising measures can be applied. Agricultural lime will be applied and sufficiently mixed with the ASS material to ensure neutralisation of any actual or potential acidity, prior to backfill replacement to the mining void. The lime will be applied at a rate of 1.5 times the amount identified as required for neutralisation by the acid-base accounting laboratory analyses (i.e. a 1.5 safety factor). The lime treated materials will be regularly monitored to ensure that the net acidity of the treated soils and any associated risks to the surrounding environment. The Boonanarring site ASS model, detailing the continuously updated locations and volumes of ASS, along with monitoring information from stockpiled and treated soils, and other relevant groundwater data will be regularly reported via site environmental reporting requirements.
35	Wildflower Society of WA	The management of acid sulphate soils is inadequate.	The proponent believes that the proposed management of acid sulphate soils is adequate. Refer to response Item 34 above.

5. Air Quality

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
36	DER	In the Baseline Air Quality Assessment report, the measurements and their interpretation are considered correct, but of insufficient extent for reliable estimation of baseline dust concentrations over monthly or seasonal time scales. For example, the duration of three months for the entire measurement period and even less for data at individual sites is considered insufficient to capture seasonal effects. It is also significantly less than the one-year duration suggested in the Dust Management Guidelines. (http://www.dec.wa.gov.au/pollution-prevention/air-quality/publications.html?showall=&start=3) The limitations imposed by a measurement program of limited duration are illustrated by the statement on page 15, that the month of March "exhibited three times the average monthly rainfall for the Gingin area." Although this supports the idea that dust control by watering is possible, the lower-than-average dust concentration resulting from higher-than-average rainfall is of very limited value in establishing baseline dust concentrations for this month. Since crucial details of the estimated dust production from the various phases of the operation are either absent from or not readily identifiable in the report, it is essentially impossible to determine whether the emissions estimates tabulated on pages 16 and 17 are reasonable. Reference is, however, made to the 'NPI Workbooks,' of which that entitled, "Emission Estimation Technique Manual for Mineral Sands Mining and Processing, Version 1.0" appears to be the most relevant. This in turn refers to the "NPI EET Manual for	The summer months were selected for baseline monitoring as they are the most likely to generate significant quantities of dust and therefore provide the most conservative of baselines. The rainfall observed in March proves the point that the dust levels of late autumn, winter and spring months will be much lower than those found in February. The proposed ongoing monitoring programme will allow for assessment of dust entering and leaving the site and, if necessary, further baseline monitoring can be undertaken in the months leading up to development. The specifics of the NPI estimation are only of relevance if modelling was to be undertaken and as indicated in the report these estimations were only intended to give relative indications of the most significant dust sources. It is agreed that more detailed assessment of mining activity and dust arising would be necessary if the model were to be relied upon. However, the intent of what was done in the assessment of dust issues associated with the proposal was to provide indicative relativities so that major dust generating activities could be identified and management actions put in place. An Outline Dust Management Plan has been prepared (Refer Attachment C) to provide further information on intended dust management. This plan will be further developed during, and will be regulated by, the Part V EP Act assessment process and the Mining Proposal approval process under the *Mining Act 1978*.

36 cont.		Mining," the current version of which is 3.1 (dated January 2012). On page 12 of the "Mining" document, a general formula is given for the estimation of the emission rate as a function of the activity rate (t/h), operating hours (h/y), uncontrolled emission factor of pollutant (kg/t0, and control efficiency (percent). It is not clear whether the estimates in the report are based on this general formula, or the formulae in Table 2 on page 15 that correspond to those operations in common with coal mining. For example, the item "Scrapers/excavators/front-end loaders (on overburden)," for which the highest yearly emission estimate of 220950 kg Total Suspended Particles (TSP) is given. It is unclear how this was arrived at. It could have been calculated by application of the formula entitles "Bulldozer on material other than coal," or "Excavators/shovels/front-end loaders (on overburden)," in reference to Appendix A section 1.1.2. Following the latter alternative, the formula given in the Appendix describes dust evolution from loading trucks, which is not considered relevant in this situation. Following the former alternative, the formula in Table 2 for TSP production requires knowledge of the moisture content (M) and mean vehicle speed (S), neither of which is specified. The DER recommends that the tabulated emissions estimates should be accompanied by full documentation of the equations used and values of all required inputs.	

6. Amenity

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
Noise			
37	Public Submitter No. 1, No. 2, No. 3	Submitters are concerned that the Noise Impact Assessment indicates that the Environmental Protection (Noise) Regulations are exceeded at their property. One submitter contends that their property is west of the proposed mine and given the significant summer easterly, will be heavily impacted by noise and light. It is noted in the PER that management and mitigation of noise includes "engagement with residents to increase noise attenuation in houses that modelling has shown the proposal to potentially impact, or enter into lease, temporary relocation, or purchase requirements." One of the submitters located near the proposal stated that they are not interested in being subject to any or all of the motivation measures aforementioned. The submitter contends that noise levels will definitely exceed the assigned levels prescribed by the Environmental Protection (Noise) Regulations at all times and under all weather conditions. Submitters contend that the EPA should require the proponent to identify and apply more substantive noise and light management and mitigation measures, as this would have a major impact on the amenity of their property.	The proponent acknowledges, as reported in Supporting Study 8.2, that there are some sensitive receptors in the vicinity of the proposal that could experience noise levels that exceed the assigned levels prescribed by the Environmental Protection (Noise) Regulations. The proponent is currently revising its planned operations to include additional mitigation measures such as only conducting night operations within the pits. There are only two residences in the vicinity of the proposal development envelope that are currently continually occupied (Sensitive Receiver E to the west of the mine site), and Receiver D – within the proposal development envelope and the proposed disturbance area). Discussions and negotiations are underway with these residents to address and ameliorate their concerns. The noise modelling will be revised to take into account equipment and operational changes, and will be submitted to DER together with proposed management, for assessment as part of The proponent's applications for Works Approvals and Licence under Part V of the EP Act. Light management will be as detailed in the PER, and will include measures such as: • Only lighting what needs to be lit for safety purposes; • Use of LED lights where practicable; and • Use of shrouding, directional lighting and sensor lighting.

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
38	DER	The Noise Impact Assessment Report by Lloyd George Acoustics (LGA) indicates that due to the short buffer distance, mining operation noise will exceed the assigned noise level at four closes neighbouring residences (B, D, E, J), depending on the mining phase. The exceedances can be as high as 9 dB, and this indicates that noise is a key environmental factor for this project. The proponent needs to demonstrate compliance with the noise regulations with management and mitigation measures. It is concluded in the noise report that "as the predicted noise resulting from the mining operations is highly dependent on the location of the mobile equipment in relation to the receiving premises, the opportunity for noise control, other than using quieter equipment, is limited." It is further proposed by LGA that "as the number of affected receivers is small, it is recommended that noise management, in the form of purchasing or leasing the affected properties for the life of the mine, should be investigated." DER considers that implementing amenity/leasing agreements with these four residences, particularly Residences D and B, may be the only practical measure to ensure compliance with the noise regulations. DER also notes that this is listed by the proponent as one of the noise management and mitigation measures. The DER recommends that the proponent demonstrates commitment to achieving amenity/leasing agreement with the four closes neighbouring residences, in particular Residences B and D, and the evidence that these agreements can be achieved.	The proponent acknowledges, as reported in Supporting Study 8.2, that there are some sensitive receptors in the vicinity of the proposal that could experience noise levels that exceed the assigned levels prescribed by the Environmental Protection (Noise) Regulations. The proponent is currently revising its planned operations to include additional mitigation measures such as only conducting night operations within the pits. There are only two residences in the vicinity of the proposal development envelope that are currently continually occupied (Sensitive Receiver E to the west of the mine site), and Receiver D – within the proposal development envelope and the proposed disturbance area). Discussions and negotiations are underway with these residents to address and ameliorate their concerns. Discussions and negotiations are underway with these residents to address and ameliorate their concerns. The noise modelling will be revised to take into account equipment and operational changes, and will be submitted to DER together with proposed management, for assessment as part of The proponent's applications for Works Approvals and Licence under Part V of the EP Act. This will include demonstrated commitment by The proponent to and achievement of amenity compensation or leasing agreements with the four closest neighbouring residences (including B & D).

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
Dust			
39	Public Submitter No. 1	The submitter is concerned that the drinking water supply may be impacted from dust deposition into the catchment system and rainwater tanks, particularly since the proposal is located in close proximity to the submitter's property.	The proponent commits to management of dust on site so that potential impacts of dust generation offsite are minimised to the greatest extent practicable. If required, The proponent would install equipment such as 'in-line' filters to the drinking water supply system. An Outline Dust Management Plan has been prepared (Refer Attachment C). This plan will be further developed during the Part V EP Act assessment process, and the Mining Proposal approval process under the *Mining Act 1978*.
40	Public Submitter No. 2, No. 3	It is noted that the PER states "most emissions associated with the proposal will alter existing background conditions and have the potential to contribute to nuisance at the nearest residences. Sustained, heavy dust loads may affect vegetation." The submitters appreciate that dust suppression activities such as watering unsealed roads and growing crops on spoils will be undertaken. However, the PER lists a range of management and mitigation measures but one of the submitters notes that there is no mention of sealing of Aurisch Road, even though usage of Aurisch Road resulting from the proposal would be a major cause of dust emissions. A second submitter located west of the proposed mine is concerned that dust will be a significant problem on their business. Dust monitoring units have been installed. Discussions have been made with the proponent for the possibility for planting trees or providing hessian fencing around the mine site to prevent dust emissions. However, the proponent has indicated that due to the mine being elevated about the submitter's property, the mitigation would be negligible. Both submitters noted that "growing temporary crops to bind	Sealing of Aurisch Road is not proposed as it will not be used for project access or transport, and therefore will not be a source of dust generation as a result of implementation of the proposal. A range of dust management and mitigation measures are proposed as outlined in the PER, which will include the key measures of minimising area of disturbance within the proposal development envelope, use of biodegradable stabilising agents on stockpiles to minimise wind and rain erosion, and could include measures such as the growing of temporary crops. An Outline Dust Management Plan has been prepared (Refer Attachment C) to provide further information on dust management for the proposal. This plan will be further developed during the Part V EP Act assessment process, and the Mining Proposal approval process under the *Mining Act 1978*. In addition, progressive rehabilitation will be undertaken. The progressive rehabilitation measures will be addressed in further detail in the Mine Rehabilitation and Closure Plan to be developed for the proposal. This plan will be assessed and approved by the Department of Mines and Petroleum (DMP) under the *Mining Act 1978*. The DMP will also be monitoring its implementation by The proponent, and compliance with identified rehabilitation and closure objectives.

40 cont.		the soil and minimise wind erosion" is listed in the PER as management for dust control. This needs to be fully detailed, including answers to the following: • where will the crops be grown? • who will grow them? • how long will they be grown for? The EPA should require the proponent to identify and apply more substantive dust management and mitigation measures as this will have a major impact on the amenity of the submitter's property located in close proximity to the mine. This should be included in the PER.	
41	Public Submitter No. 5	Drawings indicate that overburden will be placed on the submitter's land. The suggested overburden will be approximately 100 metres from the submitter's production facility. With the harsh Easterly winds, the proposed dust management program will be insufficient and will have major impacts on their land. The dust has the potential to damage their robots and packaging plant, as well as the external windrows that make their product and possibly contaminate them. The trench operations will also be approximately 300 metres from the submitter's production facility, which will likely cause excessive noise, vibration and dust. Noise and dust from the Power Corridor is also of great concern.	The proposal layout shown in the PER is indicative in nature. Individual proposal elements such as temporary overburden placement areas and topsoil stockpile areas can be placed elsewhere within the proposal envelope if required. It should be noted however, that the indicative location of the temporary overburden stockpile is north of Aurisch Road, and therefore is not on the submitter's land as claimed. Approvals for land surface access rights within the proposal development envelope and Mining Lease area is currently being negotiated with the various landowners. A range of dust management and mitigation measures are proposed for all elements of the proposal including the services corridor, which will include measures such as minimising the area disturbed within the proposal envelope and use of biodegradable stabilising agents on stockpiles to minimise wind and rain erosion. An Outline Dust Management Plan has been prepared (Refer Attachment C) to provide further information on dust management for the proposal. This plan will be further developed during the Part V EP Act assessment process, and the Mining Proposal approval process under the *Mining Act 1978*. In addition, progressive rehabilitation will be undertaken. The progressive rehabilitation measures will be addressed in further detail in the Mine Rehabilitation and Closure

41 cont.			Plan being developed for the proposal. This plan will be assessed and approved by the Department of Mines and Petroleum (DMP) under the *Mining Act 1978*. The DMP will also be monitoring its implementation by The proponent, and compliance with identified rehabilitation and closure objectives. Electricity for the proposal will be obtained from the South-West grid reticulated by connection to the nearby Western Power transmission line. There would be no noise and dust associated with the operation of the connecting power line.
42	DER	The section in relation to dust in the supporting study consists of general statements of what should be done, rather than commitment to implement specific dust mitigation measures that might be indicated by conditions. For example, in Supporting Study 7.2 Section 3.1 "Earth Moving" begins with the statement, "A significant component of the dust generating activities at this site arise from the removal of topsoils, subsoils and overburden." It is then stated that the moisture present in the overburden is expected to mitigate the dust production, and that additional watering will be required during hot dry periods. It is unclear what level of moisture content in the overburden would trigger additional watering or if triggers for additional watering would be through real-time dust level monitoring. In Section 3.2, "A significant dust generating activity that occurs on site is the movement of heavy vehicles on unpaved roads." It is unclear what the expected mass of the vehicles would be and their average speed. Further, it is unstated what the silt fraction is in the roads they would travel and under what conditions these roads would be wetted. In Section 3.3.2 "Stabilisation of rehabilitated areas" it is states "As a matter of principle the proposal to progressively	The assumed silt fraction in the roads was 30%, which is quite high (i.e. high estimate of potential dust generation). The presence of visible dust would be sufficient to trigger further wetting of these roads. The visible dust "trigger" is intended to be the most proactive means possible since it does not require dust to travel to receptors before remediation is undertaken. The ESD prepared for this assessment did not require that dispersion modelling be undertaken. Further to this, and based on conversations between Dr Mark Goldstone (air quality technical specialist and author of Supporting Studies 7.1 and 7.2) and the DER Air Quality Branch in January 2013, Dr Goldstone formed the view that it was considered by DER that uncertainties in regard to emission estimation and modelling in the context of proposals such as this indicated that the preferable approach would be to identify how and when dust emissions would be managed and what monitoring would be undertaken to demonstrate the air quality criteria at sensitive receptors had been met rather than trying to quantify the exact distance at which air quality might meet appropriate guidelines. Accordingly, given that dust modelling was not a requirement in the ESD, and based on the technical advice received, discussion in the PER and its relevant supporting studies has been focused on dust management.

42 cont.		rehabilitate is excellent " The DER supports this principle but is unable to determine how the success or progress towards such rehabilitation would be assessed. The DER recommends that dust management strategies need to expressly state specific dust mitigation measures. The DER also recommends that the impact of the dust emissions at the sensitive receptors should be determined using an appropriate dispersion model performed according to the Modelling Guidelines available from the DER. The quality of both the emissions estimates and the proposed dust mitigation measures is considered insufficient, in the Air Quality and Greenhouse Emissions Management report, to assess the air quality impacts of the proposed operation. The DER is of the opinion that satisfactory treatment of emissions requires full documentation of the equations used, and includes dispersion modelling performed similar to that outlined in the then Department of Environment's Modelling Guidelines 2006. (http://www.dec.wa.gov.au/pollution-prevention/air-quality/publications.html?showall=&start=3) Since the location of the nearest sensitive receptor is well within the 1.5 to 3 km buffer recommended in the EPA's Guidance Statement 3 for Open Cut Mining (Large Operations), a much more comprehensive and detailed assessment of the potential impact of dust is required. While is it DER's view that the uncertainties associated with emissions estimation of fugitive dust modelling make model results difficult to interpret as an indicator of environmental acceptability, location of nearby sensitive receptors indicates modelling should have been undertaken.	An Outline Dust Management Plan has been prepared (Refer Attachment C) to provide further information on dust management measures to be implemented for the proposal. This plan will be further developed during, and by regulated by, the Part V EP Act assessment process administered by the DER, and the Mining Proposal approval process under the *Mining Act 1978* administered by the DMP. The concept of progressive rehabilitation will be expanded upon in the Mine Closure Plan to be submitted to DMP for assessment and approval, and this plan will include criteria against which to assess progress towards and achievement of rehabilitation of the site.

7. Human Health

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
43	DMP	It is understood that management of radiation risk will be detailed in relevant management plans to be submitted. The DMP would like the opportunity to comment on these plans.	A detailed RMP will be prepared and submitted to the DMP for assessment and approval as per the requirements of the *Radiation Safety Act 1975*. Consultation with DMP on this plan has commenced.
44	Public Submitter No. 1	There is concern that dust generated from the proposal would impact on health and wellbeing.	The proponent commits to implementing all practicable management measures available to ensure that dust is managed on site so that there are no impacts on the health and well being of potential receptors in the vicinity of the site. Discussions have already been commenced with the owners of some neighbouring properties as to appropriate management measures. An Outline Dust Management Plan has been prepared (Refer Attachment C) to provide further information on dust management measures to be implemented for the proposal. This plan will be further developed during the Part V EP Act assessment process administered by the DER, and the Mining Proposal approval process under the *Mining Act 1978* administered by the DMP.
45	Public Submitter No. 5	The submitter is concerned with radiation risk from mining mineral sands. The proposed overburden is 100 metres away from the submitter's operations and 300 metres from their trench. With the strong easterly winds, this will contaminate the submitter's product for agricultural and home markets, as well as impact on staff.	Radiation risk to the public and the environment associated with the mining and processing of the orebodies on site is low. The operations on site require the preparation by The proponent of a Radiation Management Plan to be assessed and approved by the DMP, and site operations will be subject to controls under the *Radiation Safety Act 1975* and the Mines Safety and Inspection Regulations 1995. Ambient radiation levels will be monitored prior to, during and post operations, with results being provided to DMP in accordance with the approved management plan. As such, The proponent is of the view that this issue can and will be managed, with strong regulator overview to provide an even higher level of confidence to the community.

8. Rehabilitation and Closure

Item	Submitter	OEPA Summary of submission and/or issue	Proponent's response to comment
46	Wildflower Society of WA	There is no confidence that the proponent can manage the reconstruction of soil profiles to ensure pre-mining hydrological flows are returned or that there is adequate revegetation with a full assemblage of herbs, sedges, shrubs and trees. The Society has studied several mineral sand mines and revegetation, and found no cases where a self-sustaining ecosystem has been established. A major issue is the way most of the soils are back filled into the pits. It is impossible to re-establish the soil structure so a full range of vegetation structure can be re-established. It can be possible to get pasture to grow but not trees, and this is evident from the Iluka mine where the trees reach about two metres and die. This is due to poor soil structure post mining. The EPA should not be passing the issue to the DMP to manage as there has been no evidence that sound environmental outcomes are achieved. It is apparent that the EPA should not allow any clearing of native vegetation for mineral sand mining. The price of mineral sand mine products is also highly volatile, and whilst this is not an EPA issue, any market downturns puts pressure on the company to take shortcuts and can put rehabilitation at risk.	Hydrological flows (stream or drainage flows) within the project footprint have been mapped as ephemeral and will be managed by temporarily re-directing the drainage lines around any open pits; The original drainage lines will be returned once the pit has been backfilled. Any disturbance of the ground, whether it be agricultural or mining, is unlikely to retain the original soil profile. The model, presented in the H3 Report and H3 Addendum (Supporting Studies 4.1 and 4.1a), has incorporated lithological permeabilities based on PRAMS as well as project specific data. Additionally, data has been gathered from local landowners regarding concepts of "preferred flow pathways". All available data will be incorporated into the enhanced monitoring scheme in order to manage before and after flows. The land within the proposal development envelope is agricultural in nature and does not currently contain the full assemblage of herbs, sedges, shrubs and trees. Rehabilitation will be focused on returning the land to pre-mining condition (i.e. agricultural land), or better. A Mine Rehabilitation and Closure Plan will be developed for the proposal taking into account the outcomes of stakeholder consultation, including the requirements of the landowners. This plan will be assessed and approved by the Department of Mines and Petroleum (DMP) under the *Mining Act 1978*. The DMP will also be monitoring its implementation by The proponent, and compliance with identified rehabilitation and closure objectives.

Attach

Attachment A – Figure showing dimensions of proposed Dry Mill

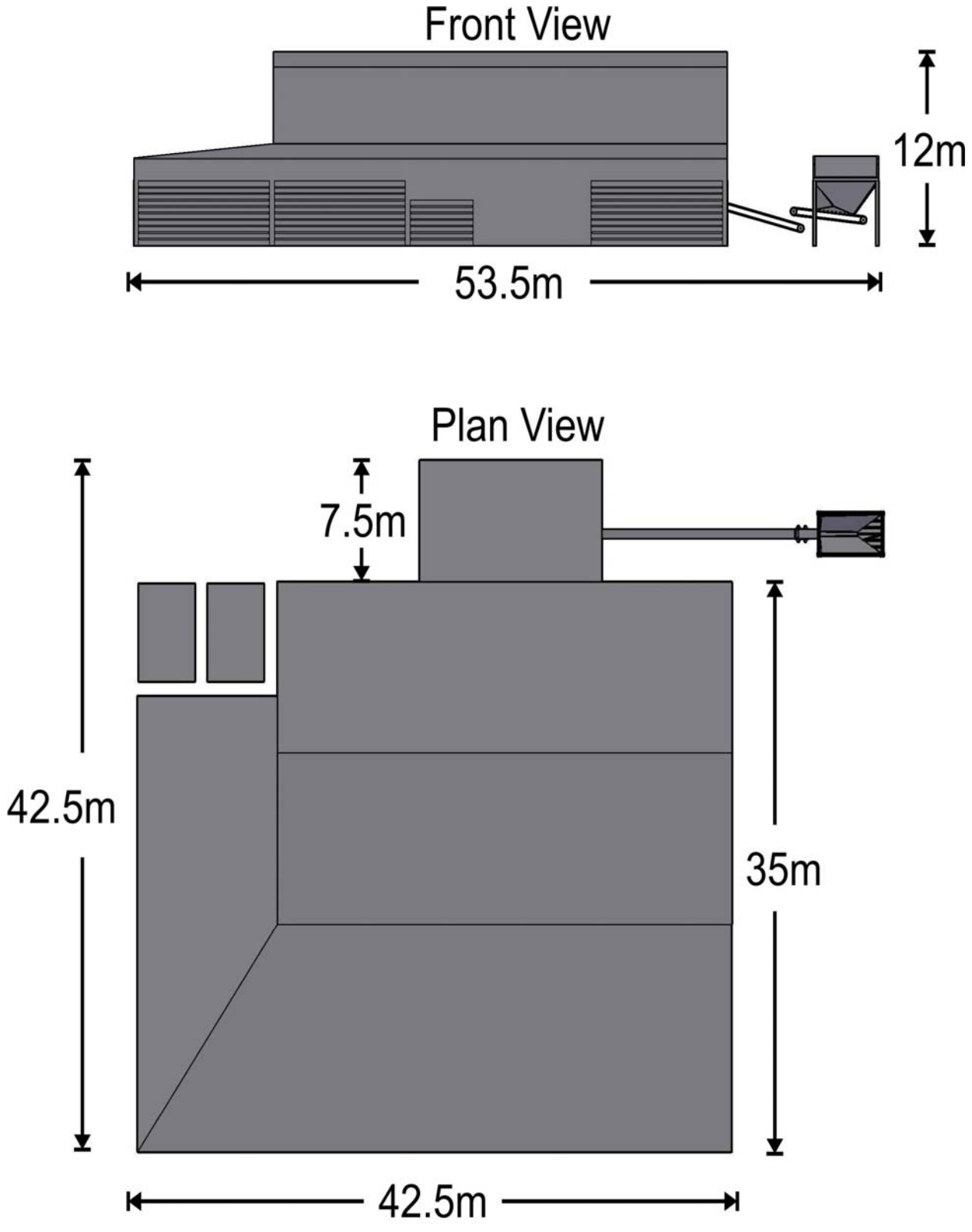
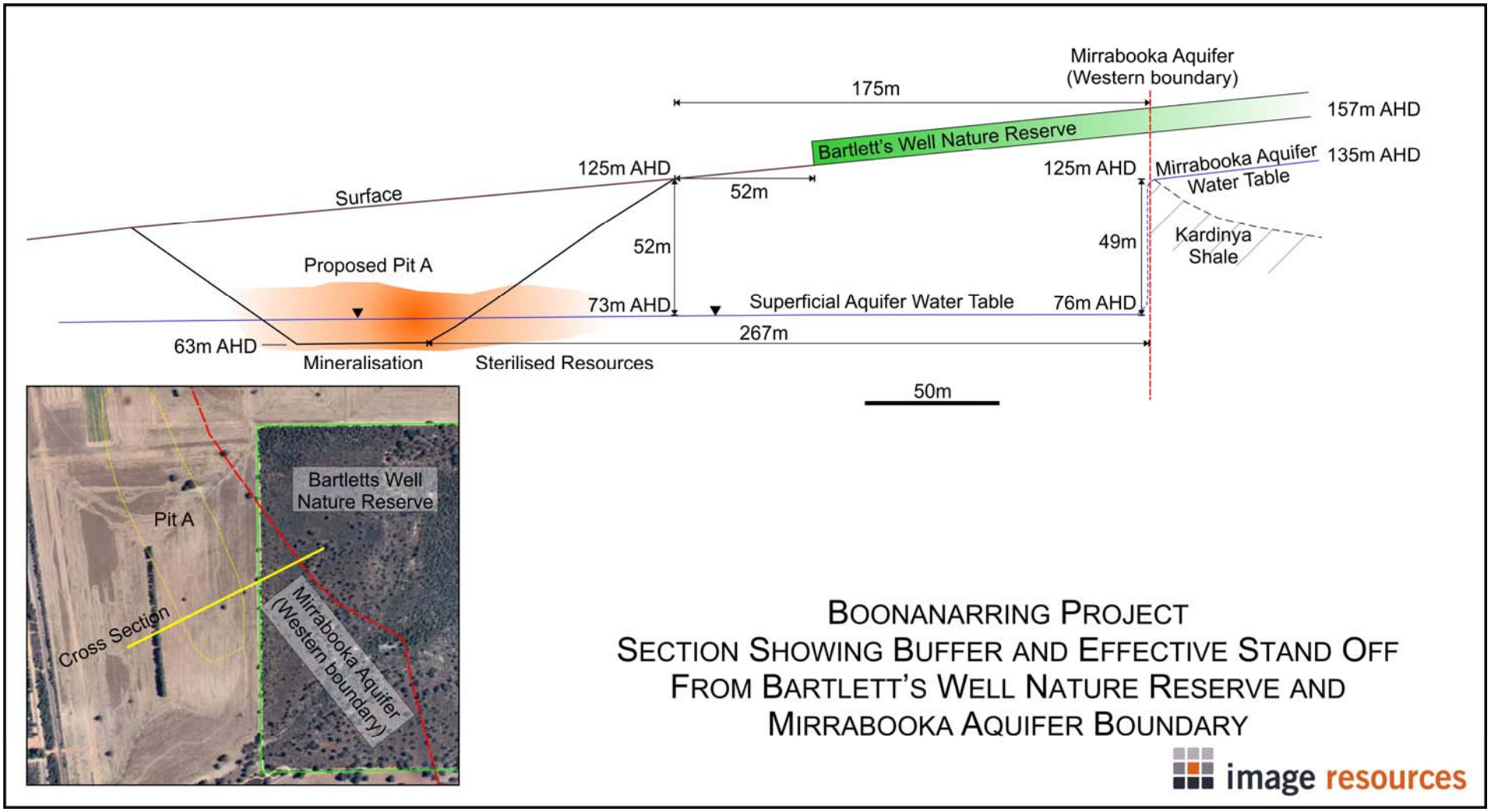
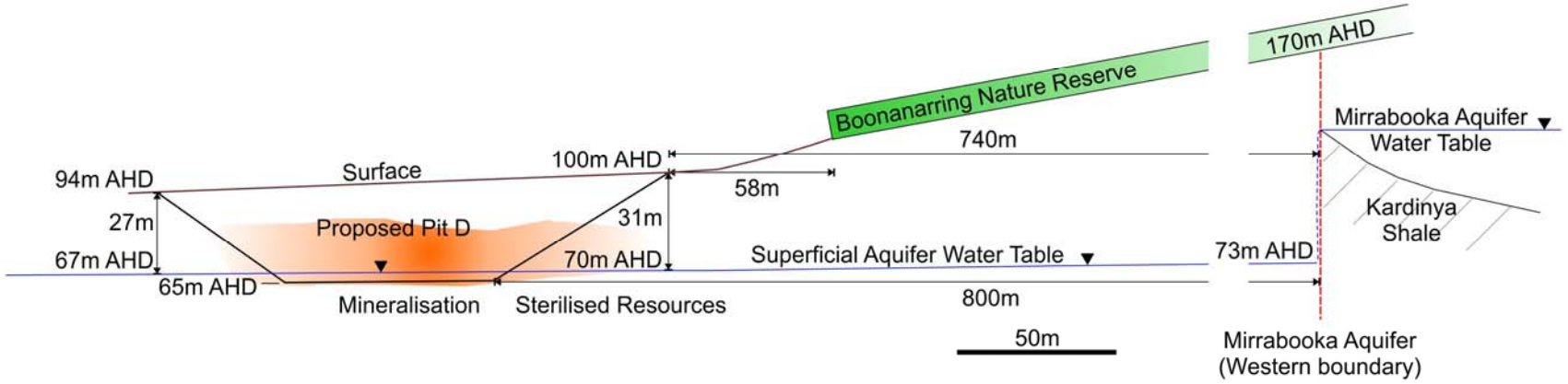
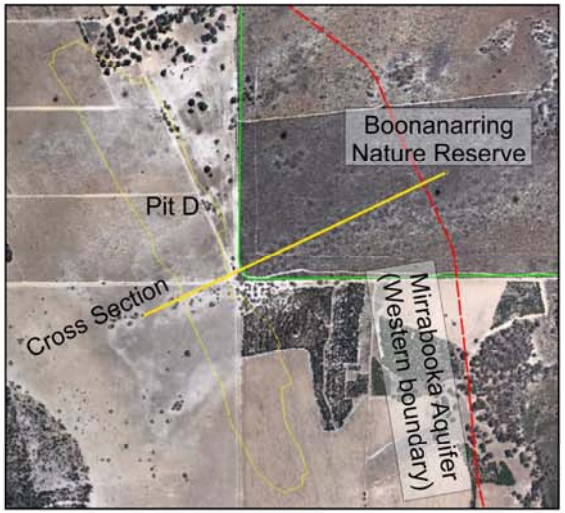


Figure 1 - Dry Mill

Attachment B – Cross Section Figures for Pits A, C and D showing relationship between the proposal, groundwater aquifers, and the Bartlett's Well and Boonanarring Nature Reserves and Collard Wetland

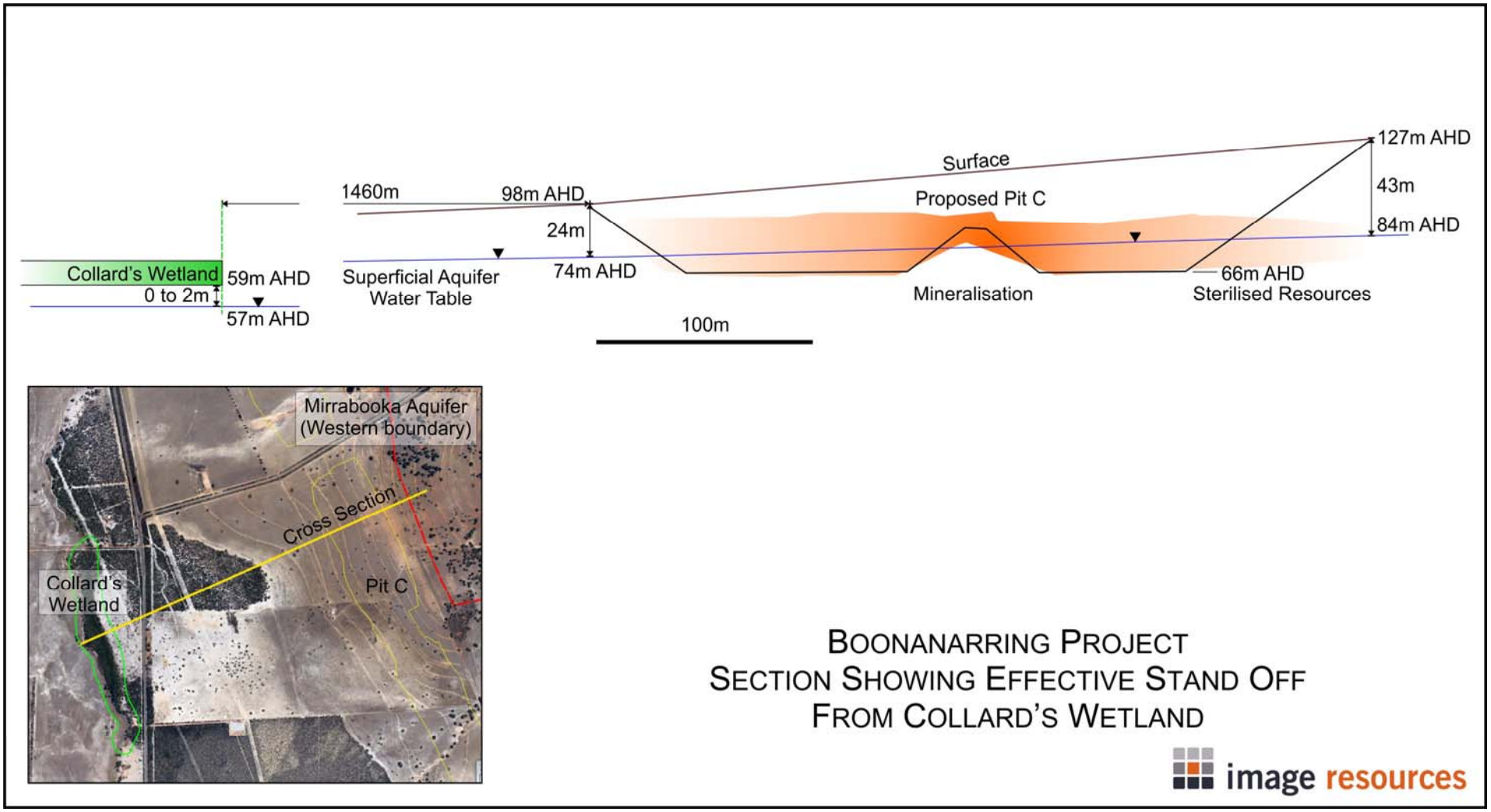

Mirrabooka Aquifer
(Western boundary)
175m
157m AHD
Bartlett's Well Nature Reserve
125m AHD
52m
125m AHD
Mirrabooka Aquifer
Water Table
135m AHD
Surface
52m
49m
Kardinya
Shale
Proposed Pit A
73m AHD
Superficial Aquifer Water Table
76m AHD
267m
63m AHD
Mineralisation
Sterilised Resources
50m
Bartletts Well
Nature Reserve
Pit A
Cross Section
Mirrabooka Aquifer
(Western boundary)
BOONANARRING PROJECT
SECTION SHOWING BUFFER AND EFFECTIVE STAND OFF
FROM BARTLETT'S WELL NATURE RESERVE AND
MIRRABOOKA AQUIFER BOUNDARY
image resources





BOONANARRING PROJECT
SECTION SHOWING BUFFER AND EFFECTIVE STAND OFF
FROM BOONANARRING NATURE RESERVE AND
MIRRABOOKA AQUIFER BOUNDARY

image resources


Collard's Wetland
59m AHD
0 to 2m
57m AHD
1460m
98m AHD
24m
74m AHD
Superficial Aquifer
Water Table
Surface
Proposed Pit C
Mineralisation
127m AHD
43m
84m AHD
66m AHD
Sterilised Resources
100m
Mirrabooka Aquifer
(Western boundary)
Cross Section
Collard's
Wetland
Pit C
BOONANARRING PROJECT
SECTION SHOWING EFFECTIVE STAND OFF
FROM COLLARD'S WETLAND
image resources

Attachment C – Boonanarring Outline Dust Management Plan

Boonanarring Mineral Sands Mine

Outline Dust Management Plan

Contents

1. Introduction

1.1 Project context

The Boonanarring Mineral Sands proposal is located approximately 12km North West of the Gingin Township at its nearest point (refer Figure1). It involves conventional open cut dry mining of mineral sands and processing of material mined through a wet concentration plant to produce a heavy minerals concentrate, and further treatment of this concentrate through a relocatable dry mill to produce ilmentite, rutile, zircon and leucoxene. The tailings material after processing the ore, along with the overburden and oversized material will be returned direct to the mining void as backfill behind the advancing mine face, with the objective of returning the site to its pre-mining agricultural condition. In addition to the processing plant, mine infrastructure also includes offices, workshops, roads, temporary overburden placement areas, topsoil stockpile areas, and solar drying cells. Modification of the intersection of Brand Highway and Wannamal Road West is required to facilitate safe transport of product to market. All project elements will be contained within the proposal development envelope (refer Figure 2).

1.2 Purpose of this plan

The purpose of this plan is to provide an outline of the controls that will be implemented to manage dust at the Boonanarring mine site so that it des not cause an unacceptable environmental impact within the site, or for the surrounding environment, or health and nuisance impacts on the workforce or neighbouring residents.

This outline plan is intended to be further developed during the next phase of regulatory approval processes under Part V of the *Environmental Protection (EP) Act1986* and the *Mining Act1978*.

1.3 Objectives

The objectives of this management plan are to ensure that impacts to:

- amenity of the mine site and surrounding areas are to as low extent affected as reasonably practicable; and
- vegetation health impacts related to dust are minimized.

1.4 Existing dust levels

A baseline survey of airborne dust in the vicinity of the proposal development envelope was undertaken over a three-month period (January – April) in the summer of 2013. This survey measured total suspended particulates (TSP), particulates with a particle size of less than 10 microns (PM10) and settled dust. Dust emissions correlated with wind speed and direction and soil moisture.

With no current mining, the PM10 level exceeded the relevant National Environmental Protection Measure (NEPM) standard on three separate

occasions during the three month survey. All monitoring sites showed TSP and settled dust levels exceeding the relevant criteria used for determining 'acceptable levels'. The monitoring results indicate that there are many and varied significant sources of dust already existing in this area (Refer to PER Supporting Study 7.1. Outback Ecology, 2013).

2. Dust management

2.1 Potential Dust Sources

The generation of dust from the project will depend upon:

- the volume of material being mined and general level of traffic on site;
- meteorological conditions, such as wind speed;
- moisture content of the dust source;
- composition of the dust, including particle size distribution and particle density.

The main sources of dust emissions from the proposal will be generated by the following activities:

- excavation of topsoil and overburden
- movement of vehicles on unpaved roads
- replacement of overburden

2.2 Potential dust receptors

Potential sensitive dust receptors are summarized in Table 2.1 (based on Table 1 of Boonanarring PER Supporting Study 7.1) and shown on Figure 3.

Table 2.1 Potential Dust Receptors

Receptor No.	Details	Receptor Type	Comment
1	Potential residential receptor	Dwelling	This dwelling is understood to be occupied on a temporary and occasional basis.
2	Bartlett's Well Nature Reserve	Environmental	DPaW managed Crown reserve.
3	Empire Oil Gas Facility	Industrial	Gas well and fractionation plant.
4	Nearest residential receptor	Dwelling	Discussion underway with landowner re mitigation and amelioration measures.
5	Potential residential receptor	Dwelling	This dwelling should be outside of the influence of dust generated on site.
6	Remnant vegetation	Environmental	Area containing vegetation is in private ownership.
7	Nearest point of Boonanarring Nature Reserve	Environmental	DPaW managed Crown reserve.

Table 2.1 cont. Potential Dust Receptors

Receptor No.	Details	Receptor Type	Comment
8	Potential residential receptor	Dwelling	Dwelling is a significant distance south-east of the proposed mine area, and therefore would be outside of the influence of any dust generated on mine site.
9	Potential residential receptor	Dwelling	Will not be occupied during mining subject to mining access agreement.
10	Potential residential receptor	Dwelling	Discussions with landowner are planned re mitigation and amelioration measures.

2.3 Potential impacts

Most emissions associated with the proposal will alter existing background conditions and have the potential to contribute to nuisance at the nearest residences. Sustained, heavy dust loads may affect vegetation.
(Refer Boonanarring PER Supporting Study 7.2, Outback Ecology, 2013a).

2.4 Dust management actions

Specific actions identified to assist in achieving dust management objectives are as outlined in Table 2.2.

Table 2.2 Dust Management Actions

Activity/Project Element	Management Action	Timing
Vegetation clearing	Do not disturb areas until required.	Throughout the duration of construction and operation.
	Minimise the area cleared to only that required.	Throughout the duration of construction and operation.
Topsoil stripping	Campaign topsoil stripping at the optimum time or year utilizing equipment which generates the least amount of dust.	Throughout the duration of construction and operation.
	Do not undertake with dry materials in high winds.	Throughout the duration of construction and operation.
Tracks and roads	Sealing of the access road from Wannamal Road West into the wet plant, HMC stockpile and office area.	During construction and to be maintained as required during operations.
	Implementation of speed limits on internal roads to minimize dust generation.	Throughout the duration of construction and operation.
	Water carts and other dust minimization measures to prevent dust lift off on unsealed roads	Throughout the duration of construction and operation.
	Regular sweeping of sealed roads.	Throughout the duration of construction and operation.

Table 2.2 cont. Dust Management Actions

Activity/Project Element	Management Action	Timing
Plant and equipment	Haulage trucks and earthmoving equipment will be clean on entry and exit to and from the site.	Throughout the duration of construction and operation.
	Implement maintenance schedule for dust control and collection equipment.	Throughout the duration of construction and operation.
	Haulage trucks carrying product off site are to be covered.	Throughout the duration of construction and operation.
Stockpile management	Use of measures such as water, clay fines underflow, biodegradable stabilizing agents to minimize wind and rain erosion.	Throughout the duration of construction and operation.
Progressive rehabilitation	Progressive rehabilitation of disturbed areas is to be undertaken, to minimize dust through the reduction of area of soil exposed to potential wind and rain erosion.	Throughout the duration of construction and operation.
Induction and communication with personnel	Induction to include discussion on potential impacts of high levels of dust, and management measures to prevent this (as above).	Throughout the duration of construction and operation.

3 Monitoring

The monitoring program for dust will be designed to ensure that the management of the operations is consistent with the management objectives. It will measure the success of management actions, and identify areas that may require improvement. Monitoring measures are outlined in Table 3.1

Table 3.1 Dust monitoring program

Monitoring Location	Frequency	Parameters	Procedure	Purpose
Proposal Area	Daily	Level of visible dust or dust lift off.	Inspections of areas where there is potential for dust emissions. Record inspections on daily dust check list during summer months.	To assess the effectiveness of dust management actions and maintain appropriate records.
	Daily	Observation of weather conditions.	Review of BoM website and visual observations on site.	To assess implications for daily work plans and what additional measures may need to be implemented to minimize potential for dust generation.

Table 3.1 cont. Dust monitoring program

Monitoring Location	Frequency	Parameters	Procedure	Purpose
Proposal Area	Scheduled routine	Maintenance inspections	Implement inspection procedures for plant and equipment and housekeeping practices	To ensure maintenance and housekeeping practices are undertaken as planned, thereby minimizing dust sources.
Boundary of Proposal Area	Monthly to establish baseline and targets, then quarterly.	Dust levels via depositional sampling. Possible use of TEOM.	Inspect results of ongoing monitoring	To ensure air quality levels are in the acceptable range.

4. Contingencies

Contingency actions have been identified to be implemented if monitoring indicates that the objectives for management of dust have are not being achieved. These are outlined in Table 4.1.

Table 4.1 Dust management contingency actions

Trigger	Action
Excessive dust generation as determined by visual observation.	1. Investigate cause. 2. Implement appropriate dust control measures to reduce dust generation. 3. Monitor the success of the control measure. If the measure is inadequate, seek alternative measures or cease active operations causing the dust generation until conditions change (e.g. wind speed lowers).
Complaints received from the public	Complaint is to be investigated and compared to monitoring observations and activities on site. If required, mitigation measures including ceasing active operations causing the dust generation until conditions change, will be implemented.
Dust levels above internal targets based on baseline ranges.	1. Investigate monitoring location to determine if activities in the area are the source of elevated levels. 2. Identify and implement additional controls. 3. Monitor success of control measures, and seek alternative measures if inadequate.

5. Reporting and Review

5.1 KPI reporting

Key Performance Indicators will be established for the plan which could include:

- zero non-compliances with Department of Environmental Regulation Works Approval or Operating License conditions;
- zero significant environmental incidents; and
- zero public complaints relating to verifiable dust emissions from the site.

5.2 Incident reporting

Proactive incident reporting procedures will be established to facilitate reporting of potential or actual failure of dust control systems on site.

5.3 Auditing

Regular audits will be conducted, in accordance with an established schedule, to ensure compliance with the management plan.

5.4 Management Plan Review

A review of the management plan will be conducted at least once per year; but could be triggered earlier by the following:

- If there is a significant change to the operation of the site;
- At the request of the Department of Environmental Regulation;
- Where deemed appropriate by the site manager or their supervisor; and
- After 2 public complaints or environmental incidents.

The function of the review is to ensure that the 'Purpose' of the plan remains correct, and that the plan is best suited to achieving the stated Purpose, and if not, is amended in the context of continuous improvement.

6. References

Image Resources 2014. Boonanarring Mineral Sands Mine Public Environmental Review.

Outback Ecology 2013. Boonanarring Baseline Air Quality Assessment

Outback Ecology 2013a. Boonanarring Mineral Sand Mine Air Quality and Greenhouse Emissions Management.

Figures

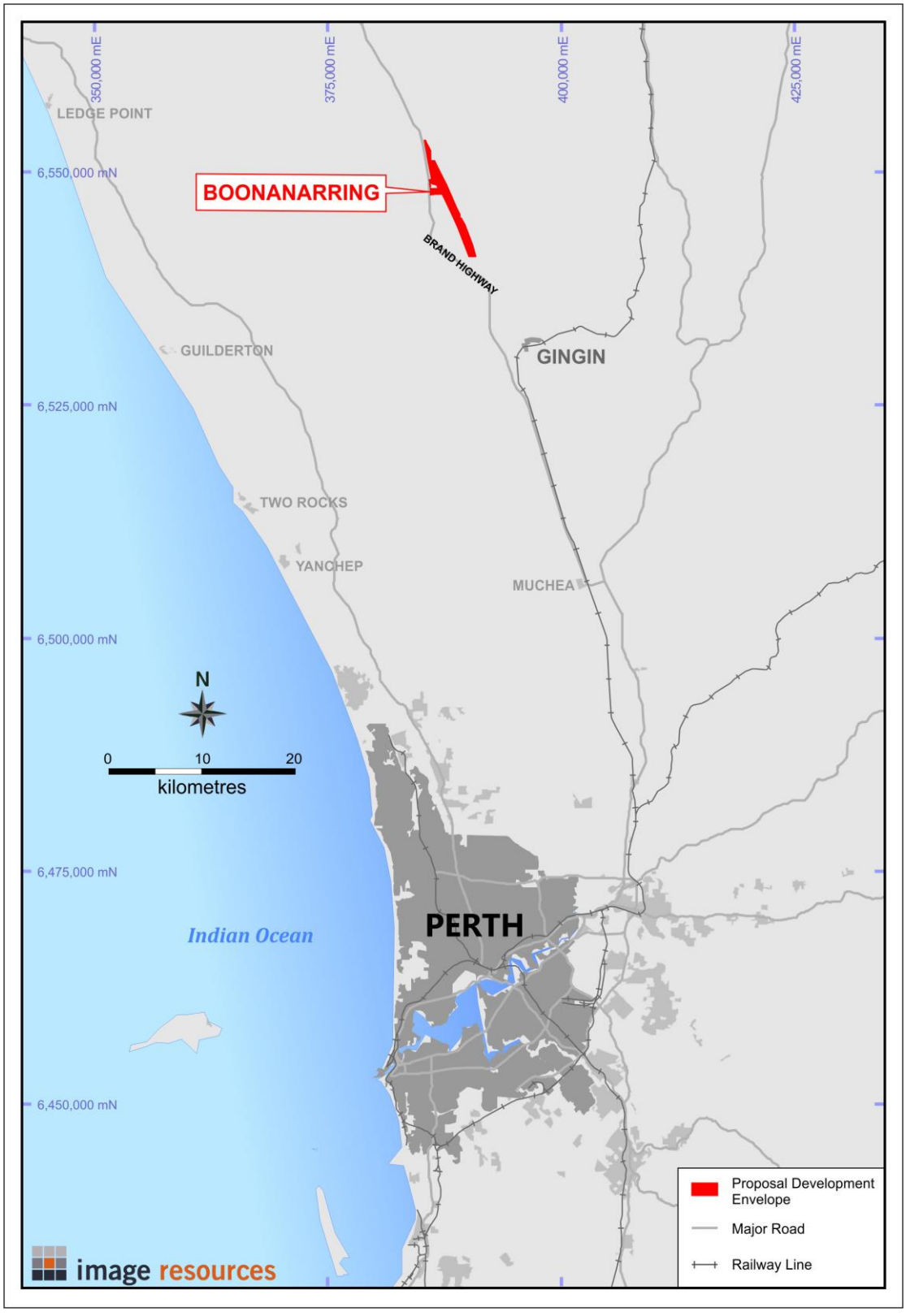


Figure 1 Proposal Location (Source: Boonanarring Mineral Sands Mine PER)

Figure 2 Proposal Development Envelope and Indicative Mine and Infrastructure Layout (Source: Boonanarring Mineral Sands Mine PER).

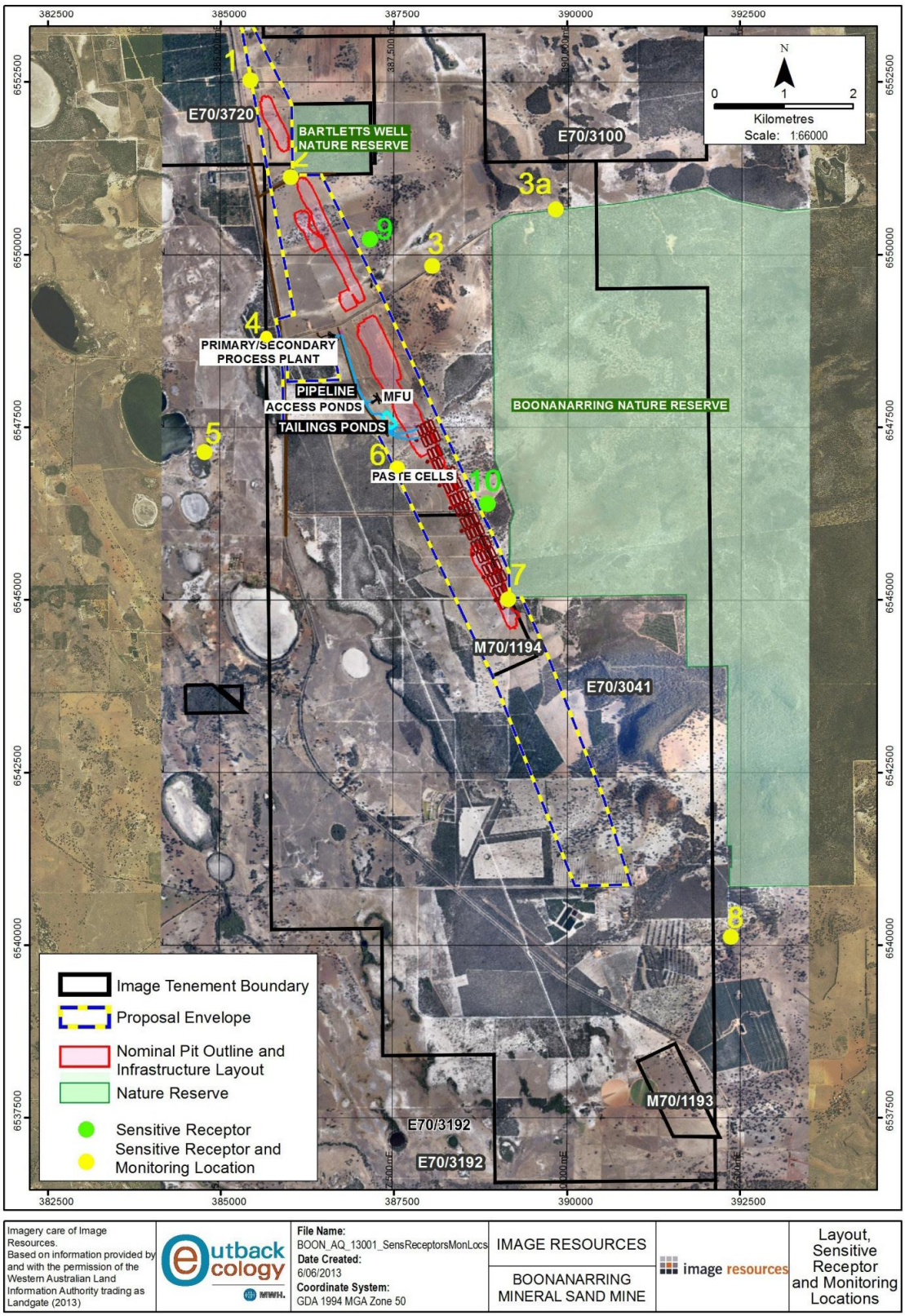


Figure 3 Indicative project layout, potential sensitive receptors and baseline monitoring locations (Source: Figure 3 from Outback Ecology, 2013a)