MRC GRAPHITE PTY LTD

MUNGLINUP GRAPHITE PROJECT

S38 & EPBC Referral: Supporting Information
Part B_a: Appendices

APPENDICES

APPENDIX A: THIRD PARTY AUTHORISATION

Farmin and Joint Venture Agreement

Gold Terrace Pty Ltd

Mineral Commodities Ltd

MRC Graphite Pty Ltd

DOMINION LEGAL

17 Lacey Street
Perth WA 6000

This Agreement is dated 17 November **2017**

Parties

1 **Gold Terrace Pty Ltd** (ACN 601 177 619) of care of 17 Lacey Street, Perth, Western Australia 6000 (**Gold Terrace**)

2 **MRC Graphite Pty Ltd** (ACN 120 113 340) of 39-43 Murray Road North, Welshpool, Western Australia 6105 (**MRCG**)

3 **Mineral Commodities Ltd** (ACN 008 478 653) of 39-43 Murray Road North, Welshpool, Western Australia 6105 (**Mineral Commodities**)

Recitals

A Gold Terrace is the sole legal and beneficial owner of the Munglinup Graphite Project (**Project**).

B Gold Terrace and Mineral Commodities entered into the Term Sheet pursuant to which MRCG has been granted the right to farmin and earn up to a 90% legal and beneficial interest in the Project's Tenements, and mining information and to associate with Gold Terrace in an unincorporated joint venture.

C Under the Term Sheet Gold Terrace acknowledged and agreed that Mineral Commodities would nominate MRCG as the party to undertake and be bound by the terms of the formal agreement. Mineral Commodities has nominated MRCG as the party to enter into this Agreement.

D The Term Sheet contemplated a formal agreement to replace the Term Sheet and the Parties agree that this Agreement replaces the Term Sheet.

Agreed terms

1. Definitions and Interpretation

1.1 Definitions

Unless the context otherwise requires, the following expressions have the respective meanings in this Agreement:

$ or dollars means Australian dollars.

Accounting Standards means the accounting standards required to be complied with under the Corporations Act and any other relevant accounting standards approved by the

Executed as an Agreement

EXECUTED by **Gold Terrace Pty Ltd** (ACN 601 177 619) in accordance with section 127 of the Corporations Act 2001:

Director/Sole Director Signature	Director/Secretary Signature
KATHRYN STRICKLAND	
Print Name	Print Name

EXECUTED by **MRC Graphite Pty Ltd** (ACN 120 113 340) in accordance with section 127 of the Corporations Act 2001:

Director/Sole Director Signature	Director/Secretary Signature
MARK V TORRES	PETER TORRES
Print Name	Print Name

EXECUTED by **Mineral Commodities Ltd** (ACN 008 478 653) in accordance with section 127 of the Corporations Act 2001:

Director/Sole Director Signature	Director/Secretary Signature
MARK V TORRES	PETER TORRES
Print Name	Print Name

chris

MRC GRAPHITE PTY LTD
ABN 92 120 113 340
Email: info@mncom.com.au
Web: www.mncom.com.au

Our Ref: MRCG-PRJ-LTR-001_20180403

3rd March 2018

To Whom It May Concern,

Re: Munglinup Graphite Project - Project Management, Baseline Assessments and Approvals Support

MRC Graphite Pty Ltd wishes to advise that Belinda Bastow, Director of Integrate Sustainability Pty Ltd (ISPL) and the ISPL Team have been engaged to Project Manage all aspects of the Baseline Assessments and associated Government approvals required under the following acts for the Munglinup Graphite Project:

- Mining Act (including Tenements, Programs of Work, Mining Proposal)
- Environmental Protection Act
- Environment Protection and Biodiversity Conservation Act
- Mine Safety & Inspection Act

Additionally, all questions relating to study scope of work should be directed to ISPL.

Yours Faithfully,

Daniel Hastings
Business Development Manager

APPENDIX B: STAKEHOLDER ENGAGEMENT REGISTER

Date	Type of Engagement	Stakeholder Organisation	Matters Discussed	Stakeholder Feedback	Response to Feedback / Outcomes / Comments
7-Feb-18	Meeting / Briefing	Department of Mines, Industry Regulation & Safety	Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Overview of the Munglinup Project with a powerpoint presentation - Authorisation: It was stress that when submitting POW or Mining Proposal it is critical that if the submitter is not the tenement holder, then a letter or copy of the agreement must be attached providing evidence that the submitter has the tenements holder approval to undertake activities on the tenement. - Tailings Management: due to the typical annual rainfall plus with significant rain event, the proponent will need to ensure the design and operations of the TSF will need to focus on rainwater management to provide overtopping or limit seepage. - Road Access: the selection of the access road into the site, and the offsite haulage of the product must take into consideration stakeholder feedback - Water: to date no onsite groundwater and surface water assessment has been completed, it is hoped that an adequate groundwater supply can be obtained from the mining areas, preventing the need for offsite supplies. - EPA / EPBC Approvals: if the project is lodged with DMIRS without the proponent referring or discussing the project with the WA EPA or DoEE and there is a significant environmental trigger, there is a risk to the project timeline because DMIRS may need to refer or liaise with one or both agencies. - Lead Agency: Clare will liaise with Graham Cobby to see if the project could be facilitated through the lead agency framework. Clare will provide feedback. - Timeline: to achieve the best possible assessment timeline it is critical the mining proposal contains all the required information, provides an appropriate level and quality of baseline environmental information to enable the assesses officer to undertake their assessment. It is also essential that effort is made to ensure baseline information helps to identify the really critical environmental factors rather than issues that are a result of poor or inadequate information. The conceptual timeline seems challenging particularly if the proponent does not adequately engage with other decision makers. - Baseline surveys: it was agreed that knowledge gaps for the project areas need to be adequately addressed. - Stakeholder: Best opinion of contact for the EPA is Robert Hughes, and the proponent is recommended to include R.A.I.N – Ravensthorpe Agricultural Initiative Network in their stakeholder engagement activities		Knowledge gaps for the project areas need to be adequately addressed. Including baseline surveys and water supply.
21-Feb-18	Presentation	Esperance / Munglinup Community	Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Overview of the company MRC - Overview of the proposed Munglinup Graphite Project - Overview of mining history at the location - Preliminary site layout - Overview of environmental assessments completed and additional work required - Perceived benefits to the community - Identification of key stakeholders		

Date	Type of Engagement	Stakeholder Organisation	Matters Discussed	Stakeholder Feedback	Response to Feedback / Outcomes / Comments
22-Feb-18	Meeting / Briefing	Department of Biodiversity, Conservation & Attractions - Parks & Wildlife Service	Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Reserve Responsibilities: the Mining and Parkland reserves are not managed by DBCA. DBCA has involvement only in relation to fire, weeds and ferals. Need to check the Regional Management plan as there may be proposals for the adjacent parkland to be transferred to the Conservation estate. - Parks & Wildlife: the section within Parks and Wildlife that are likely to be interested in the project are Species and Communities and possible Environmental Management Team – Chris Bishop. Recommend talking to Chris re DBCA involvement moving forward. - Dieback: a dieback assessment has been completed in the project areas by DBCA, the SW corner of the tenement was included, and dieback was recorded. DBCA should be able to share the report once available.		Future consultation with DBCA should be through the Species and Communities Branch
22-Feb-18	Meeting / Briefing	Shire of Esperance	Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Project location - Site access: Access to the site is likely to be via Mills Road which is in Shire of Ravensthorpe. Both local governments are seen as important stakeholders. - Water: Water disposal strategy, where practical all water will be recycled through the plant and water would only be released from site under emergency rain events. - Tailings: Consideration is being given to in pit tailings - Flooding: Recent flooding events in the area including the Munglinup River - Adjacent Landholders: MRC is adopting a good neighbour policy and is seeking to touch base with all relevant stakeholders and neighbouring landholders. MRC provided a list of adjacent land holder lots that they hope the Shire if able to provide contact information on. - Employment Opportunities: What is the projected workforce? As it currently stands post construction the operation is likely to employee 70-80 people with potentially a weekday roster for mining and support staff, processing will be 24hr/7 days. It is envisaged that staff would live regionally with buses running to and from site from Esperance and Ravensthorpe. - Tenure Expiry: what is the mine life? Current project life is 9-year with potential for extensions as the deposit is open on all sides. - Downstream Processing: Would battery manufacture occur in the Esperance Region? Currently unlikely that battery manufacture would happen in Esperance as key inputs are not readily available in Esperance. - Shire Involvement: No or limited involvement in approvals for the Project. Consideration may be given to undertaking some activities on private land, the shire does allow industry activities to occur on rural land. - Power: Powerline run past the project and there is power available via the Esperance PowerStation. The project will need some onsite back-up system to manage outages, consideration is being given to batteries and solar and a return of surplus power to the grid. Shire is happy to make the introduction to Horizon. - Next Steps: Complete the PFS and FS, recommend to the board mid-		Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Shire to provide surrounding landholder contact details - Continued contact with the Shire of Esperance

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			year. Project timelines currently has mining commencing in early 2019, critical path is likely to be the environmental approvals.		
22-Feb-18	Media Release	Esperance / Munglinup Community	• 10-minute Q&A discussion and recording carried out for inclusion in the weekly "Resources report for the Goldfields, Esperance, Mid West and Wheatbelt region of WA", ABC Regional Radio. • Emphasised the strategic importance of the project and interest as a regional development project. • Opportunities for majority local employment and encourage workforce residential in regional towns.		
23-Feb-18	Meeting / Briefing	Esperance Tjaltjraak Native Title Aboriginal Corporation	Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Overview of the Munglinup Project - Heritage surveys and possibility for sites to exist within the area and heritage approval being required. ETNAC have arrangements with archaeological and ethnological specialists and TOs to do this work - Ranger teams will be starting in the region soon - Tailings management and advising if tailings will be hazardous - Wetlands and possible discharge to the Munglinup River should not be hazardous or have downstream impacts - ETNAC are interested in contracting opportunities - Heritage surveys should be completed before exploration activities.		Summary of discussion is below. For full details see the Stakeholder Record Form / Minutes / Presentation. - Agreed to undertake heritage surveys prior to exploration activities - An aquatic fauna survey will be completed to the Munglinup River to assess potential impacts - Surface & Groundwater studies have been commissioned - Consideration given to completing a heritage survey over the project area
02-Mar-18	Site Visit	Esperance Tjaltjraak Native Title Aboriginal Corporation	On the 2 March 2018 representative from the Esperance Tjaltjraak Native Title Aboriginal Corporation, MRC Graphite Pty Ltd and field personnel undertook a field inspection of proposed exploration activities located within M74/245. The field inspection sought to identify potential areas of heritage concern associated with the location of proposed exploration activities.		Two proposed new RC lines (site 8 and 13) are located in uncleared areas close to the river and within an area of Zamia palm not common within M74/245. It was agreed that these two lines should be cleared under the supervision of Heritage Monitors preventing any impacts to potential heritage values.
13-Mar-18	Email	Esperance Tjaltjraak Native Title Aboriginal Corporation	Email regarding the progression of the ethnographic assessment of M74/245 and the archaeological assessment of the proposed site footprint and the production of two reports, one for the ethnographic assessment and the other for the archaeological assessment.		
28-Mar-18	Meeting / Briefing	Department of Mines, Industry Regulation & Safety	1. Overview of the Munglinup Project including footprint 2. Status of PFS / FS and Project Timeline 3. Status of activities for regulatory approvals (stakeholder communications, surveys, etc) 4. Status of baseline surveys completed and underway 5. Process Moving Forward • Define extent of DMIRS/RH involvement • On-going communication channels / meeting programme / proposed attendees • Process for various submissions (DMIRS and non DMIRS approvals) • First Step: briefing of other agencies, including DBCA, EPA, DWER, DMIRS (R&S); co-ordinated information meeting to be held by mid-April.		

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9-Apr-18	Email	Department of Mines, Industry Regulation & Safety	Email requesting confirmation of clearing permit requirements with a POW. Email Question: MRC are submitted a POW for the following activities (via the spatial POW system) and the DMIRS system is suggesting they need a Clearing Permit. It was my understanding that having an approved POW provided an exemption under the EP Native Vegetation Clearing Regs.		Email Response: It's likely they are hitting the mapped extent of the TEC thereby intersecting with an ESA. Clearing for exploration is not exempt in an ESA, so the system is flagging that a clearing permit may be required. The clearing permit question will not prevent them from submitting (i.e. they do not need a clearing permit application in place to submit the PoW), so I recommend they provide some extra comments to say that the tenement has been surveyed and the most likely occurrences of the TEC will be avoided.
10-Apr-18	Email	Department of Water and Environmental Regulation	Email requesting confirmation that the Munglinup Project is not located within a proclaimed surface or groundwater area and thus does not requie a 26D or a 5C		With regards to your query below, licensing to construct wells and take groundwater outside of proclaimed areas is only required when a well accesses an artesian aquifer.
12-Apr-18	Letter	Shire of Esperance	Letter notification of miscellaneous licence application for pending tenement M74/51 to connect M74/245 with the Clayhole road reserve to the north-east.		
12-Apr-18	Letter	Esperance Tjaltjraak Native Title Aboriginal Corporation	Letter notification of miscellaneous licence application for pending tenement M74/51 to connect M74/245 with the Clayhole road reserve to the north-east.		
12-Apr-18	Letter	FORTI, Luke Alexander – E74/565	Letter notification of miscellaneous licence application for pending tenement M74/51 to connect M74/245 with the Clayhole road reserve to the north-east.		Letter bounced. Resent on 18 April 2018.
12-Apr-18	Letter	PA Tucker Pty Ltd	Letter notifcation of miscellaneous licence application for pending tenement M74/51 to connect M74/245 with the Clayhole road reserve to the north-east.		

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18-Apr-18	Meeting / Briefing	Esperance Tjaltjraak Native Title Aboriginal Corporation	As discussed MRC have a long history in dealing with landowners, albeit in foreign jurisdictions, and understand the importance of appropriate engagement. Mark has also had more direct dealings with Traditional Owners with his earth moving business in Western Australia. We understand that with the project being in a Mineral Reserve, native title has been extinguished and there is no requirement for a formal agreement with the Traditional Owners. That being said, we respect and appreciate the connection the Esperance Nyungar people have with the land and will make sure that any appropriate opportunities the project may create will be discussed with ETNTAC. We need to make sure that expectations are properly managed and any opportunities that are appropriate for your members to partake in are commercial, and sustainable. MRC has no issue in supporting, through various economic and other mechanisms, ETNTAC's endeavours in this regard so long as there is that commercial sustainability underpinning the engagement. With this in mind we suggest that as a first step in building this relationship ETNTAC provide MRC with some statement of current and near term capability, especially with regard to your new ranger program, and any opportunities that you feel would fit with those capabilities. As discussed I believe that there may be some opportunity in the first instance to provide support in monthly environmental baseline data collection. When the timing is appropriate there is also the potential for seed collection and a subsequent nursey which, once we have begun rehabilitation works, could rely on MRC as a cornerstone client with contracts for long term delivery of tube stock and such. I am certain that other opportunities will also arise in areas such as training and up-skilling, direct employment, sponsorship of education programs, support businesses and other possible appropriate activities.		Our Rangers participation in monthly environmental baseline data collection is something we would welcome. I believe that there may be scope to include such activities within our Rangers TAFE certification process (discussed further below), which may give MRC some assurance that the monitoring would meet required standards. Essentially, from 1 May we will have a team of 12 male and female Rangers under the supervision of a Coordinator. The Rangers will be enrolled in two Cert III through South Regional TAFE (Indigenous Land Management and Aboriginal Sites Work). As mentioned above, environmental monitoring is a core skill set. Within a six-month period, the Rangers will also be trained in: - Remote area first aid - Chemical weed control - Green card (dieback control) - Fauna handling and - Bush fire-fighting (national accreditation). We are also currently working on an Economic Opportunity Plan for the Esperance Nyungars which will be completed by the end of June. I know that native seed collection and the establishment of a native nursery is likely to be identified as a potential business opportunity which also meets strategies under the HCP. We are in very preliminary discussions with the Water Corporation and Indigenous Land Corporation about support for such a project. No doubt the more potential project partners the better. In terms of other commercial opportunities that we would like to pursue – we are a blank canvas in that any opportunity that is not incompatible with our members' interests will be considered. The need to prioritize opportunities based on a long-term view of the Esperance economy is why we are preparing the Economic Opportunity Plan as a first step.

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23-Apr-18	Email / Letter	Shire of Esperance	Shire of Esperance received letter regarding Miscellaneous Licence application and emailed ISPL to request additional information.	Email reads: The Shire of Esperance is in receipt of your miscellaneous license application for the Munglinup Graphite project, and requests the following information to enable us to make comment on the proposal: 1) What is the proposed size of the operation? 2) What is the proposed annual tonnage of material to be extracted from the site? 3) Approximately how many vehicle movements will this equate to? 4) Are we correct in assuming that vehicles leaving the site will be heading to the Port of Esperance via the South Coast Highway and Harbour Road, or are you looking at alternative shipping arrangements (i.e. Albany, Bunbury, etc)? This will enable us to determine what level of road maintenance agreement or road construction we will require as part of the application.	MRC Graphite response to the questions raised: 1) What is the proposed size of the operation? The mining operation is anticipated to reach a maximum annual material movement of 3Mtpa. Processing throughput is planned to be 400ktpa. This is based on the outcomes of the current PFS. 2) What is the proposed annual tonnage of material to be extracted from the site? Based on the outcomes from the PFS an annual average of 56kt of graphite concentrate will be produced. 3) Approximately how many vehicle movements will this equate to? Assuming 24t per 20" container we estimate average annual movement of 100 trucks per month (2 containers on each) for product. There is likely to be a couple of containers each month for operational consumables and spares. There will likely be a couple of light vehicles each day and a bus in/out each shift. 4) Are we correct in assuming that vehicles leaving the site will be heading to the Port of Esperance via the South Coast Highway and Harbour Road, or are you looking at alternative shipping arrangements (i.e. Albany, Bunbury, etc)? We are still working through the logistics but the idea is to ship the concentrate out through Esperance port to various destinations including Kwinana. There may be an option to take a portion (up to 10ktpa) directly from Munglinup to Kwinana via the main highway or rail. This is currently being investigated.
24-Apr-18	Phone Call	PA Tucker Pty Ltd	Phone call regarding activities which occur on Clayhole Road that could be impacted by the miscellaneous licence application.	Issue raised during phone discussion: 1. Concern that Clayhole Rd would be closed to public access once upgraded 2. The road is used as a makeshift runway for spraying activities and exploration/development activities would interfere with a planned spray next week 3. He also indicated that he would probably have to build a proper runway on a paddock soon as using the road is technically illegal however the shire looks the other way for the moment. 4. Discussion on purchase of his land adjacent to the mining lease.	Outcomes from the phone discussion: 1 and 2. I assured Phillip that we would not be asking council to close the road to the public and that there is no activity planned in the area for at least the next 6 months. He was happy with this, had no issue with MRC and is keen to discuss the project further. 3. I suggested that when he selects a location for a new runway MRC may be able to assist in construction of the runway in some way shape or form, especially if we could have access. 4. He stated that he is about to put a large parcel on the market which I believe includes the paddock directly south of the Mining Lease. We need to check this with Phillip. He did not want to break apart the land parcel and indicated that the parcel is probably worth around $9 million based on recent sales. There may be scope to purchase then on-sell the land not required, or convince Phillip to carve out a small parcel directly south of our Mining lease.
23-27-Apr-18	Site Visit	Esperance Tjaltjraak Native Title Aboriginal Corporation	A week long Archeaologic and Ethnographic survey of MRC Graphite Tenure with Applied Archeology Australia (AAA) consultants and representatives from the Esperance Tjaltjraak Native Title Aboriginal Corporation. The purpose of the survey is to identify sites of cultural significance.		
30-Apr-18	Phone Call	Luke Forti	ISPL received a phone call from exploration tenement holder Luke Forti regarding Misc Licence application and potential conflicts with a proposed mining licence across the area. Indication was also given that the misc licence area is a potential water source.		

Date	Type of Engagement	Stakeholder Organisation	Matters Discussed	Stakeholder Feedback	Response to Feedback / Outcomes / Comments
7-May-18	Phone Call	Luke Forti	ISPL received a second phone call from exploration tenement holder Luke Forti regarding Misc Licence application and potential conflicts with a proposed mining licence across the area.		The message was passed on for Daniel to contact Luke and all discussions regarding E74/565 to be had by Mark.
5-Jun-18	Email / Letter	Department of Mines, Industry Regulation & Safety	ISPL received an email from DMIRS providing an update on POW Reg ID 74373.	These were the two issues I raised: 1) Can you please provide some additional information on what clearing controls will be put in place during clearing to avoid any direct or indirect impacts to this TEC, including how ground truthing will be conducted? 2) The proposed exploration activities are located within the dieback risk area. I note dieback hygiene practices were outlined in PoW Reg ID 70830. Can you please also confirm that clearing and exploration activities will not be undertaken in wet soil conditions? The proponent did advise in the resubmitted PoW that a dieback survey had been done but the report was still being finalised. However the recommendations in the report would be implemented. Unfortunately these recommendations haven't been included in the PoW documentation. It would be of value to me to know what site specific recommendations were made.	ISPL responded to address the issues raised with the following information: • Dieback – Attached to this email is a copy of the dieback assessment report. This assessment found no dieback within M74/245. It was noted that a significant proporation of the inspected are is uninterpretable due to the type of vegetation occurring. Dieback control measure proposed include: • Ensure all vehicles and machinery are clean upon arrival to site. This is particularly important for vehicles/machinery that have been working in other areas where dieback management may not be in place. • Soil movement from uninterpretable areas into uninfested areas is to be prevented. In wet conditions where soil adheres to vehicles and machinery, cleandown will be required when entering uninfested areas from an uninterpretable area. • For operations undertaken during wet conditions, inspection/hygiene points, including washdown equipment will be required at the boundary between uninfested and uninterpretable areas. Vehicles should be inspected and washed down if necessary before entering uninfested areas from uninterpretable areas. Inspection/washdown is not required when entering uninterpretable areas from uninfested areas. A Hygiene Management Plan would assist in identifying and outlining the necessary hygiene requirements. • Conduct operations under dry soil conditions. Where activities occur under dry soil conditions and soil does not adhere to vehicles and machinery, they may move from uninterpretable areas into uninfested areas without performing a cleandown. • Operational areas that are located within uninfested areas are required to be assessed every 12 months. Phytophthora Dieback occurrence information expires 12 months after the assessment completion date in operational areas and is no longer valid after this period. No further assessments are required for uninterpretable areas, as the status of these areas will not change. • TEC Management – Mapped TEC areas are being redefined and mapped following Woodman Environmental May field trip and a TEC and Significant Values Induction to be rolled out for Exploration staff. This induction will ensure that personnel involved in pegging new areas to be cleared are able to identify and avoid TEC vegetation. The induction is being developed by ISPL with Woodman input. As the original POW was replaced, I will confirm if this restarts the clock.

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6-Jun-18	Email / Letter	Department of Mines, Industry Regulation & Safety	ISPL received an email from DMIRS providing an update on POW Reg ID 74373	DMIRS advised the POW would be approved with the additional information provided	POW Reg ID 74373 approved
26-Jun-18	Meeting / Briefing	Esperance Tjaltjraak Native Title Aboriginal Corporation	Post heritage assessment meeting and site visit with AAA Consulting and ETNTAC representatives. The purpose of the field trip and meeting was to discuss the outcomes and recommendations of the AAA Heritage Report – which areas must be avoided, the plans for protecting the sites long term – lodgement in the state aboriginal Heritage database and a Project Update.		
27-Jun-18	Email / Letter	Department of Mines, Industry Regulation & Safety	POW 73238 submission to allow for the development of sumps for the Munglinup Test Pumping. A key driver for this request is to ensure that all water from the pumps test is required to effectively manage/limit the potential impacts on the environment. Without a collection area at each pilot bore there is a risk that the transfer of water will not occur at the same rate as the pump test potential resulting in the unplanned release of water.		POW assessed immediately and was approved on the 29/6/2918
28-Jun-18	Email / Letter	Esperance Tjaltjraak Native Title Aboriginal Corporation	Agreement of cultural monitors for work relating to the TSF access track, TSF test pits and turkeys nest. Once that work is completed we agree that we need to quickly move towards a Heritage Management Plan and that as a part of that plan MRC will not require cultural monitors when using previously cleared areas for other exploration activities such as the water bore pump testing and infill drilling.		Cultural monitors on site for this work
8-12-Jun-18	Site Visit	Esperance Tjaltjraak Native Title Aboriginal Corporation	Supplementary site visit to update the heritage report and include areas which were missed in the last field survey. This is as an outcome from the meeting on the 26th June 2018.		Revised heritage report

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11-Jul-18	Meeting / Briefing	Goldfields Esperance Development Commision	Provided an overview of the project and development schedule. He advised that it would be advisable to engage with the local Esperance and Ravensthorpe Shires as soon as possible with respect to roads. Agreed need to understand our requirements better. In terms of normal operating conditions the main highway should not be an issue as we will have a considerably smaller impact than Ravensthorpe Nickel. The issue is Farmer, Clayhole, Mills and Reynolds Rds. also mentioned that the GEDC now have the capability to undertake local and regional economic impact assessments. He has offered to undertake such an assessment of the Munglinup Project for free to assist in determining the likely impact of the operation to the local economy. This obviously has positives and negatives for MRC. He is going to get their analyst to contact us with the necessary inputs.		GEDC supportive of project and have capacity to assist with modeliing economic impact of the project for the region.
14-Jul-18	Meeting / Briefing	Member of Government	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. MRC was open to workers residing in Munglinup – given the short travel distance to the mine site. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the Ravensthorpe and Esperance Chambers of Commerce and Industry on conducting industry briefing sessions. Environmental: 1. MRC provided an overview of the work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc.). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance (date to be determined) – it is expected that there will be information provided about the environmental approval processes and the work being undertaken by MRC at the proposed Sessions.	Social: 1. Mr Graham raised no questions regarding the information that was provided, only noting that it was important to make a positive contribution to the community. Economic: 1. Mr Graham believed that it was important to look at a residentially based workforce given the significant economic and social impact of increasing job opportunities in regional areas. 2. Mr Graham also commented that the Government was keen to see positive action in respect of the procurement of local goods and services and utilisation of local businesses. This was consistent with the State Government's buy local policy - and believed that there were significant benefits to both the company and local economy to adopt these sorts of strategies. Environmental: 1. Mr Graham raised no queries in respect of the information provided on the environmental approval processes being undertaken by MRC. Heritage: 1. No queries raised with respect to Native Title or heritage matters. Other: 1. Mr Graham requested that MRC give every consideration to utilising the Esperance Port, however also recognising the need to complete the logistics study and for export pathway to be economically viable and should be developed in the best way to allow MRC to cater to the global market. 2. Mr Graham advised that Premier was in Esperance the following week and he would raise this with him.	Social: 1. MRC is looking to complete a Community Engagement Plan by early August 2018, which will include a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. As has already been stated, MRC will look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. Industry briefing sessions will be a requirement of the Community Engagement Plan. It is planned to liaise with the Goldfields Esperance Development Commission and Esperance and Ravensthorpe Chambers of Commerce such that any local sourcing strategies by MRC are complimentary to work being undertaken by these organisations. It is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be undertaken during October – December 2018. Environment: 1. MRC advised that it would keep Mr Graham informed of the environmental processes and advise when approvals had been referred to the relevant statutory authorities for consideration. Heritage: 1. MRC undertook to keep Mr Graham informed of the heritage work being undertaken. Other: 1. No further action

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			MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with ETNTAC and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Other: 1. MRC advised that it was yet to complete a logistics study – with the final export pathway being determined by the end destination of the product. In the event that the product was to be exported to overseas markets, it was likely that it would be trucked from the mine site to Esperance Port. Given the low volumes of approx. 55,000 tonnes per year it was expected that truck movements would not be more than 3-4 a day. Mr Graham was also advised of MRC's recent discussions with the Local Governments about road access. 2. Discussions also covered issues related to opportunities for downstream processing, and the need for the State Government to be proactive in addressing the issues of regulatory approvals, the availability of suitable land and planning approvals/infrastructure to facilitate investment decisions by private sector in value adding/downstream processing opportunities.		2. Liaison with State Government on down—stream processing opportunities currently being pursued by MRC Head Office.
16-Jul-18	Meeting / Briefing	Goldfields Esperance Development Commission	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the GEDC and ECCI. Environmental: 1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and	Social: 1. Mr Liddelow noted the information provided and emphasised the need for any community support to be aimed at delivering sustainable outcomes. He advised that a significant level of support had been provided to local community organisations through the Royalties for Regions funded Community Chest and Regional Grants Schemes. Mr Liddelow offered GEDC assistance in the development of a community based funding program, given their significant experience in grant funding. Economic: 1. Mr Liddelow advised that this approach was consistent with State Government regional development policy and aligned with the GEDC and Department of Primary Industries and Regional Development's local jobs initiative. Mr Liddelow touched on the economic impact of the cessation of the iron ore exports from Esperance and the softening of consumer demand for local businesses and services, as well as the easing of the rental and property markets. 2. Mr Liddelow advised that the GEDC had recently appointed a local content adviser to deliver on the State Government's local content/local jobs initiative. He advised that the GEDC could provide assistance in the development of local buying practices and procurement, as well as the development of business capacity to assist with tendering and compliance.	Social: 1. MRC is looking to complete its Community Engagement Plan in early August 2018, which will include a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC will continue to look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. MRC advised that it would welcome the assistance of the GEDC, and had planned to work with the GEDC and ECCI on the delivery of industry briefings and the most effective way to engage with local businesses. MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be developed during October – December 2018. Environment: 1. MRC outlined that the issue in respect of Alpha Fine Chemicals was different to the MRC Graphite project – insofar as AFC's proposal was to develop downstream processing of nickel hydroxide utilising

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			Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other: Nil	Environmental: 1. Mr Liddelow noted the information provided advised that there had been some sensitivity in the community regarding potential environmental impacts and that this would need to be managed carefully given the recent experience with Alpha Fine Chemicals. Heritage: 1. Mr Liddelow noted the information provided and advised that MRCs approach was consistent with those advocated by both the GEDC and DPIRD, under the direction of their Minister Alannah MacTiernan. He advised that both agencies had been directed to deliver tangible opportunities to increase aboriginal employment and business development and commercial contracting opportunities. Other: Nil	chemical processes on land situated adjacent to peri-urban development and within the catchment of the RAMSAR designated wetlands. The MRC project involved the extraction of graphite through open pit operations and purification of the product utilising a concentrator without the use of deleterious reagents. Further, MRC intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. Heritage: 1. MRC to brief the GEDC on potential aboriginal employment and business development opportunities as they arise. Other: Nil
16-Jul-18	Meeting / Briefing	Office of Hon Peter Rundle MLA and Hon Colin De Grussa MLC	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the GEDC and ECCI. Environmental:	Social: 1. Ms Castledine noted the information provided. Economic: 1. Ms Castledine noted the information provided 2. Ms Castledine noted the information provided and advised that through her previous experience as CEO of the ECCI, it had been difficult for local businesses to secure significant business opportunities with mining interests in the past. Environmental: 1. Ms Castledine noted the information provided. Heritage: 1. Ms Castledine noted the information provided. Other: Nil	Social: 1. MRC is looking to complete its Community Engagement Plan in early August 2018, which will include a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC will continue to look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. MRC advised that it would work with the GEDC and ECCI on industry briefings and the most effective way to engage with local businesses. MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be developed during October – December 2018. Environment: 1. MRC will ensure that the office of Mr Rundle and Mr De Grussa are

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			1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other:		provided with briefings on environmental activities and the progression of the approvals processes. Heritage: 1. No further action required. Other: Nil
17-Jul-18	Meeting / Briefing	Shire of Ravensthorpe	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the Ravensthorpe and Esperance Chambers of Commerce and Industry on conducting industry briefing sessions.	Social: 1. No queries or concerns were raised in respect of social issues. Economic: 1. The Shire of Ravensthorpe queried whether the Project would look to have workers reside in either Ravensthorpe or Hopetoun – given that Hopetoun had a surplus of housing which had been constructed to cater for the Ravensthorpe Nickel Project. 2. The Shire noted the information provided and commented that their previous experience with both the Galaxy and First Quantum Minerals operations was that there had been minimal take up of local businesses - aside from sporadic contracting opportunities. The general observation is that businesses could not rely on long term contracts as these were often taken up by larger Perth based companies or suppliers. Environmental: 1. The Shire mentioned that there had been some issues related to the noise and visual impact of the Galaxy mine, given its close proximity to the township of Ravensthorpe.	Social: 1. MRC is currently developing a Community Engagement Plan which will be completed in early August 2018. It is expected that the Plan will include a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC was open to workers residing in Munglinup – given the short travel distance to the mine site. However, there may not be sufficient numbers to warrant bussing arrangements to either Hopetoun or Ravensthorpe and personal travel would need to be considered in respect to OHS requirements for fatigue management etc. 2. MRC agreed that it was often difficult to obtain certain services which required specific skills or operational capacity that was not available or capable of being provided by local businesses – and it was often difficult for local businesses to invest in significant additional capacity or develop expertise in the absence of a long term

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			Environmental: 1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. Contingent on the completion of the Community Engagement Plan, it is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. Other: 1. MRC advised that it was yet to complete a logistics study – with the final export pathway being determined by the end destination of the product. In the event that the product was to be exported through the Port of Esperance, MRC were investigating the use of Farmers and Clayhole Rds for heavy vehicle access into and out of the mine site (road trains) – these roads all within the Shire of Esperance. MRC advised that it was considering the utilisation of Mills Rd (which falls within the Shire of Ravensthorpe) for light and emergency services vehicle access.	Heritage: 1. The Shire noted the information and advised that they saw no correlation in respect of the heritage and NT matters and their functions as a local government. Other: 1. The Shire advised that it had significant experience in the assessment and upgrade of Shire roads for use by mining companies – citing both Galaxy and First Quantum Minerals as examples. The Shire further advised that Mills Rd was already designated for heavy vehicle use for roads trains up to a maximum length of 36.5m, however these vehicles were restricted from using the road in wet weather.	contractual commitment by the mining company. Notwithstanding this, it was MRC's intent to work with both the GEDC and RRCI on holding industry briefings, as well as determine the best and most effective way to engage with local businesses in the region. MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be developed during October – December 2018. Environment: 1. MRC advised that it intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. Heritage: 1. No further action required – other than to ensure that the Shire was briefed on heritage and native title matters that may have an impact on the local government. Other: 1. MRC requested a copy of the Shire's cadastral map defining the current road reserve and designation for heavy vehicle access.

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25-Jul-18	Phone Call	Alistair Tucker	Woodman Environmental Consulting had requested access to the Tucker property immediately adjacent to the eastern boundary of the Mining Reserve in order to carry our flora survey work. Access was difficult inside the Reserve due to thick vegetation and the fire break having been grown over. The request was sent through at 5:00pmon the 25th July 2018, the day before access was required. Shayne Flanagan contacted Alistair Tucker by telephone at 5:30pm 25th July 2018. Mr Tucker advised that he was very uncomfortable about granting access to the farm at such short notice and without having a better understanding of the legal implications for them, and how that would play out down the track for future access. The issue was not pressed with Mr Tucker, given his reference to a previous incident where a contractor had sought to gain access to their property without the knowledge of MRCG.	Mr Tucker did query whether MRCG would be seeking to gain access through legal means, in the absence of any consent by the owners. The reason for his query was difficult to understand, other than he had assumed that the first option for MRCG was to pursue legal means of access in the event that access by the landowner was not granted.	Shayne Flanagan assured Mr Tucker that MRCG had adopted a 'good neighbour' policy and would always seek to come to an amicable agreement on any matters as this was always the best course of action if good relations and trust between the parties were to be established going forward. Mr Tucker advised that at this stage they would not be granting access. However, it was also agreed that we would arrange a follow up meeting during the week ending 4 August 2018, pending Mr Tucker's availability, to further discuss ways in which we can progress the access issue such that all parties are comfortable and satisfied with the arrangements.
30-Jul-18	Phone Call	Shire of Ravensthorpe	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the Ravensthorpe and Esperance Chambers of Commerce and Industry on conducting industry briefing sessions. Environmental:	Social: 1. No queries or concerns were raised in respect of social issues. Economic: 1. The CEO queried whether the Project would look to have workers reside in either Ravensthorpe or Hopetoun – given that Hopetoun had a surplus of housing which had been constructed to cater for the Ravensthorpe Nickel Project. 2. The CEIO noted the information provided and commented that it would be beneficial to the district and local economy for local businesses to have the opportunity to have the opportunity to tender for work with MRC. Environmental: 1. As at the previous meeting with the Shire, the CEO mentioned that there had been some issues related to the noise and visual impact of the Galaxy mine, given its close proximity to the township of Ravensthorpe. Heritage: 1. The CEO noted the information provided.	Social: 1. MRC is currently developing a Community Engagement Plan which will be completed in early August 2018. It is expected that the Plan will include a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC was open to workers residing in Munglinup – given the short travel distance to the mine site. However, there may not be sufficient numbers to warrant bussing arrangements to either Hopetoun or Ravensthorpe and personal travel would need to be considered in respect to OHS requirements for fatigue management etc. MRC advised that it was their intention to work with both the GEDC and RRCI on holding industry briefings, as well as determine the best and most effective way to engage with local businesses in the region – such that they had to ability to bid for work. MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed

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			1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. Contingent on the completion of the Community Engagement Plan, it is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. Other: 1. Advised CEO that MRCG was currently evaluating options regarding access to the minesite. At this stage possible options were using Mills Rd/Reynolds Rd (Shire of Ravensthorpe) for light vehicle/emergency access, with heavy vehicle access along Farmers Rd/Clayhole Rd (Shire of Esperance).	Other: 1. The CEO indicated that they could not see any issues with Mills Rd/ Reynolds Rd being utilised, contingent on any consequential upgrades and ongoing maintenance of the roads being financially underwritten by MRCG. The premise being that any upgrades or accelerated deterioration of the roads would be directly related to utilisation by the mining company. This will be a matter for further negotiation between the Shire and MRCG – and is not something I provided a position on. The CEO advised that the Shire could undertake the works, but would need confirmation of the specifications for the road that would be required (this would also be required to determine relevant alignment etc). The CEO also advised that the Shire (and more broadly Local Government) was having problems securing Native Vegetation Clearing Permits for road development/construction. The Shire currently prepares and submits the permits in-house. He advised that they would be very open to collaborating with MRCG on securing the clearing permits etc if they were necessary for any upgrades to Mills Rd. The CEO also advised that at the point where Reynolds Rd crosses to the eastern side of the Munglinup River, it is within the Shire of Esperance. He did not see that as an issue – given that the Shires of Ravensthorpe and Esperance currently have a resource sharing arrangement and there is a very good opportunity for collaboration. However, it would be a good idea to touch base the Esperance to ensure that they were aware of the possibility of upgrading Reynolds Rd.	implementation methodology to be developed during October – December 2018. Environment: 1. MRC advised that it intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. Heritage: 1. No further action required – other than to ensure that the Shire was briefed on heritage and native title matters that may have an impact on the local government. Other: It was agreed that the Shire and MRC would conduct a site visit and assessment of Mills Rd to determine its suitability for light and emergency services vehicle all weather access – such that a determination could be made on whether any upgrade works were required. In the event that the road required upgrading, the Shire and MRC will enter into further discussions regarding Native Vegetation Clearing Permits and negotiations in respect the costs for upgrading and future maintenance.

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2-Aug-18	Meeting / Briefing	Shire of Ravensthorpe	Shayne Flanagan met with the Ravensthorpe Shire Engineer and Manager Corporate Services specifically to discuss road access utilising Mills Rd for light and emergency services vehicle access:	• Travelled Road with Engineer between South Coast Hwy and Munglinup River (Shire Boundary); • Shire engineer advised that existing Rd design was suitable for vehicle traffic up to semi-trailer (with light vehicles having all weather access and truck access over 8tons being restricted during wet weather); • On that basis the Shire considered that no native vegetation clearing permit was required. • If road condition required improvement it would possibly involve re-sheeting and gradient/ drainage improvements which could be completed within the existing road envelope; • He advised that the Shire could undertake this work – most likely utilising contractors under their existing panel contractor arrangements within a timeframe agreed with MRCG, subject to any negotiated arrangements with the Shire. • The engineer also advised that if MRCG required development of Mills Road beyond its existing alignment or width, it would need to provide specifications of its requirements to the Shire.	The entry point from Mills Road into the mine reserve is via Reynold Rd, which falls within the Shire of Esperance. Shayne Flanagan to make contact with the Esperance Shire. The Shire of Ravensthorpe has already had an informal discussion, at officer level, with the Esperance Shire regarding road access to the mine site given that Mills Rd traverses both Shires. The Shire representatives advised that the Shire Council was receptive to working with MRC on whatever road upgrades may be deemed necessary by the company, however, in their view the road in its current configuration and condition was more than adequate to accommodate light and emergency vehicles, bearing in mind that it was already used by heavy vehicles up to 36.5m.
3-Aug-18	Meeting / Briefing	Shire of Esperance	Shayne Flanagan met with the Esperance Shire (Richard Hindley, Manager Strategic Planning and Land Projects/ Neil Williams, Manager Engineering Development) regarding options MRCG were exploring for light and emergency services vehicle access into the Mining reserve utilising Reynolds Rd from its junction with Mills Rd.	The Esperance Shire advised that MRC should look at the option of the Shire transferring responsibility for the road to MRC, rather than the Shire having to work through a process of gaining native vegetation clearance permits and road development. In the event that this is not an option for MRC, the Shire advised that they would happily work in collaboration with MRC in respect of gaining the necessary approvals and work towards an agreement on the costs of upgrading and maintaining the road.	Matter referred to Daniel Hastings for consideration in respect of the transfer of the road from the Esperance Shire to MRC (Email dated 3 August 2018).
8-Aug-18	Meeting / Briefing	Shire of Esperance	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local	Social: 1. No queries or concerns were raised in respect of social issues. Economic: 1. Mr Scott welcomed the position that MRC was taking in respect of a residentially based workforce as a preferred option, given the economic benefits that would flow on for the town and district. He advised that there had been an outflow of people from Esperance with the cessation of iron ore exports through the port of Esperance, with over 100 jobs lost from the withdrawal of the Aurizon rail operations alone. 2. Mr Scott was receptive to the position taken by MRC in respect of local procurement – but was cautious in respect of the actual reality between having a policy and ensuring that local businesses were provided with a real opportunity to tender for work. Mr Scott cited previous examples of mining interests stating similar aspirations which have not translated to local businesses as a first option. Environmental:	Social: 1. MRC has recently completed a Community Engagement Plan, which includes a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC will continue to look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. MRC agreed that the devil will be in the detail in respect of the implementation of the policies and the extent to which there will be a preferential loading when it came to local businesses. It was MRC's intent to work with both the GEDC and ECCI on holding industry briefings, as well as determine the best and most effective way to engage with local businesses in the region.

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			procurement and employment policies and would liaise with the Ravensthorpe and Esperance Chambers of Commerce and Industry on conducting industry briefing sessions. Environmental: 1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other: 1. MRC advised that it was yet to complete a logistics study – with the final export pathway being determined by the end destination of the product. In the event that the product was to be exported through the Port of Esperance, MRC were investigating the use of Farmers and Clayhole Rds for heavy vehicle access into and out of the mine site (road trains). MRC had already been in discussions with Shire of Esperance officers at a preliminary level to ascertain current road designations (approval for road train use) and the protocols applied by the Shire for the upgrade and recurrent maintenance costs for roads. MRC outlined that it had also discussed the potential upgrade of the portion of Reynolds Rd that sat within the Shire of Esperance for utilisation by light and emergency services vehicles. Shire Officers had put forward a proposition for MRC to take on responsibility for	1. Mr Scott made reference to the issues experienced by Alpha Fine Chemicals with respect to the location of its proposed nickel sulphate processing plant in Myrup and the reaction of the adjacent landowners. He thought that there may be a similar issue in Munglinup. 2. Mr Scott also queried the number of truck movements involved in exporting the product, in the event that it was to be exported through the Esperance Port. The query was raised on similar grounds to those raised by the Esperance Port in understanding the impact on the Esperance Port Access Corridor and any potential impacts on the Esperance community. Heritage: 1. Mr Scott noted the information provided and advised that the Shire was currently in negotiation with ETNTAC on land access issues. Other: 1. Mr Scott advised that he could see not see any issue with the utilisation of Farmers and Clayhole Rds for heavy vehicle access, contingent on agreement of the costs for upgrading and future maintenance, compliance with current road design rules for the vehicles that will be used, and ensuring minimal impact on existing road users and adjacent landowners (which would be managed by the Shire). Mr Scott also supported the proposal for the Shire to relinquish the portion of Reynolds Rd that was needed by MRC for access to the mine site, such that responsibility for the road's upgrade and ongoing maintenance would rest with MRC.	MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be developed during October – December 2018. Environment: 1. MRC outlined that the issue in respect of Alpha Fine Chemicals was different to the MRC Graphite project – insofar as AFC's proposal was to develop downstream processing of nickel hydroxide utilising chemical processes on land situated adjacent to peri-urban development and within the catchment of the RAMSAR designated wetlands. The MRC project involved the extraction of graphite through open pit operations and purification of the product utilising a concentrator without the use of deleterious reagents. Further, MRC intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. 2. MRC outlined that it was looking at approximately 3-4 truck movements a day, given that the Project involved exporting 55,000 tonnes per annum. The Shire advised that the Esperance Port Access Corridor (EPAC) had recently been upgraded to accommodate a greater number of truck and rail movements – and that the additional truck movements related to the MRC Graphite project were minimal in the comparison to that which is already using the EPAC for the export of over 2.5 million tonnes of grain per annum through the port. MRC also advised that it was undertaking a logistics study to determine the most effective pathway to market and would brief the Shire once it had been completed. Heritage: 1. No further action required – other than to ensure that the Shire was briefed on heritage and native title matters that may have an impact on the local government. Other: 1. MRC to complete the logistics study to determine heavy vehicle configuration and number of truck movements, such that specifications for Farmers and Clayhole Rds could be determined. Upon completion of the logistics study, discussions with the Shire to recommence in respect of a possible audit of current road design and scope of work for any necessary upgrades. The matter of the transfer of Reynolds Rd by the Shire to MRC was referred to Daniel Hastings for consideration (Refer email 3 August 2018). It is advisable to consider that the portion of Reynolds Rd that

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			the road, given that it is currently not a fully formed road and is not maintained by the Shire, and once the Project is operational its sole purpose would be to provide access to the mine site. MRC had advised that it would consider this option.		sits outside the current Mining Reserve should remain a public road that MRC could consider taking responsibility only for the portion that sits within the Mining Reserve.
9-Aug-18	Meeting / Briefing	Esperance Chamber of Commerce and Industry	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the GEDC and ECCI. Environmental: 1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation.	Social: 1. Ms Ryan enquired on whether MRC would be open to providing direct sponsorship support for ECCI or ECCI events. Ms Ryan provided a copy of the ECCU sponsorship package and membership application. Economic: 1. Ms Ryan advised that the ECCI was very supportive and a keen advocate for the utilisation of a residentially based workforce – especially in the context of the broader economic benefits this could deliver to the town and local businesses. Ms Ryan advised that there had been an exodus of families from Esperance due to the cessation of iron ore exports through the port of Esperance, with over 100 jobs lost from the withdrawal of the Aurizon rail operations alone. This has had a significant impact on local business, as well as local schools and community organisations. 2. MS Ryan advised that the ECCI would be open to working with MRC on industry briefings and assisting with any opportunities for MRC to engage effectively with local businesses. Ms Ryan, raised similar issues as had been raised by the Esperance Shire, insofar as the past experiences where mining interest had stated similar intentions which had not translated to local businesses deriving a significant benefit due to a preference to utilise larger Perth based businesses. Environmental: 1. Ms Ryan noted the information provided and ECCI advised that there had been some sensitivity in the community regarding potential environmental impacts and that this would need to be managed carefully given the recent experience with Alpha Fine Chemicals. Heritage: 1. Ms Ryan noted the information provided and advised that practical engagement with ETNTAC on commercial and contracting opportunities were seen as a positive step – however emphasising the need for any engagement to be underpinned by sustainable business methodology. Other: Nil	Social: 1. MRC has recently completed a Community Engagement Plan, which includes a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Ms Ryan was advised that MRC would consider sponsoring arrangements once it had achieved project approval and in the context of MRC Board approved sponsoring arrangements. It was confirmed that MRC was already a member of the ECCI. Economic: 1. MRC will continue to look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. MRC agreed that the devil will be in the detail in respect of the implementation of the policies and the extent to which there will be a preferential loading when it came to local businesses. It was MRC's intent to work with both the GEDC and ECCI on holding industry briefings, as well as determine the best and most effective way to engage with local businesses in the region. MRC advised that it is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be developed during October – December 2018. Environment: 1. MRC outlined that the issue in respect of Alpha Fine Chemicals was different to the MRC Graphite project – insofar as AFC's proposal was to develop downstream processing of nickel hydroxide utilising chemical processes on land situated adjacent to peri-urban development and within the catchment of the RAMSAR designated wetlands. The MRC project involved the extraction of graphite through open pit operations and purification of the product utilising a concentrator without the use of deleterious reagents. Further, MRC intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. Heritage: 1. No further action required.

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			ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other: Nil		Other: Nil
10-Aug-18	Meeting / Briefing	Member of Government	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. Economic: 1. MRC advised that there would be up to 63 residentially based workers. However, it was expected that these would mainly be based in Esperance. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC was also currently assessing the possibility of a 5 day working week and daily bus-in/bus-out arrangements for most workers. There will still be a need for a 24/7 operation of the concentrator which will involve some night shift arrangements. MRC was open to workers residing in Munglinup – given the short travel distance to the mine site. 2. MRC advised that it was in the process of developing local procurement and employment policies and would liaise with the Ravensthorpe and Esperance Chambers of Commerce and Industry on conducting industry briefing sessions. Environmental: 1. MRC provided an overview of the work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc.). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance (date to be determined) – it is expected that there will be information provided about the environmental approval processes and the work being undertaken by MRC at the proposed Sessions. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible.	Social: 1. Mr Rundle raised no questions regarding the information that was provided. Economic: 1. Mr Rundle noted the information provided and advised that he had been a keen advocate for residentially based workforces rather than FiFo. 2. Mr Rundle noted the information provided and advocated that MRC work with the GEDC and local chambers of commerce in investigating ways to engage with the local business community. Environmental: 1. Mr Rundle noted the information provided and raised no queries other than the sensitivities that may be raised by local landowners – making special note of minimising the impact on adjacent farming operations. Heritage: 1. Mr Rundle noted the information provided and advised that he had also been in discussions with ETNTAC on the potential for commercial and employment opportunities related to the MRC Project. Other: 1. Mr Rundle noted the information provided – making the comment that any additional utilisation of the Esperance Port would be beneficial to the Esperance economy and community given the recent cessation of iron ore exports through the port and the impact that this had on both the Port and Esperance economy. 2. Mr Rundle advised that he had recently met with the Premier, Mark McGowan and had raised the prospect of downstream processing - emphasising the point that graphite, along with lithium, nickel and cobalt were critical to the future production of batteries. Mr Rundle made the comment that the current dialogue in the battery technology space seemed to be dominated by lithium – and the conversation broadened to include the other commodities	Social: 1. MRC completed a Community Engagement Plan in early August 2018, which includes a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. As has already been stated, MRC will look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. 2. Industry briefing sessions are set out as a requirement of the Community Engagement Plan. It is planned to liaise with the Goldfields Esperance Development Commission and Esperance and Ravensthorpe Chambers of Commerce such that any local sourcing strategies by MRC are complimentary to work being undertaken by these organisations. It is expected that the high level local procurement policies will be drafted by September 2018, with more detailed implementation methodology to be undertaken during October – December 2018. Environment: 1. MRC advised that it would keep Mr Rundle informed of the environmental processes and advise when approvals had been referred to the relevant statutory authorities for consideration. Further, MRC intends to provide comprehensive information to neighbouring landowners and the Munglinup community to ensure that they have a thorough understanding of the environmental processes and the work being undertaken by MRC, as well as have the opportunity to provide feedback and raise any concerns they may have. It is MRC's intention to be as open and transparent as it possibly can. Heritage: 1. MRC undertook to keep Mr Rundle informed of the heritage work being undertaken and progression of commercial and employment opportunities with ETNTAC.

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			Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other: 1. MRC advised that it was yet to complete a logistics study – with the final export pathway being determined by the end destination of the product. In the event that the product was to be exported to overseas markets, it was likely that it would be trucked from the mine site to Esperance Port. Given the low volumes of approx. 55,000 tonnes per year it was expected that truck movements would not be more than 3-4 a day. Mr Graham was also advised of MRC's recent discussions with the Local Governments about road access. 2. Discussions also covered issues related to opportunities for downstream processing, and the need for the State Government to be proactive in addressing the issues of regulatory approvals, the availability of suitable land and planning approvals/infrastructure to facilitate investment decisions by private sector in value adding/downstream processing opportunities.		Other: 1. No further action 2. Liaison with State Government on down—stream processing opportunities currently being pursued by MRC Head Office.
10-Aug-18	Meeting / Briefing	Southern Ports Authority	Social: 1. MRC advised that it was looking to adopt a proactive and positive influence on the communities in which it operated. It has a strong track record on making a social contribution – with the example given of the recent initiatives it had been adopting through its operations in South Africa. MRC advised that it had recently completed a Community Engagement Plan, which includes a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC advised that there would be up to 63 residentially based workers - most likely base in Esperance – with the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). MRC also advised that the projected timing of the project (contingent	Social: 1. The Port raised no queries related to social issues – given that the meeting was focussed on providing them with an understanding of the nature of the project, timelines for approvals and operations and potential throughput for the Port Economic: 1. Mr Byers expressed an interest in the approach being adopted by MRC – insofar as pursuing the option of a residentially based workforce given the recent round of redundancies at the Esperance Port, with the expectation of more redundancies in September 2018. With the additional loss of approximately 100 jobs from the rail operator (due to cessation of iron ore exports) there may be an opportunity for Port workers (with transferrable skills) to find employment with MRC. This would be good for retention of workers and their families in the town of Esperance. Environmental: 1. Mr Byers noted the information provided. 2. Mr Byers advised that the Port could see no issue in the product	Social: 1. No further action required – other than incorporating social elements in overall future briefings. Economic: 2. MRC will continue to look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. MRC had already received expressions of interest from Port employees who had either been made redundant or were looking at the potential of taking up future redundancy options. These expressions had been forwarded to MRC HR Department for future reference. There is a minimum timing difference of over 12 months between the Port redundancies in June and September 2018 and the potential commencement of operations of the Project in Q4 2019. This may diminish the opportunity for take up of redundant Port employees as they may have already secured employment elsewhere.

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			on securing the necessary environmental approvals and completion of a bankable feasibility study) was the commencement of operations in the last quarter 2019. Environmental: 1. MRC outlined the substantial work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. It is also expected that Community Information Sessions will be held in both Munglinup and Esperance in late August – these will include information about the environmental approval processes and the work being undertaken by MRC. MRC's aim was to be as thorough is possible in respect to the work being undertaken regarding the environmental approvals and was ensuring that the process was as transparent as possible. 2. MRC advised that it was likely that the product would be in the form of a concentrate and exported in bulka bags (possibly packed inside 20 foot containers). However this would be contingent on completion of offtake agreements and a logistics study. Heritage: 1. MRC advised that it had been in discussions with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) and had undertaken heritage surveys with members of ETNTAC. Several sites of interest had already been identified. Future heritage survey work is planned in collaboration with ETNTAC and work is underway in developing a Cultural Heritage Management Plan which will set the protocols for current and ongoing management of heritage sites in accordance with State and Federal legislation. ETNTAC rangers have also been onsite monitoring clearing to ensure that no heritage sites are disturbed. MRC has also been in discussions with ETNTAC CEO to look at opportunities for future aboriginal employment and procurement of services. Other: Nil	being exported in the proposed form, however, it would be advisable to inform the Port of the final method proposed for export as soon as it is known, such that it could ensure compliance with its environmental licences. As a general rule, the export of product in fully enclosed bulka bags or containers represent little or no issues in respect of the Port licences, and it was only where product was exported as bulk concentrate directly into a ship's hold utilising bulk outloading processes that there were more significant licensing and community impact considerations. 3. The Port queried how many truck movements would be involved – in the context of the impact on the Esperance Port Access Corridor and local residents. The Port advised that $120m had recently been spent on upgrading the EPAC to improve truck and rail efficiency into the port, and to remove any interface with local residential traffic through grade separation. Significant work had also been undertaken in respect of noise amelioration with bunding and noise screen walls constructed. The Esperance Town Planning Scheme had also been amended to include a noise buffer zone to ensure any building development had appropriate noise reduction materials used in their construction. Heritage: 1. Mr Byers noted the information. Other: Nil	MRC will continue to liaise with the Port on any employment opportunities presented by the Project. Environment: 1. No further action required – other than incorporating an update on the environmental processes and associated timelines in overall future briefings. 2. MRC will provide information on the proposed method for export to the Port as soon as it has been finalised. 3. MRC outlined that it was looking at approximately 3-4 truck movements a day, given that the Project involved exporting 55,000 tonnes per annum. The Shire advised that the Esperance Port Access Corridor (EPAC) had recently been upgraded to accommodate a greater number of truck and rail movements – and that the additional truck movements related to the MRC Graphite project were minimal in the comparison to that which is already using the EPAC for the export of over 2.5 million tonnes of grain per annum through the port. MRC also advised that it was undertaking a logistics study to determine the most effective pathway to market and would brief the Port once it had been completed. Heritage: 1. No further action required. Other: Nil

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14-Aug-18	Phone call/ Email	Land owners/ Community members	Shayne Flanagan made contact by telephone to make introduction and explain details of the Community Information Session being held in Munglinup on the 20th August 2018. Personal invitation to the Community Information Session was then sent by email.	All had a rudimentary knowledge of the Project. and advised that they were very keen to learn more about the Project. All were provided with contact details for the Senior Social Responsibility Adviser and were advised that a one-on-one meeting and briefing could be arranged at their convenience if they were not able to attend the Community Information Session.	Rudimentary knowledge of project - follow-up to be undertaken if unable to attend the Community Information Session at Munglinup
20-Aug-18	Community Event	Land owners/ Community members	Attendees: • Landowners (adjoining Mining Reserve 27414) • Adjacent Landowners (neighbouring farms) • Local Community o Residents of the townsite of Munglinup o Members of the Munglinup Community Group o Members of the Munglinup Farmers Group • Local business owners • Local Government (Shire of Ravensthorpe) The Community Information Session was publicised by: • direct invitations to local landowners and community groups via email and telephone calls; • banners posted at the local general store/roadhouse and caravan park; • Via the membership networks of the Munglinup Community Group and Munglinup Farmers Group (includes all local sporting groups); • Esperance Express newspaper website (13 August 2018); • Community broadcasts on local radio (Triple M Radio 747) throughout the week leading up to the session; and • The Shire of Ravensthorpe Community Facebook page The Community Information Session was attended by 30 people with all attendees given the opportunity to provide their telephone and email contact details should they wish to receive more information about the Project throughout its development. This information was entered into the Munglinup Local Community Contact Register. The Session was conducted in an informal interactive way, with attendees invited to ask questions during a power point presentation. The presentation set out information about the following: • Mineral Commodities Ltd – a general overview of the company and the legal entity through which the Munglinup Graphite Project is being developed. • An overview of the Project, inclusive of o Extraction and processing methodology; o Projected mine life and tonnages to be mined and processed; o Proposed heavy and light vehicle access routes; o Environmental and heritage approval process, including: § Relevant legislation (Federal and State); § Relevant licences and permits;	Social: 1. Emergency Services – concern was raised by local St John's Ambulance volunteer on whether the mine-site would be relying on the local Munglinup St John's Ambulance service for medical emergencies – thereby creating the potential for the community to be without an ambulance service while it catering to the mine. Economic: 1. Local contracting – a query was raised on whether there would be local sourcing of contractors. The premise of the question was along the lines of ensuring that there was a direct economic benefit to the local community. 2. Potential for Apprenticeships – a query was raised on whether there would be any apprenticeships or training opportunities for young people. Environmental: 1. Tailings dam construction – a query was raised about whether the tailings dam would be pvc lined and what steps would be taken to ensure that tailings would not be released into the Munglinup River Catchment. Heritage: No queries were raised in respect of Native Title or heritage matters. Other: 1. Access Roads – a query was raised on what local roads were to be used for mine access and the potential number of truck movements on South Coast Hwy.	Social: 1. MRC recognises the concerns of the community and would more than likely opt for having its own emergency services vehicles onsite, such that there would be no impact on the community in the event of either a medical for natural emergency. It was intended that the mine site, once operational, would have suitably trained personnel and clear protocols to manage a medical or natural emergency. MRC would also look to work with the community in exploring opportunities where it can support existing volunteer emergency and medical service providers. Economic: 1. MRC intention is to utilise as much local content as possible – bearing in mind it is subject to the requirements of the ASX and needs to ensure best value for money. As set out in the presentation, MRC intends to work with the Goldfields Esperance Development Commission (State Government) and local Chambers of Commerce (ECCI, RRCI) to hold industry briefings and explore the best ways to engage with local businesses to maximise opportunities. 2. At this stage, a final structure of the workforce has not been determined. In the event that trade based positions are required, and the circumstances are consistent with the efficient and economic operation of the mine, MRC would look to explore training opportunities for young people looking to enter the workforce. Environment: 1. The attendees were advised that the intent was to utlise the existing topography of the site to assist with construction of the tailing dam. Utilisation of existing ridge lines would form the dam walls on three sides, with the lower western side constructed of mining waste material. It was intended to clay line the bottom of the dam (including ridge lines), with pvc lining of the constructed western dam wall. However, further work was required to ensure that clay lining would be sufficient. Heritage: Nil Other: 1. As set out in the presentation. MRC is currently liaising with the

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			§ Timeline and outline of background studies across all environmental categories. o Overall timelines for the Project. • Community Engagement, including: o Projected employment and economic impact for the project; o Industry engagement strategies; o Future community engagement activities; and o Key contact details.		Shires of Ravensthorpe and Esperance on accessing local roads to gain entry into the mine site utilising the local road network. The expectation is that any heavy vehicle access will utilise roads on which road trains already operate (for grain and fertiliser cartage). MRC is acutely aware of the need to ensure any roads on which it operates are upgraded and maintained to acceptable standards, such that safety of road users and the ongoing operations of adjacent farms are not adversely impacted. MRC is also currently liaising with Main Roads WA (Goldfields Esperance Regional Office) regarding its intentions to operate vehicles up to a maximum length of 36.5m (current RAV level for the region). Total and daily truck movements and vehicle GCM will be determined upon the completion of a Logistics Study.
21-Aug-18	Community Event	Community members, Key Stakeholders, Local Govt, interest and industry Groups	Attendees: • Local Community o Residents of the townsite of Esperance o Members of service clubs • Local business owners • Local Government (Shire of Esperance) • Industry and Interest Groups • Members of Government • Government Agencies The Community Information Session was publicised by: • direct invitations to local government, members of government, members of industry and interest groups via email and telephone calls; • banners posted on community bulletin boards at local shopping centres • Via the membership networks of the local Rotary and Lions Clubs; • Esperance Express newspaper website (13 August 2018); • Community broadcasts on local radio (Triple M Radio 747) throughout the week leading up to the session; and • The Shire of Esperance Community Facebook page The Community Information Session was attended by 35 people with all attendees given the opportunity to provide their telephone and email contact details should they wish to receive more information about the Project throughout its development. This information was entered into the Key Stakeholder Community Contact Register. The Session was conducted in an informal interactive way, with attendees invited to ask questions during a power point presentation. The presentation set out information about the following: • Mineral Commodities Ltd – a general overview of the company and the legal entity through which the Munglinup Graphite Project is being developed. • An overview of the Project, inclusive of o Extraction and processing methodology; o Projected mine life and tonnages to be mined and processed; o Proposed heavy and light vehicle access routes; o Environmental and heritage approval process, including:	There were no questions raised during the presentation itself. After some prompting, several attendees raised queries regarding the project timelines and project process. Some comments were made about the positive effects the project could have on the Esperance community and economy.	General community feedback was positive, with a degree of optimism on the opportunities that could be delivered to the local community and economy. One local interest group, Local Environmental Action Forum requested further information regarding the environmental background studies which were currently being undertaken as part of the environmental approval process (requested during one-on-one conversation after conclusion of the presentation). An undertaking was given to provide the information subject to approval by MRC.

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			§ Relevant legislation (Federal and State); § Relevant licences and permits; § Timeline and outline of background studies across all environmental categories. o Overall timelines for the Project. • Community Engagement, including: o Projected employment and economic impact for the project; o Industry engagement strategies; o Future community engagement activities; and o Key contact details.		
27-Aug-18	Phone Call/Meeting	Main Roads WA	Shayne Flanagan contacted Shane Power to outline the options currently being considered by MRC Graphite for light and heavy vehicle access to the mine site. A map indicating the proposed access roads was provided by follow-up email. Mr Power was advised that it was probable that product would be transported by trucks up to a length of 36.5m, with configuration and GCM to be confirmed pending the completion of a logistics study. He was advised that it is estimated that a total of 56,000 tonnes a year will be exported over a 9 year mine life (which is expected to increase depending on further exploration). As yet it hasn't been determined whether the product will be shipped from Esperance port or trucked directly to Kwinana.	Main Roads advised that heavy vehicles had been approved for use on both Farmers Rd and South Coast Hwy under the National Heavy Vehicle Scheme up to the classification N7.2 (Tandem Drive Heavy Vehicles up to 36.5m). Notwithstanding that, he advised that the intersection between Farmers Rd and South Coast Hwy would need to be audited to confirm that it complies with the current standards applied by Main Roads for N7.2 Classification vehicles. Main Road's policy is that any new user would be required to pay for the required upgrade of the intersection if it is found to be non-compliant, irrespective of it already being approved for restricted access vehicle use. This will be a matter for negotiation between MRC Graphite and the State.	Mr Power was advised that further information would be provided upon completion of the logistics study by MRC Graphite.
12-Sep-18	Meeting / Briefing	Esperance Tjaltjraak Native Title Aboriginal Corporation	Social: Nil Economic: 1. MRC enquired on the progress of ETNTAC's Economic Opportunity Plan (EOP), as it would be logical to engage with ETNTAC once it had considered the EOP and had a greater degree of clarity on how it was looking to position the organization to take up commercial opportunities in both the immediate and longer terms. MRC advised that it was open to engaging with ETNTAC throughout this process and will ensure that ETNTAC are fulling briefed on critical development milestones of the Project, as well as any identified commercial/contracting opportunities that may arise which align with their EOP. Environmental: 1. MRC provided an overview of the work which was currently underway in completing environmental background studies (inclusive of flora, fauna, subterranean and surface water etc.). It is estimated that MRC will be in a position to submit its environmental approvals (State and Federal) in October 2018. Heritage: 1. MRC enquired on whether ETNTAC had any issues with the recent heritage work and site visits that had been undertaken – in terms of access, outcomes and ongoing collaboration. 2. MRC advised that it had completed a draft Cultural Heritage	Social: Nil Economic: 1. Peter Bednall referenced the discussions that had occurred with Daniel Hastings and Mark Caruso regarding commercial/economic opportunities that could be available to ETNTAC - in the form of the potential for native seed collection and nursery services to provide tube stock for rehabilitation, as well as contracted transport services. (Refer meeting 18 April 2018 Mark Caruso/Daniel Hastings). He advised that ETNTAC had not yet completed its EOP (KPMG have been engaged to develop the plan which was initially due for completion in June 2018). He Advised that ETNTAC would look to engage with MRC about prospective commercial opportunities once they had completed the EOP and assessed near term opportunities aligned with existing capability, as well as longer term opportunities which would require investment in the development of capability and capacity. He advised that any opportunities would need to be commercially sustainable. Environmental: 1. Mr Bednall provided no comment on the environmental processes. Heritage: 1. Peter Bednall advised that there did not appear to be any issues and that all parties were working well together in good faith. However, he did suggest that it would be advisable to document the actions or agreed outcomes at the end of each site visit to ensure	Social: Nil Economic: 1. ETNTAC will provide MRC with a copy of its EOP once it had been finalised, following which MRC will work with ETNTAC to identify near term opportunities and those that require further development of ETNTAC commercial capacity and operating capability. It is expected that the EOP would be in draft form by October 2018. Environment: 1. MRC advised that it would keep Mr Bednall informed of the environmental processes and advise when approvals had been referred to the relevant statutory authorities for consideration. MRC also advised Mr Bednall that it would keep ETNTAC informed of any economic opportunities that may be available through t the environmental approval processes, as well as those that may arise as a result of obligations that the environmental authorities may place on MRC as a result of the environmental processes. Heritage: 1. Matter referred to Belinda Bastow and Dan Ball for consideration. It is understood that a draft document had been developed and this would be forwarded to ETNTAC for consideration prior to the next site visit. 2. Cultural Heritage Plan to be forwarded to ETNTAC for their review

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			Management Plan, which was currently under internal review prior to being sent to ETNTAC for consideration. The intent of the Plan was to ensure that all parties were operating with complete transparency and understanding on the roles and responsibilities of all parties. Other: Nil	there was no confusion or ambiguity on the part of either party. 2. Peter Bednall advised that he had the opportunity to review the draft Table of Contents for the Plan and believed the Plan would set a good foundation for MRC and ETNTAC to work together on Cultural and Heritage matters. Other: Nil	prior to the end of September 2018 Other: Nil
21-Sep-18	Meeting / Briefing	Department of Mines, Industry Regulation & Safety	The purpose of this meeting was to discuss the content and submission of two Programmes of Work that Integrate Sustainability have submitted on behalf of MRC Graphite. Ryan Hepworth from DMIRS, at the time of the meeting, was in the process of reviewing the information provided with the applications. Ryan asked for additional information relating to the applications, in particular the Threatened Ecological Community, so that he could progress their approval. The discussion covered POW76241 on additional sumps and pads, POW76073 and the eastern access track and POW74373 on drilling in the north of M74/245.	POW76241 – There was some confusion around where pads and sumps had already been approved and where additional pads and sumps were being requested POW76073 – There was concern regarding the lack of vegetation mapping on the eastern side of the mining reserve where the proposed eastern access track would extend. Confirmation requested on the extent of the TEC on this side and if it would be impacted. POW74373 – Updated TEC mapping shows that a large drilling polygon which has already been approved covers an extent of the TEC in the north of M74/245. Confirmation requested regarding if this activity has commenced and/or will proceed and notification that a clearing permit is required for the clearing of the TEC.	POW76241 – Review the information provided by MRC Graphite and update the POW if required. POW76073 – Provision of an updated report by Woodman Environmental which covers the extent of the TEC on the eastern side. The access track does pass through the TEC and will require a clearing permit to proceed as it is classed as an Environmentally Sensitive Area. Further information on the extent of the TEC to be requested from Woodman Environmental. The possibility of using the existing firebreak as the road corridor was suggested which could utilise the clearing exemptions, further information is required to confirm if this is a viable option. To allow the POW to be processed the best way forward is to resubmit the POW with the eastern access track removed so that the other activities can be assessed and approved. The eastern access track can be resubmitted as a separate POW at a later date. POW76253 has been submitted to cover the activities minus the access road. POW74373 – Clearing of the TEC requires a clearing permit. Discussion that sterilisation drilling in this northern polygon is no longer required by MRC due to the identification of the TEC in this area. DMIRS requested written confirmation that this was the case and the TEC would not be cleared.
27-Sep-18	Meeting / Briefing	Member of Government	Social: 1. MRC provided an update on the community engagement activities it had undertaken during the past three months, inclusive of the Community Information Sessions that had been held in Munglinup and Esperance on the 20th and 21st August 2018, respectively. Economic: 1. As had been outlined previously, MRC emphasised that its preference was to employ a residentially based workforce – which is estimated to be approximately 63 employees. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). 2. MRC advised that it was keen to engage with the State Government on the potential for downstream processing, in the context of the Lithium and Energy Materials Strategy currently under development. Comment was made on the need to ensure that proper consideration was given to graphite as a key ingredient in battery technology, alongside lithium, cobalt and nickel. Environmental: 1. MRC provided an update on the environmental approval process and the extensive work that has been undertaken. He was advised that MRC were currently undertaking a spring survey of flora and would soon be commencing a water bore program to further investigate the subterranean hydrology of the site, as well as undertaken	Social: 1. Mr Graham raised no questions regarding the information that was provided. Economic: 1. Mr Graham enquired on whether it was possible to employ workers that had recently been made redundant at the Port of Esperance – as he believed that they would have transferrable skills and would avoid the necessity for them to move away from Esperance. 2. Mr Graham advised that he would ensure that graphite, and specifically the Munglinup Graphite Project, were given appropriate consideration - he would highlight the project in his next meeting with the Premier. Environmental: 1. Mr Graham raised no queries in respect of the information provided on the environmental approval processes being undertaken by MRC. Heritage: 1. Mr Graham raised no queries with respect to heritage survey matters. 2. Mr Graham made the observation that there was no obligation on MRC with respect to employment or commercial arrangements – given that Native Title had been extinguished and a land access agreement had not been entered into. On that basis he	Social: 1. Nil Economic: 1. MRC advised that it had already received informal expressions of interest from several current and recently redundant Esperance Port employees. The issue was the time lag between the most recent round of redundancies (September 2018) and the potential start-up of operations of the Project (Q4 2019). 2. Nil Environment: 1. MRC advised that it would keep Mr Graham informed of the environmental processes and advise when approvals had been referred to the relevant statutory authorities for consideration. Heritage: 1. MRC undertook to keep Mr Graham informed of the heritage work being undertaken. 2. MRC undertook to keep Mr Graham informed of any economic or commercial opportunities identified between MRC and ETNTAC.

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			further water sampling. Mr Graham was advised that MRC was still on track to submit its environmental approvals (State and Federal) in October 2018. Heritage: 1. MRC advised that it had been in discussions with ETNTAC and had continues to undertake heritage surveys with members of ETNTAC. Several sites of interest had already been identified. 2. Mr Graham was also advised that MRC had engaged with ETNTAC in good faith in respect of potential economic and commercial opportunities for Traditional Owners. He was advised that MRC had offered to review ETNTAC draft Economic Opportunity Strategy once it had been completed – such that potential near term opportunities could be identified based on existing capability and capacity, as well as longer term opportunities that would require a more sophisticated business approach. Other: 1. MRC advised that it had recently engaged a consultant to undertake a logistics study. MRC had also engaged with Main Roads WA and the Shires of Esperance and Ravensthorpe in respect of road access into the mine site. It was highlighted that a substantial portion of the roads under consideration were already designated as heavy vehicle routes – with two roads (Clayhole and Reynolds Rds) within the Shire of Esperance requiring upgrade and reclassification for road train use.	applauded the approach being taken by MRC in working with ETNTAC on potential economic and commercial opportunities. Other: 1. Mr Graham noted the information provided.	Other: 1. No further action
05-Oct-18	Meeting / Briefing	ETNTAC	Social: Nil Economic: 1. MRC enquired on the progress of ETNTAC's Economic Opportunity Plan (EOP), as it would be logical to engage with ETNTAC once it had considered the EOP and had a greater degree of clarity on how it was looking to position the organization to take up commercial opportunities in both the immediate and longer terms. As discusses with ETNTAC CEO, Peter Bednall on the 12th September 2018, MRC is open to engaging with ETNTAC throughout this process and working with ETNTAC to identify commercial/contracting opportunities that may arise which align with their EOP. Environmental: Nil Heritage: Nil Other: Nil	Social: Nil Economic: 1. Nicky Sudmeyer provided a preliminary draft EOP that had been developed by KPMG. She advised that her focus was to work through the identified opportunities in the EOP and provide a briefing to the ETNTAC Board on what opportunities could be achieved in the immediate future. She advised that the Board were keen to progress the opportunities that had been identified as a result of earlier discussions with Daniel Hastings and Mark Caruso – as these had been included as high priority opportunities in the Plan. In confidence, Ms Sudmeyer expressed concern that the Board seemed overly ambitious about what ETNTAC could achieve in the short term, given their lack of commercial and business capacity as an organisation. Environmental: Nil Heritage: Nil Other: Nil	Social: Nil Economic: 1. On reviewing the draft EOP, it is apparent that KPMG has undertaken a rudimentary desktop analysis of the current demographic and economic profile of the Esperance region (based on data from the ABS, Local Government Authority and GEDC), with little detailed 'on the ground' investigation or analysis. In setting out their suggested economic opportunities, it is clear that they have simply relied on information provided by ETNTAC, with particular reference to the opportunities that may arise through commercial/contracting arrangements with MRC. Initial feedback provided to ETNTAC on the EOP essentially focussed on the need for the identified economic opportunities to be supported by an analysis of the current capability and capacity of ETNTAC as a service provider – as well as a roadmap to guiding the organisation on developing its inherent business capabilities. In the absence of this, it would be difficult for ETNTAC to be competitive against other service providers or operate as a commercially sustainable business. It was suggested that ETNTAC look at adding this to the EOP, such that the Board could be well informed on the work needed to develop their organisation in alignment with their economic opportunity aspirations. Environment: Nil Heritage: Nil Other: Nil

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08-Oct-18	Presentation	Esperance Rotary Club	Social: Refer PPT Presentation and general presentation outline. Economic: Refer PPT Presentation and general presentation outline. Environmental: Refer PPT Presentation and general presentation outline. Heritage: Refer PPT Presentation and general presentation outline. Other: Nil	Social: 1. A query was raised by the President of the Esperance Agricultural Society on whether MRC would look at providing funding or sponsorship to local community groups. Economic: 1. Local contracting – a query was raised on whether there would be local sourcing of contractors and whether local businesses would have an opportunity to provide services – especially during the construction phase of the Project. 2. Members welcomed the approach by MRC to look at a residentially based workforce as its preferred option – rather than FiFo. There was commentary about the tight economic times being endured by the local economy and the need for additional job opportunities to both retain and attract people to the region. Environmental: 1. There were no queries or comments raised about the environmental elements of the Project. Heritage: No queries were raised in respect of Native Title or heritage matters. Other: 1. Access Roads – a query was raised on what local roads were to be used for mine access and the potential upgrade of the intersection between Farmers Rd and n South Coast Hwy.	Social: 1. MRC completed a Community Engagement Plan in early August 2018, which includes a strategy on social engagement and potential opportunities for community sponsorship or partnering. It is likely that this will be contingent on the Project approval - with scoping of potential opportunities to be undertaken in alignment with project approval decision timelines. Economic: 1. MRC intention is to utilise as much local content as possible – bearing in mind it is subject to the requirements of the ASX and needs to ensure best value for money. As set out in the presentation, MRC intends to work with the Goldfields Esperance Development Commission (State Government) and local Chambers of Commerce (ECCI, RRCI) to hold industry briefings and explore the best ways to engage with local businesses to maximise opportunities. 2. As has already been stated, MRC will look at a residentially based workforce for its direct employees, as well as those employed by contractors, as a first option. Environment: 1. Nil Heritage: 1. Nil Other: 1. MRC is currently liaising with Main Roads WA (Goldfields Esperance Regional Office) regarding its intentions to operate vehicles up to a maximum length of 36.5m (current RAV level for the region). Once a decision has been made on the heavy vehicle configuration Main Roads will undertake an audit of the intersection to ensure that it complies with current design standards.
08-Oct-18	Meeting / Briefing	Southern Ports Authority	Social: Nil Economic: Nil Environmental: MRC advised that it had engaged Latitude Management and Development (Dave Hewson) to undertake a Logistics Study, to inform the environmental approval submissions, as well as provide MRC with options in respect of the transport logistics options available to it to export its product to the world market. MRC advised that it was likely that the product would be in the form of a concentrate and exported in bulka bags (possibly packed inside 20 foot containers). However this would be contingent on completion of offtake agreements and the logistics study. Heritage: Nil	Social: Nil Economic: Nil Environmental: Mr Bates advised that as a result of recent regulatory work undertaken by the Port, it had streamlined the processes through which additional products could be added to its licence issued under the EPA Act. What used to take up to 18 months to complete, could now by achieved in 28 days. Mr Bates could see no issues with the export of graphite through the Esperance Port, especially as a packaged product in either Bulka Bags or containers. He advised that the export of Graphite had been discussed at the Port Consultative Committee and there had been no issues raised by members (The PCC is comprised of community members, environmental groups, ECCI, Shire and local members of government).	Social: Nil Economic: Nil Environment: MRC requested a copy of the Southern Ports Authority – Environmental Approval Guide for New Clients and the Self-Assessment Decision Making Flowchart, such that it could ensure that all requirements are well understood and that the necessary processes are able to be commenced when required. Heritage: Nil Other: Dave Hewson advised that he would distil the information provided and would revert once he had discussed the various options and their relative merits with MRC. He acknowledged

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			Other: Dave Hewson outlined the work that he had been engaged to undertake – related to investigating the best options for the export of the MRC product. He advised that this early stage, MRC had indicated a preference for exporting the product in either bulk bags, or bulka bags enclosed in containers. Mr Hewson set out a range of scenarios, primarily: 1. Transport bulka bags by truck directly from mine site to Port. This would require access to undercover storage for the period of time necessary to accumulate the bulka bags required for a shipment. 2. Transport bulk bags by truck from mine site to storage facility within Esperance town site and campaign load once ship has docked. 3. Transport bulka bags directly from mine site to Port and load into containers at the Port. This would require access to storage at the port and container loading capability. 4. Transport bulka bags to storage facility within Esperance town site and load into containers which would then be transported to the Port and stored awaiting shipment.	Heritage: Nil Other: Mr Bates advised that the Port could accommodated either bulka bags or containers, however, in its experience it has found that export using containers seems to be a more practical and efficient method. In respect of the options under consideration he advised: 1. There is currently adequate undercover storage space at the port but this could change in the event that FQM recommences exports through the Port – which is a possibility in mid-2019. This could also be a relatively expensive options given that it would require leasing of port facilities and more man-power relative to containers. 2. This is a possible option and would avoid the need for certainty around long term access to undercover storage at the port. The Port has significant experience with campaign loading and has the traffic management and port access processes to ensure that this can be done successfully with negligible delays to ship loading. 3. Advised that this has similar issues to option 1 related to long term access to undercover storage for bulka bags and container loading within the Port. Advised that the Port could easily managing container out-loading. 4. Advised that this is the Port's preferred option, as it simply involves the Port facilitating the export of containers. It has substantial capacity for container storage which would allow for consolidation of shipments at the Port. He did not recommend campaign loading of containers – given the potential delays in administration of accepting enclosed containers at the port.	that it would be a good idea to engage with the Port as early as possible in respect securing the necessary environmental licensing approvals.
10-Oct-18	Meeting / Briefing	Member of Government	Social: 1. MRC provided an update on the community engagement activities it had undertaken during the past three months, inclusive of the Community Information Sessions that had been held in Munglinup and Esperance on the 20th and 21st August 2018, respectively. Economic: 1. MRC emphasised that its preference was to employ a residentially based workforce – which is estimated to be approximately 63 employees. There was also the possibility of a further 47 additional employees required to undertake mining operations (likely to be a contract mining arrangement). 2. MRC advised that it was exploring the feasibility of downstream processing, in the context of the Lithium and Energy Materials Strategy currently under development by the WA State Government. MRC also advised of the large potential for graphite in the development of new technolody – related to the adoption of graphene. Environmental: 1. MRC provided an update on the environmental approval	Social: 1. Mr Wilson raised no questions regarding the information that was provided. Economic: 1. Mr Wilson welcomed the approach by MRC, given the tight economic environment in the district, with the recent closure of several businesses in Esperance. 2. Mr Wilson provided generic commentary on the issues related to Australian mineral development and the failure of previous governments and industry to adequately create pathways for value add and downstream processing. Environmental: 1. Mr Wilson noted the information provided and made reference to the need to engage as early in the process as possible with the Department of Environment and Energy (Cth). Heritage: 1. Mr Wilson raised no queries with respect to heritage matters. 2. Mr Wilson advised that sustainable and commercially sound	Social: 1. Nil Economic: 1. MRC advised that it had already received informal expressions of interest from several current and recently redundant Esperance Port employees. 2. MRC advised that more had to be done by both the State and Federal Governments to de-risk private investment and create investment pathways. Environment: 1. MRC advised that it was meeting with DoEE representatives on the 11th October 2018 to provide an update on the project and gain a clearer detailed understanding of the specific requirements the DoEE would require in terms of the referrals. Heritage: 1. MRC undertook to keep Mr Wilson informed of the heritage work being undertaken. 2. MRC undertook to keep Mr Wilson informed of any economic

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			process and the extensive work that has been undertaken. MRC is currently undertaking a spring survey of flora and has commenced a water bore program to further investigate the subterranean hydrology of the site, as well as undertaken further water sampling. MRC were looking to submit its environmental referrals (State and Federal) in late October 2018. Heritage: 1. MRC advised that it engaged extensively with the Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC) through 2018, and continues to undertake heritage surveys with members of ETNTAC. Several sites of interest had already been identified. 2. MRC advised that it continues to work collaboratively with ETNTAC good faith in respect of potential economic and commercial opportunities for Traditional Owners. MRC had offered to review ETNTAC draft Economic Opportunity Strategy once it had been completed – such that potential near term opportunities could be identified based on existing capability and capacity, as well as longer term opportunities that would require a more sophisticated business approach. Other: Nil	economic development opportunities, whilst a noble aspiration, were historically difficult to achieve. Mr Wilson acknowledged the approach being taken by MRC with its early and comprehensive engagement. Other:	or commercial opportunities identified between MRC and ETNTAC. Other: Nil
11-Oct-18	Meeting / Briefing	EPA Services	The purpose of the meeting was to discuss the referral of the Munglinup Graphite Project under the EP Act. Over the course of the meeting ISPL provided an overview of the Project and the environmental matters. EPA Services provided information on their expectations and the level of detail they would like to see within the referral document. The following matters were discussed: • Overview of the Munglinup Graphite Project including the company, the location, current site layout. • A solar plant is being considered for power to the site which would be located to the south of the processing plant. It was commented that the Department of Jobs, Tourism, Science and Innovation may be worth contacting regarding the battery market, funding and offsets. • Discussion was had around the transport of the end product form the site to the Esperance port by truck with the product contained in bulka bags. • Overview of the baseline surveys which have been completed to date and a brief overview of the results of the surveys. o The focus on flora and fauna surveys has been to address the gaps from the 2015 survey. o Information on Native Title in the area and that MRC has been working with the Esperance Nyungars. o Work is currently underway to understand the groundwater aspects at the site. Currently all groundwater is likely to be sourced onsite for use within the plant. o Flora and vegetation work have been completed to define habitat for underground orchid and the TEC. These will be avoided wherever possible. o Fauna surveys and additional targeted threatened species habitat mapping has been undertaken.	• The EPA raised concerns about the management of tailings and kerosene in the tails. • The EPA raised the question regarding how well the bulka bags will contain the product? The EPA indicated that the logistics and containment of the product should be considered and clearly explained, even if the product is not hazardous, because of the history surrounding the Esperance Port. • The EPA indicated that they would like to see detailed evidence of consultation with the Esperance Nyungars around the Project including their opinions and consent of the project. • The EPA raised the question surrounding GDE's including subterranean and terrestrial. • The EPA raised questions regarding the scenarios under which discharge to the river may be required. ISPL indicated further work was required to understand this aspect. The EPA requested that a reasonable approach should be developed and put forward for assessment if required. This aspect is likely to also come under Part 5 approvals if needed. • The EPA raised the point that from a legal perspective if the TEC is within the development envelope it will be considered as being cleared even if it is not within the disturbance envelope. • The comment was made that State listed TECs may require an offset. • The EPA outlined that where Carnaby Habitat is present the best option is to follow the guidance provided by DoEE on which guidelines to use. DBCA will be consulted during the process regarding this species. • The EPA stated that if we are also referring to DOEE it would be wise to state this in the referral document and to highlight the preferred accredited process. • Offsets may be required if the project is assessed at EPA or EPBC level and it would be wise to begin considering this early	• It was provided that the TSF would be a lined facility and further analysis of the tailing's material is currently underway. • ISPL provided that the geology is not suitable for subterranean fauna and that terrestrial GDEs are currently being examined. • The comment was made that the development envelope could be adjusted to remove more of the TEC.

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			• Potential need for emergency discharge to the Munglinup River was highlighted.	and starting the discussion with the right people. • It would be worth examining this project from a Holistic Impact Assessment to encompass the TEC, Carnaby's and other species • The EPA indicated that the pathway of the project through the EIA process may be influenced by the level of community input and interest, input and consultation with other departments and specialists like DBCA, as well as the decision by DoEE. • The EPA indicated that if there is uncertainty regarding any of the studies or factors such as new species, additional information would be required and this may mean additional surveys. • The EPA suggested that the pathway might be an Assessment on Referred Information with the possibility of requesting for additional details to complete the assessment. • The EPA did highlight that due to Christmas, shutdowns and workload they may not be able to meet a December deadline on a decision.	
11-Oct-18	Meeting / Briefing	DoEE (Cth)	The purpose of the meeting was to discuss the referral of the Munglinup Graphite Project under the EPBC Act. Over the course of the meeting ISPL provided an overview of the Porject including the matters of national environmental significance. DoEE provided information on their expectations and the level of detail they would like to see within the referral document. The following matter were discussed: • Overview of the Munglinup Graphite Project including the company, the location, current site layout. • Overview of the baseline surveys which have been completed to date. The focus on flora and fauna surveys has been to address the gaps from the 2015 survey. Brief overviews of the results of the surveys was provided. • Each matter of national environmental significance (MNES) was discussed including the Underground Orchid, Kwongkan Shrubland TEC, Carnaby's Cockatoo, Malleefowl, Chuditch.	• DoEE raised the question about work which has been completed for the underground orchid and indicated that in the referral there should be detailed commentary around the reasons why there is unlikely to be a population within the area. • DoEE indicated that the notes provided show that the Draft guidelines have been used. They said that these guidelines should not be used for surveys as they have not been signed off. Rather the current guidelines from 2012 should be used for the survey and to assess habitat. • DoEE indicated that of particular importance is foraging habitat within 12km of known breeding and roosting sites. They would like to see this information in the referral document with maps and text descriptions. • DoEE indicated the Birdlife Australia, DBCA, WAM or Tony Kirkby would be worth contacting to determine known roosting and breeding sites in the region. • DoEE indicated that the referral must include clarity on the hectares to be cleared of the TEC and how the TEC interacts with the project. They also would like to see detailed maps of the TEC extent. • DoEE said that the referral must clearly explain the habitat and why it is or is not currently suitable for Malleefowl and if it could be again in the future. • DoEE indicated that the referral must clearly explain and define the habitat characteristics and outline why or why not the Chuditch is likely to be present. • DoEE would like to see updated maps within the referral which show the habitat over the disturbance footprint. • DoEE would like to clearly see the hectares of clearing of habitat for each MNES. • DoEE would like the referral to consider the regional context including the presenting maps of threatened species records form a regional perspective. • The supporting document should indicate that the process preferred is an accredited process with the EPA. • Offsets should not be considered in the referral but DoEE indicated that offsets may be relevant if this is deemed a controlled action. • DoEE mentioned that the referral should also consider the indirect impacts to MNES during construction and operational	• ISPL provided a summary of the Underground Orchid habitat and why there is unlikely to be a population in the area. • ISPL indicated that the fauna report would be updated to reflect the current Guidelines. • ISPL will update the referral document to address the comments raised by the DoEE.

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				phases. • DoEE recommend presenting the worst-case scenario in the referral to assess, eg. The maximum amount of clearing. • DoEE indicated that currently statutory timelines are not being met and to expect delays on the decision. Submitting in October may not have a response by Christmas.	
23-Oct-18	Meeting / Briefing	Munginup Community	Social: MRC reaffirmed its preference to employ a residentially based workforce, predominantly based in Esperance. It was reiterated that there would be the facility for people to reside in Munglinup, however due to the shortage of housing this may provide difficult – as MRC were not planning on purchasing or constructing housing in the Munglinup townsite. Economic: MRC advised that it had been utilising local contractors where possible – citing examples such as the local earthmoving contractors, road house, fuel supplies and meals for site contractors. Advised that this serves to reinforce MRC's commitment to utilising local content where practicable. Environmental: MRC provided a further outline of the work that had been undertaken during the August Community Information Session. This has included completion of the spring flora survey and commencement of water boring and hydrological testing. MRC advised that is had met with EPA and DoEE personnel to clarify their requirements prior to the submission of the Project approvals – possible in late October/early November. Heritage: MRC advised that it had been working collaboratively with ETNTAC on conducting heritage surveys during August and September, as well as providing ETNTAC with a draft Cultural Heritage Management Plan for consideration such that all parties had a joint understanding and agreement on how heritage matters would be managed during the development, construction and operation of the Project. Reference was made to the Section 5 application which had been lodged under the Aboriginal Heritage Act 1972, for inclusion of the Munglinup River and its tributaries as a sacred site. Other: MRC provided further information about the discussions that had been held with the Shires of Ravensthorpe and Esperance and Main Roads WA regarding road access to the Site. As had been outlined at the August Community Information Session, the intent was to utilise Mills Rd (Shire of Ravensthorpe) for	Social: The Shire of Ravensthorpe (CEO) advised that other mining companies in the region had found it difficult to source residentially based workers and that MRC may need to consider alternate options for sourcing its employees. They saw the main impediment being the 100km road trip to and from Esperance which would add 2.5hours to each working day. They suggested MRC consider the construction of a mining camp in Munglinup where workers could reside during their work week and travel back to Esperance to be with their families when they are not rostered. The Shire also advised that this option should be placed on the table ASAP given the difficulty of accessing land and the long lead times in the establishment of services etc. Most land that had been identified for future development is classified as State Reserve and subject to Native Title, which would add to the complexity of access. Economic: Community members noted that local contractors where currently being utilised and the positive impact this was having on the community. Environmental: Community members noted the information provided – especially with respect to the hydrology work that was being undertaken. As had been raised at the August Community Information Session, the construction and integrity of the tailings dam was raised – especially in respect of the material that would be used to line the dam, as well as strategies to manage high rainfall events which could lead to the dam overtopping and the contents of the dam being discharged into the environment (and ultimately into the Munglinup River. Heritage: Local land owners advised that they had received notification of the Application as their farms were affected - given that tributaries ran through their properties. Several had lodged submissions on their own right. There was general acceptance of the need to respect and safeguard sacred sites and areas of significance in respect of Aboriginal cultural and heritage – however the main area of concern was the nature under which the application had been lodged, the fact that the application had not been submitted through ETNTAC and the absence of	Social: MRC advised that it would consider the information provided by the Shire in its planning phase for the Project – as regards strategies to attract and retain residentially based workers as a first preference – especially when weighed against the added costs and complexity of developing a workers camp in Munglinup. Economic: MRC intention is to utilise as much local content as possible – bearing in mind it is subject to the requirements of the ASX and needs to ensure best value for money. As set out in the presentation, MRC intends to work with the Goldfields Esperance Development Commission (State Government) and local Chambers of Commerce (ECCI, RRCI) to hold industry briefings and explore the best ways to engage with local businesses to maximise opportunities. Environment: The attendees were advised that the intent was to utlise the existing topography of the site to assist with construction of the tailing dam. Utilisation of existing ridge lines would form the dam walls on three sides, with the lower western side constructed of mining waste material. Lining of the dam was still being investigated. The scenario of managing high rainfall events and the potential for overtopping of the dam was also being worked through as part of the design process for the dam, as well as being dealt with in the environmental approval process. Heritage: MRC advised that it had lodged a submission in respect of the Mining Reserve and had been liaising directly with ETNTAC on the matter – given that they are the Prescribed Body Corporate and recognised representatives of the Esperance Nyungar People under the 2015 Native Title Determination. MRC emphasised the constructive and collaborative working relationship it had established with ETNTAC and that it was necessary to be respectful of Aboriginal heritage and to ensure due process was followed. MRC advised local land owners that if they had any concerns regarding native title or heritage matters, the first point of contact should be ETNTAC. MRC was cognisant of not providing advice or direction to the local community or land owners on matters of aboriginal heritage or

Date	Type of Engagement	Stakeholder Organisation	Matters Discussed	Stakeholder Feedback	Response to Feedback / Outcomes / Comments
			light and emergency service vehicle access. Clayhole and Farmers Rd (Shire of Esperance) would be used for heavy vehicle access. All roads would need to be audited to ensure that they complied with current design standards for heavy vehicles (Category 7 36.5m road trains) inclusive of the intersection of Farmers Rd and South Coast Hwy.	any consultation on discussions with local land owners by the parties that lodged the application. Other: Community members noted the information provided.	the Act. Other: MRC would ensure that the local community and land owners are kept updated on road access and the potential level of truck movements that will take place during construction and operation of the Project.

APPENDIX C: BASELINE SURVEYS

APPENDIX C-1: Integrate Sustainability - Soil Desktop Review & Field Assessment (DRAFT)

APPENDIX C-2: Rockwater - Desktop Hydrology Assessment

APPENDIX C-3: Rockwater - Surface Water Management Study Stage 2 (DRAFT)

APPENDIX C-4: Rockwater - Stage 1 Hydrogeological Assessment

APPENDIX C-5: Ecologia - Flora and Fauna Assessment

APPENDIX C-6: Woodman - Peer Review Level 2 Flora and Vegetation Assessment

APPENDIX C-7: Woodman - Survey of Kwongkan Shrubland TEC and *Rhizanthella johnstonii*

APPENDIX C-8: Woodman – Detailed Flora and Vegetation Assessment (Interim Report)

APPENDIX C-9: Glevan - Phytophthora Dieback Assessment

APPENDIX C-10: Biostat - Fauna Assessment Peer Review

APPENDIX C-11: Red Dog - Complementary Fauna Survey

APPENDIX C-12: Biota –Short Range Endemic Fauna Pilot Study

APPENDIX C-13: Biota - Munglinup Graphite Project Subterranean Fauna Pilot Study

APPENDIX C-14: WRM - Munglinup River Water Quality & Aquatic Fauna Survey

APPENDIX C-15: Applied Archaeology - Ethnographic and Archaeological Survey

APPENDIX C-16: IBSA Data Packages

APPENDIX C-1: Integrate Sustainability - Soil Desktop Review & Field Assessment (DRAFT)

November 7, 2018

Munglinup Graphite Project

Soil & Landforms Desktop Review and Field Assessment

INTEGRATE SUSTAINABILITY PTY LTD

Munglinup Graphite Project – Soil & Landforms
Desktop Review and Field Assessment

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This report should be cited as 'Integrate Sustainability. 2018. *"Munglinup Graphite Project – Soil and Landforms Desktop Review and Field Assessment".* Report prepared for MRC Graphite Pty Ltd'

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This document has been prepared based on assumptions as reported throughout and upon information and data supplied by others or generated by ISPL. This document has been subject to review and changes from the Client and the Client's representative.

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Executive Summary

Integrate Sustainability Pty Ltd were engaged to complete a soil and landform assessment for MRC Graphite Pty Ltd for the proposed Munglinup Graphite Project. The Munglinup Graphite Project (the Project) is located in the Great Southern district of Western Australia, 3km to the north of the town of Munglinup and 105km west of Esperance. The Project is located on mining tenement M74/245 and sections of E74/565 and E74/505.

The field component of the soil assessment was completed in June 2018. The purpose of the baseline soil and landform assessment is to provide information on the properties of soils within the Project area. Including the soil resources and any adverse soil properties which may influence on rehabilitation and closure activities.

Access was somewhat limited during the field survey and a total of 19 soil test pits were completed, some of which were excavated by hand due to dense vegetation while the majority were excavated using a 1.6 tonne excavator. An additional two soil samples were collected from within the Tailings Storage Facility footprint at a later date when access was improved. All soil samples were analysed by CSBP Laboratory.

Using the site observations and laboratory results the soils within the Project area have been classified into soil classes. A soil class has been defined as a group of similar soil profiles which share similar soil properties including surrounding vegetation, colour, texture, pH, ESP, nutrient availability to allow for some variation within each soil class. Six soil classes have been identified within the Project area, these being:

- White sandy gravel
- Grey sand
- Brown sandy clay loam
- Dark brown sandy loam
- Grey brown sandy loam over white clay, and
- Brown red silt loam

There was considerable variation between the soil classes identified within the Project area. Overall, the soil profile typically has 2 to 5cm of organic material followed by an A horizon in the top 20 to 30cm.

Material most suitable for rehabilitation activities will most likely be located within the top 20cm of overburden. The Grey Sandy Duplex and White Gravelly Sand soil classes have a low ESP and are unlikely to dispersive. These soils may be suitable for use on constructed slopes; however, these soil classes occur predominantly outside of the disturbance area. The remaining soil classes within the Project Area have a high clay content and an ESP over 6%. These soil classes are likely to be dispersive and may not be suitable on constructed slopes. In particular the Calcareous Brown Clay Loam and Brown Red Silt Loam soils have very high dispersive characteristics. The use of these soils would present an erosion risk. Managing these dispersive characteristics will be particularly relevant for rehabilitation activities for the Munglinup Graphite Project.

1 Introduction

Integrate Sustainability Pty Ltd (ISPL) has been engaged by MRC Graphite (MRC) to undertake a baseline soil assessment of the Munglinup Graphite Project. Under the mining proposal and mine closure guidelines material characterisation work is required to identify physical and geochemical properties that have the potential to cause environmental harm or influence rehabilitation and closure activities. Early detection of these potential issues and materials means that management strategies can be tailored, planned and implemented. This includes identifying problematic soils as well as soils which are suitable for use during rehabilitation activities. As part of this assessment a field survey to assess soil within the Project area was completed by ISPL personnel and an MRC representative from the 18th to 23rd of June 2018.

1.1 Project Overview

The Munglinup Graphite Project (the Project) is located in the Great Southern district of Western Australia, 3km to the north of the town of Munglinup and 105km west of Esperance (*Figure 1.1*). The Project is located on mining tenement M74/245 and sections of E74/565 and E74/505. A total of six open pits are proposed as part of the Munglinup Graphite Project (MRC Graphite, 2018c) as well as waste rock landforms, a tailings storage facility and processing infrastructure. Graphite is to be mined and processed on-site with the final product trucked to Esperance for distribution to the market.

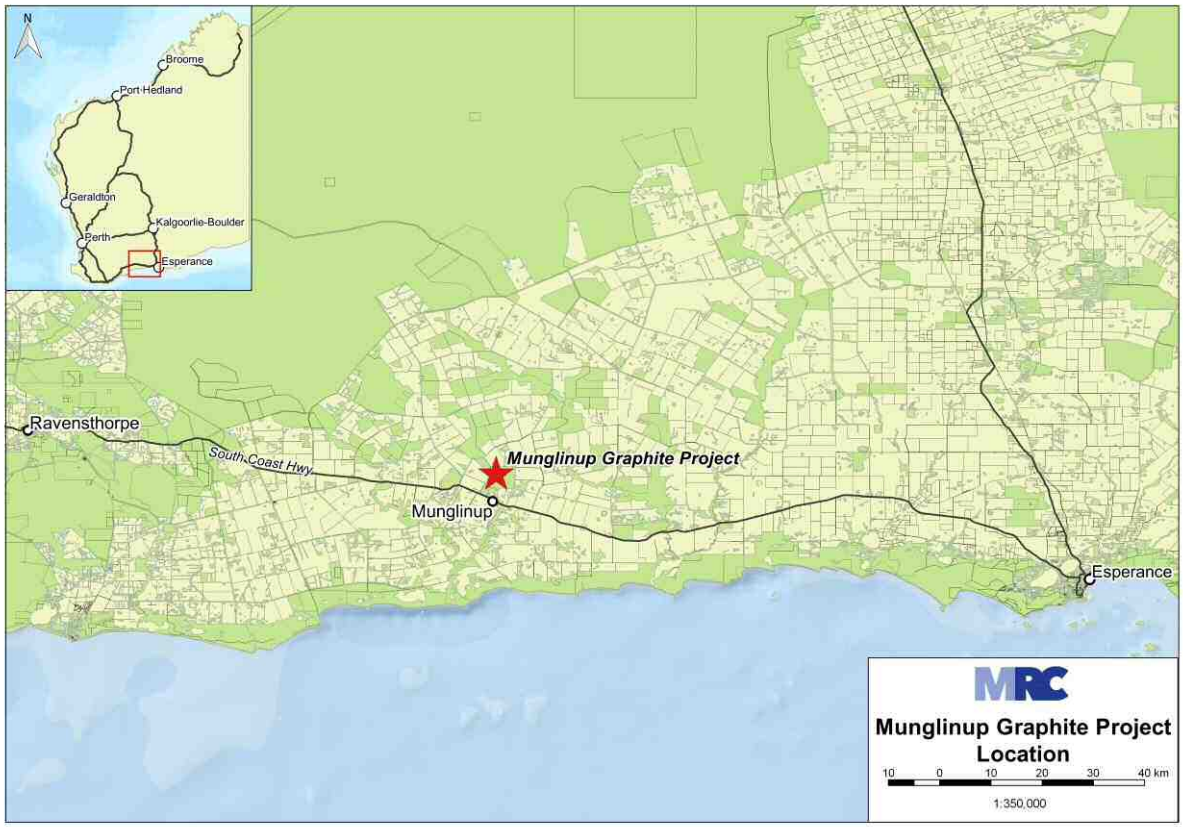


Figure 1.1 Location of the Munglinup Graphite Project

1.2 Scope of Work

The purpose of the baseline soil and landform assessment is to provide information on the properties of soils within the Project area. Including the soil resources and any adverse soil properties which may influence on rehabilitation and closure activities. As part of the soil and landform assessment the following activities have been completed:

- Review publicly available data and information relating to soils and landforms;
- Identify landform characteristics by analysing a digital elevation model;

- A field survey of the soils in the Munglinup area to describe soils present and collect soil samples;
- Analysis of the physical and chemical properties of soil samples by a laboratory;
- Identify and map soil types;
- Identify soil resources and available volumes; and
- Produce a report outlining the methods and results from the field assessment providing information on any adverse soil properties.

1.3 Limitations

The following limitations of the soil and landform assessment are observed:

- The vegetation within the Project area is very dense in some areas with very few existing tracks. As a result, access to the waste rock landform, tailings storage facility and processing plant footprints was limited. Sampling within these areas was therefore limited or unable to be undertaken.
- In some places the soil was very rocky and hard. As a result, soil test pits were not able to be excavated to a depth of 1 metre. Hence a true soil horizon assessment could not be completed.
- Due to limited access in some locations as a result of existing tracks, some soil test pits were dug by hand using a shovel. These test pits were challenging and were not excavated to a depth of 1 metre. In some locations the soil test pits dug by hand reached a depth of 20 centimetres before being too difficult and rocky to dig any further. Hence a true soil horizon assessment could not be completed.
- The field survey was completed in the winter months. As a result, the soil in some location was moist and the colour recorded in the field may not have been a true representation of the dry soil colour.

However, the data collected from the soil test pits and sample analysis is still suitable to provide a baseline overview of soils in the Project area.

2 Existing Environment

2.1 Climate

The Project area is located along the South Coast in the Great Southern region of Western Australia. The climate in this region is temperate Mediterranean with warm summers and mild to cool winters. Long term weather data has been compiled from the Bureau of Meteorology (BoM) weather recording stations at Munglinup Melaleuca (station number 012281) for the period 1975 to 2001 and Munglinup West (station number 012044) for the period 2002 – 2018 and is presented in *Figure 2.1*. The summer temperatures range from 28 to 30 degrees C with winter temperatures ranging from 17 to 6 degrees C. Rainfall occurs throughout the year but is more prevalent in the winter months from May to September, with an average annual rainfall of 497mm.

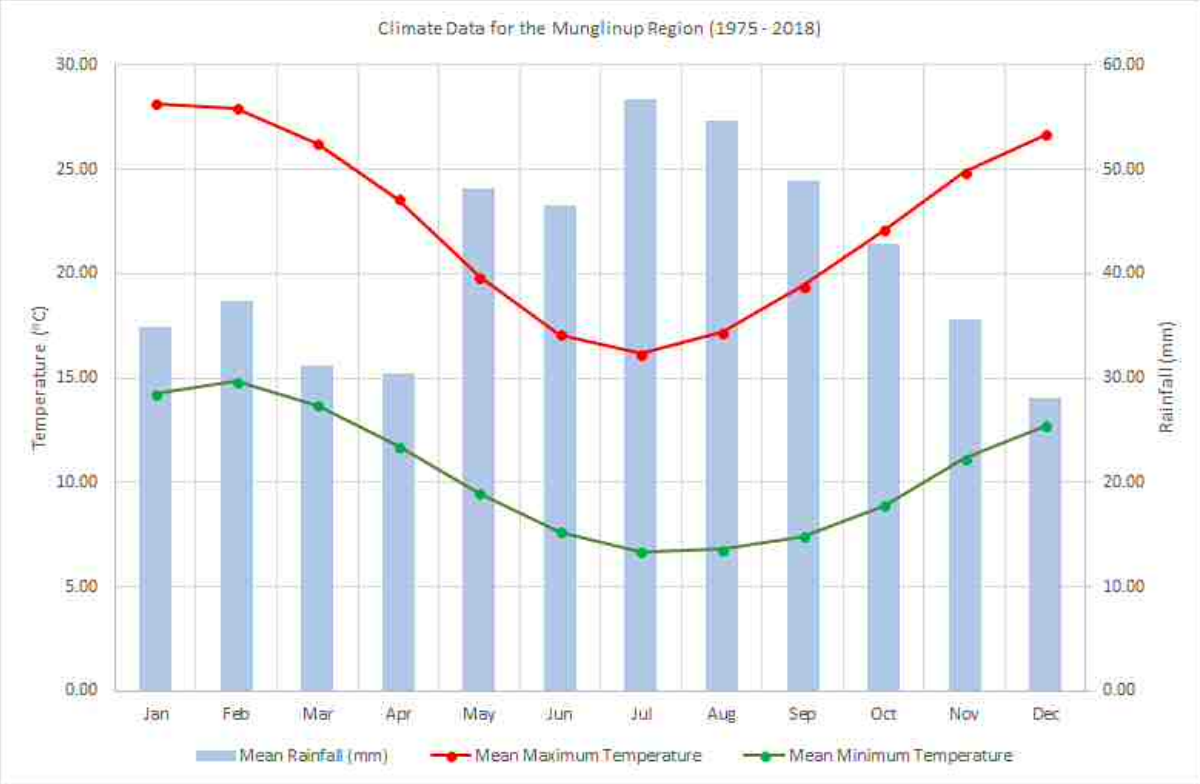


Figure 2.1 Mean monthly weather for the Munglinup region (1975 – 2018) (BoM, 2018)

2.2 Geological Setting

The Munglinup Graphite Project is located within the Northern Foreland of the Albany-Fraser Orogen. The Munglinup graphite deposits are hosted in a distinctive paragneiss of the Munglinup Gneiss (which is itself, predominantly orthogneiss). Structurally the prospect is located adjacent to the intersection between the north-east trending Fraser Range Fault and the north-west trending Merredin Fault in a zone of graphitic schists within a sequence of hornblende and hornblende-garnet gneisses.

Within the Project area graphitic mineralisation lies within the altered amphibolite and is associated with ferruginised zones, jaspilite, quartz veining and magnesite. The mineralised zones are deeply weathered (Rockwater, 2018b). Host rocks are an amphibolite or altered amphibolite which is highly metamorphosed (amphibolite to granulite facies).

2.3 Hydrology

Topography across the Project area is low to moderate with some ridges with relief of less than 40m. Drainage across the Project area trends southwards via two main drainage features, the Munglinup River and the Clayhole Creek, a tributary of the Munglinup River (Rockwater, 2018a). The Munglinup River is a tributary of the larger Young River, the two rivers meet approximately 17km south of the Project area, flowing towards the ocean (Rockwater, 2018a). The Munglinup River has a catchment area of approximately 32,300 ha originating on the sandplain north of the South Coast Highway and the Project area (Gee & Simons, 1997). The Munglinup River flows predominantly in the winter months with small pools remaining during the summer months.

2.4 Landform and Soils

The Munglinup Graphite Project and the soil survey study site are located within the Esperance Interim Biogeographic Regionalisation of Australia (IBRA) zone and the Recherche (ESP2) IBRA Subregion. The ESP2 subregion is characterised by Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones (IBRA, 2001).

The Project area is located within the Stirling Province and the Esperance Sandplain (245) landscape mapping zone. The landforms of the area are level to gently undulating plains dissected by a number of short rivers flowing south to meet the ocean (Purdie, et al., 2004). Soils in this landscape zone are generally grey fine sandy duplex soils and fine sands (Purdie, et al., 2004).

Two land systems of the Esperance Sandplain have been identified within the Project area, the Young System and the Munglinup System. The Young System is characterised by river valleys deeply incised into Tertiary sediments with grey shallow sandy duplex soils and grey deep gravelly soils (Nicholas & Gee, 1998). The Munglinup System is characterised by gently undulating plains and rises with some level plains consisting of Tertiary sediments overlying undulating Archean granite and gneiss basement with grey deep and shallow sandy duplex soils, moderately deep sandy gravels and pale deep sand (Nicholas & Gee, 1998).

At a finer scale, two subsystems, Young 1 Subsystem and the Munglinup 1 Subsystem, are located within the tenement area. The Young 1 Subsystem is characterised by rocky outcrops and breakaways with gullies along hillslopes. The soils are grey shallow sandy duplex soils. The Munglinup 1 Subsystem is characterised by drained plains and rises with gentle slopes. The soils are a mixture of deep and shallow sandy duplex soils and deep sandy gravels with occasional clays and other duplex soils. Detailed descriptions of each subsystem are provided in *Table 2.1* and their extent across the Project area presented in *Figure 2.2*.

Table 2.1. Land systems of the Project area (Nicholas & Gee, 1998).

Land System	Code	Description
Young 1 Subsystem	245Yo_1	An incised river valley (<60 m deep) with breakaways, rock outcrop, short gullies along hillslopes and alluvial plains. Grey shallow sandy duplex soils, associated grey deep sandy duplex (gravelly) soils. Minor pale deep sands, brown deep sands, unnamed clays and shallow skeletal soils.
Munglinup 1 Subsystem	245Mu_1	Externally drained plains and rises with gently inclined slopes some small level plains on upper slopes and catchment divides. Grey deep and shallow sandy duplex (gravelly) soils and moderately deep sandy gravels. Minor pale deep sands, unnamed clays and other duplex soils.

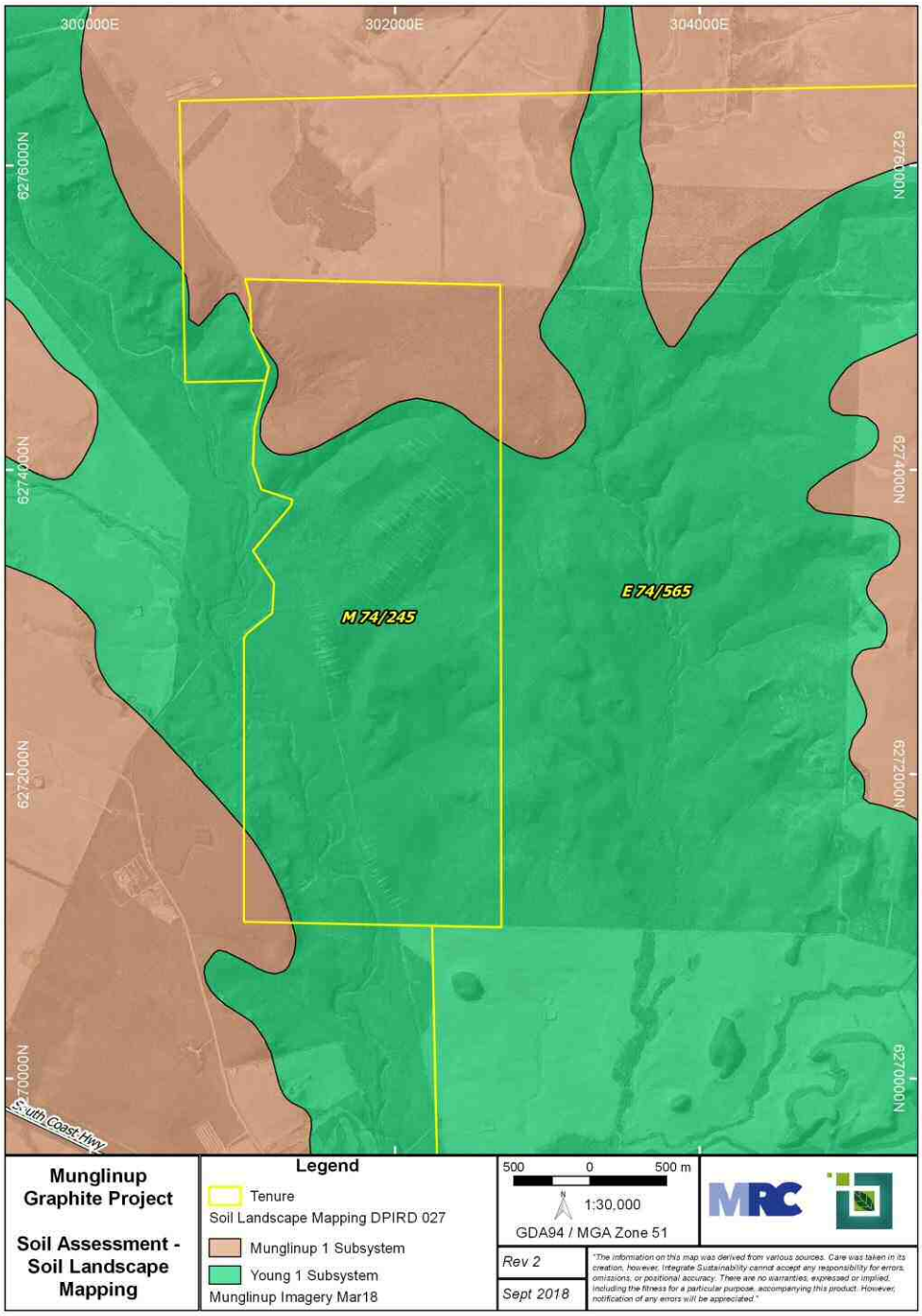


Figure 2.2 Land systems of the Project area

2.4.1 Soil Types

The soils of the south-west of Australia share many similarities. Soils have a high degree of weathering dating back to the Cretaceous. There is also widespread laterisation in some areas accounting for a high degree of leaching and the accumulation of iron and aluminium near the surface. The vast majority of soils within the south-west have a very low fertility, and are deficient in many major and minor elements required for plant growth such as nitrogen, phosphorus and potassium. The coarse textured sands to sandy loams dominate across the south-west especially within the surface soil horizons. Kaolinite is the dominant clay mineral present in regional soils and is related to the intense weathering of laterite and granite. (Moore, 2001).

Munglinup is within the agricultural zone of Western Australia. The Department of Primary Industries and Regional Development (DPIRD) has broad soil information relating to the agricultural areas where previous surveys have been completed. While these soil surveys have targeted soil properties for agricultural purposes it is still relevant information to understand the soil types of the Project area. Using the Soil Classification and MySoil tools on the DPIRD website broad soil types could be identified for the Munglinup area. These include:

- Alkaline shallow duplexes with sand or loam topsoil to 30cm and a clay subsoil
- Deep sandy duplexes with pale yellow topsoil up to 80cm with a clay subsoil
- Pale deep sands that are water repellent and
- Shallow sandy duplexes with grey sand to 30cm and clay subsoil
  (DPIRD, 2017)

2.5 Vegetation

The Recherche (ESP2) IBRA Subregion consists of vegetation types that are diverse and comprised of varying scrub, heath and woodland communities (IBRA, 2001; Ecologia Environment, 2015). Proteaceous scrubs and Mallee heaths are present on sandplains, herb fields and heaths occur on granite and quartzite ranges while Eucalyptus woodlands predominate gullies and alluvial foot slopes (IBRA, 2001; Ecologia Environment, 2015).

The Project area lies within Beard's South-West Botanical Province. Broadscale vegetation mapping completed by Beard in 1973 and revised in 2001 identifies three vegetation types across the Project area. These being medium woodlands of *Eucalyptus cornuta*, Mallee shrubland of *Eucalyptus eremophila* and *Eucalyptus redunca* and Mallee heath with scattered *Eucalyptus tetragona* and various heathy shrubs. Vegetation descriptions are provided in *Table 2.2* and are mapped in *Figure 2.3*.

Table 2.2. Beard's vegetation descriptions for the Project area

Vegetation Type	Association	Description
Woodland	931	Medium woodland; Yate (*Eucalyptus cornuta*)
Mallee-heath	47	Mixed heath with scattered mallee e.g. tallerack *Eucalyptus tetragona*
Mallee-shrubland	516	Eucalypt shrubland *Eucalyptus eremophila, E. redunca*, *E. spp*.

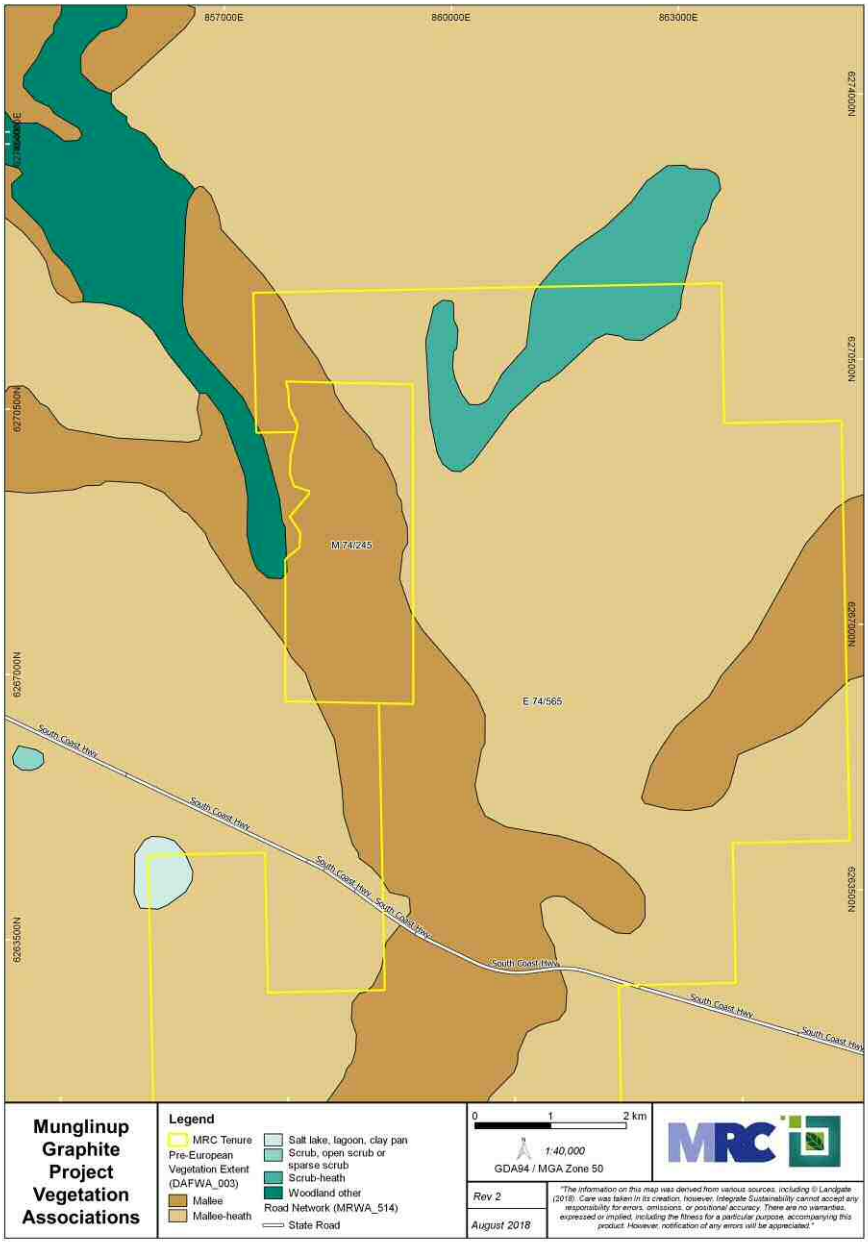


Figure 2.3 Beards vegetation types across the Project area

Much of the vegetation surrounding the Munglinup townsite has been historically cleared for farming and agriculture with remnant patches of vegetation remaining along the river systems of the region. The vegetation types across the Project area are diverse ranging from Eucalypt woodlands to proteaceous heath and mixed mallee-heath woodlands. In 2015 Ecologia completed a flora and vegetation survey across the Project area. They identified five vegetation types within the tenement boundary of M74/245. Ecologica identified the dominant vegetation type across the Project area as being Eucalypt woodland of *E. flocktoniae* over mid sparse shrubland of *Acacia* and *Grevillea* species (EfAi) followed by open mallee woodland of *E. pleurocarpa* over mid sparse shrublands of *Banksia*, *Calothamnus*, *Leucopogon* and *Hibbertia* species (EpleBaMt) (Ecologia Environment, 2015). Detailed vegetation descriptions from the Ecologia study are provided in *Table 2.3* and are mapped in *Figure 2.4*

Table 2.3. Ecologia 2015 vegetation descriptions for the Project area

Vegetation Type	Description
EfAi	*Eucalyptus flocktoniae* and *E. uncinata* mid woodland, over *Acacia ingrata* and *Grevillea pectinata* mid sparse shrubland.

Vegetation Type	Description
EpleBaMt	*Eucalyptus pleurocarpa* mid open mallee woodland, over *Banksia armata subsp. armata* and *Calothamnus gracilis* mid sparse shrubland, over *Melaleuca tuberculata var. tuberculata, Leucopogon crassifolius*, and *Hibbertia gracilipes* low sparse shrubland.
AhMeTm	*Allocasuarina huegeliana, Eucalyptus occidentalis*, and *Eucalyptus pileata* low open woodland, over *Melaleuca elliptica* mid sparse shrubland, over *Lepidosperma sanguinolentum* and *Tetraria* sp. Mt Madden (C.D. Turley 40 BP/897) low sparse sedgeland.
EplaAgMa:	*Eucalyptus platypus* (or *E. dielsii*) low open forest, over *Acacia glaucoptera* and *Melaleuca acuminata* subsp. *acuminata* mid sparse shrubland, over *Lepidosperma* spp. or *Austrostipa* spp. low sparse sedgeland/grassland.
EoAcNa	*Eucalyptus occidentalis* mid woodland, over *Acacia cyclops, Acacia saligna* subsp. *lindleyi*, and *Acacia sulcata* subsp. *platyphylla*, and *Thomasia angustifolia* mid sparse shrubland, over *Lepidosperma sanguinolentum* low sparse sedgeland.

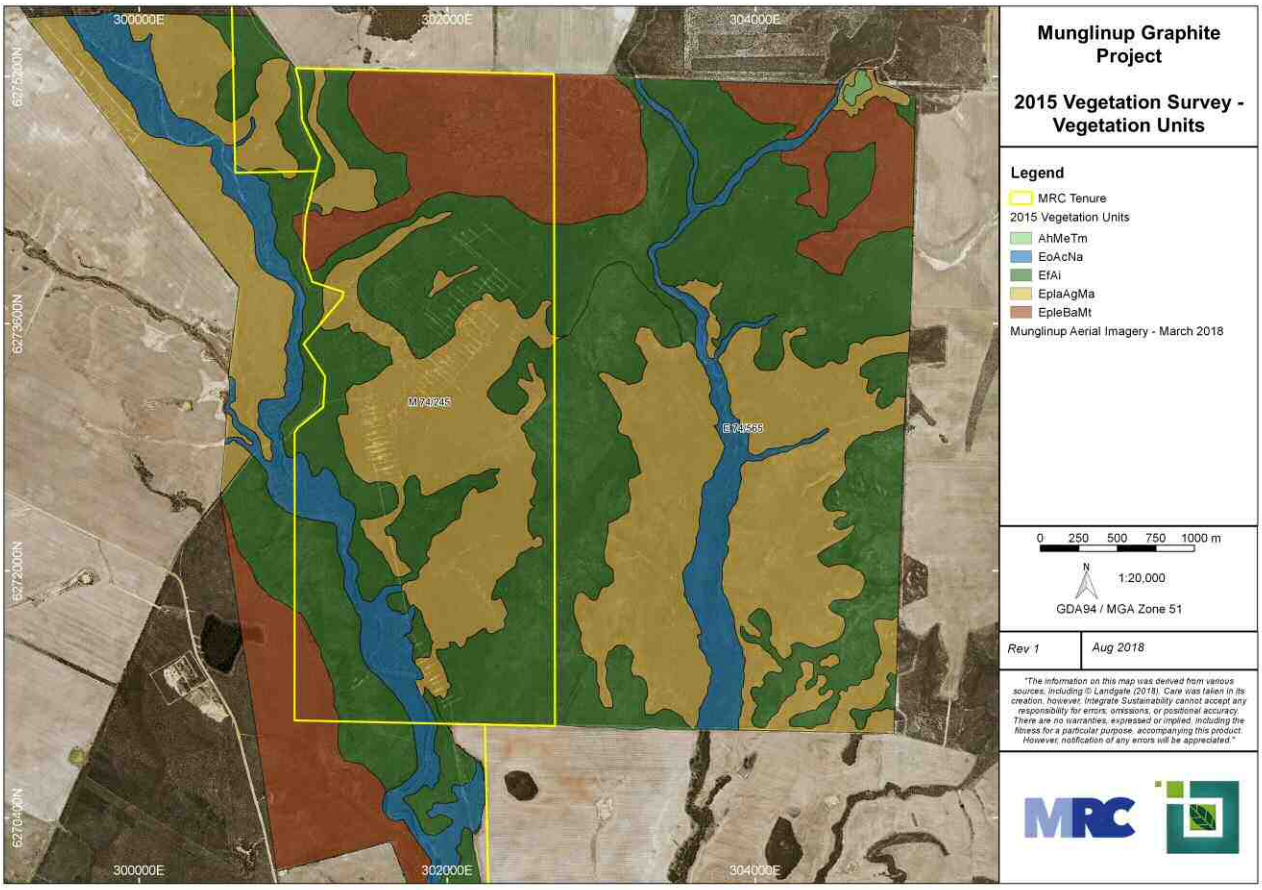


Figure 2.4 Ecologia 2015 vegetation types across the Project area

2.6 Phytophthora Dieback

Munglinup and the Project area occur within the Dieback Risk Zone of south-west Australia. Glevan Consulting completed a Phytophthora Dieback Assessment across the accessible areas (drill lines and tracks) of the tenement in April 2018. No Phytophthora Dieback infestations were observed within the Project area. The majority (228 ha) of the study area was observed to be uninterpretable due to

the presence of vegetation types containing an insufficient coverage of reliable indicator species (Glevan Consulting, 2018). While Phytophthora Dieback is not currently known within the Project area, hygiene measures were observed during the soil field survey to reduce the potential to introduce or spread Phytophthora Dieback and other soil related pathogens and weeds.

3 Methodology

3.1 Regulatory Requirements

Completing a soil assessment is required to be undertaken and submitted with a Mining Proposal. The Department of Mines, Industry Regulation and Safety (DMIRS) provide guidance on the minimum inputs and parameters that should be examined for soil assessments which will accompany a Mining Proposal. In addition to the DMIRS guidance material there are a number of guides and documents which provide detailed information on the field methodology, laboratory testing and analysis of soil types. The following documents and sources have been utilised or reviewed by ISPL to complete this soil assessment. These include:

- Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals, (DMP 2016)
- Guidelines for Preparing Mine Closure Plans, (DMP & EPA 2015)
- Guidelines for Mining Proposals in Western Australia, (DMP 2016)
- Australian Soil and Land Survey Field Handbook, (McDonald, et al. 2009)
- Guidelines for Surveying Soil and Land Resources, (CSIRO 2008)
- Soils Made Easy: A simple guide to describing soils (DPIRD 2013)
- Soil Groups of WA: A simple guide to the main soils of Western Australia (Schoknecht and Pathan 2013)
- The Australian Soil Classification (Isbell & NCST, 2016)
- Landscape Function Analysis: Procedures for monitoring and assessing landscapes (Tongway and Hindley 2004)

3.2 Assessment Methodology

3.2.1 Survey Scale

The number of samples required for any soil assessment is dictated by the required scale of mapping and the purpose of the survey. The density of sampling sites is defined in the Guidelines for Surveying Soil and Land Resources (CSIRO, 2008). For high intensity and resolution surveys suitable for farm planning a sampling regime of 1 site per 25ha is recommended while for a low intensity and resolution survey suitable for regional planning a sampling regime of 1 site per 100ha or more is recommended (Table 3.1). ISPL are undertaking a medium intensity soil survey suitable to map at a resolution of 1:50,000 with 1 site per 40ha. For the Project area of 625ha a total of 19 soil test pits have been completed. An additional two soil samples were collected from within the Tailings Storage Facility at a later date when access was improved. The location of the soil test pits within the MRC tenure is shown in Figure 3.1.

Table 3.1. Density of soil sampling based on objectives (CSIRO 2008)

Intensity Level	NRCS 'order'	Inspection Density	Publication Scale	Minimum Delineation Size (0.4cm^2)	Kind of Map Unit	Objectives
Very High	1st	> 4 per ha	1:2 500	0.025 ha	Detailed	Site planning, engineering, precision agriculture
High	1st	1 per 0.8ha to 4 ha	1:10 000	0.4 ha	Less detailed	Intensive uses, small fields, urban land, engineering works
Moderately High	2nd	1 per 4 ha to 25 ha	1:25 000	2.5 ha	Moderately detailed	Moderately intensive uses at field level, details Project planning
Medium	3rd	1 per 20ha to 100ha	1:50 000	10 ha	General or simple	Moderately intensive uses at farm level, semi detailed Project planning
Low	4th	1 per 100ha to 400ha	1:100 000	40 ha	General / simple	Extensive land uses, Project feasibility, district level planning
Very Low	5th	<1 per 100 ha	1:250 000	250 ha	Simple	National land inventory, regional planning
Exploratory		Opportunistic	Up to 1:500 000	100 000 ha	Categorically general	General information

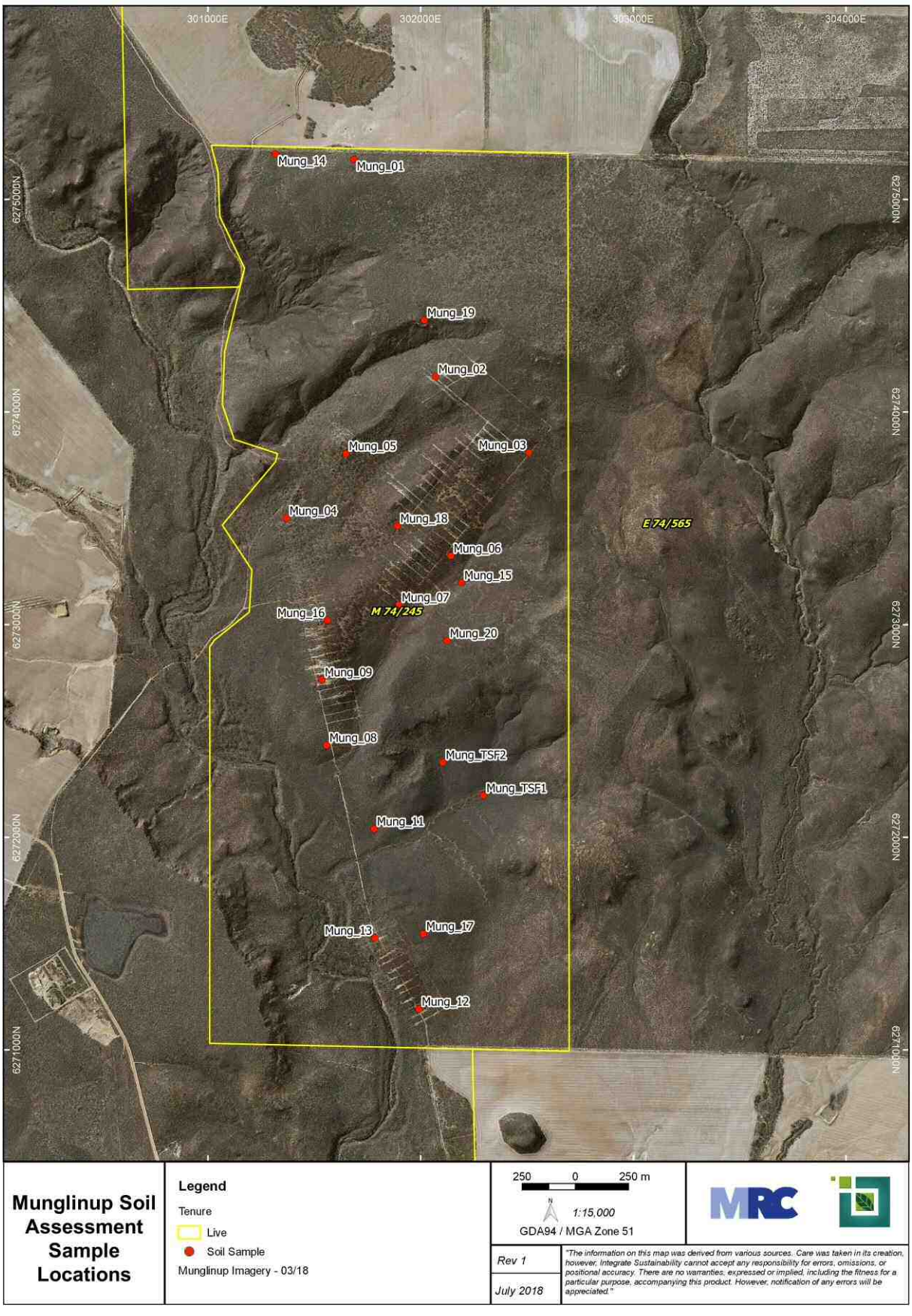


Figure 3.1. Location of soil test pits

3.2.2 Field Assessment

The field activities relating to the Munglinup soil survey were completed from the 18th to the 23rd of June 2018. Field activities were completed by two people, Sophie Monaco from ISPL and Jordan Serve from MRC.

To assess the soil, a test pit was excavated using a 1.4t mini excavator or by hand using a shovel in areas not accessible by the mini excavator. Test pits were excavated to a depth of 1 metre where possible with the mini excavator. Test pits excavated by hand were to a depth of between 0.2 to 0.5 metres depending on the hardness of the soil and presence of rocks.

Field Observations

A number of observations were made in the field at each soil test pit location. These included observations of the soil surface conditions as well as the soil horizons.

The following information was recorded for all soil test pits:

- GPS location
- Site ID
- Date
- Time
- Temperature in C
- Slope
- Surrounding vegetation description
- Presence of drainage features
- Presence of geomorphological features
- Previous disturbance

Soil surface conditions were assessed using a 0.5 metre quadrat. The observations recorded at each soil test pit before excavation included:

- Litter cover (%)
- Perennial vegetation cover (%)
- Rainsplash protection
- Crust presence and brokenness
- Soil erosion type and severity
- Deposited material
- Cryptogam
- Surface roughness
- Resistance to disturbance
- Water repellence

Once the soil test pit had been excavated, the following observations were recorded at each soil test pit for each soil horizon:

- Horizon depth (cm)
- Soil colour (Munsell colour chart Hue Value / Chroma)
- Presence of roots
- Soil texture (behaviour of moist bolus)
- Coarse fragments presence and size
- Structure type
- Description
- Sample taken and sample ID

Laboratory Analysis

Samples from each test pit were collected. Samples were taken from the A horizon for all soil test pits. Where present, soil samples were also taken from the B horizon. A total of 28 soil samples were taken during the soil field assessment. All soil samples were assessed by CSBP for the following parameters:

- pH
- Electrical Conductivity
- Exchangeable cations (K^+, Ca^{2+}, Mg^{2+}, Na^+, Al^{3+})
- Effective cation exchange capacity (ECEC) calculation
- Sodicity as Exchangeable sodium percentage (ESP) calculation
- Organic carbon
- Total N (plant available nutrients)
- Total P (plant available nutrients)
- Available (Colwell) P and K (plant available nutrients)
- Available Sulphur (KCl)
- Trace elements (Cu, Zn, Mn, Fe)
- Fizz Test (Carbonates)
- Particle size distribution
- Emerson dispersion test

An additional two soil samples were taken from the Tailings Storage Facility footprint at a later date when access was improved. Both soil samples were assessed by CSBP for the parameters listed above and have been included in this report. Soil surface assessments were not completed for these sites.

4 Landform Assessment

The land surface within the vicinity of the Munglinup Graphite Project is dominated by valleys and ridges associated with the Munglinup River. The landform assessment for the Munglinup Graphite Project was completed using Quantum GIS (QGIS) and a digital elevation model (DEM) to generate contours and cross profiles of the surrounding landscape.

Within the broader surrounding area, the lowest point of the land surface is 64m above sea level and rises to 158m on ridges which occur outside the tenement boundary. Within the tenement boundary the lowest point is 70m above sea level within the Munglinup River valley to the south west corner, with the highest feature rising to 130m above sea level along a small hill in the northern portion of the tenement.

The naturally occurring slopes of features was also assessed using QGIS. Across the surrounding area, slope angles are relatively flat with the greatest slope angle being 10°. The lowest slope angle is 0.2° and occurs primarily across the farmland areas and along the plateaus. Slope angle is greatest within the valleys, particularly along the Munglinup River and its tributaries. This suggests that significant erosion has occurred over time in these areas.

The landforms and topography of the tenement area are an important feature for site layout planning and final design of waste landforms. In general, naturally occurring landforms are relatively flat on the top with the highest slope angles towards the top of the landform taking a general concave overall slope.

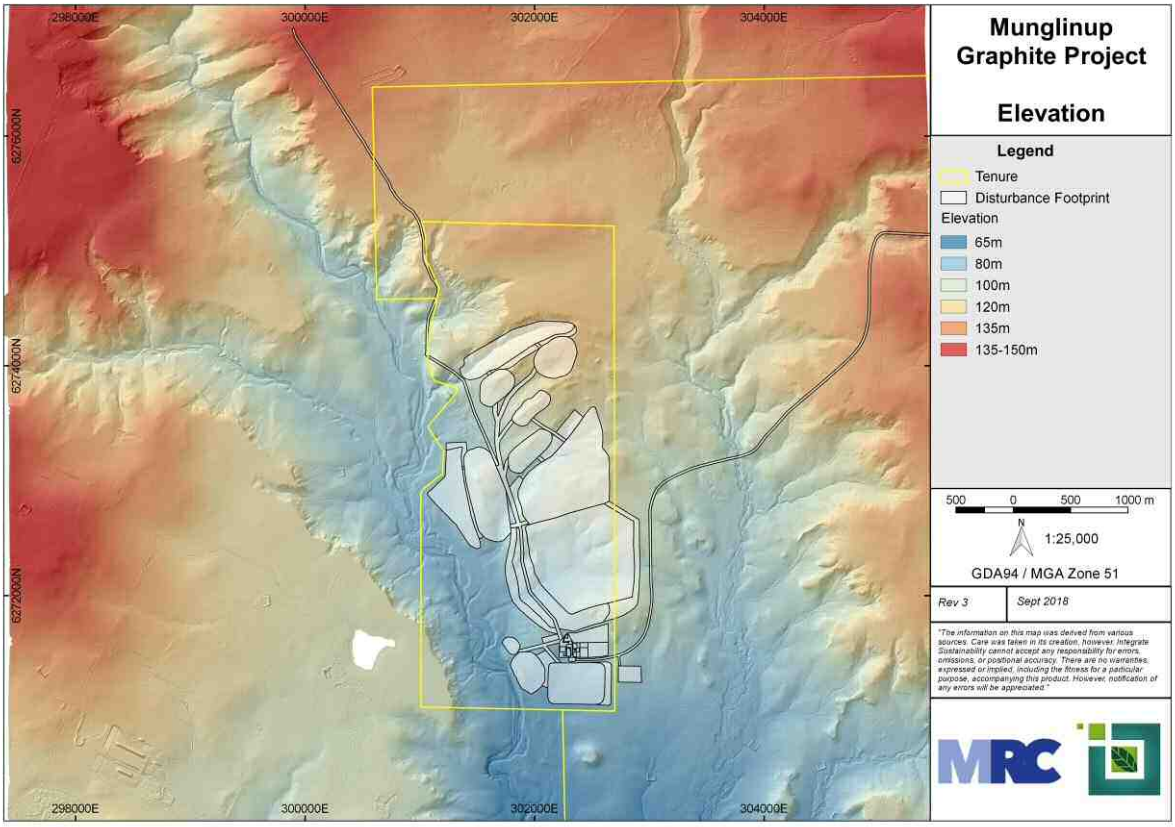


Figure 4.1. Elevation of the Munglinup Graphite Project

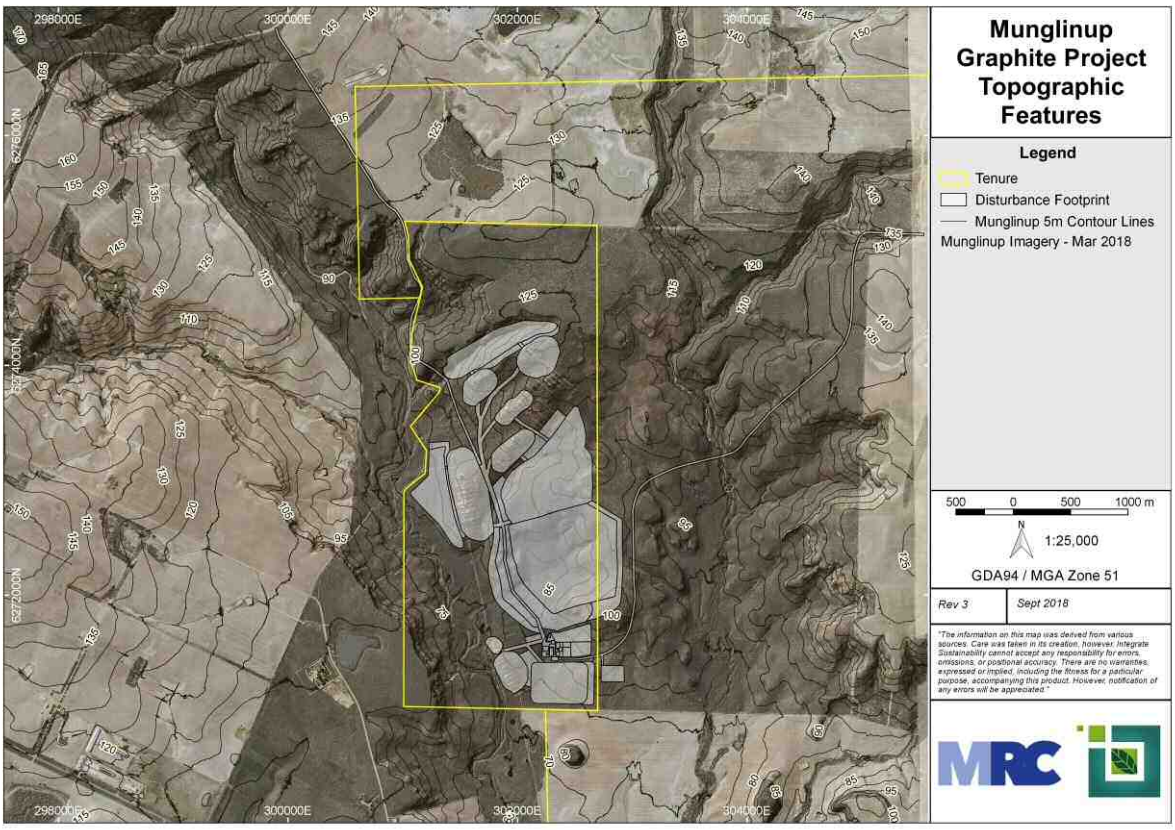


Figure 4.2. Topographical features of the Munglinup Graphite Project

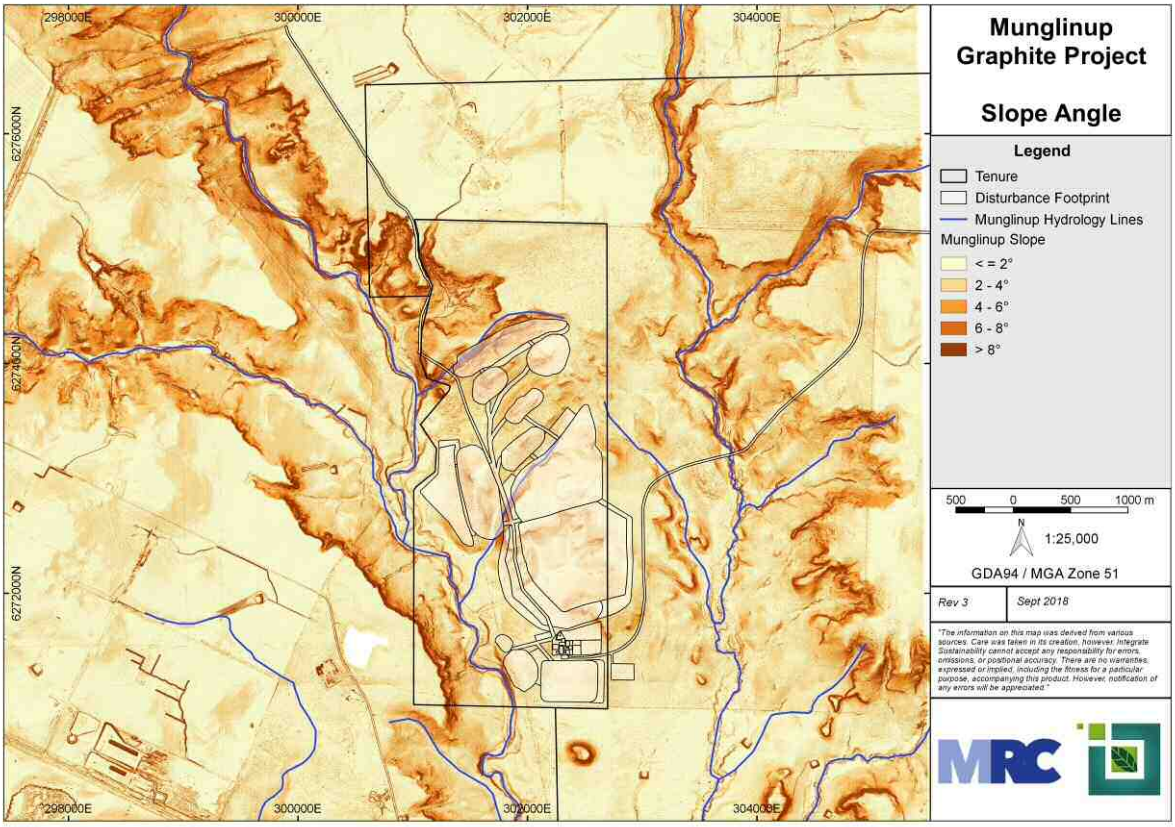


Figure 4.3. Slope angle of the Munglinup Graphite Project

5 Munglinup Soils

5.1 Soil Classes

Right across the Project site the soils are variable. There are clear boundaries which can be seen in the change of vegetation and surface soil colour when examining satellite imagery and driving along site access tracks. Broadly the topsoils of the Project area are within the first 30cm. Soils are predominantly sandy loam in texture.

Using the site observations and laboratory results the soils within the Project area have been classified into soil classes. A soil class has been defined as a group of similar soil profiles which share similar soil properties including surrounding vegetation, colour, texture, pH, ESP, nutrient availability (CSIRO, 2008). This has allowed for some variation within each of the soil classes. Six soil classes have been identified within the Project area which also correlate with known soils of the Munglinup area as mapped by DPIRD. The soil classes identified at Munglinup are outlined in Table 5.1 and discussed in the following sections.

Table 5.1. Summary of soil types at Munglinup

Munglinup Soil Class	DPIRD Soil Type	Soil Land System
White gravelly sand	Deep sandy duplex	Munglinup 1 Subsystem
Grey sandy duplex	Shallow sandy duplex	Young 1 Subsystem
Brown loam duplex	Brown Shallow Loamy Duplex	Munglinup 1 Subsystem Young 1 Subsystem
Alkaline grey loam duplex	Alkaline shallow duplexes	Young 1 Subsystem
Calcareous brown clay loam	Calcareous loamy earth	Young 1 Subsystem
Deep brown red silt loam	Loamy earths	Young 1 Subsystem

Figure 5.1. Soil classes of the Munglinup Graphite Project

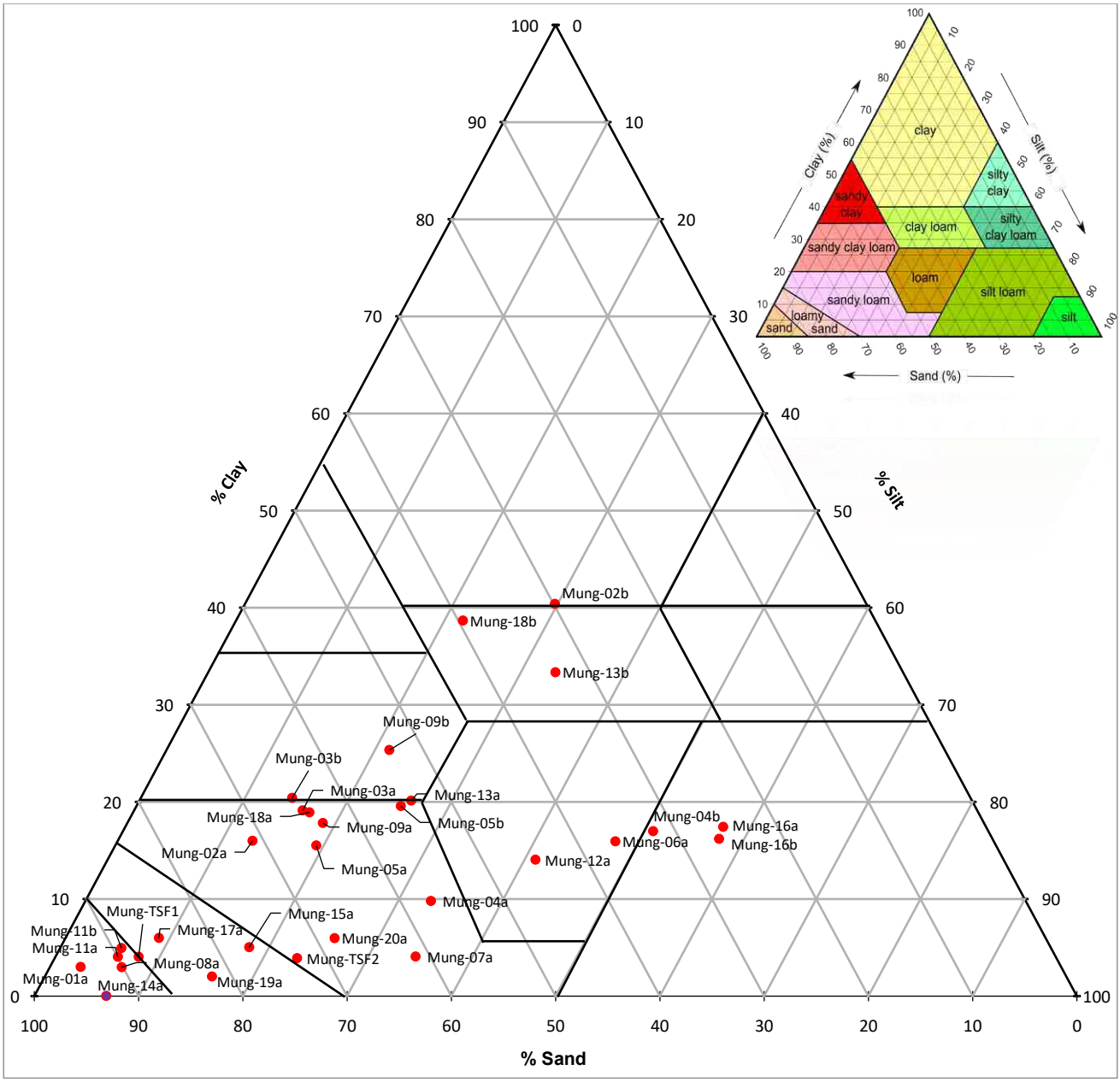


Figure 5.2. Soil classes of the Munglinup Graphite Project – Ternary Diagram

5.1.1 White Gravelly Sand

The white gravelly sand soil class is present in the northern area of the Project area and was encountered at sites Mung_01 and Mung_14. This soil class corresponds to the distribution of the Threatened Ecological Community 'Proteaceous Dominated Kwongan Shrublands' which is a dense and highly diverse shrubland community. It also relates to the EpleBaMt vegetation type as mapped by Ecologia in 2015.

The soil surface in this area is loose and sandy with a small amount of leaf litter coverage (<10%). A cryptogam layer is present helping to stabilise the soil surface. A very shallow layer of organic material is present (<2cm) and is dark brown in colour.

The topsoil in this area is a pale with a mottled colour of grey white with a high gravel content. The topsoil has a slightly acidic pH (5.5 to 6). The nutrient composition of the soil is nitrogen and potassium deficient with moderate phosphorus but is iron enriched. Soil is non-saline and sandy in texture. This A horizon extends to 25cm at which point a rock and clay hardpan is reached, the extent and

composition of this B horizon is unknown and was not able to be sampled. Based on the soils of the region it is likely to be a sodic clay.

Table 5.2. Soil Type Characteristics Table – White Gravelly Sand

Factor	Result / Description	Profile
Soil Type	White Gravelly Sand	
Colour	Grey White	
Sites	Mung_01, Mung_14	
Soil Surface	Minimal leaf litter, cryptogam present, loose sandy surface easily broken	
Soil Classification	Grey Deep Sandy Duplex soil group 403	
Horizon A		
Texture	Sand	
Roots	Fine roots present, some larger woody roots present but scarce	
pH_{Ca}	5.5 – 6	
Fizz	Slight fizz, slightly carbonaceous	
Sodicity	ESP 4.8% non-sodic	
Exchangeable Cations	CEC 1.7 meq/100g	

Figure 5.3. White Gravelly Sand soil class

5.1.2 Grey Sandy Duplex

The Grey Sandy Duplex soil class is scattered across the tenure area and is loosely associated with the EfAi vegetation type as mapped by Ecologia in 2015. The soil class occurs within valleys and drainage areas.

The soil surface in these areas has a slight crust yet is slightly sandy and easily broken. There is a moderate amount of leaf litter (25-50%) and deposited material. A dark and shallow layer of organic material is present which is between 2 – 5cm in depth.

The topsoil and A horizon of this soil class is grey in colour and sand in texture and the pH is slightly acidic (6 to 6.5). The nutrient composition of the soil is nitrogen deficient (0.03%) with a high extractable phosphorus content (42.62 mg/kg). Topsoils are non-saline (0.06 dS/m) but have a high iron content (42.29 mg/kg). Some small gravels and stones are present throughout the A horizon, there is very little soil structure with sand grains and loose sand visible. This A horizon extends to 25cm. There are some fine roots present throughout this horizon. At 25cm a clay hardpan is reached which is yellow in colour and is very difficult to break. The extent and composition of this B horizon is unknown as not enough material could be broken away to be sampled. Based on the soils of the region it is likely to be a sodic clay.

Table 5.3. Soil Type Characteristics Table – Grey Sandy Duplex

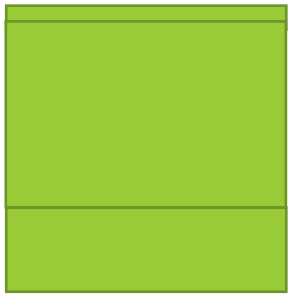
Factor	Result / Description	Profile
Soil Type	Grey Sand	
Colour	Grey	
Sites	Mung_11, Mung_08, Mung_17, Mung_TSF1	
Soil Surface	Leaf litter present, slight crust with some cryptogam	
Soil Classification	Grey Shallow Sandy Duplex soil group 404	
Horizon A		
Texture	Sand	
Roots	Fine roots present	
pH_{Ca}	6 – 6.5	
Fizz	No Fizz, not carbonaceous	
Sodicity	ESP 7.02% moderately sodic	
Cation Exchange Capacity	CEC 3.84 meq/100g	

Figure 5.4. Grey Sandy Duplex soil class

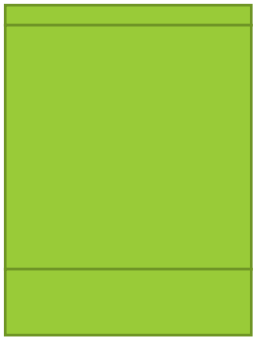
5.1.3 Brown Loam Duplex

The brown loam duplex is the most prevalent soil class across the Project area. It occurs along flat and slightly sloping areas and is associated with eucalyptus woodlands with a shrub understorey and is broadly associated with the vegetation type EplaAgMa as mapped by Ecologia in 2015.

The soil surface in these areas has a dense leaf litter cover of 75 to 100% coverage. After removing the leaf litter there is no soil crust and the soil surface is loose, sandy and easily broken. A dark brown layer of organic material is present to 3-5cm.

The topsoil and A horizon of this soil class is brown to dark brown in colour and sandy loam in texture. The pH of the soil ranges from slightly acidic to neutral (6 – 7.3) and is non-saline (0.21 dS/m). The nutrient composition of the soil is nitrogen deficient (0.06%), high phosphorus (47.4 mg/kg) and iron content (36.88 mg/kg). The structure of this soil horizon varied but was blocky and compacted in most places, some stones and small pebbles were evident. There are roots present in this horizon which range from fine to thick woody roots. The A horizon extends up to 35cm. At this point, or shallower, a red clay hardpan is hit which is very compacted and difficult to dig into. A sample of this material was not taken due to compaction. Based on the soils of the region it is likely to be a sodic clay.

Table 5.4. Soil Type Characteristics Table – Brown Loam Duplex

Factor	**Result / Description**	**Profile**
Soil Type	Brown Loam Duplex	
Colour	Brown to Dark Brown	
Sites	Mung_15, Mung_19, Mung_07, Mung_20, Mung_04, Mung_TSF2	
Soil Surface	High amount of leaf litter	
Soil Classification	Brown Shallow Loamy Duplex soil group 508	
Horizon A		
Texture	Sandy loam	
Roots	Fine roots present and woody roots present	
pH_{Ca}	6 to 7.3	
Fizz	Slight Fizz	
Sodicity	ESP 14% Strongly Sodic	
Exchangeable Cations	CEC 21.66 meq/100g	

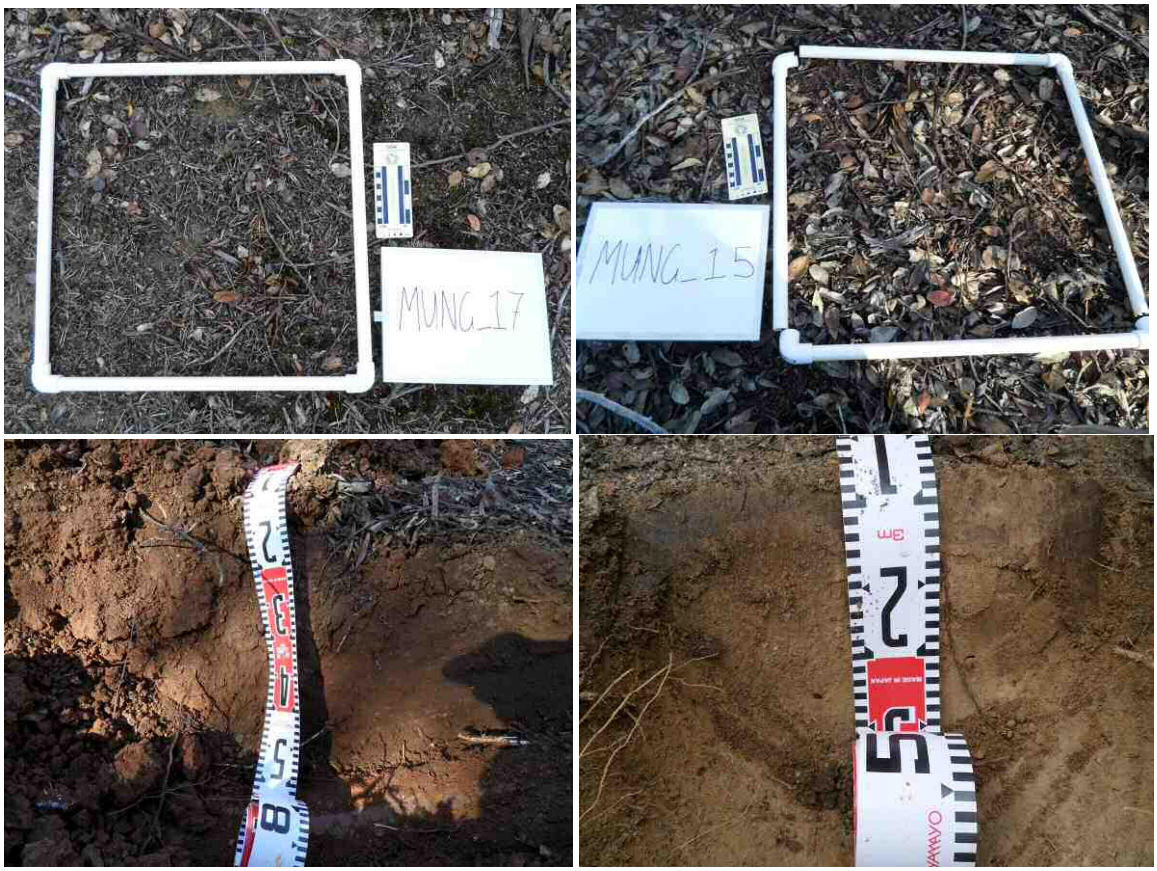


Figure 5.5. Brown Loam Duplex soil class

5.1.4 Alkaline Grey Loam Duplex

The alkaline grey loam duplex soil class was very distinctive when encountered within the Project area. This soil class is located within undulating areas and near slopes. Large white rocks are often exposed on the surface where this soil class is present. The associated vegetation is an open Eucalyptus woodland with a dense shrub layer. This is broadly related to the EfAi vegetation type classified by Ecologia in 2015.

The soil surface in this area is characterised by large white rocks on the surface with a relative amount of leaf litter (50-75%). There is some soil crust present but this is easily broken and loose and sandy. A dark brown layer of organic material is present between 3-5cm. Roots are present in this layer, particularly those of grasses.

The A horizon of this soil class is grey brown in colour and sandy loam in texture. The pH of this horizon is slightly alkaline ranging from 7.5 to 8.7 and is non-saline (0.53 dS/m). Soil from this horizon shows a strong effervescence indicating it is calcareous. The nutrient composition shows a medium rating of total nitrogen (0.19 %), very high phosphorus (95.82 mg/kg) and iron (22.08 mg/kg). The structure of this soil horizon varied but was quite sandy and loose, breaking away easily. Roots are present in this horizon ranging from fine roots to thicker woody roots. The A horizon is shallow and extends from 5 to 20cm.

The B horizon of this soil class is significantly lighter than the A horizon ranging from a light grey to white and is clay loam in texture. The pH of this horizon is alkaline ranging from 8.7 to 9.6, an increase in pH compared to the A horizon, and is non-saline (0.58 dS/m). Soil from this horizon shows a strong effervescence indicating it is calcareous. The nutrient composition shows it is very nitrogen deficient (0.05%), lower phosphorus content than the A horizon (52.85 mg/kg). There is also considerably less iron in the soil (8.46 mg/kg). The structure of this horizon was strongly cohesive and either presented

as one cohesive mass or blocky. When broken this material was very fine. No roots were present in this layer. The B horizon extended from 20 to 60cm. At this point it became too difficult to dig through.

Table 5.5. Soil Type Characteristics Table – Alkaline Grey loam Duplex

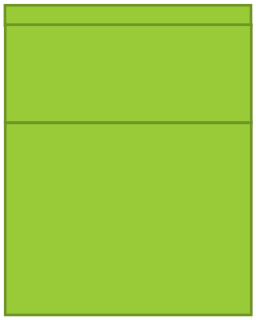
Factor	**Result / Description**	**Profile**
Soil Type	Alkaline Grey Loam Duplex	
Sites	Mung_13, Mung_18, Mung_05, Mung_02	
Soil Surface	moderate amount of leaf litter. Rocks on the surface	
Soil Classification	Alakline Grey Shallow Loamy Duplex soil group 502	
Horizon A		
Colour	Grey brown	
Texture	Sandy loam	
Roots	Fine roots present and woody roots present	
pH_{Ca}	7.5 – 8.7	
Fizz	Strongly effervescent	
Sodicity	ESP 8.45% Marginally sodic	
Exchangeable Cations	CEC 35.9 meq/100g	
Horizon B		
Colour	White	
Texture	Clay loam	
Roots	No	
pH_{Ca}	8.7 – 9.6	
Fizz	Very strong effervescence	
Sodicity	ESP 23.63% Strongly Sodic	
Exchangeable Cations	CEC 24.15 meq/100g	

Figure 5.6. Alkaline Grey Loam Duplex

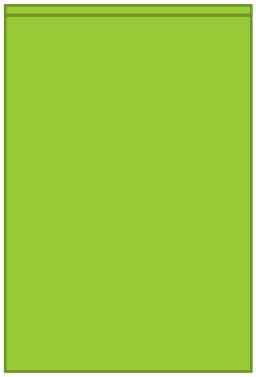
5.1.5 Calcareous Brown Clay Loam

The calcareous brown clay loam was recorded at two sites. This soil class differed to others in that there was almost no differentiation between the A and B horizon other than a subtle grading of colour. This soil class is located within flat areas and is associated with mallees and other eucalyptus species over a dense understorey of shrubs and occasional grasses.

The soil surface is characterised by a small coverage of leaf litter (10-25%) and rocky exposures and gravel. There is a soil crust present but this is easily broken and slightly sandy. There is a moderate cryptogam contribution with mosses and lichens on the soil surface. A very shallow, up to 2cm, organic material layer is present and is dark brown in colour. Some roots are present in this layer.

The A horizon of this soil class is light brown in colour and sandy loam in texture. The pH of this horizon is slightly alkaline (7.8 to 8.5) and non-saline (1.25 dS/m). Soil from this horizon shows a strong effervescence indicating it is calcareous. The nutrient composition shows nitrogen deficiency (0.08 %), high phosphorus (59.95 mg/kg) and iron (15.19 mg/kg). There was very little variation between the A and B horizon. Soil samples taken from further down the test pit had similar properties. The colour is light brown however the soil texture was slightly different with a higher clay content and verged on sandy clay loam. The pH is similar ranging from 7.9 to 8.7 and being non-saline (1.16 dS/m). The nutrient composition is also similar showing nitrogen deficiency (0.06%), high phosphorus (48.4 mg/kg) and iron (11.61 mg/kg). The structure of the soil was loose and sandy with some large stones present. Both fine and thick woody roots were present up to 50cm. After 50cm the soil became more compacted.

Table 5.6. Soil Type Characteristics Table – Calcareous Brown Clay Loam

Factor	**Result / Description**	**Profile**
Soil Type	Calcareous Brown Clay Loam	
Sites	Mung_03, Mung_09	
Soil Surface	Slight amount of leaf litter. Rocks on the surface Moderate cryptogam	
Soil Classification	Calcareous Loamy Earth soil group 542	
Horizon A		
Colour	Brown	
Texture	Sandy loam to sandy clay loam	
Roots	Fine roots present and woody roots present	

Factor	Result / Description	Profile
pH_{Ca}	7.8 – 8.7	
Electrical Conductivity	1.21 dS/m	
Fizz	Strongly effervescent	
Sodicity	ESP 33.05% highly sodic	
Exchangeable Cations	31.65 meq/100g	

Figure 5.7. Calcareous Brown Clay Loam

5.1.6 Deep Brown Red Silt Loam

The brown red silt loam soil class was recorded at three sites and is strongly associated with the 'spear tree country' of *Eucalyptus platypus*. This species occurs in pockets across the Project area as a woodland with minimal groundcovers and mid-storey.

The soil surface of this soil class has a thick leaf litter cover of 75 to 100%. There is no soil crust present and no cryptogam cover. There is no evidence of an organic material layer rather the soil surface is the same brown red colour as the horizon beneath.

There was very little variation between an A and B horizon in this soil class. Soil pits were completed to a depth of 1m at which point the soil appeared visibly similar across the whole profile. This soil class has a brown red colour and is loam to silt loam in texture. The pH is alkaline (8.1) and non-saline (0.67 dS/m). The soil shows a moderate effervescence indicating it is calcareous. The nutrient composition shows nitrogen deficiency (0.05 mg/kg), high phosphorus (62.5 mg/kg) and iron (21.2 mg/kg). The soil was strongly cohesive likely a result of recent rain and came apart easily in large clumps or blocks. Both fine and woody roots were present in the top 30cm of the soil profile.

Table 5.7. Soil Type Characteristics Table – Deep Brown Red Silt Loam

Factor	Result / Description	Profile
Soil Type	Brown red silt loam	
Sites	Mung_06, Mung_12, Mung_16	
Soil Surface	High amount of leaf litter	
Soil Classification	Loamy Earths	
Horizon A		
Colour	Brown red	
Texture	Loam to silt loam	
Roots	Fine roots present and woody roots present	
pH_{Ca}	7.9 – 8.3	
Electrical Conductivity	0.67 dS/m	

Factor	Result / Description	Profile
Fizz	Moderately effervescent	
Sodicity	ESP 19.08% Strongly Sodic	
Exchangeable Cation	CEC 37.58 meq/100g	

Figure 5.8. Deep Brown Red Silt Loam

5.2 Soil Properties

The properties of soil can have a significant influence on their ability to maintain healthy vegetation and their use for rehabilitation. Most importantly the soil properties can identify the likelihood of soil or growth medium to be susceptible to erosion. This can ensure that the correct soils are stockpiled and placed in suitable locations during rehabilitation to minimise erosion potential. There are three factors which can influence the likelihood of soil to be susceptible to erosion and these are all interlinked. These properties are soil structure, dispersion and sodicity.

Soil Structure

Soil structure refers to the way soil particles group together to form aggregates (McDonald, et al., 2009). Soil aggregates can vary in size from small crumbs to large blocks (McDonald, et al., 2009). Soil structure is important for allowing water retention as well as drainage and to allow root penetration and nutrient retention (Agriculture Victoria, 2006). Sand is weakly structured as the sand particles have only a weakly cohesive whereas heavy clays which are strongly cohesive can have a massive structure which removes pore spaces between soil aggregates (Agriculture Victoria, 2006). Soils which are structurally stable retain their shape when subjected to rainfall (DPIRD, 2018).

Dispersion

A dispersive soil is structurally unstable. Under wetting or rainfall the bonds of soil aggregates collapse and the individual soil particles disperse or separate (DPIRD, 2018). Essentially dispersion results in the collapse of the soil structure resulting in slumping, loss of porosity and erosion (DPIRD, 2018). Some dispersive soils will be acidic however, the majority of dispersive soils in the south-west are strongly alkaline (pH_{Ca} >8.5) (DPIRD, 2018). Many of these alkaline dispersive soils are also high in salt and boron (DPIRD, 2018).

Sodicity

A sodic soil is classified as a soil which contains greater than 6% exchangeable sodium (ESP) (DPIW Tasmania, 2009). Sodicity can have an influence on soil structure because the sodium can weaken the bonds between soil particles (McDonald, et al., 2009). Typically, on contact with water sodic soils will disperse, meaning the clay and soil particles separate (McDonald, et al., 2009). Upon drying sodic soils and the dispersed clay particles will set hard (McDonald, et al., 2009). Importantly, not all sodic soils will be dispersive and not all dispersive soils are sodic (DPIW Tasmania, 2009). Other chemical parameters may also influence the soil to make it dispersive. Organic matter, clay mineralogy and high iron content can prevent sodic soils from dispersing (DPIW Tasmania, 2009).

5.2.1 Sodicity / Dispersion and Erosion Potential

The exchangeable sodium percentage (ESP) is used as an indicator of dispersion potential with soils having an ESP value of >6% classed as sodic and likely to be dispersive (Hazelton & Murphy, 2007). However, determining whether a soil will be dispersive is also related to the complex interaction of salinity, clay content and exchangeable cations.

Two of the soil classes at Munglinup are structurally stable and unlikely to be dispersive. These are the White Gravelly Sand and Grey Sandy Duplex soil classes. Both these soil classes are acidic, have a low clay content and a high iron content and are non-sodic (4.8% and 5.6% respectively).

The remaining soil classes at Munglinup are moderately to highly sodic. The Brown Loam Duplex soil class is acidic and has a high iron content and a moderate clay content. This soil class is potentially dispersive under the right conditions however the iron and acidic nature of the soil may reduce its dispersive characteristics. The Alkaline Grey Loam Duplex soil class has an A horizon which is moderately sodic (8.45%), alkaline with a high iron content and moderate clay content. The A horizon is potentially dispersive. The B horizon is highly sodic (23%), strongly alkaline and has a higher clay content compared to the A horizon. The B horizon also has a lower iron content. The B horizon is potentially dispersive and more likely to disperse under the right conditions compared to the A horizon.

The Calcareous Brown Clay Loam soil class is highly sodic (33%), alkaline, with a low iron content and a moderate clay content (17%). This soil class has a higher salinity compared to the other soil classes. This soil class is likely to be very dispersive when under the right conditions.

The Brown Red Silt Loam soil class is highly sodic (19%), alkaline with a high iron content and a very high clay content of 50%. This soil class is likely to be very dispersive when under the right conditions.

Overall, the soils at Munglinup contain a relatively high clay content and are sodic in nature. It is highly probable that soils will be dispersive during and following rainfall events which could result in significant erosion issues if soils and growth medium are not appropriately managed.

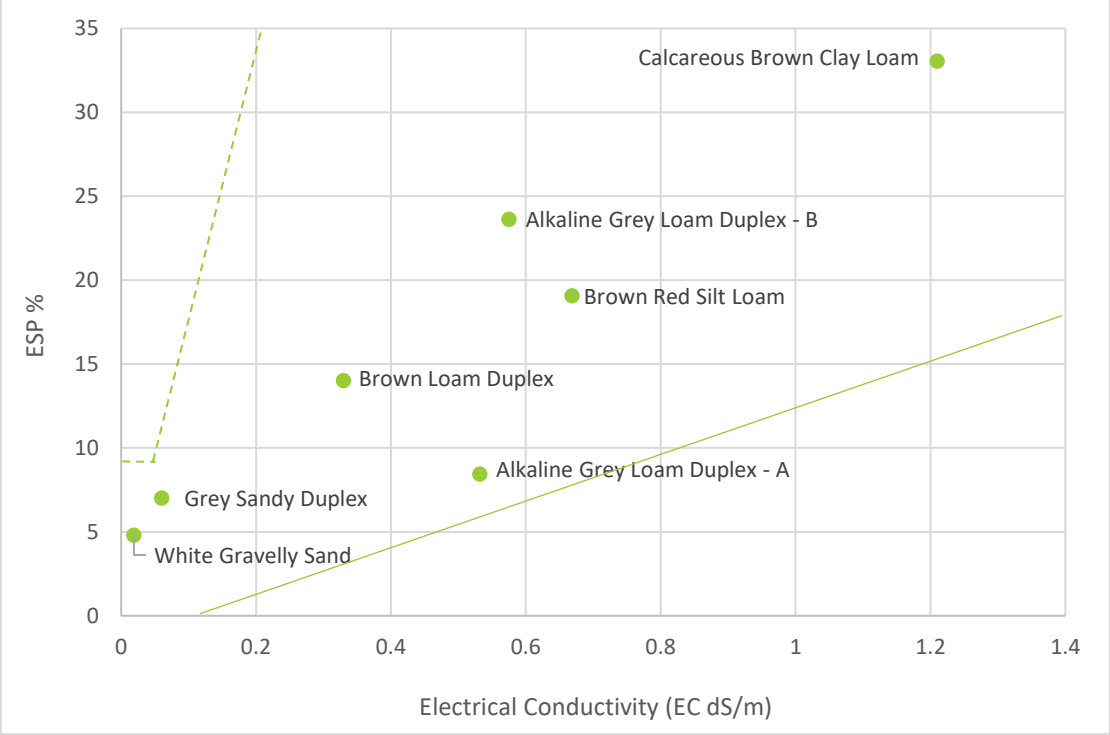


Figure 5.9. Relationship between Electrical Conductivity and ESP %.
Soils with a low EC and high ESP% are highly dispersive (dotted line). Soils above the solid line are potentially dispersive. Adapted from (Hazelton & Murphy, 2007)

5.2.2 Cation Exchange Capacity

Cation exchange capacity is the ability for soils to hold and exchange cations and provides a buffering effect to changes in pH, available nutrients, calcium and structural changes (Hazelton & Murphy, 2007). As the Cation Exchange Capacity (CEC) is a major factor in controlling soil structure and stability as well as plant available nutrients a low CEC means that the soil will have a low resistance to changes in soil chemistry whereas a higher CEC will mean the soil is able to retain plant nutrients and resist changes in soil chemistry (Hazelton & Murphy, 2007). The most abundant cations in soils are calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na), aluminium (Al) is also abundant in strongly acidic soils. Summing the concentrations of these abundant cations gives the effective CEC (ECEC) as a percentage (Hazelton & Murphy, 2007). Soils that are high in sodium and magnesium show more dispersion than soils high in sodium and calcium (Hazelton & Murphy, 2007).

Both the White Gravelly Sand and Grey Sand Duplex soil classes at Munglinup show very low levels of exchangeable cations and a low ECEC % which would be expected given the high sand content of the soil. The Brown Loam Duplex soil class shows moderate to high levels of calcium, magnesium and sodium with a higher ECEC % reflecting a higher clay content and dispersion potential. The A horizon of the Alkaline Grey Loam Duplex soil class shows a moderate to high level of calcium and magnesium whereas the B horizon shows slightly lower levels of calcium and magnesium. Both horizons have a high ECEC% indicating a higher clay content. The Calcareous Brown Clay Loam soil class has a very high sodium and magnesium level with a high calcium level and an overall high ECEC %. The high clay content and sodium level indicate dispersion characteristics. Lastly the Brown Red Silt Loam shows very high levels of sodium, magnesium and high levels of calcium and potassium with a high overall ECEC %. The high sodium and ECEC% indicate dispersive characteristics.

Table 5.8. Average exchangeable cations and effective cation exchange capacity of soil classes at Munglinup

	Soil Class							
Parameter	**Grey Sandy Duplex**	**White Sandy Gravel**	**Brown Loam Duplex**	**Alkaline Grey Loam Duplex - A**	**Alkaline Grey Loam Duplex - B**	**Calcareous Brown Clay Loam - A**	**Calcareous Brown Clay Loam - B**	**Brown Red Silt Loam**
Exc. Aluminium meq/100g	0.03	0.05	0.06	0.03	0.02	0.04	0.03	0.06
Exc. Calcium meq/100g	2.78	0.92	9.09	14.19	5.21	12.86	10.68	13.54
Exc. Magnesium meq/100g	0.89	0.58	7.30	18.09	14.19	11.86	8.68	15.13
Exc. Potassium meq/100g	0.17	0.08	0.62	0.65	0.29	0.81	0.72	1.22
Exc. Sodium meq/100g	0.19	0.08	2.73	2.96	4.45	8.84	8.80	7.62
ECEC meq/100g	4.08	1.70	19.83	35.90	24.15	34.40	28.90	37.58
ESP Exchangeable %	5.63	4.80	13.84	8.45	23.63	29.35	36.75	19.08

5.2.3 Fertility / Plant Available Nutrients

The soils of the south-west are naturally nutrient deficient with low fertility reflecting deep weathering, leaching and little input from organic material (Gole, 2006). The three main nutrients required for plant growth are nitrogen (N), phosphorus (P) and potassium (K). Plants also require other nutrients which are commonly found in the soil in smaller concentrations, these being copper (Cu), iron (Fe), manganese (Mg) and zinc (Zn).

All of the soil classes at Munglinup are deficient in nitrogen and organic carbon. Potassium at all soil classes is within the typical ratings for Australian soils. Sulfur is low in the Grey Sand, White Sandy Gravel and Brown Sandy Loam soil classes (<5). Iron is particularly low (<10) within the B horizon of the Grey Brown Sandy Loam over White Clay soil class. Manganese is low across all soil classes.

Table 5.9. Average plant available nutrients, organic carbon, nitrogen and phosphorus in Munglinup soil classes

	Soil Class							
Parameter	**Grey Sandy Duplex**	**White Gravelly Sand**	**Brown Loamy Duplex**	**Alkaline Grey Loam Duplex - A**	**Alkaline Grey Loam Duplex - B**	**Calcareous Brown Clay Loam - A**	**Calcareous Brown Clay Loam - B**	**Brown red silt loam**
Total Nitrogen %	0.03	0.02	0.07	0.19	0.05	0.09	0.06	0.06
Total Phosphorus mg/kg	35.68	13.90	49.35	95.83	52.85	59.95	48.40	62.58
Phosphorus Colwell mg/kg	2.00	< 2	3.20	6.75	3.00	4.00	3.00	2.00
Potassium Colwell mg/kg	81.00	36.50	257.13	289.75	126.50	302.50	310.00	433.00
Organic Carbon %	0.80	0.77	1.48	2.96	1.11	1.44	1.13	1.44
Sulfur mg/kg	3.30	1.80	11.20	25.80	39.05	135.05	147.85	37.08
DTPA Copper mg/kg	0.27	0.19	1.48	4.10	3.90	2.26	1.56	6.53
DTPA Iron mg/kg	43.19	30.71	35.22	22.08	8.46	15.19	11.61	21.17
DTPA Manganese mg/kg	2.26	0.34	4.38	4.28	1.23	1.15	0.82	3.42
DTPA Zinc mg/kg	0.12	0.17	0.24	0.37	0.17	0.23	0.22	0.22

5.3 Summary of Soil Properties

From the soil analysis results and observations mad in the field of the soil at the Munglinup Graphite Project, the follow can be broadly stated:

- All soil classes within the Project Area have low nutrient levels indicating low fertility. This is common for south-west Australian soils and should not be a limiting factor for native vegetation establishment. An addition of fertiliser may be beneficial to replenish or improve soil nutrients in rehabilitation areas.
- Soils were harder than anticipated, particularly with depth, showing underlying hardpan clays in some areas.
- Overall, the soil profiles indicate 2 to 5cm of organic material followed by an A horizon in the top 20 to 30cm. Rehabilitation material of surface soils will likely be to an average depth of 20cm.
- The Grey Sandy Duplex and White Gravelly Sand soil classes have a low ESP and are unlikely to dispersive. These soils may be suitable for use on constructed slope angles, however, these soil classes occur predominantly outside of the disturbance area.
- The remaining soil classes within the Project Area have a high clay content and an ESP over 6%. These soil classes are likely to be dispersive and may not be suitable on constructed slope angles. In particular the Calcareous Brown Clay Loam and Brown Red Silt Loam soil classes have very high dispersive characteristics. The use of these soils would present an erosion risk.

These conclusions are based on a limited number of soil samples from across the Project Area. It may be worthwhile to complete targeted soil sampling within the final disturbance footprint to verify soil properties and quantities to be highly confident in the rehabilitation materials available. This is of

particular note within the waste rock landform footprint where soil test pits were completed by hand and a true representation of the soil profile could not be gained.

6 Soil Management

6.1 Available Material

The top 10cm of soil will contain the highest quantities of seeds, biological material and nutrients which will be beneficial for rehabilitation. However, for the purposes of estimating available growth medium material and overall stripping depth of 20cm has been assumed. This will include the top 10cm which will contain the soil seed bank and will also include the A horizon which appears suitable for use as a growth medium. The following assumptions have been made in estimating available material:

- All soil to 30cm will be stripped from all locations where disturbance will occur
- Soil extents are estimated using a planar surface

The disturbance footprint is currently estimated at between 330 – 350ha; however, the site layout has not been finalised. A breakdown of the disturbance footprint is provided in Table 6.1.

Table 6.1. Disturbance by soil type for the Munglinup Graphite Project

Disturbance	Area (ha)					
	Grey Sandy Duplex	White Gravelly Sand	Brown Loam Duplex	Alkaline Grey Loam Duplex	Calcareous Brown Clay Loam	Brown Red Silt Loam
Open Pit	4.6		15.09	23.51	8.82	11.34
Waste Rock Landform	18.61		89.19	4.19	4.49	4.09
Tailings Storage Facility	15.05		41.79			
Plant & Infrastructure	3.72		4.54			
Roads / Tracks	3.49		10.81	0.94	0.04	1.41
Total (ha)	**45.47**	**0**	**161.42**	**28.64**	**13.35**	**16.84**

The disturbance footprint and the soil classification map were used to estimate the volume of growth medium material for the Munglinup Graphite Project. This was completed using QGIS. An estimated total volume of growth medium collected to a depth of 20cm for the disturbance footprint within M74/245 only is 531,440m^3. This has been further broken down by soil class and is presented in Table 6.2. It should be noted that this does not include the portion of the TSF and eastern access road on E74/565 or the western access road.

Table 6.2. Potential growth medium available for the Munglinup Graphite Project

Soil Class	Volume m3 (20cm)
Grey Sandy Duplex	90,940
White Gravelly Sand	0
Brown Loam Duplex	322,840
Alkaline Grey Loam Duplex	57,280
Calcareous Brown Clay Loam	26,700
Brown Red Silt Loam	33,680
Total	**531,440**

6.2 Soil Collection / Stripping

Soil collection and stripping must not occur in wet conditions. Soil handling in wet conditions can result in soil compaction and increase the risk of spreading soil borne diseases such as Phytophthora Dieback as well as weeds. Topsoil and growth medium can be stored in stockpiles which are up to 2m in height. The soil classes which have dispersive characteristics should be stockpiled separately to avoid the mixing of material. These topsoil stockpiles should be located away from future mining activity but close to areas which will be rehabilitated. Storing soil in stockpiles can cause degradation to the soil and ideally soil should be stored in a stockpile for less than 12 months if possible. For soils that are stockpiled for longer than 12 months the addition of fertiliser may be required to replenish organic carbon and nutrients lost during stockpiling (DIIS, 2016). The most common techniques used for soil stripping are a loader and truck, scraper or bulldozer pushing topsoil into a windrow (DIIS, 2016). Soil stockpiles should be monitored for erosion, weed infestation, nutrient status, pH and electrical conductivity on an annual basis (DIIS, 2016). In addition, a record should be maintained outlining the soil materials available and used for rehabilitation across the site.

6.3 Soil Use

Growth medium including rocky material should be spread across the surface to be rehabilitated. Once completed the area should be seeded and lightly ripped on the contour. In the south-west rehabilitation activities including the spreading of growth medium will be most effective during Autumn.

6.4 Vegetation

Vegetation which has been cleared can also be a useful rehabilitation material. Vegetation debris can minimise the impact of raindrops on the soil surface, provide habitat niches for fauna and provide an additional source of seed for species which retain a canopy stored seed bank (DIIS, 2016). Vegetation debris applied to a waste rock landform may also act to stabilise the soil surface to reduce erosional influences (DIIS, 2016). Vegetation can be stockpiled close to the areas to be rehabilitated and spread across the surface in a volume sufficient to form a continuous cover.

6.5 Erosion and Stability

Four of the soil classes within the Project Area show strongly dispersive characteristics, in particular the Brown Red Silt Loam and Calcareous Brown Clay Loam. This means that these two soil classes will be highly susceptible to erosion and may not be suitable for placement on constructed slopes. The Brown Red Silt Loam and Calcareous Brown Clay Loam dispersive soils may still be suitable for use on flat surfaces. The addition of gypsum to these soils may also assist in reducing their dispersive characteristics and erosion potential.

The Brown Loam Duplex and Alkaline Grey Loam Duplex also show strong dispersive characteristics. These soil classes are also likely to be susceptible to erosion if placed on constructed slopes. The Brown Loam Duplex soil class is the dominant soil class across the Project Area and the majority of growth medium collected will come from this soil class. As growth medium material the erosion and stability on constructed slopes could be improved by constructing slopes with a low slope angle and through the application of laterite or rocky material in conjunction with the growth medium. There will be a small amount of suitable rocky material extracted from the open pits. It is recommended that this material be stockpiled and used for rehabilitation activities, particularly on constructed slopes to improve overall stability.

7 Conclusions & Recommendations

In summary, six soil classes have been identified within the Project Area at Munglinup. Two of these soil classes are unlikely to be dispersive. The remaining 4 soil classes show potentially dispersive

characteristics, in particular the Brown Sandy Clay Loam and Brown Red Silt Loam which are very likely to be dispersive. Managing these dispersive characteristics will be particularly relevant for rehabilitation activities for the Munglinup Graphite Project. ISPL make the following recommendations:

- 90,940m^3 of growth medium material of non-dispersive soil material is available for rehabilitation.
- 440,500m^3 of growth medium material of potentially dispersive material is available for rehabilitation. This material may not be suitable for placing on constructed slopes.
- To minimise erosion potential:
    - Constructed slope angles should be kept low wherever possible. The surrounding landforms present average slopes of 8 degrees.
    - The addition of gypsum to potentially dispersive growth medium should be considered.
    - The addition of fertiliser to growth medium material stockpiled for an extended period of time (>12 months) should be considered.
    - Stockpile and re-spreading vegetation material on rehabilitation areas should be considered to re-establish fauna habitat and reduce erosion potential.
- It may be worthwhile to complete targeted soil sampling within the final disturbance footprint to verify soil properties and quantities to be highly confident in the rehabilitation materials available. This is of particular note within the waste rock landform footprint where soil test pits were completed by hand and a true representation of the soil profile could not be gained.

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Appendix 1 – Soil Analysis Results

Nutrients by soil class

	Soil Class																																	
Parameter	**Grey Sandy Duplex**				**White Gravelly Sand**		**Brown Loam Duplex**								**Alkaline Grey Loam Duplex**								**Calcareous Brown Clay Loam**				**Brown red silt loam**				**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Horizon	A				A		A								A				B				A		B		A				B				
Site ID	Mung_08a	Mung-11a	Mung-11b	Mung-TSF1	Mung-01a	Mung-14a	Mung-04b	Mung-04a	Mung-07a	Mung-15a	Mung-17a	Mung-19a	Mung-20a	Mung-TSF2	Mung-02a	Mung-05a	Mung-13a	Mung-18a	Mung-02b	Mung-05b	Mung-13b	Mung-18b	Mung-03a	Mung-09a	Mung-03b	Mung-09b	Mung-06a	Mung-12a	Mung-16a	Mung-16b						
Total Nitrogen %	0.02	0.05	0.01	0.04	0.02	0.02	0.08	0.15	0.08	0.1	0.03	0.03	0.06	0.03	0.13	0.38	0.12	0.14	0.02	0.06	0.04	0.09	0.12	0.05	0.1	0.02	0.07	0.05	0.07	0.04	0.01	0.38	0.08	0.02	0.1	0.1
Total Phosphorus mg/kg	14.8	38.8	31.1	58.00	10.7	17.1	63	80.7	44.3	58.5	70.4	16.2	36	25.7	51.2	148.7	86.2	97.2	18.9	79.6	44.6	68.3	52.3	67.6	49.5	47.3	76.2	62.3	54.5	57.3	10.7	148.7	54.85	18.9	79.6	79.6
Phosphorus Colwell mg/kg	< 2	2	< 2	2.00	< 2	< 2	< 2	4	3	4	< 2	< 2	3	2	8	8	5	6	< 2	3	< 2	3	5	3	4	2	2	2	2	2	2	8	3.81	2	4	4
Potassium Colwell mg/kg	56.00	66.00	46.00	156.00	25	48.00	455.00	475.00	315.00	216.00	40.00	100.00	264.00	192	364	245.00	335.00	215.00	136.00	118.00	182.00	70.00	295.00	310.00	266.00	354.00	395.00	390.00	502.00	445.00	25	502	239.34	70	445	445
Organic Carbon %	0.46	1.24	0.46	1.05	0.94	0.60	1.19	2.47	1.68	2.39	0.57	1.18	1.68	0.7	2.9	4.86	1.99	2.08	0.51	2.09	0.69	1.15	1.98	0.90	1.77	0.49	2.42	0.84	1.61	0.89	0.46	4.86	1.57	0.49	2.09	2.09
Sulfur mg/kg	4.20	2.70	2.30	4.00	1.7	1.90	32.40	5.60	7.10	3.20	4.00	5.10	7.50	24.7	84.1	3.70	5.20	10.20	89.30	6.50	46.20	14.20	13.60	256.50	30.30	265.40	38.40	5.10	12.70	92.10	1.7	256.5	23.3	6.5	265.4	265.4
DTPA Copper mg/kg	0.34	0.28	0.26	0.20	0.12	0.25	4.83	2.86	1.89	0.50	0.16	0.20	0.45	0.97	2.27	4.49	5.75	3.87	0.78	6.75	4.20	3.85	2.31	2.21	2.32	0.79	8.89	5.86	6.46	4.91	0.12	8.89	2.40	0.78	6.75	6.75
DTPA Iron mg/kg	56.09	17.45	57.91	41.32	23.34	38.07	23.64	20.08	33.28	47.69	38.66	30.63	47.31	40.48	25.86	24.58	12.26	25.62	4.76	10.11	8.94	10.01	16.63	13.75	14.27	8.94	29.05	12.64	22.06	20.92	12.26	57.91	30.36	4.76	20.92	20.92
DTPA Manganese mg/kg	1.46	2.29	0.47	4.80	0.42	0.26	3.27	5.7	7.64	11.22	0.37	1.88	2.66	2.29	3.34	5.53	3.72	4.54	1	0.87	1.08	1.95	1.21	1.08	0.99	0.65	6.62	2	2.74	2.33	0.26	11.22	3.28	0.65	2.33	2.33
DTPA Zinc mg/kg	0.09	0.16	0.14	0.07	0.16	0.18	0.24	0.33	0.39	0.37	0.05	0.16	0.26	0.08	0.29	0.4	0.48	0.29	0.15	0.16	0.23	0.15	0.22	0.24	0.26	0.17	0.31	0.18	0.16	0.22	0.05	0.48	0.22	0.15	0.26	0.26

Exchangeable Cations by soil class

	Soil Class																																
Parameter	**Grey Sandy Duplex**				**White Sandy Gravel**		**Brown Loam Duplex**								**Alkaline Grey Loam Duplex**								**Brown Sandy Clay Loam**				**Brown red silt loam**				**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Horizon	**A**				**A**		**A**								**A**				**B**				**A**		**B**		**A**				**B**			
Parameter	Mung_08a	Mung-11a	Mung-11b	Mung-TSF1	Mung-01a	Mung-14a	Mung-04b	Mung-04a	Mung-07a	Mung-15a	Mung-17a	Mung-19a	Mung-20a	Mung-TSF2	Mung-02a	Mung-05a	Mung-13a	Mung-18a	Mung-02b	Mung-05b	Mung-13b	Mung-18b	Mung-03a	Mung-09a	Mung-03b	Mung-09b	Mung-06a	Mung-12a	Mung-16a	Mung-16b						
Exc. Aluminium meq/100g	0.046	0.016	0.03	0.03	0.036	0.07	0.049	0.059	0.066	0.046	0.023	0.098	0.037	0.117	0.016	0.037	0.041	0.02	0.007	0.027	0.021	0.016	0.06	0.026	0.024	0.033	0.052	0.058	0.078	0.06	0.016	0.117	0.0452609	0.007	0.06	0.05
Exc. Calcium meq/100g	2.09	3.4	0.96	4.67	0.87	0.96	16.22	19.01	10.85	10.66	1.41	2.93	7.44	4.23	10.4	22.61	16.3	7.46	1.57	10.08	5.09	4.11	22.2	3.52	19.09	2.26	11.93	18.67	12.96	10.6	0.87	22.61	8.9908696	1.57	22.2	12.59
Exc. Magnesium meq/100g	0.58	0.85	0.7	1.43	0.37	0.79	15.88	10.41	9.14	5.74	0.99	2.88	8.49	4.87	16.69	17.53	16.08	22.06	3.67	22.09	15.75	15.23	13.75	9.97	11.93	5.42	17.33	5.89	19.57	17.73	0.37	22.06	8.8547826	3.67	22.09	14.28286
Exc. Potassium meq/100g	0.11	0.13	0.10	0.35	0.05	0.1	1.17	1.17	0.72	0.52	0.08	0.21	0.59	0.51	0.8	0.51	0.8	0.49	0.31	0.25	0.42	0.17	0.82	0.8	0.68	0.75	1.07	1.11	1.44	1.25	0.05	1.44	0.6039113	0.17	1.07	0.832857
Exc. Sodium meq/100g	0.15	0.11	0.2	0.30	0.07	0.08	8.97	2.12	1.42	1.01	0.36	0.87	2.45	4.67	7.68	0.41	1.72	2.01	6.48	0.72	8.42	2.16	3.75	13.93	4.85	12.75	7.66	1.77	8.51	12.52	0.07	13.93	3.5873913	0.72	12.75	7.374286
ECEC meq/100g	3	4.5	2	6.80	1.4	2	42.3	32.8	22.2	18	2.9	7	19	14.4	35.6	41.1	34.9	32	12	33.2	29.7	21.7	40.6	28.2	36.6	21.2	38	27.5	42.6	42.2	1.4	42.6	22.086957	12	40.6	32.61429
ESP Exchangeable %	5.2	2.5	10.3	4.50	5.2	4.4	21.2	6.5	6.4	5.7	12.6	12.7	12.9	32.7	21.6	1	4.9	6.3	53.9	2.2	28.4	10	9.3	49.4	13.3	60.2	20.2	6.4	20	29.7	1	49.4	14.96087	2.2	60.2	24.72857

APPENDIX C-2: Rockwater - Desktop Hydrology Assessment

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MRC GRAPHITE PTY LTD

INITIAL DESKTOP HYDROLOGY ASSESSMENT FOR PROPOSED MINING OPERATION AT MUNGLINUP GRAPHITE PROJECT

MAY 2018

1. INTRODUCTION

This report presents the initial desktop assessment (Stage 1) of the hydrology relevant to surface-water flow in the vicinity of the Munglinup Graphite Project, which is planned to be a mining operation undertaken by MRC Graphite Pty Ltd (MRC).

The project is located within Mining Lease M74/245, lying about 2 to 5 km north of the Munglinup township (about 75 km ESE of Ravensthorpe), and is traversed in its south-western corner by the south-draining Munglinup River (Figures 1 to 3). Five mine pits are proposed to be excavated: Halberts Main Zone, Halberts South Zone, Harris Area, McCarthy West Area, and McCarthy East Area.

This Stage 1 desktop hydrology assessment utilises available rainfall data and topographical information to estimate peak surface-water flows from the Munglinup River catchment at the proposed project site. The analysis provides calculated values of typical design peak flows up to the Probable Maximum Flood (PMF) / 2000 year Average Recurrence Interval (ARI) event.

Hydraulic analysis to assess flood impact to specific proposed pits and mine infrastructure layout for Mining Approval purposes is not included in this Stage 1 scope. The current available topographical data are not sufficient in detail and accuracy to meet the regulatory compliance requirements. For example, the 5 m topographic contours are of insufficient resolution to show the narrow, deep channel at the base of the river. The detailed hydraulic analysis will be undertaken in the proposed Stage 2 scope when more-accurate LiDAR survey data are available.

The purpose of this Stage 1 work is to provide the following:

- The adopted flood estimation methodology for application to Stage 2 hydrological evaluation. The adopted method will be selected by assessing the estimated peak flows of Catchment HS (with outflow located approximately adjacent to Halberts South pit) using all available current industry best practices and guidelines such as Australian Rainfall and Runoff 2016 (ARR2016).
- Locations of local watercourses that could potentially impact or be impacted by mine development within the proposed project area.
- Comments relating to the potential flood impact of the proposed mine pits infrastructure layout plan.

2. AREA DESCRIPTION

The Munglinup project area lies about 20 km north of the southern coastline of Western Australia at an elevation of about 90 m above sea level. Topography is low to moderate, with relief of less than 40 m in the surrounding 5 Km. Drainage trends southwards via two main features, Munglinup River and Claypole Creek. Geologically, there is thin cover of Quaternary-age colluvium and Tertiary-age siltstone over crystalline bedrock (migmatite) of Archaean or Proterozoic age.

Based on long-term (116 years) data from Ravensthorpe, located 80 km to the west, the average annual rainfall is about 430 mm, with monthly averages between 24 mm (in December) and 47 mm (in July). The highest recorded daily rainfall at Ravensthorpe was 113 mm (for 5 January 2007). For the same day, the rainfall recorded at the Munglinup station was 154 mm. Any account of the extent of flooding (if any) from this event is not to hand.

Floods were reported from the Ravensthorpe area in early February 2017, when a total rainfall of 238.6 mm was recorded over a period of five days. No data are to hand concerning flooding at this time in the Munglinup vicinity.

3. DATA

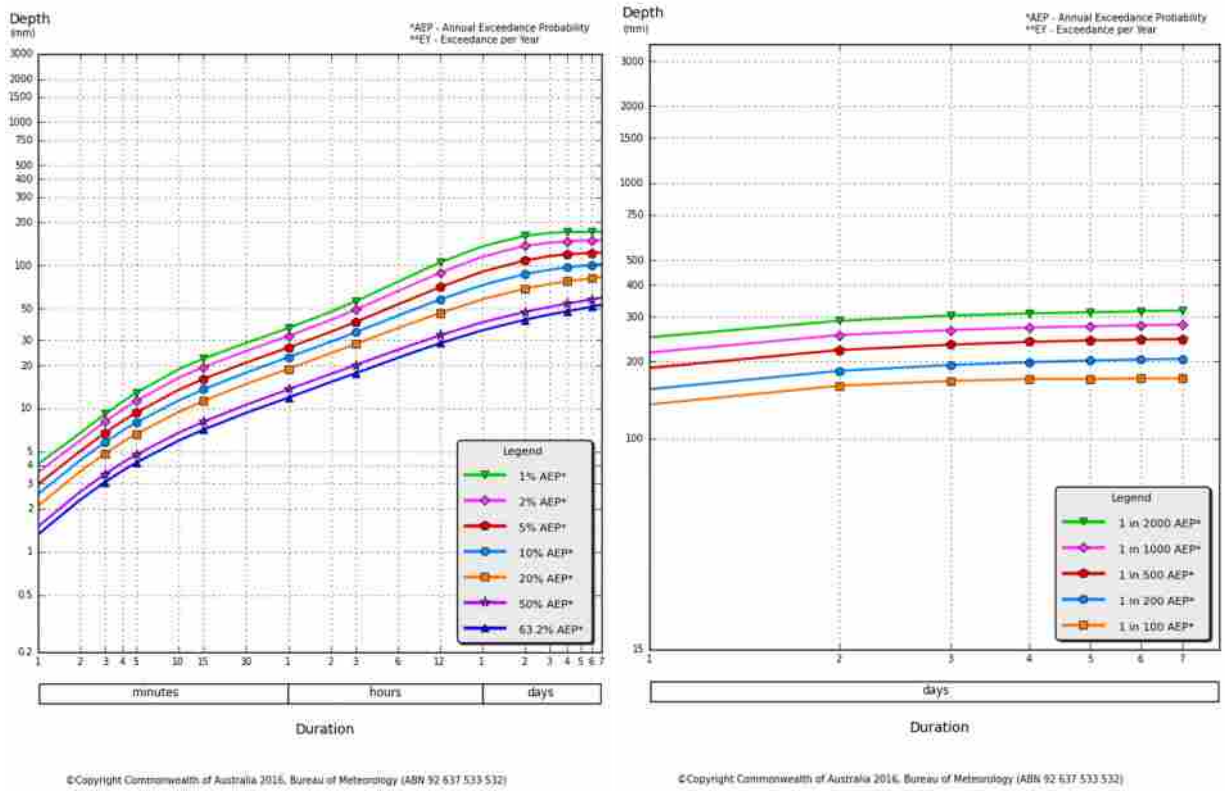
The following project-specific data were used to conduct the assessment described in this report:

- Satellite imagery from Google Earth Pro (Google, 2018).
- Digital elevation model (DEM) covering the project area from Shuttle Radar Topography (SRTM) dataset (NASA, 2011); it gives ground surface contours at 5m intervals.
- Proposed location and conceptual layout of the mine pits, TSF, waste dump and infrastructure foot print (provided by the client in dxf format, April 2018).

4. HYDROLOGY

4.1. RAINFALL

Intensity Frequency Duration (IFD) curves for the Munglinup Graphite Project site were prepared using the web-based tool developed by the Bureau of Meteorology (BOM, 2016). The IFD curves for all design intervals up to the 1 in 2000 Annual Exceedance Probabilty (AEP) are presented in Text-Figure 1.



Text-Figure 1: IFD curves for Munglinup Graphite Project site (BOM, 2016)

4.2. USE OF ARI AND AEP

The latest publication of Australian Rainfall and Runoff (ARR) 2016 uses the term Annual Exceedance Probability (AEP, expressed as %) to describe the design frequency levels. Previous ARR publications used Average Recurrence Interval (ARI, in unit of years). Table 1 presents the exact conversion of typically used AEP intervals to ARI, followed by the pre-ARR2016 ARI equivalent.

Table 1: Conversion between ARI and AEP

AEP (%)	50%	20%	10%	5%	2%	1%	0.05%
Exact ARI (Years)	1.44	4.48	9.49	19.50	49.50	99.50	1999.50
Adopted ARI (Years)	2	5	10	20	50	100	2000

In order to maintain consistency, this report uses the term ARI with context to Table 1.

4.3. CATCHMENT AREA DELINIATION

The proposed mine site layout plan shows that there is the potential for flood impact from the Munglinup River catchment system. For the Stage 1 assessment:

- Satellite imagery and the 5 m interval contours were used to estimate the flow paths of the Munglinup River and contributing watercourses (Figure 3). It is noted that the contours do not accurately incorporate the narrow channel of the river bed, leading to imprecise evaluations of flood levels and extent.

- From the contour plan and the proposed mine site layout plan, it appears that the Halberts South pit is the most likely to be impacted by the main Munglinup River.
- All other pits and infrastructure layout could potentially be affected by smaller watercourses that flow into the Munglinup River.
- The topographic contours were used to delineate the Munglinup River catchment area at Halberts South pit (Catchment HS).
- The characteristics of Catchment HS are presented in Table 2.
- These characteristics were used to select the appropriate flood estimation method for the Stage 2 work.

Table 2: Catchment HS characteristics

Catchment Characteristics	Area (km^2)	Length (km)	Slope (m/km)	Average Annual Rainfall (mm)	Clearing (%)
	121	20	7.5	505	80

4.4. PEAK FLOW ESTIMATION

In Western Australia, peak flows from ungauged catchments are estimated using the rational and index flood methods provided by Australian Rainfall and Runoff in 1987 (ARR1987).

Peak flow estimation methods for Catchment HS are included in the ARR1987 for the Wheatbelt climatic region. The peak flows estimated using the rational and index flood methods for Catchment HS are presented in Table 3. The 2000 year ARI peak flow was determined by extrapolation based on the frequency factors calculated from the IFD curves.

Table 3: ARR1987 rational and index flood methods

ARR1987 Method	Average Recurrence Interval (Years) / Peak Flow (m^3/s)						
	2	5	10	20	50	100	2000
Rational	7	14	24	42	72	94	156
Index Flood	7	14	25	43	80	85	102
Adopted design	7	14	25	43	80	94	156

The higher estimated peak flow at each design interval was selected as adopted design flow for Catchment HS. This approach is appropriate because both methods gave similar estimates of peak flows.

It should be noted that in the publication of ARR 2016, the regional flood methods used by ARR1987 were replaced with the web-based Regional Flood Frequency Estimation (RFFE) model. The results produced by the RFFE model for many regions in WA have been assessed to be unrealistic. It is likely that other states encountered the same problems with the method, because shortly after publication, the RFFE model was re-issued as a draft along with a Limits of Applicability statement.

Despite the caveats associated with using the RFFE model, the industry still acknowledges its value as an additional flood estimation method, where applicable. For completeness, the RFFE model was applied to Catchment HS to generate the estimated peak flows in Table 4. The much higher flows calculated using the RFFE model compared to those using the ARR1987 methods highlights the limitations of applying RFFE model in WA. From our experience the flows calculated by the 1987 methods generally give a good indication of actual flows.

Table 4: RFFE model results (Not recommended – for information only)

ARR2016 RFFE Model	Average Recurrence Interval (Years) / Peak Flow (m^3/s)						
	2	**5**	**10**	**20**	**50**	**100**	**2000**
5% CL	18	44	65	96	126	168	272
95% CL	212	517	762	1130	1530	2130	3393
Recommended	62	151	223	330	438	592	952

The ARR1987 regional rational and index flood methods will be adopted for this project and used for all the Stage 2 work.

Although the topographic data are insufficiently accurate for hydraulic calculations, a preliminary estimate was made of the likely flood along the main Munglinup River channel. The width of flow could be about 160 m wide in a 1-in-100 year flood, and about 200 m wide in a Probable Maximum Flood (PMF). This estimate should be taken as a rough indication, and not relied upon in mine and infrastructure design. Any risk of impact on the pits from such floods could be minimised by the usual 1+ m perimeter bunds around the pits.

With regard to the two small water courses in the project area, trending south-westerly, it is noted that their traces marked in Figure 3 do not coincide well with the topographic contours. For example, the contours suggest that the south-westerly trending drainage line shown to touch the southern boundary of Halberts Main Pit might intersect the eastern side of the pit about 100-200 metres further to the north. The differences might be resolved with more-accurate contours.

The widths of the 100-year flood along the two small water courses will be very small, estimated to be less than 3 m at a depth of 0.1 m (and will depend largely on the stream-bed configuration); such a width would not be realistically depicted in Figure 3.

5. CONCLUSION AND COMMENTS

The following are the conclusions and comments based on the Stage 1 hydrology desktop assessment:

- The mine pits that are planned to be constructed within the area designated as Catchment HS could potentially be impacted by flooding generated by the Munglinup River system.
- Satellite imagery and 5 m interval contours have been used to estimate theoretical flow paths (in Fig. 2) of the Munglinup River and contributing watercourses. These lines are indicative paths only and require confirmation in the Stage 2 assessment which is planned to utilise 1 m contour intervals.
- The characteristics of Catchment HS were used to assess the most suitable method for flood peak flow estimation for the mine area.
- The ARR1987 regional rational and index flood methods were selected and these are recommended for Stage 2 to estimate peak flows from local sub-catchments within the mine site.
- At Stage 2, the local watercourses and sub-catchments will be redefined using detailed LiDAR survey data.

- Although the topographic data are insufficiently accurate for detailed hydraulic calculations, a preliminary estimate was made of the likely flood width along the main Munglinup River channel. The width of flow could be about 160 m wide in a 1-in-100 year flood, and about 200 m wide in a Probable Maximum Flood (PMF). This estimate should be taken as a rough indication, and not relied upon in mine and infrastructure design.

Dated: **1 May 2018** **Rockwater Pty Ltd**

J Goh
Senior Hydrologist

PH Wharton
Principal Hydrogeologist

FIGURES

Figure 1

Munglinup Graphite Project

Overview Location

Legend

MRC Tenure

M 74/245

Road Network (MRWA_514)

State Road

Local Road

Google Satellite Imagery

1 0 1 km

N

1:60,000

GDA94 / MGA Zone 51

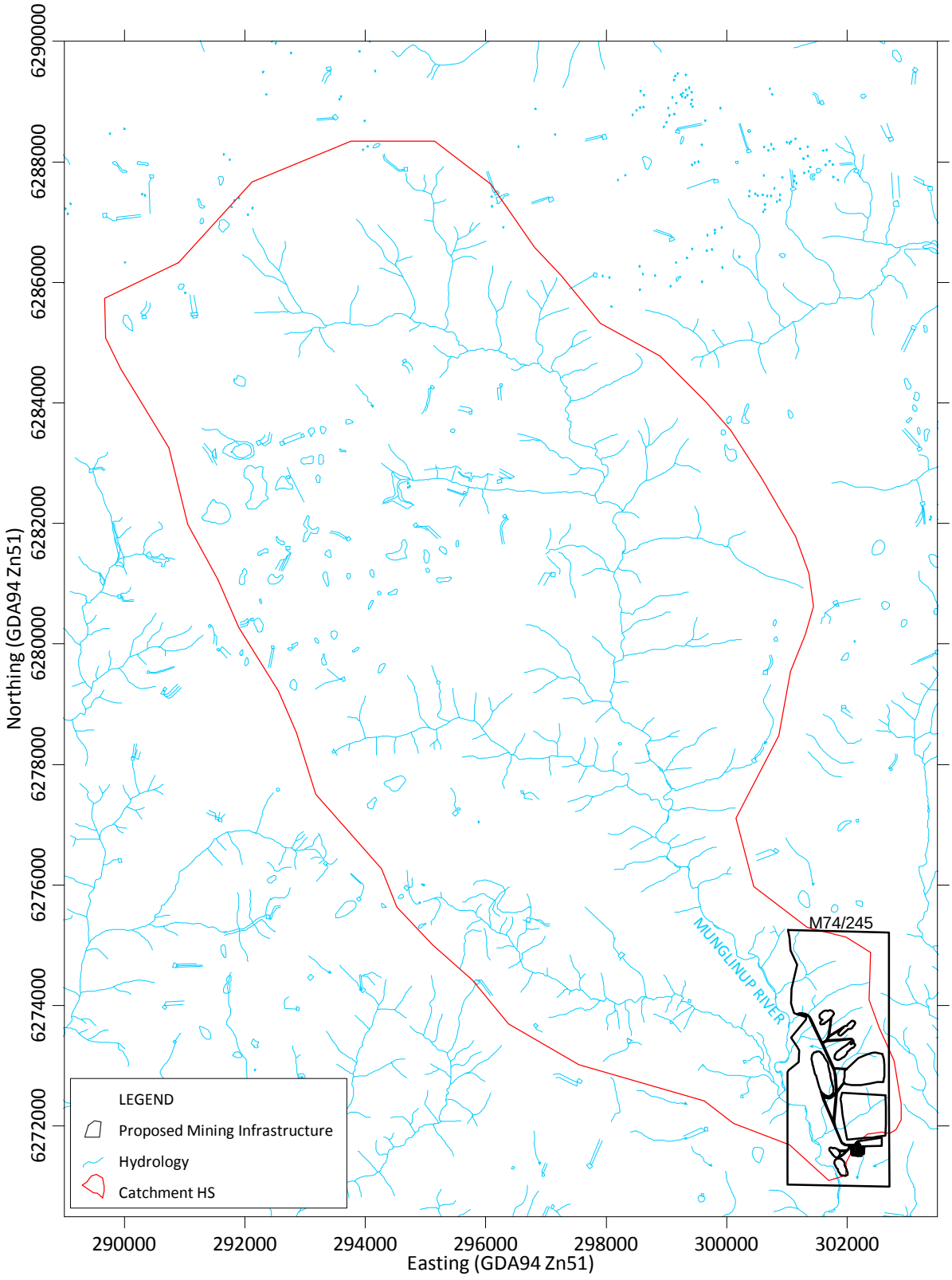
Rockwater
CONSULTANT HYDROGEOLOGISTS

Rev 1

Apr 2018

"The information on this map was derived from various sources. Care was taken in its creation, however, Integrate Sustainability cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated."

Figure 2



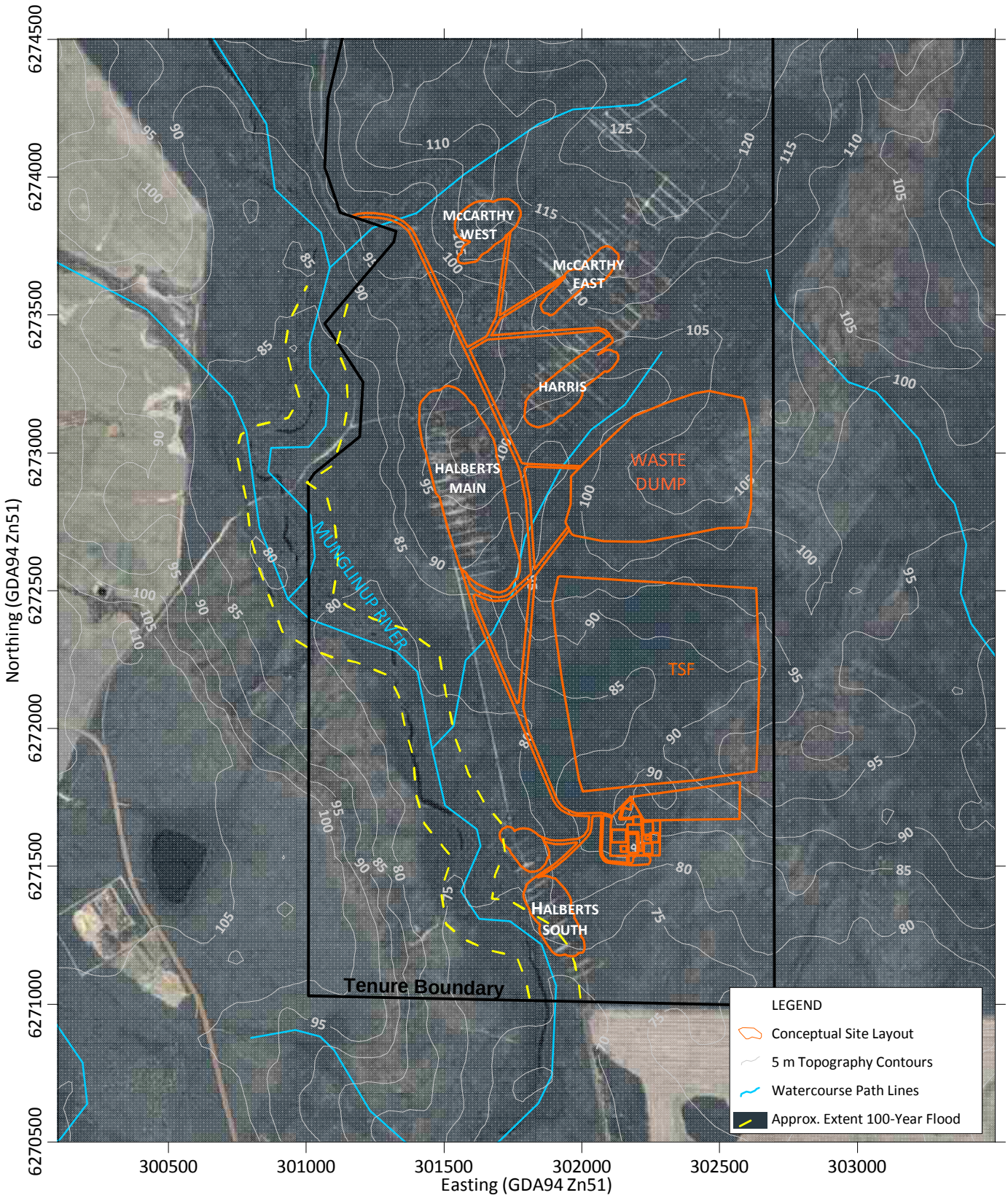
65-5/Surfer/18-01/Figure 2 new.srf

CLIENT:	MRC Graphite
PROJECT:	Munglinup
DATE:	April 2018
Dwg. No:	65-5/18/1-2

MINE LOCATION WITH
CATCHMENT HS OUTLINE

Rockwater

Figure 3



65-5/Surfer/18-01/Figure 3.srf

CLIENT:	MRC Graphite
PROJECT:	Munglinup
DATE:	April 2018
Dwg. No:	65-5/18/1-3

CONCEPTUAL SITE LAYOUT WITH WATERCOURSE PATH LINES

Rockwater

APPENDIX C-3: Rockwater - Surface Water Management Study Stage 2 (DRAFT)

MUNGLINUP GRAPHITE PROJECT

SURFACE WATER MANAGEMENT STUDY STAGE 2

REPORT FOR
MRC GRAPHITE PTY LTD

AUGUST 2018

Rockwater
HYDROGEOLOGICAL AND ENVIRONMENTAL CONSULTANTS

Report No. 65-5/18/04

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REVISION	AUTHOR	REVIEW	AUTHORISED	ISSUED
Draft	JG	PW		28/08/18

1. INTRODUCTION

1.1. BACKGROUND

This report presents the Stage 2 Surface Water Management Study for the Munglinup Graphite Project which is planned to be undertaken by MRC Graphite Pty Ltd (MRC). This assessment follows the findings and recommendations in Stage 1 Desktop Initial Hydrology Assessment (Rockwater, 2018).

1.2. PROJECT DESCRIPTION

The Munglinup Graphite Project is located within Mining Lease M74/245 lying about 2 to 5 km north of the Munglinup township (about 75 km ESE of Ravensthorpe), and is traversed in its south-western corner by the south-draining Munglinup River (see Figure 1). Five mine pits are proposed to be excavated:

- McCarthy West Pit;
- McCarthy East Pit;
- Harris Pit;
- Halberts Main Pit; and
- Halberts South Pit (which has two lobes).

1.3. SCOPE OF WORK

The scope and deliverables of this study include the following:

- Hydrological assessment, using the recommended methods from Stage 1 study, to estimate surface water flows impacting the mine site, road and infrastructure, for 2, 5, 10, 20, 50, 100 and 2000 year ARI design events;
- Diversion drain requirements and impact assessment for 1-in-100 and 1-in-2000 year ARI peak flows, including velocities and erosion potential;
- Surface infrastructure (roads, waste dumps, TSF, plant etc.) surface flow environmental impact assessment;
- Open pit abandonment bund requirements;
- Drainage management for the haul roads and diversion channels, to minimise environmental impacts; and
- Surface flood water drainage / diversion / sediment basin design – during operations and post mine closure.

1.3.1. INFORMATION PROVIDED BY MRC GRAPHITE PTY LTD

The following information and data were provided by MRC:

- Detailed LiDAR topographical survey data around the project area.
- GIS datasets of the mine site layout plan and road network (shapefiles).

1.4. METHODOLOGY

Rivers and creeks and associated catchments were defined and delineated from the LiDAR topographical survey data provided by MRC.

The design peak flows for each catchment were determined using the methods given in Australian Rainfall and Runoff (ARR,1987 and as updated), including the Rational and Index Flood methods.

The extent, velocity and flows within creeks and drainage channels were determined at selected cross-sections using Manning's equation.

2. EXISTING ENVIRONMENT

2.1. CLIMATE

Munglinup has a temperate climate with warm to hot summers and cool to mild winters.

Average monthly rainfalls at Munglinup (BoM Stn. 009868, 1970 to 2018) range from 24.3 mm in December to 59.5 mm in August; with an annual average of 534 mm (Table 1). Rainfall is irregular, but on average is somewhat higher in winter than in summer. The highest monthly rainfall was in February 2017 when 226 mm fell, with 198.2 mm from the 8th to 12th February. It resulted from the passage of a tropical low – the resultant flooding washed away a bridge over the Phillips River on the South Coast Highway west of Ravensthorpe.

Table 1: Average Rainfall and Dam Evaporation (mm), Munglinup

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall	28.8	28.8	37.2	36.3	58.2	55.8	57.3	59.5	56.7	46.5	36.5	24.3	533.8
Dam Evap.	246	190	169	118	79	56	69	76	98	135	177	224	1,637

Average dam evaporation (Luke, Burke and O'Brien, 1988) exceeds average rainfall in all months of the year (Table 1), and by a factor of three overall.

Temperatures were recorded at the Munglinup BoM station from 1970 to 1973, and indicate monthly mean minimum temperatures ranging from about 6 oC in August to 14 to 15 ^{o}C in February; and mean maximum temperatures ranging from about 17 oC in July and August to 28 to 29 ^{o}C in February.

2.2. TOPOGRAPHY

The Project area lies on a lightly dissected peneplain which rises from the coast in the south to about 140 m AHD at the northern end of M74/245. The peneplain is more steeply incised along the Munglinup River. Elevated areas are generally covered by sandy soils, whereas there is colluvium with minor alluvium and rock outcrops in the incised areas.

2.3. LAND SYSTEMS AND SOILS

Schoknecht and Pathan (2013) indicate the soils at Munglinup are grey sandy duplexes over non-alkaline clay, often with gravel. At the time of publication, soil – landscape mapping of the Ravensthorpe region, which includes Munglinup, was completed but unpublished.

2.4. VEGETATION AND LAND-USE

Much of the area around Munglinup has been cleared for agriculture, but M74/245 is largely uncleared except on drillhole lines and at old mine workings.

Ecologia (2015) cited maps prepared by Beard that show most of the tenement classed as Shrublands comprising mainly Mallee scrub and Black Marlock (Eucalyptus redunca). The north-eastern corner of the tenement extends into Shrublands of Tallerack (Eucalyptus pleurocarpa) Mallee-heath.

Four vegetation units were mapped by Ecologia, although two covered most of the study area:

- EfAi (44.96% of area): Eucalyptus flocktoniae and E. uncinata mid woodland, over Acacia ingrate and Grevillea pectinata mid sparse shrubland; and

- EpleBaMt (30.36 % of area): Eucalyptus pleurocarpa mid open mallee woodland, over Banksia armata subsp. armata and Calothamnus gracilis mid sparse shrubland, over Melaleuca tuberculata var. tuberculata, Leucopogon crassifolius, and Hibbertia gracilipes low sparse shrubland.

2.5. CATCHMENTS, RIVERS AND DRAINAGE

The project area is located immediately east of the 121 km^2 catchment of the ephemeral Munglinup River (Fig. 2).

In the project area there are five small tributaries that drain westwards to the River (Fig. 3). These are described in the section on Hydrology, below.

2.6. WATER QUALITY

South Coast Rivercare website reports that the Munglinup River flows from the sandplain north of Munglinup. The river lies generally within a vegetative corridor. It flows for only short periods each winter, or negligibly in dry winters, and is naturally brackish to saline. This information is based on measurements taken by Andy Chapman since 1998.

It is likely that the salinity is lower in high flows, and probably fresh in flood flows.

There are a few water quality data for the Munglinup River on the Department of Water and Environmental Regulation (DWER) Water Information Reporting (WIR) database. These are summarised in Table 2.

Table 2: Water Quality, Munglinup River

Site No. (WIR)	mE (GDA94)	mN (GDA94)	Sample Period	TDS (mg/L)	TSS (mg/L)	EC (µS/cm)	pH	TN (mg/L)	TP (mg/L)	Turbidity (NTU)
6011218	298919	6276715	26/08/2006	24320			7.4	1.6	0.06	29.9
6011109	300900	6272766	Jun-98-Jun-00			0.06, 39,300	7.4-8.1	0.9-2.4	0.01-0.19	10-30
6011158	302033	6269455	Nov-98-Mar-00				7.2-8.0	0.9-3.5	0.02-0.08	10-40
6011029	302539	6268315	Jun-71-Jan-99		15, 90	27,500-37,200	7.8-8.3	1.0-4.2	0.04-0.14	55

They indicate that the river water is generally saline, slightly alkaline, contains some suspended sediment, and has generally low concentrations of nitrogen and phosphorus.

2.7. LOCAL WATER USE / MANAGEMENT

The DWER Water Register has no record of licences to take water from the Munglinup River or its tributaries.

South Coast Rivercare has an interest in the quality of water in the Oldfield River catchment, which includes the Munglinup River; and DWER has the regulatory responsibility to manage all rivers in the State. The main parameters of concern are likely to be nutrients (nitrogen and phosphorus), suspended solids/turbidity, and dissolved oxygen.

3. POTENTIAL IMPACTS ON THE PROJECT

3.1. HYDROLOGY

The mine layout plan shows that there are five small tributaries flowing west into the Munglinup River that could impact the proposed mine infrastructure and activities. For the purpose of this study these creeks have been named Creek A, Creek B, Creek C, Creek D and Creek E (see Figure 3).

The local creeks and associated catchments (Fig. 4) were defined and delineated from the LiDAR topographical survey data provided by MRC.

3.1.1. CATCHMENT CHARACTERISTICS

The catchment characteristics of the local creeks are presented in Table 3, together with Catchment HS which was identified in the Stage 1 assessment. The catchments of Creek A, Creek B and Creek D were sectioned based on the hydraulic assessment requirements described in Section 3.2 of this report. The catchment characteristics of Creek E were not determined because any surface water impact is effectively removed by the proposed TSF.

Table 3: Catchment characteristics

Catchment	Area (km^2)	Length (km)	Slope (m/km)	Average Annual Rainfall (mm)	Clearing (%)
HS	121	20	7.5	505	80
A1	0.35	1.00	25.0	505	80
A2	0.44	1.25	25.0	505	80
B1	0.19	0.60	33.3	505	80
B2	0.37	1.05	33.3	505	80
C	0.17	0.73	34.2	505	80
D1	0.49	1.07	28.0	505	80
D2	0.70	1.35	25.9	505	80
D3	0.79	1.60	23.1	505	80

3.1.2. PEAK FLOW ESTIMATION

The design peak flows for each catchment were determined using the higher value of Australian Rainfall and Runoff (ARR1987) regional rational and index flood methods as recommended, based on the findings in the Stage 1 study. The adopted design peak flows are presented in Table 4. The results using both methods are included in Appendix A.

Table 4: Adopted design peak flows

Catchment	Adopted	Average Recurrence Interval (Years)						
		2	5	10	20	50	100	2000
HS	Peak Flow (m^3/s)	6.90	14.09	24.48	42.41	71.65	94.34	155.71
A1	Peak Flow (m^3/s)	0.21	0.45	0.79	1.39	2.39	3.20	6.44
A2	Peak Flow (m^3/s)	0.24	0.49	0.87	1.53	2.74	3.51	7.24
B1	Peak Flow (m^3/s)	0.16	0.33	0.59	1.04	1.80	2.41	4.71
B2	Peak Flow (m^3/s)	0.22	0.46	0.81	1.43	2.47	3.27	6.63
C	Peak Flow (m^3/s)	0.14	0.29	0.51	0.90	1.56	2.09	4.45
D1	Peak Flow (m^3/s)	0.27	0.56	0.99	1.74	2.99	3.98	7.65
D2	Peak Flow (m^3/s)	0.33	0.68	1.20	2.10	3.61	4.77	9.16
D3	Peak Flow (m^3/s)	0.34	0.70	1.24	2.17	3.89	4.92	9.73

3.2. HYDRAULICS

The locations of flow paths that could impact the pits and infrastructure were identified from aerial photography and the LiDAR survey provided by MRC. The extent, velocity and flows within these flow paths were then determined at selected cross-sections where stage-discharge and stage-velocity relationships were calculated using Manning's equation (Equation 1).

$$V = \frac{1}{n} \cdot \left(\frac{A}{P} \right)^{2/3} \cdot (S)^{1/2}$$

Equation 1

Where:

n *is a dimensionless roughness coefficient*

A *is the wetted waterway area (m^2)*

P *is the wetted perimeter (m)*

S *is the hydraulic gradient (m/m)*

The continuity Equation 2 was used to estimate flow Q (m^3/s):

$$Q = A \cdot V$$

Equation 2

Where:

A *is the waterway area in (m^2)*

V *is the velocity (m/s)*

The value for the roughness coefficient, "n" in Equation 3, at each cross-section was estimated using observations from aerial photography and the slopes were estimated from the LiDAR survey.

The purpose of this analysis was to assess whether the 1-in-100 year and 1-in-2000 year ARI peak flows would adversely impact the pits and infrastructure, and to provide information for the concept design of protective measures, if required.

A list of cross-sections hydraulically analysed and the adjoining pits that flows could impact are presented in Table 5. The locations of these cross-sections are shown in Figure 5.

Table 5: Cross-section and impact assessment

Cross Section	Impact
XS_1	McCarthy West Pit
XS_2	McCarthy West Pit & McCarthy East Pit
XS_3	Halberts Main Pit
XS_4	Harris Pit & Waste Rock Landform
XS_5	Halberts Main Pit & Waste Rock Landform
XS_6	Halberts Main Pit & Haul / LV Road
XS_7	Halberts South Pit (Northern Lobe)
XS_8	Halberts South Pit

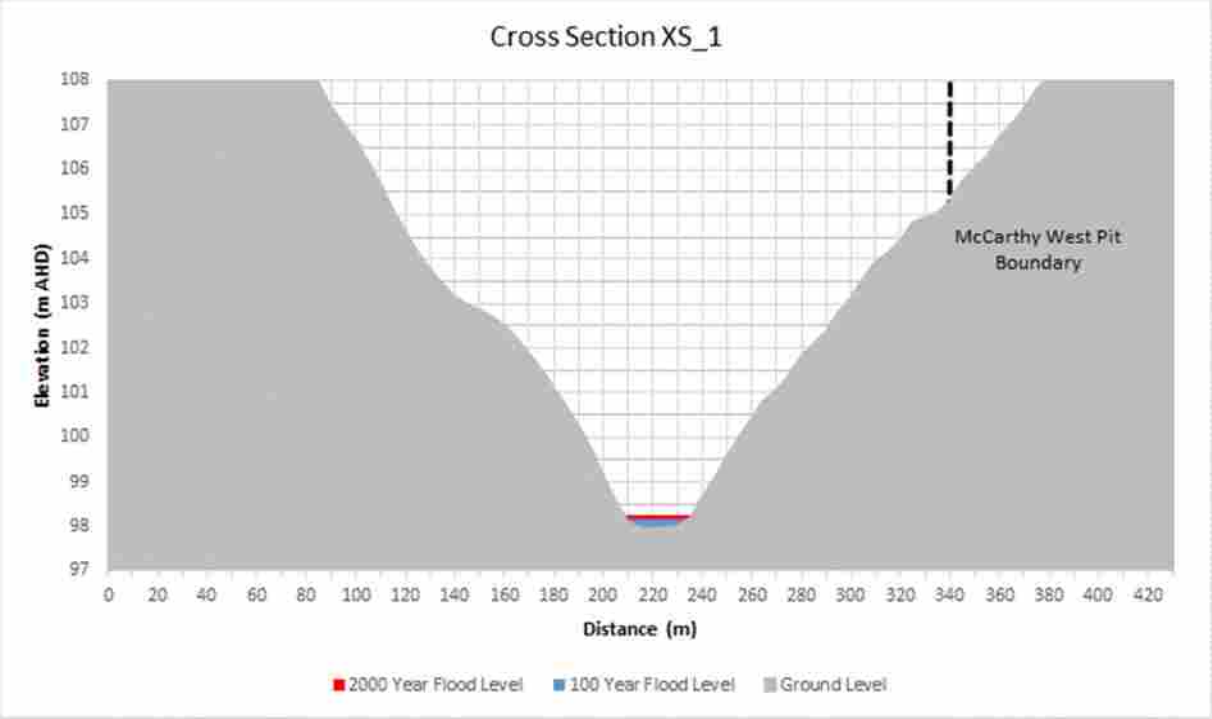
3.2.1. RESULTS

The hydraulic results, including flood levels and flow velocities at each cross section for the 1-in-100 and 1-in-2000 year ARI flood events are presented in Table 6. The results for other storm events are included in Appendix B.

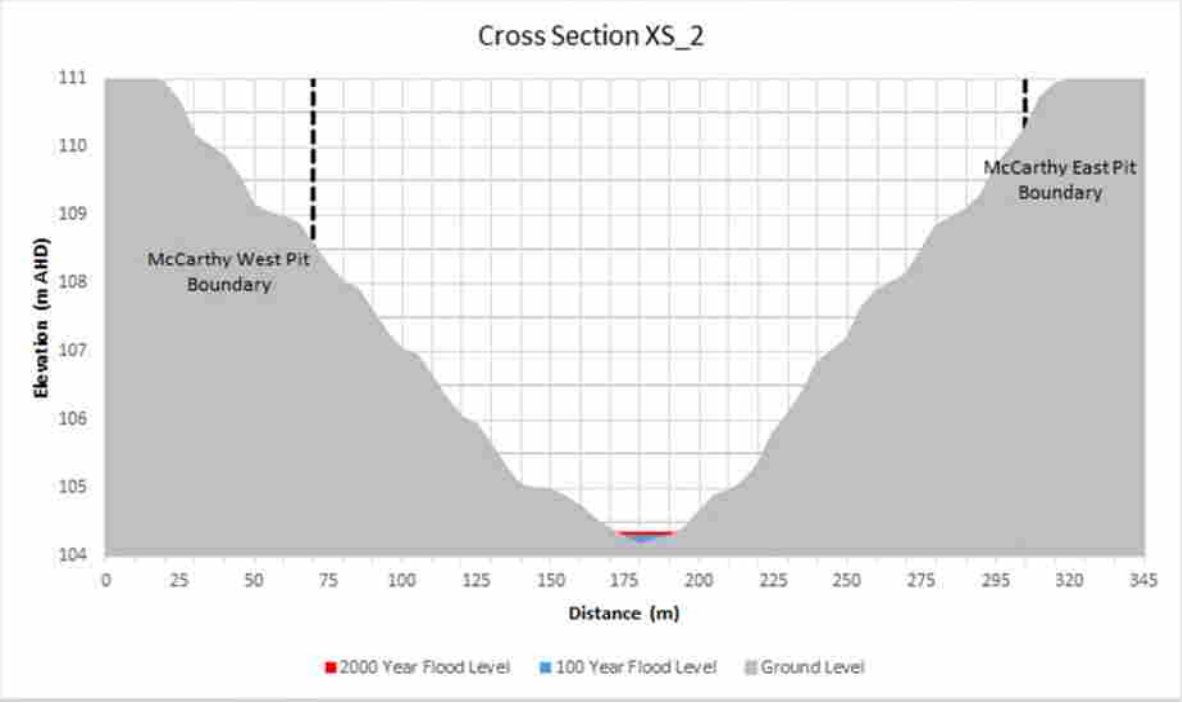
Table 6: Hydraulic results

Cross Section	Contributing Catchment	Impact Mine Pit and Infrastructure	Hydraulic Results	1-in-100 Year	1-in-2000 Year
XS_1	A1	McCarthy West Pit	Peak Flow (m^3/s)	3.20	6.44
			Flood Level (m AHD)	98.17	98.26
			Maximum Depth (m)	0.22	0.31
			Velocity (m/s)	0.79	1.00
XS_2	B1	McCarthy West Pit & McCarthy East Pit	Peak Flow (m^3/s)	2.41	4.71
			Flood Level (m AHD)	104.32	104.37
			Maximum Depth (m)	0.16	0.21
			Velocity (m/s)	1.65	2.00
XS_3	C	Halberts Main Pit	Peak Flow (m^3/s)	2.09	4.45
			Flood Level (m AHD)	90.05	90.12
			Maximum Depth (m)	0.17	0.24
			Velocity (m/s)	0.60	0.77
XS_4	D1	Harris Pit & Waste Rock Landform	Peak Flow (m^3/s)	3.98	7.65
			Flood Level (m AHD)	90.16	90.23
			Maximum Depth (m)	0.19	0.26
			Velocity (m/s)	0.54	0.68
XS_5	D2	Halberts Main Pit & Waste Rock Landform	Peak Flow (m^3/s)	4.77	9.16
			Flood Level (m AHD)	86.25	86.37
			Maximum Depth (m)	0.28	0.39
			Velocity (m/s)	0.69	0.87
XS_6	D3	Halberts Main Pit & Haul / LV Road	Peak Flow (m^3/s)	4.92	9.73
			Flood Level (m AHD)	83.22	83.35
			Maximum Depth (m)	0.33	0.46
			Velocity (m/s)	0.73	0.91
XS_7	HS	Halberts South Pit (Nth Lobe)	Peak Flow (m^3/s)	94.34	155.71
			Flood Level (m AHD)	72.57	73.09
			Maximum Depth (m)	1.57	2.09
			Velocity (m/s)	0.93	0.83
XS_8	HS	Halberts South Pit	Peak Flow (m^3/s)	94.34	155.71
			Flood Level (m AHD)	71.40	72.29
			Maximum Depth (m)	2.37	3.26
			Velocity (m/s)	1.30	0.86

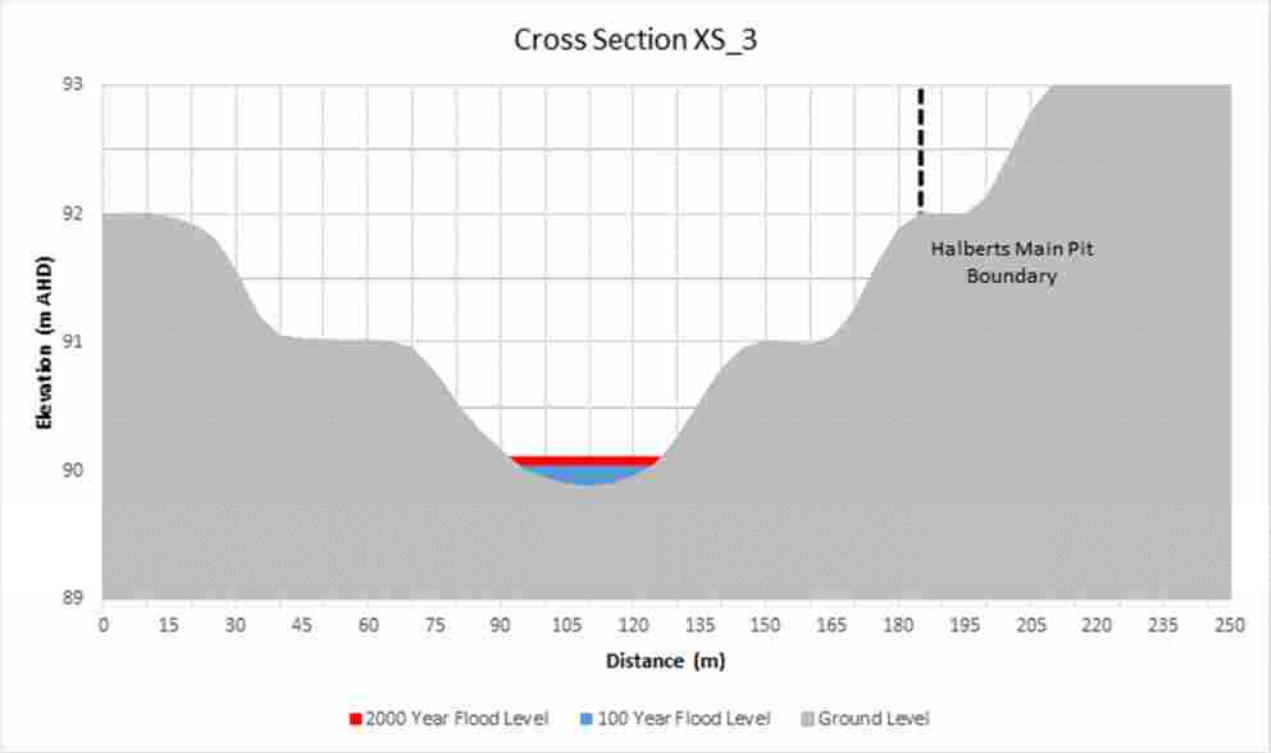
The results showing the extent and depths of flows at the eight cross-section locations relative to the proposed pits and infrastructure boundaries are shown in Text-Figure 1 to Text-Figure 8. All cross-sections are presented as looking upstream.



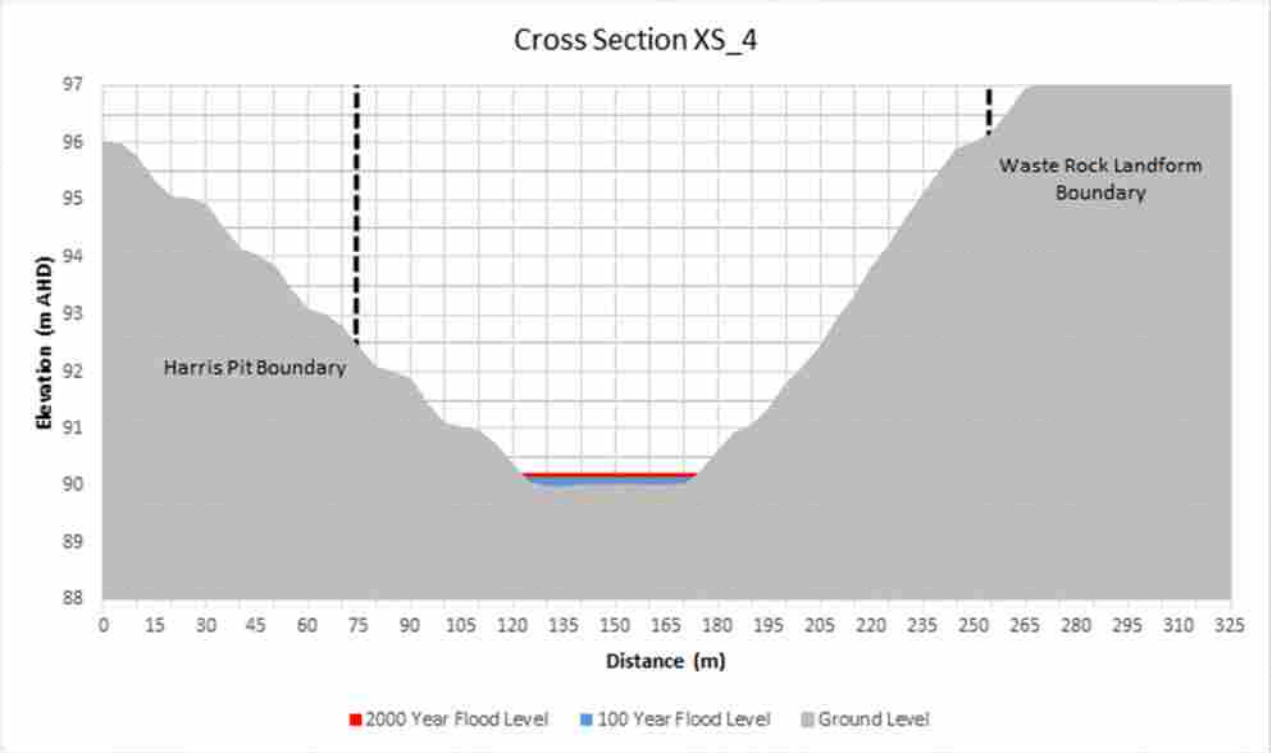
Text-Figure 1: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_1



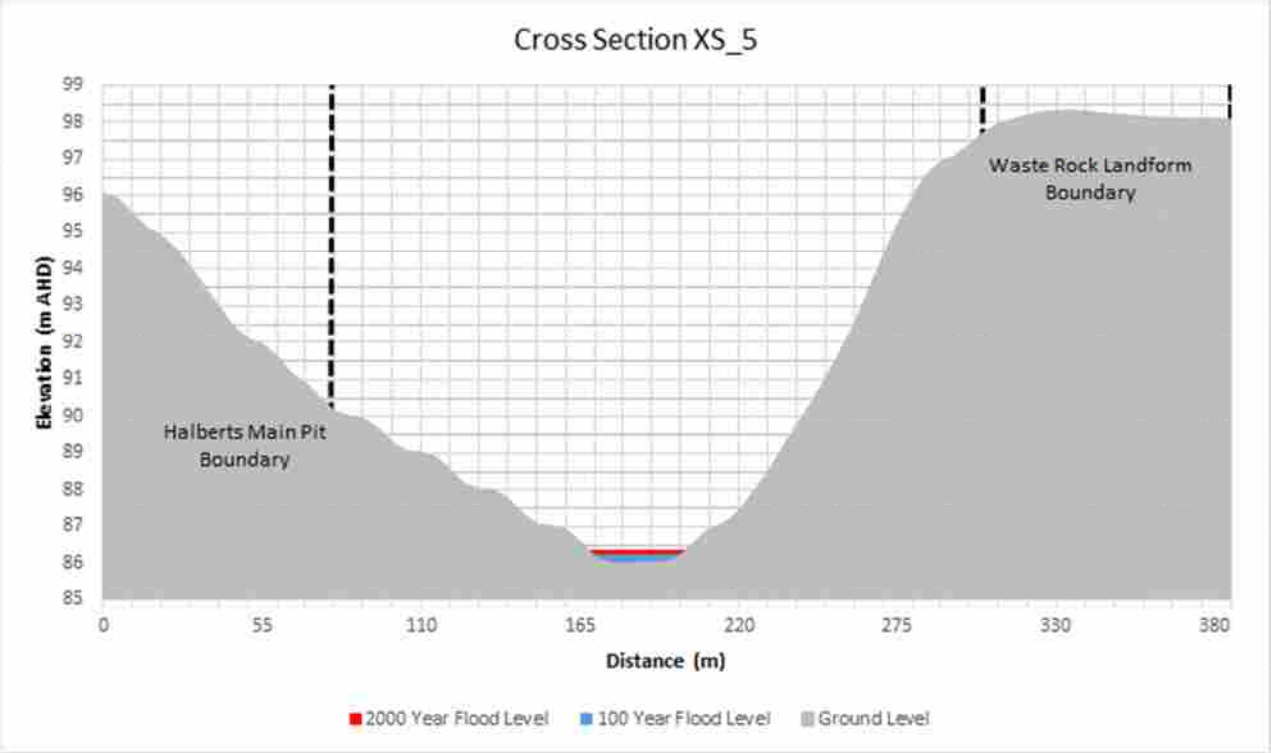
Text-Figure 2: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_2



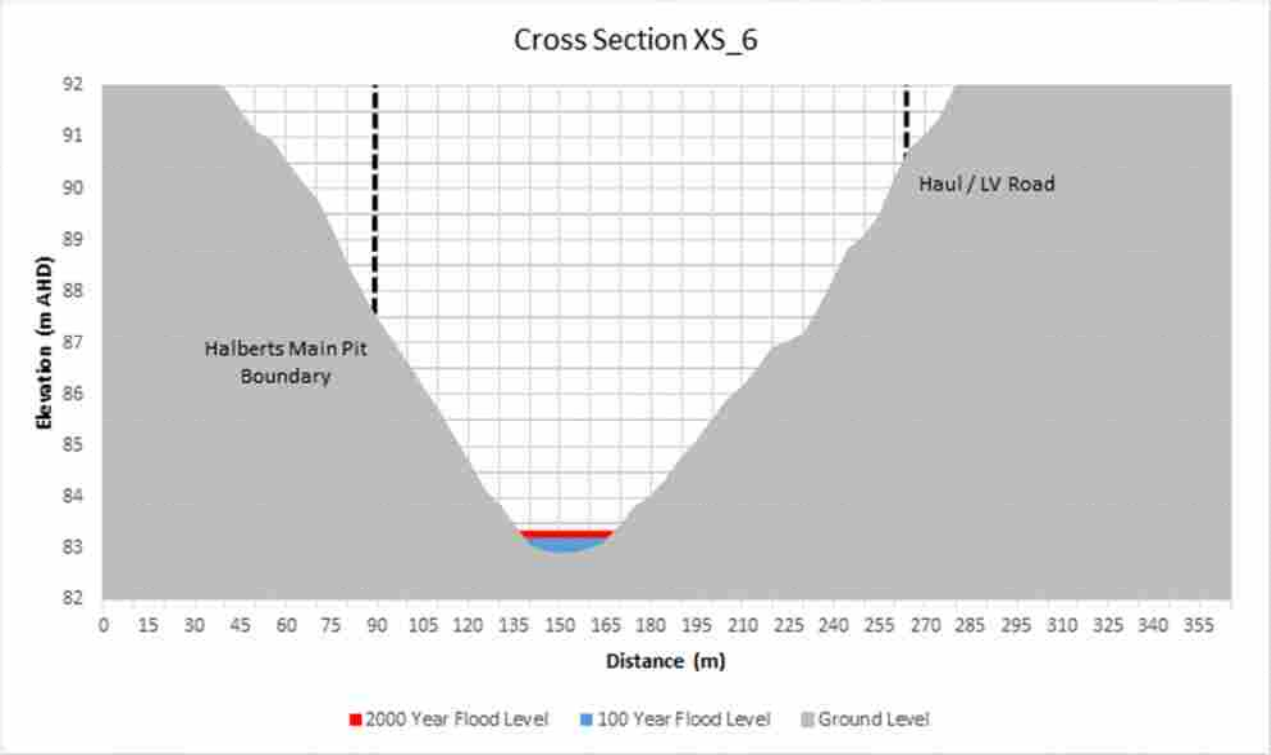
Text-Figure 3: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_3



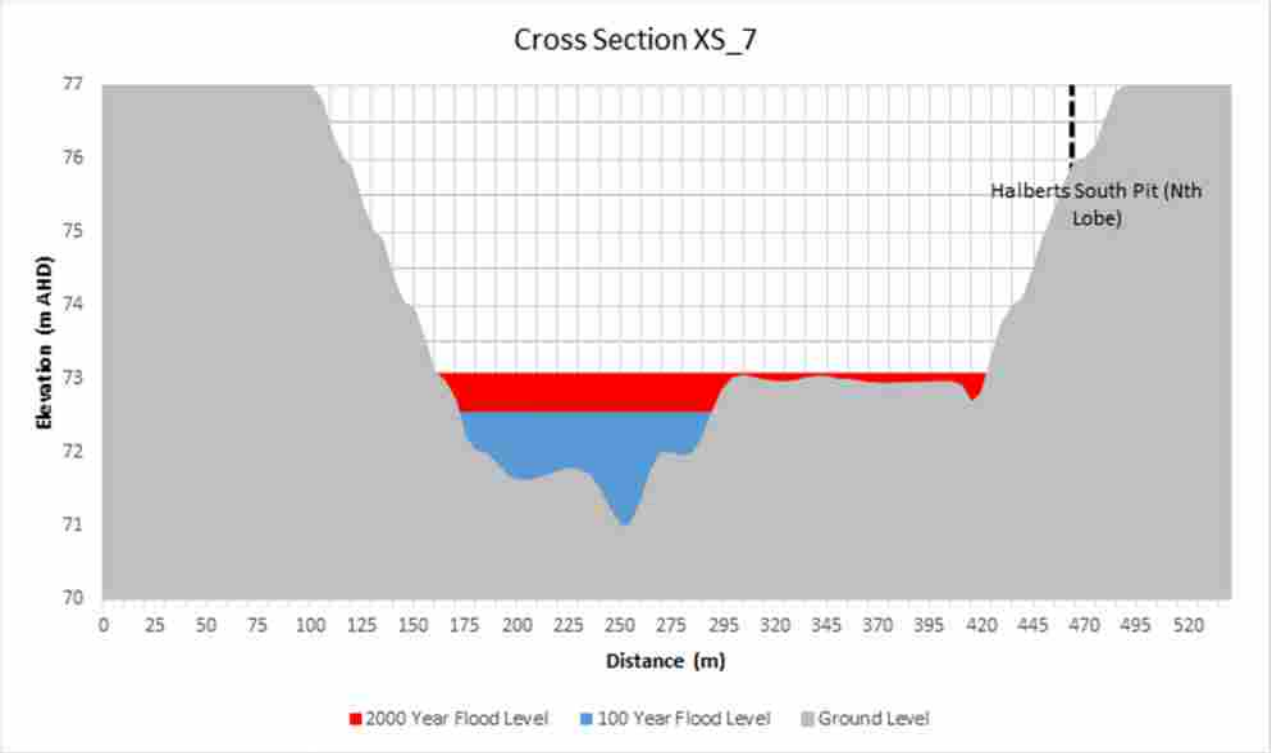
Text-Figure 4: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_4



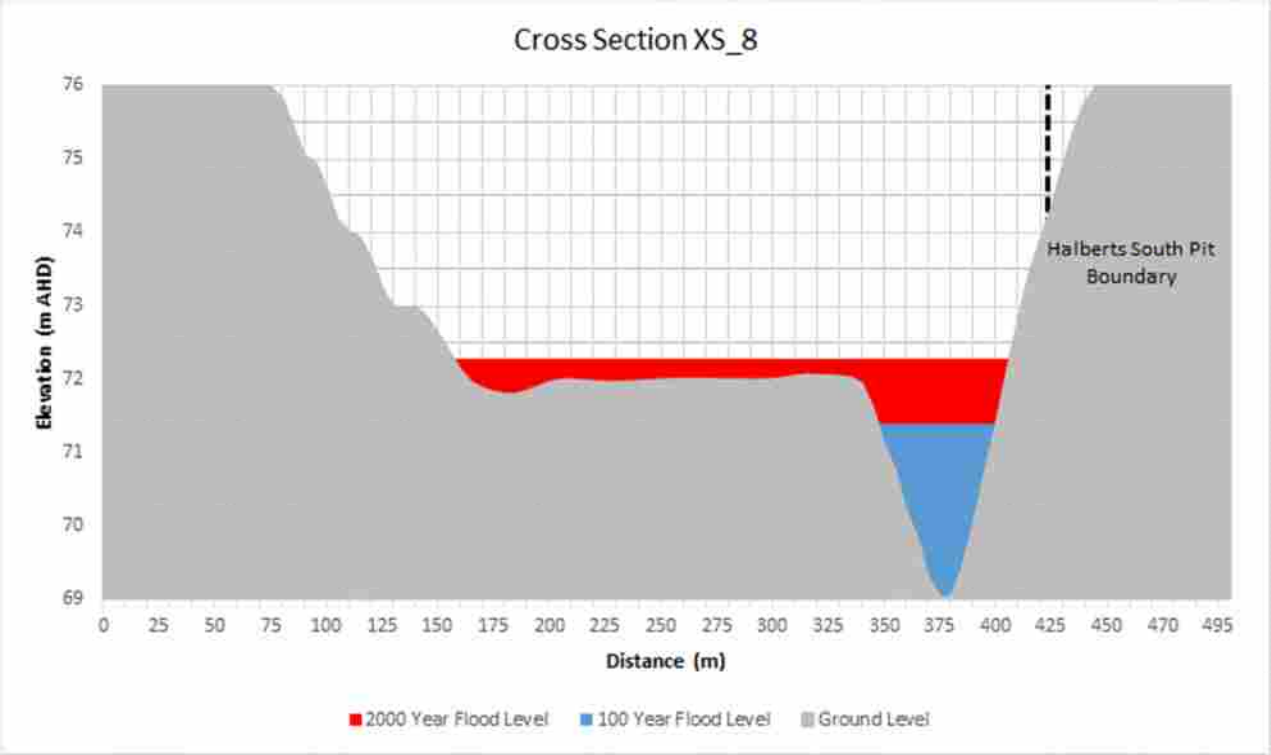
Text-Figure 5: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_5



Text-Figure 6: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_6



Text-Figure 7: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_7



Text-Figure 8: 1-in-100 and 1-in-2000 year ARI flood levels at cross section XS_8

3.2.2. MINE PITS, WASTE ROCK LANDFORM, TSF, STOCKPILE & ROM AND PLANT FACILITIES

It is evident from the cross-sections above that if the 1-in-100 and the 1-in-2000 (assumed PMF) year storms eventuate, the flood will not adversely impact the five pits. The boundaries of these pits range from 2 m to 6 m above the peak flow stages of the 1-in-100 and the 1-in-2000 year ARI flood events. These conditions are similar at the proposed Waste Rock Landform layout. The proposed tailings storage facility (TSF), ROM and other mine plant and facilities are located at the top of local catchments and therefore will also not be impacted by flooding resulting from surface runoff.

With exception of the peak flows from Catchment HS of the Munglinup River, which are 94.34 m^3/s and 155.71 m^3/s for the two rare storm events, the runoff from local catchments ranges from 5.0 m^3/s to 10.0 m^3/s with maximum flow velocities in the order of 1.0 m/s. These low magnitude hydraulic forces will not likely create other adverse conditions such as sediment transport, scouring and wave action.

3.2.3. HAUL / LV ROAD CROSSINGS

The proposed mine haul / LV road network crosses the local creeks at a number of locations within the project area. These locations, named FWC_1 to FWC_9, are shown in Figure 5 and are listed in Table 7, together with the associated creek crossing.

Table 7: Road floodway and culvert crossing locations

Location	Crossing
FWC_1	Creek A, Catchment A2
FWC_2	Creek B, Catchment B1
FWC_3	Creek B, Catchment B2
FWC_4	Creek C, Catchment C
FWC_5	Creek D, Catchment D1
FWC_6	Creek D, Catchment D2
FWC_7	Creek D, Catchment D3, Option 1 Diversion Drain
FWC_8	Creek D, Catchment D3, Option 2 Diversion Drain
FWC_9	Creek D, Catchment D3, Option 2 Diversion Drain
FWC_10	Local runoff between Haul / LV Road and TSF. Plus Catchment D3, Option 1 Diversion Drain

The peak flows at these crossings are relatively low and slow, and therefore it is expected that any issues relating to serviceability and vulnerability of the road network will likely to be associated with drainage, rather than damage from flooding.

At the detailed design stage, it is recommended that a simple floodway is constructed at these crossings, to accommodate the adopted vertical road profile. The option of using graded rocks or nominal culverts with these floodways should be considered, in order to manage the local drainage away from the road to prevent damage and bogging of heavy vehicles.

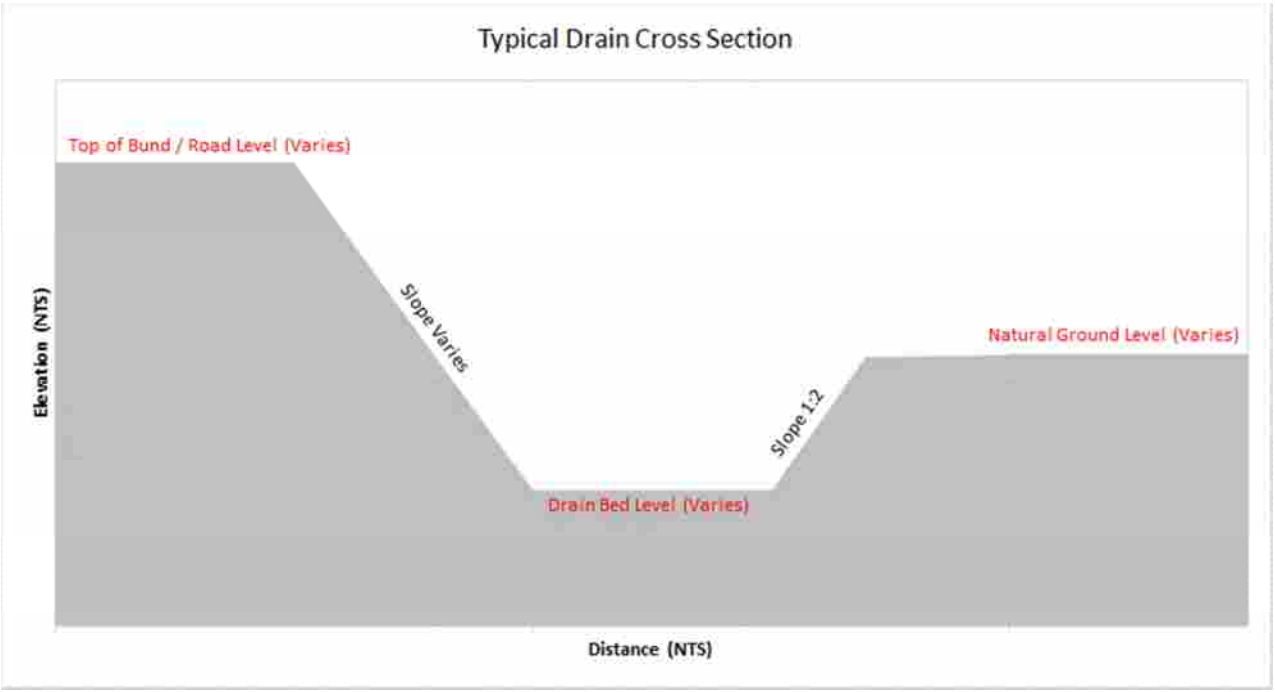
The governing criteria in designing the length of floodway and treatment at these crossings should be drainage for regularly occurring storm events, not serviceability and immunity for large flood events.

The proposed mine layout obstructs the natural flow of Creek D at the south-eastern boundary of Halberts Main Pit, at approximately cross-section XS_6. Based on the natural topography, a perimeter bund will be constructed to protect Halberts Main Pit. The flood water will dam in the area between the perimeter bund and FWC_6. Possible options to remediate this are presented in Section 3.2.4.

3.2.4. DIVERSION DRAIN CONCEPTS

Two preliminary conceptual diversion drain options are proposed to mitigate the potential damming of flows at the south eastern boundary of Halberts Main Pit perimeter bund and the road at FWC_6 (see Figure 6). In addition to these two concepts, it is recommended that options of pumping be explored and considered, if assessed to be more cost effective.

It is important to note that if the diversion drain options are preferred, a detailed design incorporating a site specific investigation is warranted, in order to ensure the hydraulic gradient and velocity from Creek D are maintained. A typical cross-section of the drain is shown in Text-Figure 9.



Text-Figure 9: Typical concept cross-section of drain

3.2.4.1. Option 1: Diversion FWC_5 to FWC_10

This option will allow the discharge from FWC_5 to flow along the natural creek before banking against the road at FWC_6, from where a diversion drain is proposed upstream of the road to convey the flow to Creek E at location FWC_10. Text-Figure 10 shows the concept long section of Option 1.

The proposed diversion drain, running parallel with the road, is approximately 1 km in length and will comprise an excavated channel with the road embankment acting as a bund. The depth and width of the channel will likely be nominal in size. This option would require a maximum cut in the order of 12 m deep, which is not feasible. The cut drain section would be approximately 560 m long, starting at an elevation of 86.5 m AHD (FWC_6) and ends at 84.0 m AHD where it daylights and flows to FWC_10.

Text-Figure 10: Option 1 diversion drain from FWC_5 to FWC_10 concept long section

3.2.4.2. Option 2: Diversion FWC_6 to FWC_8

This option will allow Creek D to discharge across the proposed floodway at FWC_6, before being diverted to traverse along a drain on the south east boundary of Halberts Main Pit, which takes the flow across the proposed floodway location FWC_8, and back to the natural channel of Creek D. Text-Figure 11 shows the concept long section of Option 2.

The proposed diversion drain is approximately 400 m in length and will utilise the south-east boundary of Halberts Main Pit bund together with a nominally sized channel. This option could require a maximum cut in the order of 6 m deep. The cut drain section would be approximately 250 m long, starting at an elevation of 84.0 m AHD were the bed of Creek D meets with Halberts Main Pit boundary and ends at 81.0 m AHD, just upstream of FWC_8.

Text-Figure 11: Option 2 diversion drain from FWC_6 to FWC_8 concept long section

This option would require a substantial amount of earthmoving. In the design stage, consideration should be given to allowing runoff to pond behind the bund around Halberts Main pit, and installing a pump station to pump water away from the pond.

4. POTENTIAL IMPACTS ON SURFACE WATER

This section presents comments and recommendations relating to environmental issues to be considered and addressed for mining approval purposes.

4.1. EROSION AND SEDIMENT TRANSPORT IN DISCHARGED WATER

The main flow regime of the Munglinup River is unaffected by the proposed mining activities and it is assessed that remedial measures associated with sediment transport and scour are not warranted. Similarly, flows in the local Creek A, Creek B, Creek C, and Creek F are generally undisturbed, except at the proposed road floodway locations, which will be appropriately managed to mitigate any concerns associated with erosion and sediment transport.

As discussed in Section 3.2.4, a section of Creek D is proposed to be realigned and diverted along the upstream of the Haul / LV Road or the south-east boundary of Halberts Main Pit. The natural flow velocity for the 1 in 2000 year ARI peak flow of 9.16 m^3/s is in the order of 1.0 m/s. In order to prevent any erosion and sediment transport, the flow regime should not be significantly altered. It is recommended that at the detailed design stage, the diversion drain at the preferred alignment option is designed to a similar hydraulic gradient to the natural creek gradient and the cross-section is configured to limit the velocity to 1.0 m/s.

The proposed layout plan shows that the natural catchment of Creek E will be filled by the TSF. In order to prevent sediment from the TSF to flow into the natural creek, it is recommended that a suitably configured perimeter bund be constructed at the base of the TSF. This recommendation is for regulatory compliance for both the operational period and mine closure.

The upper catchment of Creek F is likely to include run-off from the proposed Ore Stockpile and ROM, Plant and Workshops/Administration facility. If there are potential contaminants such as hydrocarbons stored in these areas, it is recommended that an appropriate sediment basin be designed and constructed to prevent pollution of the receiving water at Creek F.

A programme of water quality monitoring will be required to demonstrate that mining activities have no impact on surface water quality downstream of the mine.

4.2. MINE CLOSURE

To comply with the Environmental Protection's (EPA) guideline for mine closure the following are required for mine closure:

- Post-operation abandonment bunds. These are to be constructed to the final configuration of all the pits.
- Perimeter bunds are to be constructed at the Waste Rock Landform, TSF and Stockpile and ROM to prevent erosion.

- The detail, configuration and configuration of these bunds will be determined at the detailed design stage when all pits, infrastructure and road design are confirmed.
- Based on this assessment, these bunds will not be designed to protect against flood water and are expected to be nominal in size, typically 1–2 m in height.

As the proposed concept diversion drain sections of Creek D are to be designed to maintain the flow regime of the natural creek, no additional adjustment is needed for mine closure.

4.3. MANAGEMENT MEASURES

As discussed above, management measures pre- and post-closure will include:

- Perimeter bunds to prevent inadvertent access to the pits, protect against flood flows (locally) and top prevent erosion of storage areas;
- Diversion drains, where required, to prevent ponding of flood flows;
- Sedimentation ponds (if required); and
- Monitoring of water quality to show management measures are effective.

5. CONCLUSIONS AND RECOMMENDATIONS

The following are concluding comments and recommendations relating to the surface water management of the Munglinup Graphite Project, including all pits, mine infrastructure and Haul / LV Road network for mining approval requirements.

5.1. MINE PITS, WASTE ROCK LANDFORM, TSF, STOCKPILE & ROM AND PLANT FACILITIES

This assessment confirms that, in general, flooding from the main Munglinup River and local creeks will not adversely impact the pits, and therefore no flood protection measures are warranted. The exception is the flow path of Creek D, which, based on the current layout configuration, will be obstructed by Halberts Main Pit. The recommended remedial measure of diversion drains are presented Section 3.2.4 and are summarised in Section 0.

To address environmental concerns relating to erosion and sediment transport, it is recommended that nominal 1 m high perimeter bunds be constructed at the foot the Waste Rock Landform, TSF, Stockpile and ROM, and Plant Facilities.

At the upper catchment of Creek F, if there are potential contaminants such as hydrocarbons, it is recommended that an appropriate sediment basin be designed and constructed to prevent contaminants from flowing into the receiving water.

5.2. HAUL / LV ROAD CROSSINGS

Based on the current proposed layout plan, there are up to nine locations, depending on the selection diversion drain option (Section 0), where the local creeks cross the proposed Haul / LV Road network. The peak flows for the ultimate 1-in-2000 year ARI event run-off is between 5 m^3/s and 10 m^3/s at these

locations. The hydraulic analysis results confirm that drainage rather than flood considerations are to be addressed for detailed design.

It is recommended that floodways are to be constructed at these crossing locations. The design of these floodways are to include inlet and outlet drains. To allow ephemeral drainage and prevent bogging due to heavy vehicle pounding, the road pavement of floodway should be constructed with porous graded rocks, with the addition of nominal drainage culverts, where appropriate.

5.3. DIVERSION DRAIN OPTIONS

Two preliminary conceptual diversion drain options were proposed in Section 3.2.4, to mitigate potential damming of flows at the eastern boundary of Halberts Main Pit.

The preferred option will depend on the adopted configuration of the pit, infrastructure and road layout. Based on the existing proposed layout, Option 2 requiring a 400 m diversion drain appears to be the more feasible, as it will require substantially less cut and drain excavation to construct.

It is important to note that if the diversion drain options are preferred, a detailed design incorporating a site specific investigation is warranted, in order to ensure the hydraulic gradient and velocity from Creek D are maintained.

In addition to these two diversion concepts, it is recommended that options of pumping be explored and considered in the design stage, that could be more cost effective. One option would be to allow runoff to pond behind the bund around Halberts Main pit, and installing a pump station to pump water away from the pond.

5.4. MINE CLOSURE

To comply with the EPA's guideline for mine closure, post mine operation abandonment bunds are required around all pits, the Waste Rock Landform, TSF, Stockpile and ROM.

The detail, configuration and alignment of these bunds will be determined at the detailed design stage when all pits, infrastructure and road design are confirmed. Perimeter bunds are designed for safety requirements and will be in accordance with Department of Mines, Industry Regulation and Safety (DMIRS) regulatory specifications (DIR, 1997).

As the proposed concept diversion drain sections of Creek D are to be designed to maintain the flow regime of the natural creek, no additional adjustment is warranted for mine closure.

Dated: 28 August 2018

Rockwater Pty Ltd
J Goh
Senior Hydrologist

Phil Wharton
Principal

REFERENCES

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DIR (1997), Safety bund walls around abandoned open pit mines. Department of Industry and Resources document No. ZMA048HA.

Rockwater, 2018, Initial desktop hydrology assessment for proposed mining operation at Munglinup Graphite Project. Report to MRC Graphite Pty Ltd.

Schoknecht, N.R., and Pathan, S., 2013, Soil groups of Western Australia: a simple guide to the main soils of Western Australia (4th ed.). Dept. of Agriculture and Food, Western Australia, Perth. Report 380.

FIGURES

Figure 1

Munglinup Graphite Project

Overview Location

Legend

MRC Tenure

M 74/245

Road Network (MRWA_514)

State Road

Local Road

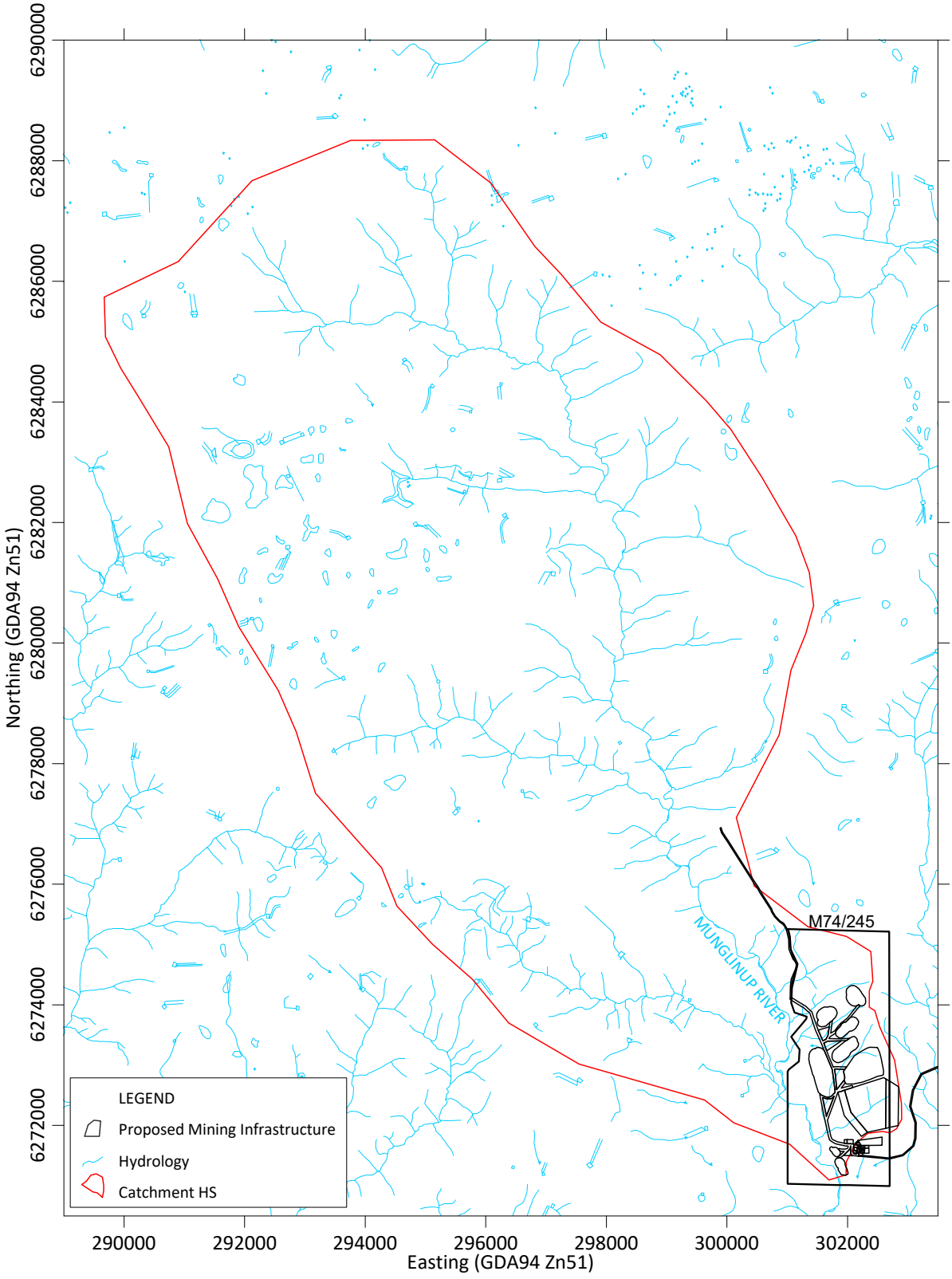
Google Satellite Imagery

Rev 1

Apr 2018

"The information on this map was derived from various sources. Care was taken in its creation, however, Integrate Sustainability cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated."

Figure 2



65-5/Surfer/18-04/Figure 2.srf

CLIENT:	MRC Graphite
PROJECT:	Munglinup
DATE:	August 2018
Dwg. No:	65-5/18/4-2

MINE LOCATION WITH
CATCHMENT HS OUTLINE

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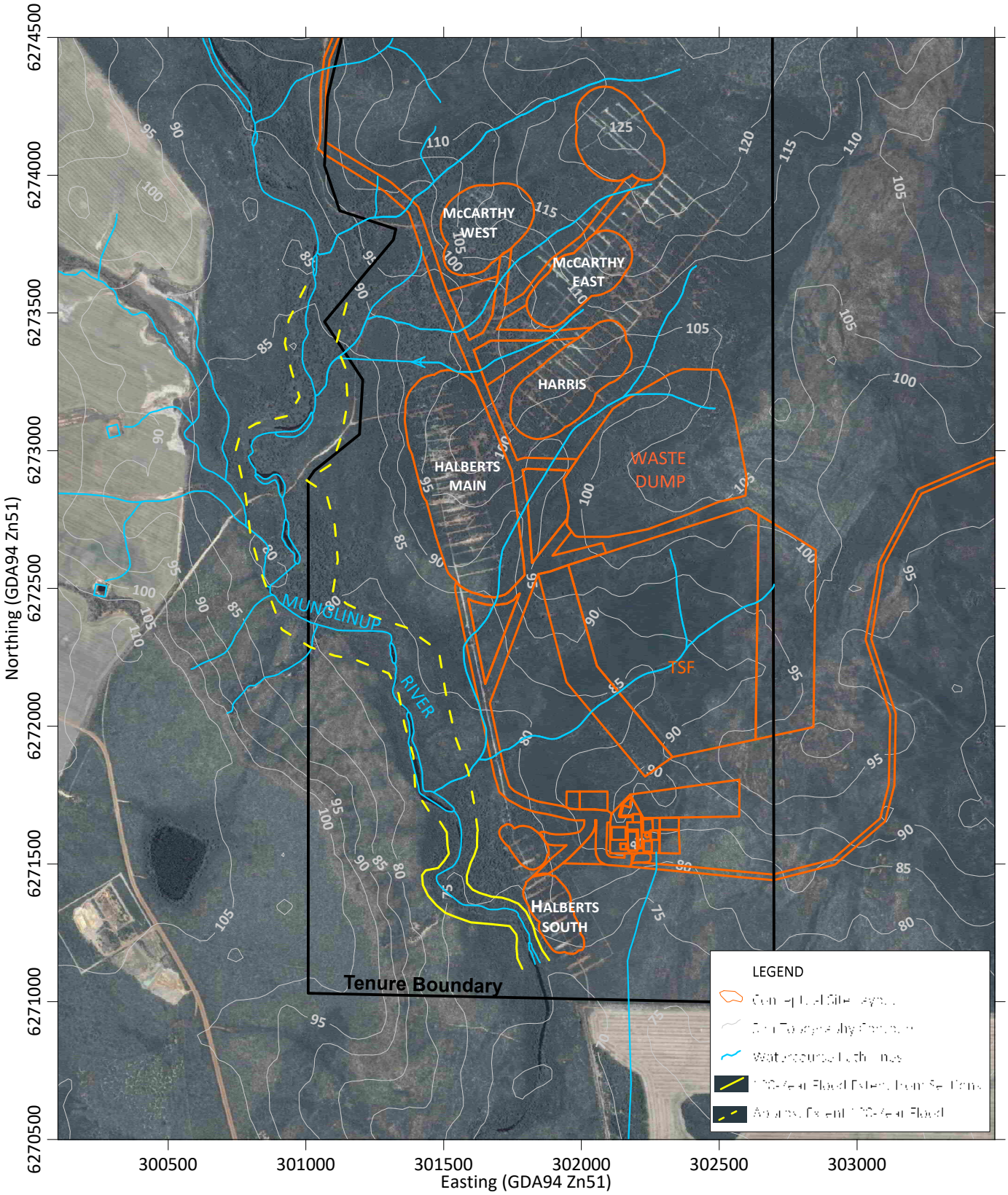
Figure 3



65-5/Surfer/18-04/Figure 3.srf

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PROJECT:	Munglinup
DATE:	August 2018
Dwg. No:	65-5/18/4-3

CONCEPTUAL SITE LAYOUT WITH WATERCOURSE PATH LINES

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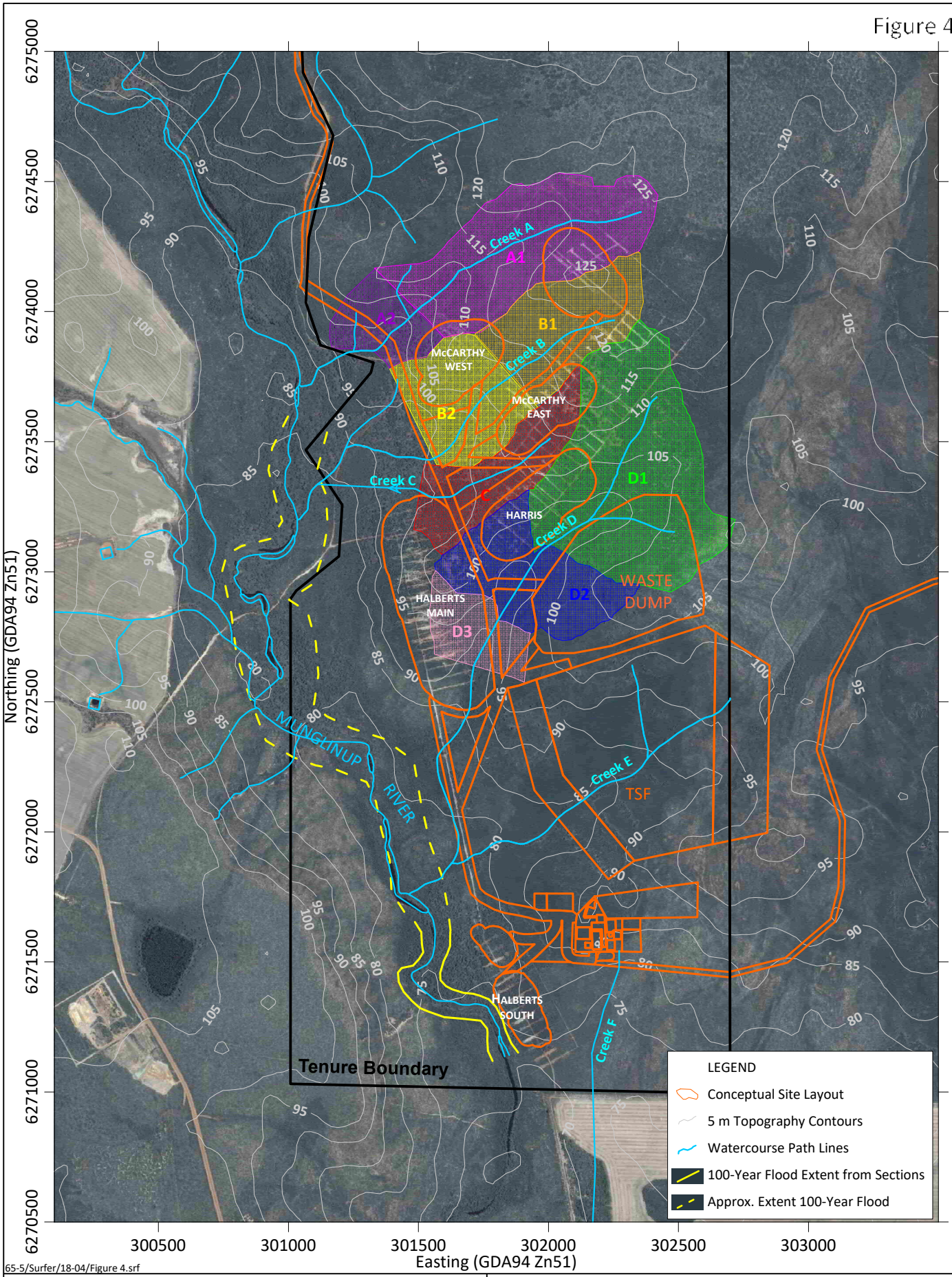
Figure 4



65-5/Surfer/18-04/Figure 4.srf

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PROJECT:	Munglinup
DATE:	August 2018
Dwg. No:	65-5/18/4-4

LOCAL CATCHMENTS

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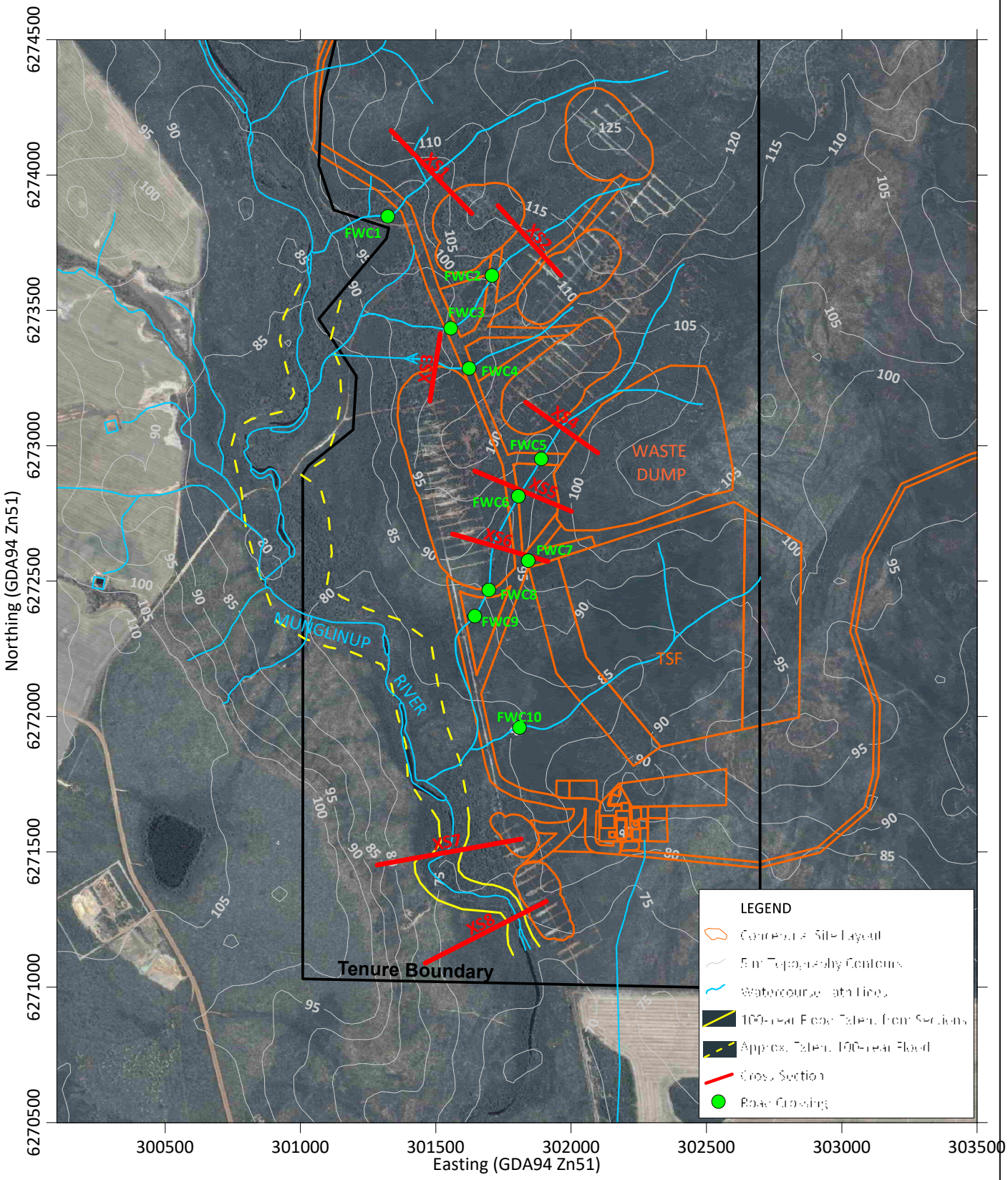
Figure 5



65-5/Surfer/18-04/Figure 5.srf

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PROJECT:	Munglinup
DATE:	August 2018
Dwg. No:	65-5/18/4-5

CROSS -SECTIONS AND ROAD CROSSINGS

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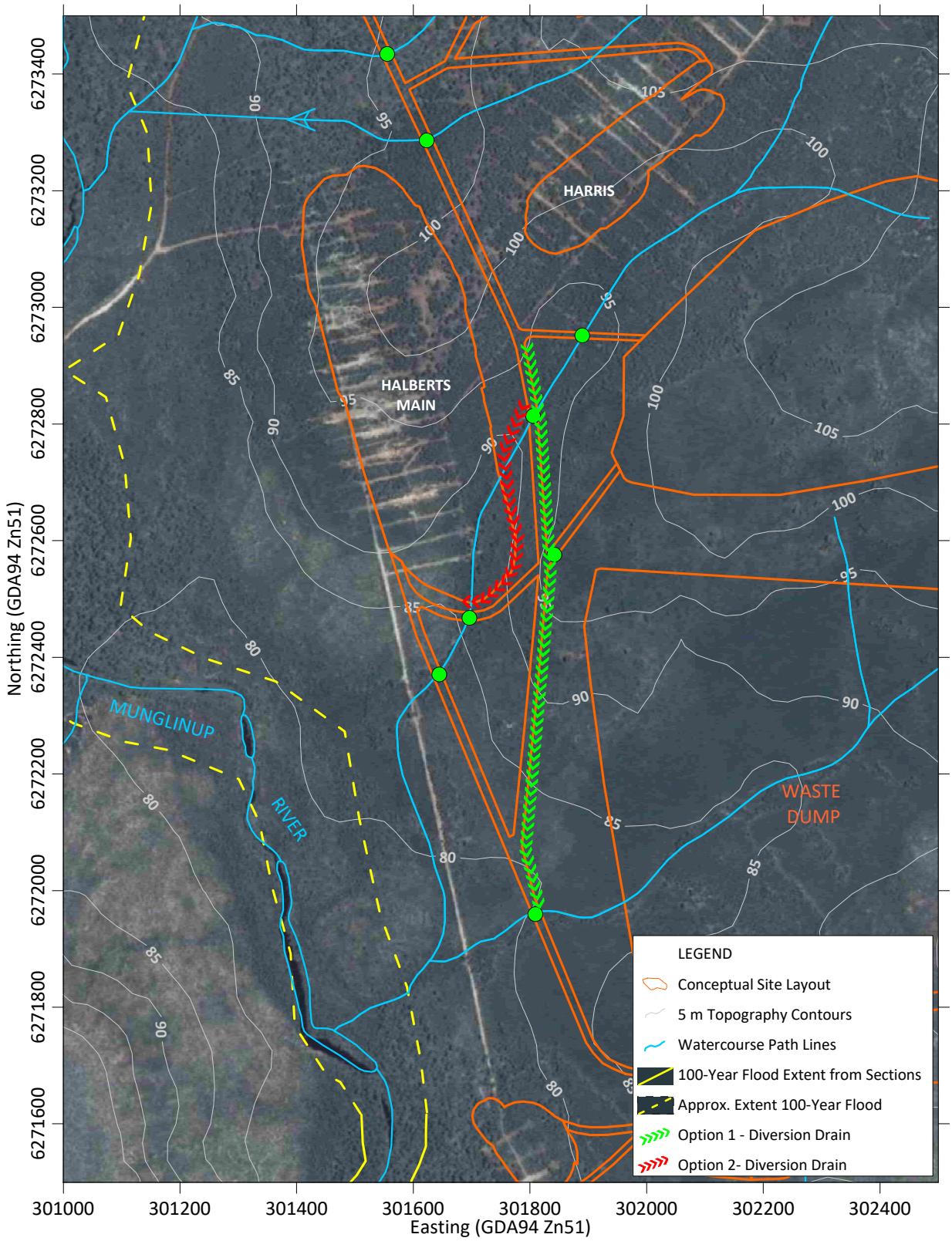
Figure 6



65-5/Surfer/18-04/Figure 6.srf

CLIENT:	MRC Graphite
PROJECT:	Munglinup
DATE:	August 2018
Dwg. No:	65-5/18/4-6

DIVERSION DRAIN OPTIONS

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APPENDIX A: HYDROLOGY CALCULATIONS

HYDROLOGY RESULTS

Catchment	Area	Length	Slope	Average Annual Rainfall	Clearing	ARR1987 Wheatbelt Region	Average Recurrence Interval (Years)						
	(km^2)	(km)	(m/km)	(mm)	(%)		2	5	10	20	50	100	2000
HS	121	20	7.5	505	80	Rational (m^3/s)	6.90	14.09	24.48	42.41	71.65	94.34	155.71
						Index (m^3/s)	7.04	14.08	24.78	42.94	79.54	84.92	102.13
						Adopted (m^3/s)	7.04	14.09	24.78	42.94	79.54	94.34	155.71
A1	0.35	1.00	25.0	505	80	Rational (m^3/s)	0.21	0.45	0.79	1.39	2.39	3.20	5.26
						Index (m^3/s)	0.21	0.42	0.74	1.29	2.38	2.55	6.44
						Adopted (m^3/s)	0.21	0.45	0.79	1.39	2.39	3.20	6.44
A2	0.44	1.25	25.0	505	80	Rational (m^3/s)	0.23	0.49	0.87	1.53	2.63	3.51	5.78
						Index (m^3/s)	0.24	0.48	0.85	1.48	2.74	2.92	7.24
						Adopted (m^3/s)	0.24	0.49	0.87	1.53	2.74	3.51	7.24
B1	0.19	0.60	33.3	505	80	Rational (m^3/s)	0.16	0.33	0.59	1.04	1.80	2.41	3.97
						Index (m^3/s)	0.15	0.29	0.51	0.89	1.65	1.76	4.71
						Adopted (m^3/s)	0.16	0.33	0.59	1.04	1.80	2.41	4.71
B2	0.37	1.05	33.3	505	80	Rational (m^3/s)	0.22	0.46	0.81	1.43	2.45	3.27	5.39
						Index (m^3/s)	0.22	0.44	0.77	1.33	2.47	2.63	6.63
						Adopted (m^3/s)	0.22	0.46	0.81	1.43	2.47	3.27	6.63
C	0.17	0.73	34.2	505	80	Rational (m^3/s)	0.13	0.29	0.51	0.90	1.56	2.09	3.44
						Index (m^3/s)	0.14	0.27	0.48	0.83	1.55	1.65	4.45
						Adopted (m^3/s)	0.14	0.29	0.51	0.90	1.56	2.09	4.45
D1	0.49	1.07	28.0	505	80	Rational (m^3/s)	0.27	0.56	0.99	1.74	2.99	3.98	6.56
						Index (m^3/s)	0.26	0.52	0.91	1.58	2.92	3.12	7.65
						Adopted (m^3/s)	0.27	0.56	0.99	1.74	2.99	3.98	7.65
D2	0.70	1.35	25.9	505	80	Rational (m^3/s)	0.33	0.68	1.20	2.10	3.59	4.77	7.86
						Index (m^3/s)	0.32	0.64	1.13	1.95	3.61	3.86	9.16
						Adopted (m^3/s)	0.33	0.68	1.20	2.10	3.61	4.77	9.16
D3	0.79	1.60	23.1	505	80	Rational (m^3/s)	0.34	0.70	1.24	2.17	3.71	4.92	8.11
						Index (m^3/s)	0.34	0.69	1.21	2.10	3.89	4.15	9.73
						Adopted (m^3/s)	0.34	0.70	1.24	2.17	3.89	4.92	9.73

APPENDIX B: HYDRAULIC CALCULATIONS

HYDRAULIC RESULTS

Cross Section	Slope (m/m)	Manning's n	ARI (years)	2	5	10	20	50	100	2000
XS_1	0.025	0.06	Peak Flow (m^3/s)	0.21	0.45	0.79	1.39	2.39	3.20	6.44
			Flood Level (m AHD)	98.01	98.03	98.06	98.10	98.14	98.17	98.26
			Maximum Depth (m)	0.06	0.08	0.11	0.15	0.19	0.22	0.31
			Velocity (m/s)	0.31	0.40	0.49	0.59	0.71	0.79	1.00
			Channel Area (m^2)	0.68	1.11	1.61	2.36	3.36	4.07	6.42
XS_2	0.028	0.06	Peak Flow (m^3/s)	0.16	0.33	0.59	1.04	1.80	2.41	4.71
			Flood Level (m AHD)	104.25	104.28	104.31	104.34	104.39	104.41	104.49
			Maximum Depth (m)	0.09	0.12	0.15	0.18	0.23	0.25	0.33
			Velocity (m/s)	0.33	0.39	0.47	0.55	0.64	0.70	0.86
			Channel Area (m^2)	0.48	0.84	1.27	1.89	2.81	3.46	5.46
XS_3	0.024	0.06	Peak Flow (m^3/s)	0.14	0.29	0.51	0.90	1.56	2.09	4.45
			Flood Level (m AHD)	89.93	89.95	89.97	90.00	90.03	90.05	90.12
			Maximum Depth (m)	0.05	0.07	0.09	0.12	0.15	0.17	0.24
			Velocity (m/s)	0.27	0.33	0.39	0.47	0.56	0.61	0.79
			Channel Area (m^2)	0.53	0.88	1.30	1.92	2.81	3.43	5.66
XS_4	0.013	0.06	Peak Flow (m^3/s)	0.27	0.56	0.99	1.74	2.99	3.98	7.65
			Flood Level (m AHD)	90.03	90.04	90.06	90.08	90.11	90.13	90.19
			Maximum Depth (m)	0.06	0.07	0.09	0.11	0.14	0.16	0.22
			Velocity (m/s)	0.23	0.31	0.39	0.48	0.59	0.66	0.84
			Channel Area (m^2)	1.15	1.81	2.57	3.63	5.07	6.05	9.14
XS_5	0.013	0.06	Peak Flow (m^3/s)	0.33	0.68	1.20	2.10	3.61	4.77	9.16
			Flood Level (m AHD)	86.04	86.06	86.09	86.13	86.18	86.21	86.30
			Maximum Depth (m)	0.07	0.09	0.12	0.16	0.21	0.24	0.33
			Velocity (m/s)	0.33	0.44	0.53	0.64	0.77	0.85	1.07
			Channel Area (m^2)	0.99	1.56	2.26	3.27	4.68	5.61	8.54
XS_6	0.013	0.06	Peak Flow (m^3/s)	0.34	0.70	1.24	2.17	3.89	4.92	9.73
			Flood Level (m AHD)	82.97	83.01	83.04	83.08	83.14	83.17	83.28
			Maximum Depth (m)	0.08	0.11	0.15	0.19	0.25	0.28	0.39
			Velocity (m/s)	0.38	0.48	0.57	0.68	0.83	0.90	1.13
			Channel Area (m^2)	0.90	1.47	2.18	3.17	4.68	5.45	8.58
XS_7	0.004	0.06	Peak Flow (m^3/s)	6.90	14.09	24.48	42.41	71.65	94.34	155.71
			Flood Level (m AHD)	71.45	71.69	71.82	71.94	72.11	72.19	72.37
			Maximum Depth (m)	0.45	0.69	0.83	0.95	1.11	1.19	1.38
			Velocity (m/s)	1.15	1.08	1.14	1.38	1.51	1.66	2.00
			Channel Area (m^2)	5.98	13.04	21.44	30.81	47.51	56.90	77.98
XS_8	0.004	0.06	Peak Flow (m^3/s)	6.90	14.09	24.48	42.41	71.65	94.34	155.71
			Flood Level (m AHD)	69.50	69.69	69.89	70.14	70.43	70.61	71.01
			Maximum Depth (m)	0.47	0.66	0.85	1.11	1.40	1.58	1.98
			Velocity (m/s)	1.23	1.53	1.78	2.05	2.38	2.57	2.91
			Channel Area (m^2)	5.61	9.23	13.75	20.65	30.10	36.68	53.53